Human factors & safety culture: Challenges & opportunities for the port environment

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ABSTRACT

The critical role of understanding Human Factors and the importance of Safety Culture in the maritime sector is becoming much more topical. While the key focus of much of the research in this sector has been on seagoing vessels, it is also important to recognise that ports and docks can be particularly dangerous and hazardous environments. The objective of this paper is to report on an exploratory research study assessing the safety culture and human factor awareness in a large European port environment. The research study adopted a multi-methods approach that included the completion of a Safety Culture Assessment Survey across a port environment (161 responses) and research interviews (11 in total) with a port authority company. The research concludes that there is an increasing awareness of human factors and a move towards a positive safety culture that facilitates an open and resilient approach to all safety practices. However much more focused research is required focusing on the specific complexities, constraints and shared processes of our port environments.

1. Introduction

The maritime sector is facing many challenges with recent reports of an increase in the frequency of accidents both in shipping and at ports (Global Risk Reports, 2016). Human and organisational factors account for 80% of maritime accidents worldwide (Berg, 2013). An understanding of the role of human factors and safety culture has become an important issue for this sector.

To date, most of the research and practice has been concerned with "human behaviour aboard seagoing vessels, with the major focus being on maritime transport – the merchant or merchant marine" (McLachlan, 2017; p. 2).

Berg (2013) highlights that the "maritime transport system is 25 times riskier than the air transport system according to the accounts for deaths for every 100 km" (2012: p. 344). In addition, a number of recent high profile incidents suggest that the absence of a fully implemented safety culture is still an issue which some shipping companies will need to be addressed as a matter of priority (Veiga, 2002).

While the key focus of much of the research in this sector has been on seagoing vessels, it is also important to recognise that ports and docks can be particularly dangerous and hazardous environments, especially if there is not awareness of human factors and a move towards a positive safety culture that facilitates an open and resilient

approach to all safety practices.

The objective of this paper is to report on an exploratory research study assessing the safety culture and human factor awareness in a large European port environment and to propose some challenges and opportunities for the port environment in relation to safety culture. The research study took a socio-technical systems approach and employed a mixed-methods that included the completion of a Safety Culture Assessment Survey (SCAS) across a port environment and qualitative interviews with key stakeholders in a port authority company.

1.1. Background to the port environment

The International Maritime Organisation (IMO) is the specialised agency with responsibility for developing conventions and protocols governing every facet of shipping (including the port environment) and these are then adopted into law and codes of practice by the relevant national agencies. Their overall philosophy is that of continuous improvement and the national agencies provide practical guidelines on how health and safety can be achieved in the ports and docks sector.

International statistics indicate that the main causes of accidents in ports are slips and trips (one in five personal injury accidents in the maritime industry is due to slips, trips and falls [IMO, 2006]) being hit by moving or falling objects, falls and manual handling (International

Shipping Federation, ISF, 2011). Threats to the health of persons working in ports and docks include back and other musculoskeletal injuries, noise and dust related injuries. A high proportion of accidents to port workers occur on container ships. There is also an increasing trend in the number of accidents involving port cranes and other port mobile equipment which have resulted in serious injuries and fatalities (Darbra et al., 2006). Contributing factors have been identified as lack of an effective safety culture, inadequate risk assessment and operations management, inadequate operating procedures, lack of training and awareness, bigger and faster port equipment, bigger ships, increased port throughputs, faster ship turnarounds, more extreme weather conditions (International Shipping Federation, ISF, 2011).

2. Safety culture

While there is no single definition of 'safety culture,' in light of the Chernobyl disaster, safety culture was defined by INSAG as "an organisational atmosphere where safety and health is understood to be, and is accepted as, the number one priority" (INSAG, 1996). Therefore a positive safety culture needs to be seen as the way safety is perceived, valued and prioritised in an organisation. It reflects the tangible commitment to safety at all levels in the organisation and should permeate all aspects of the work environment. All of which requires a level of awareness, support and accountability for safety on the part of every individual in an organisation.

The IMO (IMO, 2003) offers their own practical working definition:

"A safety culture can be defined as a culture in which there is considerable informed endeavour to reduce risks to the individual, ships and the marine environment to a level that is as low as is reasonably practicable."

IMO, MSC 77/17

Gordon et al. (2007) states that if there is a safety management system (SMS) but no real commitment or culture towards safety, then the management system will not be effective, as decisions will not prioritise safety. Similarly, if there is a good safety culture, but no management system, then the way that safety is organised may be inconsistent, under-resourced and not seen as business driven (Gordon et al., 2007).

3. Safety culture maturity

The maturity model concept is a fairly recent research phenomena within the discipline of safety management and safety culture and has been applied to safety culture development within a number of "safety critical" industries, such as mining, aviation, petro-chemical, oil and gas. Parker et al. (2006) demonstrated the real need for a novel multi-dimensional and dynamic concept of safety culture which was developed from Westrum's (Westrum, 1996, 2004) Typology of Organisational Culture and Reason's work (Reason, 1997) on managing the risks of organisational accidents.

These models were advanced to allow organisations to understand their own level of safety culture maturity by' assessing the level of compliance with various key elements of safety culture across a number of stages that represent different levels of maturity' (Foster and Hoult, 2013). In most organisations a combination of survey, safety performance indicators and audits have been used in order to get a picture of the current safety levels.

Fig. 1 provides an example of a typical Cultural Safety Maturity Model (Foster and Hoult, 2013). This approach highlights a five stage approach towards and effective safety culture from a highly vulnerable (where the organisation will 'accept that accidents happen' to a highly resilient state (which is used to describe an organisation that has successfully integrated safety and risk management into its operations).

The framework advances the notion that as an organisation's safety culture develops and becomes more mature as it progresses upwards through the levels. This then should result in greater trust, accountability, free and open reporting and transparency as staff view the changes positively (Reason, 1997; Weick and Sutcliffe, 2001).

3.1. Socio-technical systems and human factors

There is no doubt that human factors are contributory factors in relation to the main causes of accidents in ports (e.g., slips and trips, falls etc.) and for many organisations embracing safety and human factor initiatives is all part of the same discussion (Parker et al., 2006). For example, the Port of London Authority was motivated to launch a safety culture campaign to help reduce the number of incidents in the Port when it emerged that Human Factors contributed to over half of all reported incidents. This was an excellent initiative, however it is important to highlight that a critical element when examining human factors and violations is to fully understand how individuals within the system (the organisation) make sense of the system (Weick, 1995) and this can only be done with a cogent analysis of how the system really works in practice (Mc Donald, 2015). Therefore there is a very strong argument about focusing on normal operational practice: how work is actually done; the variability in performance; and understanding ways in which people make operational systems function effectively all of which are essential to understanding how things break down (Mc Donald, 2015). Similarly, the emphasis of making safety work in everyday practices, supported by interpersonal processes, is in line with the aspirations of current safety management but are often very difficult to fulfil (Hollnagel, 2018). We can begin to see how these aspects work if we consider safety culture and human factors from a Socio-Technical Systems (STS) perspective which has the capability to provide the basis for moving from a reactive state to a more resilient state of safety culture maturity.

Despite much work done on Systems approaches and Systems of Systems (Corrigan and McDonald, 2014; Stanton et al., 2017) there is still a tendency to adhere to the practices of Safety I (Hollnagel, 2014, 2018). Many safety critical industries are well aware of the philosophy behind Safety II and yet do not always embrace this in practice (Hollnagel, 2018). There are numerous potential reasons for this such as operational cost, resources (time, money, human resources, facilities etc.), political and organisation will within the respective organisations. Mansouri et al. (2010) describe a risk management-based decision analysis framework which may go some lengths in supporting decisions to priorities how to move (cost-effectively from Safety I towards Safety II). However, if Ports now and Ports of the future are to contend with the changing economic, political and geographic forces that will undoubtedly present themselves, they must be ready. They must be resilient and in doing so need to go beyond Safety II. We need to strive for "Safety II +". The safety culture of our Ports need to reflect this.

Pant et al. (2014) and Hosseini and Barker (2016) explore welcome measurement of resilience (in terms of vulnerability and recoverability) which is worthy of further exploration in future research in this area. It is worthy of establishing how mature your safety culture is and how resilient your organisation is likely to be when faced with both every day and adverse operational conditions, but it is also prudent to attempt to predict how your organisation with deal with potential disruption. Disruption is keenly depicted in Lam and Su (2015) with respect to Asian Ports. This work highlights the portents of likely disruption that we may face such as climate change, security challenges and political instability. It also stresses the importance of multi-agency co-operation and collaboration. Bauk et al. (2016, 2017) highlight examples of how Ports can benefit from improved Information and Communication Technology (ICT), to support such co-ordination which is especially important for ports which are still developing.

Such complex interplay between agencies requires appropriate methods of analysis if stakeholders are to be able to communicate and co-ordinate effectively at the operational level. This is why a socio-technical systems approach was chosen as the main vehicle for the
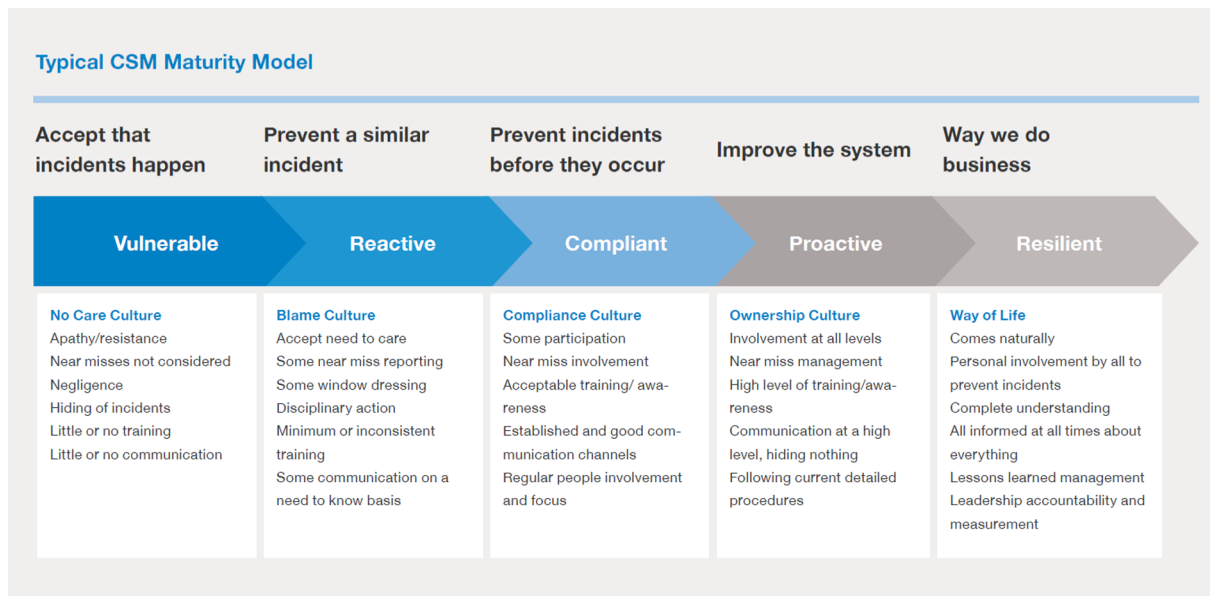
Typical CSM Maturity Model

Accept that incidents happen	Prevent a similar incident	Prevent incidents before they occur	Improve the system	Way we do business
Vulnerable	**Reactive**	**Compliant**	**Proactive**	**Resilient**
No Care Culture Apathy/resistance Near misses not considered Negligence Hiding of incidents Little or no training Little or no communication	**Blame Culture** Accept need to care Some near miss reporting Some window dressing Disciplinary action Minimum or inconsistent training Some communication on a need to know basis	**Compliance Culture** Some participation Near miss involvement Acceptable training/ awareness Established and good communication channels Regular people involvement and focus	**Ownership Culture** Involvement at all levels Near miss management High level of training/awareness Communication at a high level, hiding nothing Following current detailed procedures	**Way of Life** Comes naturally Personal involvement by all to prevent incidents Complete understanding All informed at all times about everything Lessons learned management Leadership accountability and measurement

Fig. 1. Cultural safety maturity model (Foster and Hoult, 2013).

analysis. Interest in the Socio-Technical Systems (STS) approach to safety culture and human factors reflects a growing belief that many dimensions of safety are emergent properties of such systems (Carayon et al., 2015). A STS is the synergetic interaction and integration of humans, processes, information and knowledge flows, technology, structures and the external environment in the workplace. Interactions are key in the STS approach and recognising the broad STS and the respective interactions between the different levels contribute to a more effective and integrated analysis of safety culture (Robertson et al., 2015).

Therefore a core theoretical proposition of this research approach is that understanding the functionality of a STS (whether that be at an organisational level or wider intra-organisational level) is the key to understanding it more effectively, changing it to achieve better outcomes, or designing a better functioning and safer future system that facilitates a more positive safety culture (Mc Donald, 2015).

SCOPE – **S**ystem **C**hange and **OP**erations **E**valuation is a conceptual and software system that was developed and rigorously tested as part of a series of EU funded projects (AMPOS, HILAS, MASCA, PROSPERO; ACROSS). Fig. 2 provides an outline of the conceptual approach.

The SCOPE conceptual approach focuses on four interlocking and interdependent levels of analysis: (i) process functionality (operational processes & management processes); (ii) social cohesion (trust, social networks); (iii) technology, all of which are mediated through (iv) collective knowledge and information cycles. Corrigan et al. (2015) demonstrated the application of the SCOPE methodology to assist with the analysis and creation of dynamic process mapping. Therefore, the
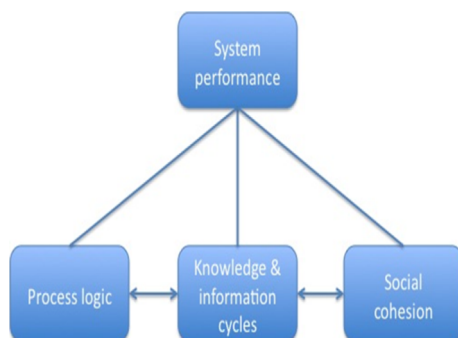
overall methodology that was deployed focused on an analysis at each of these four levels.

As a result, this approach provided a key mechanism for analysing the current Safety Culture within the port environment. This analysis was mapped onto a Safety Cultural Maturity Model in order to provide an indication of where the port is on their journey towards a fully embedded and resilient safety culture.

4. Methodology

This research took a socio-technical systems approach and employed mixed-methods that included the completion of a Safety Culture Assessment Survey across a port environment and qualitative interviews with key stakeholders in a port authority company.

4.1. Safety Cultural Assessment Survey (SCAS)

4.1.1. Survey tool

The survey consisted of 35 questions and was adapted from research carried out in EU projects (MASCA, InnHF, ManuVAR, HILAS). The original survey was developed by University of Laguna as part of the HILAS project (Diaz-Cabrera et al., 2007, 2008). All measures in the original survey were validated. The adaptation for the port SCAS consisted of changing language and terminology to be relevant to the port environment. The survey was then piloted to check for consistency of language in the adapted version.

Participants were asked to agree or disagree via a 5-point Likert-type rating scale (i.e. strongly agree, agree, neutral, disagree or strongly disagree) and it also consisted of some free text sections where participants could provide additional comments. The survey covered the following themes:

- Background Information
- Safety Training
- Hazard Identification and Risk
- Safety Awareness
- Reporting Incidents
- Responding to Incidents and Accidents

The researchers piloted the SCAS with a representative sample of operational and managerial staff in order to evaluate the survey for inconsistencies, fine-tuning of language, terminology etc. and to ensure

Fig. 2. SCOPE conceptual approach (Mc Donald, 2015).

that the questions were relevant for of the each groups taking part (i.e. operational staff, management, clerical staff). Only minor changes were made in relation to the survey format and the categorisation of key levels of staff. The survey was updated and finalised from this pilot study.

4.1.2. Survey participants

Ethics approval was obtained by Trinity College Dublin School of Psychology Ethics Committee and all participation was on a voluntary and informed basis.

The researchers contacted a total of ten companies in the port with a request to disseminate the SCAS. Eight of these agreed to take part in the survey. For most of the companies times and places were agreed for the researchers to disseminate surveys directly to their staff and request their voluntary participation. In other companies an appointed person agreed to distribute the surveys. In such cases, the blank surveys were left in a public space and a notice given out to staff asking them to take part. Completed surveys were collected by the researchers at an agreed time in all of the companies and in line with the agreed ethical guidelines

1. Participant Information sheet: – this sheet described the purpose and scope of the research project and contained the contact details of the researchers should anyone have any questions re their participation or wish to withdraw their participation. This form was to be retained by participants.
2. Participant Consent form: this form described the research project and detailed the rights of the participant including confidentiality and anonymity. Each participant signed this consent form and handed it back to the researchers either directly after completion of the survey or to the designated individual distributing the SCAS. All the consent forms and SCAS were handed back in sealed envelopes provided by the researchers as per ethical guidelines.
3. SCAS: The survey was completely anonymous. The survey was completed by participants and placed back in the sealed envelope and handed to the researchers as per ethical guidelines.

Participants were advised of their right to withdraw their participation at any stage until the data were pooled.

4.2. Research semi-structured interviews

4.2.1. Interview protocol

The overall objective of the semi-structured interviews was to further explore current approaches to managing safety and human factors in the port environment, focusing on staff who have responsibility for managing safety and operational experience in dealing with such issues. These interviews supplemented the SCAS as it allowed the researchers to further explore how safety and human factors is currently understood and managed within the Port Environment.

In light of the STS theoretical approach, the resulting data were analysed under the following headings – Health & Safety Goals; Processes (Management & Operational); Social Cohesion (Trust and Collaboration); Information & Knowledge Flows; and Technology as per the SCOPE framework. For each of these elements the analysis and interpretation focused on the where the company was in relation to the following:

- **Past state** – To provide an indication of where the port was in the previous (7 + years) in relation to safety.
- **Present state** – To provide an indication of where the port is currently in relation to safety.
- **Facilitators/Challenges** – To provide an indication on what are the key facilitators that currently support safety practices and policies and what are the current blockers/challenges to moving towards a more positive safety culture.

- **Proposed recommendations and expected impact** – To provide an indication of key recommendations and how these could potentially support the move towards a more positive safety culture.

4.2.2. Participants

The researchers contacted a total of ten companies in the port and requested their participation in the semi-structured interviews. Three of these agreed to take part in the research interviews. Of those three companies, in only one company were there enough interviews carried out to reach data saturation. Thus the findings here represent those of the port authority company. The participants that took part in the interview were those with responsibility for operational and strategic safety as well as port operatives.

Again, participants were invited on a voluntary and informed basis to participate and allowed seven days to reflect upon the participant information sheets given to them. Dedicated times and locations were agreed with the staff in the company and two researchers conducted each of the interviews. Permission to record and take notes was sought by the researchers. The interviews, lasted between 40 and 60 min, were recorded and fully transcribed. All data from these interviews was stored securely and de-identified in accordance with ethical guidelines.

5. Results

The results section is presented in two parts. The first section provides a high level descriptive overview of the key findings from the Safety Cultural Assessment Survey and the second section provides the key findings from the semi-structured research interviews.

5.1. Safety cultural assessment survey results

The key findings are organised per section of the survey (Safety Training, Hazard Identification & Risk, Safety Awareness, Incidents & Accidents). Comparisons are also made across employee grading (Management, Supervisor and Operational), age and length of employment. Some additional background information is presented at the beginning of the survey results section.

5.2. Background information

5.2.1. Demographics

A total of 161 surveys were completed across the port. The majority of participants (65%) were from operational levels, 16% were in supervisory roles and 19% were from management roles (17% management, 2% executive management) (see Fig. 3).
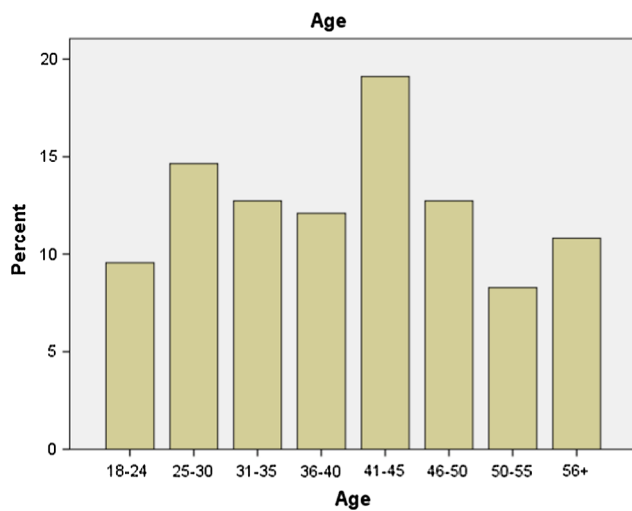

Fig. 3. Employee grade.

Fig. 4. Participant age.

40% of participants were from land-based operations, 24% of participants were from marine-based operations and 36% were from clerical and support staff.

The distribution of ages is shown is Fig. 4.

- 9% of respondents were aged between 18 and 24 years old.
- 15% of respondents were aged between 25 and 30 years old.
- 13% of respondents were aged between 31 and 35 years old.
- 12% of respondents were aged between 36 and 40 years old.
- 19% of respondents were aged between 41 and 45 years old.
- 13% of respondents were aged between 46 and 50 years old.
- 8% of respondents were aged between 51 and 55 years old.11% of respondents were aged 56 years old and above.

5.2.2. Safety training (ST)

Most responses were hugely positive towards Safety training across the port environment. For example, 85% of respondents agreed (40% agreed and 45% strongly agreed) that they are confident they had the right experience and qualifications to do their job. Interestingly a substantial number of respondents (81%) felt that they had the necessary safety training to do the job they do, that their training had covered all the safety risks associated with the work they do and yet 46% of respondents stated that they would like more Safety training. Most respondents (78%) also agreed that management placed a high priority on safety.

5.2.3. Hazard Identification & Risk (HIR)

The responses to all questions in this section of the survey were very encouraging. Most respondents (81%) agreed that people don't take risks and that they were confident their colleagues understood the hazards and risks associated with their work (80% of respondents). Also, most respondents (84%) agreed that it is not necessary for them to take risks to get their job done. The vast majority (87%) of respondents agreed that they understood how hazards and risks associated with their work can impact safety.

5.2.4. Safety Awareness (SA)

Responses to questions on Safety Awareness were positive. In terms of awareness of Safety Improvement activities at the port, 73% of respondents had been aware of these. Respondents were also positive about their fellow team members as 83% of them agreed that people in their team were committed to safety. Almost half of staff felt that safety was considered as more important than productivity (49% agreed), however many did not (32% were neutral and 19% disagreed). Most respondents (71% agreed) felt that they were able to access the right

equipment for them to be able to do their job safely. Safety procedures were considered to be strictly followed by 66% of respondents and 80% stated that they do not feel under pressure to ignore safety procedures.

Questions relating to the responsibility for safety presented some interesting perceptions. 59% of respondents felt that it was not the responsibility of a manager to check for everyone's errors, however, 26% disagreed and stated that it was the responsibility of a manager. Furthermore, 88% agreed that everyone is responsible for their own work.

Management were perceived in a positive light in relation to safety concerns. 70% of respondents agreed that management takes safety seriously and that their own line managers were receptive to ideas on how to improve safety (71% agreed). Most respondents also agreed (68%) that management does not wait for an incident to occur before considering safety.

5.2.5. Reporting Incidents (RI)

Responses to reporting incidents in the port was generally positive. 78% of respondents felt that the reporting system they had was good. Interestingly, 91% of respondents indicated that they would own up if they made an error which indicates a substantial level of openness from staff. Most respondents (78%) agreed that they would be dealt with in a fair manner if they reported an error.

A challenge for reporting incidents in the port is evident from 7% of respondents being afraid to submit a report and that only 36% of respondents stating that they would always receive feedback if they submitted a report.

5.2.6. Incidents and Accidents (IA)

The responses to reporting incidents and accidents in the port was mostly positive. Most respondents (58%) agreed that incidents are always reported and that appropriate action is taken with those involved. However, only 49% of respondents agreed that near misses were always reported. Management is perceived to be genuine in their motivation for investigating accidents as 67% of respondents agreed that they investigated accidents in order to find weaknesses in the procedures rather than to identify who was to blame. It should also be noted that almost one quarter (23%) of respondents did not agree.

5.3. Age

Since the sample was evenly split between participants who were either over (49%) or under 40-years-old (51%) an analysis was conducted to see if age had an impact on employee perceptions of the safety culture in port. A one-way between subjects ANOVA was conducted with age as a factor. The following statements were found to have significant differences associated with them:

Safety Training (ST5): I am confident that I have the right experience/qualifications for the work I do. $(F_{(7, 145)} = 2.623, p < 0.05)$.

Those over 40 were more confident that they had the right qualifications and experience for the work they do.

Hazard Identification and Risk (HIR2): I am confident that all my colleagues understand the hazards and risks associated with their work. $(F_{(7, 145)} = 2.207, p < 0.05)$.

Those under 40 were more confident that their colleagues understood the hazards and risks associated with their work.

Safety Awareness (SA2): I am aware of Safety Improvement activities in Port.

$(F_{(7, 146)} = 2.363, p < 0.05)$.

Those over 40 were more aware if the safety improvement activities in Port than those under 40.

Reporting Incidents (RI5): I am confident that any incident that I report would be dealt with by the right person. $(F_{(7, 145)} = 2.575, p < 0.05)$.

Those under 40 were more confident that any incident that they reported would be dealt with by the right person.

Table 1
Safety culture perceptual differences between management and supervisors.

Area	Statement	Results
Safety Training	(ST2) The training I had covered all the safety risks associated with the work for which I am responsible	There was a significant difference in the scores for Management (M = 1.59, SD = 0.68) and Supervisors (M = 1.96, SD = 0.62); t(51) = −2.05, p = 0.045. Management were in greater agreement than Supervisors that the training they had covered all the safety risks associated with the work for which they are responsible
Safety Awareness	(SA9) Management does not wait for an incident to occur before considering safety	There was a significant difference in the scores for Management (M = 1.64, SD = 0.78) and Supervisors (M = 2.25, SD = 0.90); t(50) = −2.61, p = 0.012. Management were in greater agreement than Supervisors that Management does not wait for an incident to occur before considering safety.
	(SA12) There are always enough people available to get the job done according to procedures/instructions/rules	There was a significant difference in the scores for Management (M = 2.03, SD = 0.82) and Supervisors (M = 2.79, SD = 1.22); t(51) = −2.69, p = 0.01. Management were in greater agreement than Supervisors that there are always enough people available to get the job done according to procedures/instructions/rules.
Incidents & Accidents	(IA4) Management investigates incidents to understand weaknesses in procedures rather than just identifying who is to blame	There was a significant difference in the scores for Management (M = 1.79, SD = 0.56) and Supervisors (M = 2.29, SD = 0.99); t(51) = −2.29, p = 0. 026. Management were in greater agreement than Supervisors that Management investigates incidents to understand weaknesses in procedures rather than just identifying who is to blame.
	(IA5) I am confident that any incident that I report would be dealt with by the right person	There was a significant difference in the scores for Management (M = 1.61, SD = 0.50) and Supervisors (M = 2.00, SD = 0.66); t(50) = −2.45, p = 0.018. Management were in greater agreement than Supervisors that they were confident that any incident that they reported would be dealt with by the right person.

5.3.1. Differences in safety culture perceptions between management & supervisors

Table 1 highlights the significant differences found between the responses of Management and Supervisors. The responses here demonstrate that management had a more positive perception of Safety Culture in Port.

5.3.2. Differences in safety culture perceptions between management & operational staff

This section presents the significant differences found in responses between Management and Operational staff within the Port environment. Table 2 highlights the significant differences found between the responses of Management and Operational Staff. The responses here demonstrate that management had a more positive perception of Safety Culture in Port.

5.3.3. Differences in safety culture perceptions between supervisors & operational staff

This section presents the significant differences found in responses between Supervisors and Operational staff within the Port Environment. Table 3 highlights the significant differences found between the responses of Supervisors and Operational Staff. The number of significant differences between the groups is much smaller. Only one such difference was found, indicating that there is greater alignment in the perception of safety culture in the Port between Supervisors and Operational staff.

5.3.4. Differences in safety culture perceptions depending on length of time working in the port

This section presents the significant differences found in responses between those staff who had worked 10 years or fewer in the Port and those whom had worked 11 years or longer in the Port Environment. Table 4 highlights the significant differences found between the responses of those staff whom had worked in the Port for 10 of fewer years and those whom had worked in the Port for 11 years or longer. Those whom had worked in the Port for between 0 and 10 years demonstrated a more positive perception of Safety Culture than those whom had worked in the Port for 11 years or longer.

5.3.5. Analysis of semi-structured research interviews

This section of the report provides a high level overview of key findings from the semi-structured interviews with the Port Authority.

As already the mentioned the research interviews were analysed according to the following headings:

- **Past state** – To provide an indication of where the port authority company was in the past (7 + years ago) in relation to health and safety.
- **Present state** – To provide an indication of where the port authority company is currently in relation to health and safety.
- **Facilitators/Challenges** – To provide an indication on what are the key facilitators that currently support safety practices and policies and what are the current blockers/challenges to moving towards a more positive safety culture. The challenges also represent some examples of the risks and hazards identified by participants during the interviews.
- **Proposed recommendations and expected impact** – To provide an indication of key recommendations and how they could potentially support the move towards a more positive safety culture.

Table 5 provides a high level overview of the key findings (including examples of current challenges, risk, hazards and facilitators, recommendations and expected impact).

5.4. Summary of key findings

- There seems to be a very distinct turning point (past 5–7 years) in relation to the port's authority change of approach in prioritising H & S. Due to regulation and legislation H&S has evolved and the focus has been on continuously identifying all the risks, dangers and hazards and developing mitigating actions to eliminate them.
- A considerable amount of work has been devoted to improving H & S practices and developing a more positive Safety Culture within the port authority. Most notably:
  o Dedicated H & S specialists at both managerial and operational levels.
  o Systematic gap analysis across all operational areas and risk assessments carried out.
  o Streamlined and standardised the H & S SOPs.
  o Established a H & S committee made up of representatives from all key functions.
  o A number of visible signs of a heightened awareness of H & S (e.g. high-vis jackets, etc.)
  o Vision to move H & S beyond compliance (moving beyond it just

Table 2
Safety culture perceptual differences between management and operational staff.

Area	Statement	Results
Safety Training	(ST2) The training I had covered all the safety risks associated with the work for which I am responsible	There was a significant difference in the scores for Management (M = 1.59, SD = 0.68) and Operational Staff (M = 2.05, SD = 0.99); t(121) = −2.35, p = 0.02. Management were in greater agreement than operational staff that the training they had covered all the safety risks associated with the work for which I am responsible.
	(ST3) Management place a high priority on training	There was a significant difference in the scores for Management (M = 1.72, SD = 0.59) and Operational Staff (M = 2.13, SD = 1.02); t(120) = −2.02, p = 0.045. Management were in greater agreement than operational staff that Management place a high priority on training
Hazard Id. & Risk	(HIR 4) I am confident that I understand how the hazards and risks associated with my work can impact safety	There was a significant difference in the scores for Management (M = 1.41, SD = 0.57) and Operational Staff (M = 1.70, SD = 0.68); t(119) = −2.03, p = 0.044. Management were in greater agreement than operational staff that they were confident that they understand how the hazards and risks associated with their work could impact safety.
Safety Awareness	(SA1) I have good knowledge of maintenance rules & procedures	There was a significant difference in the scores for Management (M = 1.66, SD = 0.61) and Operational Staff (M = 1.96, SD = 0.72); t(123) = −2.04, p = 0.043. Management were in greater agreement than operational staff that they had good knowledge of maintenance rules & procedures
	(SA3) Senior management take safety seriously	There was a significant difference in the scores for Management (M = 1.61, SD = 0.69) and Operational Staff (M = 2.04, SD = 0.95); t(118) = −2.26, p = 0.02. Management were in greater agreement than operational staff that Senior management take safety seriously.
	(SA4) My line manager is receptive to ideas on how to improve safety	There was a significant difference in the scores for Management (M = 1.59, SD = 0.64) and Operational Staff (M = 2.09, SD = 0.88); t(120) = −2.77, p = 0.006. Management were in greater agreement than operational staff that their line manager was receptive to ideas on how to improve safety
	(SA5) It is not the responsibility of a manager or supervisor to check for everyone's safety	There was a significant difference in the scores for Management (M = 3.21, SD = 1.29) and Operational Staff (M = 2.63, SD = 1.15); t(121) = 2.31, p = 0.023. More Operational staff than management agreed that it was not the responsibility of a manager or supervisor to check for everyone's safety.
	(SA8) I don't feel pressured to ignore safety procedures	There was a significant difference in the scores for Management (M = 1.46, SD = 0.64) and Operational Staff (M = 2.16, SD = 0.98); t(122) = −3.53, p = 0.02. Management were in greater agreement than operational staff that they don't feel pressured to ignore safety procedures
	(SA9) Management does not wait for an incident to occur before considering safety	There was a significant difference in the scores for Management (M = 1.59, SD = 0.68) and Operational Staff (M = 2.05, SD = 0.99); t(121) = −2.35, p = 0.001. Management were in greater agreement than operational staff that Management does not wait for an incident to occur before considering safety
	(SA12) There are always enough people available to get the job done according to procedures/instructions/rules	There was a significant difference in the scores for Management (M = 2.03, SD = 0.82) and Operational Staff (M = 2.56, SD = 1.18); t(123) = −2.25, p = 0.026. Management were in greater agreement than operational staff that there are always enough people available to get the job done according to procedures/instructions/rules.
	(SA14) People can always get the equipment they need to do the job safely	There was a significant difference in the scores for Management (M = 1.62, SD = 0.56) and Operational Staff (M = 2.15, SD = 1.03); t(123) = −2.64, p = 0.009. Management were in greater agreement than operational staff that People can always get the equipment they need to do the job safely.
Reporting Incidents	(RI3) I am confident that any incident that I report would be handled quickly	There was a significant difference in the scores for Management (M = 1.66, SD = 0.55) and Operational Staff (M = 2.11, SD = 1.01); t(123) = −2.23, p = 0.021. Management were in greater agreement than operational staff that they were confident that any incident that they reported would be handled quickly.
	(RI4) I would be afraid to submit a report	There was a significant difference in the scores for Management (M = 4.35, SD = 0.80) and Operational Staff (M = 3.08, SD = 1.07); t(119) = 2.43, p = 0.017. More Managers disagreed with this statement.
Incidents & Accidents	(IA4) Management investigates incidents to understand weaknesses in procedures rather than just identifying who is to blame	There was a significant difference in the scores for Management (M = 1.79, SD = 0.56) and Operational Staff (M = 2.20, SD = 1.01); t(122) = −2.08, p = 0.04. Management were in greater agreement than operational staff that Management investigates incidents to understand weaknesses in procedures rather than just identifying who is to blame.
	(IA5) I am confident that any incident that I report would be dealt with by the right person	There was a significant difference in the scores for Management (M = 1.61, SD = 0.50) and Operational Staff (M = 2.00, SD = 0.90); t(121) = −2.21, p = 0.029. Management were in greater agreement than operational staff that they were confident that any incident that they reported would be dealt with by the right person.

Table 3
Safety culture perceptual differences between supervisors and operational staff.

Area	Statement	Results
Safety Awareness	(SA4) My line manager is receptive to ideas on how to improve safety	There was a significant difference in the scores for Supervisors (M = 1.71, SD = 0.69) and Operational Staff (M = 2.09, SD = 0.88); t(117) = −2.01, p = 0.047. Supervisors were in greater agreement than operational staff that their line manager is receptive to ideas on how to improve safety.

Table 4
Safety culture perceptual differences for years worked in port.

Area	Statement	Results
Hazard Id. & Risk	(HIR4) I am confident that I understand how the hazards and risks associated with my work can impact safety	There was a significant difference in the scores for 0–10 years in Port (M = 1.52, SD = 0.58) and 11 + years in Port (M = 1.74, SD = 0.69); t(140) = −2.06, p = 0.041 Those staff who worked in the Port for 0–10 years were in greater agreement than those whom has worked in the Port for 11 years or longer that they were confident that I understand how the hazards and risks associated with my work can impact safety.
Safety Awareness	(SA2) I am aware of Safety Improvement activities in Port	There was a significant difference in the scores for 0–10 years in Port (M = 2.08, SD = 0.91) and 11 + years in Port (M = 2.44, SD = 0.97); t(143) = −2.32, p = 0.022 Those staff who worked in the Port for 0–10 years were in greater agreement than those whom has worked in the Port for 11 years or longer that they were aware of Safety Improvement activities in Port.
	(SA6) Everyone is responsible for their own work	There was a significant difference in the scores for 0–10 years in Port (M = 1.71, SD = 0.78) and 11 + years in Port (M = 2.01, SD = 1.03); t(144) = −2.07, p = 0.040 Those staff who worked in the Port for 0–10 years were in greater agreement than those whom has worked in the Port for 11 years or longer that everyone is responsible for their own work.
	(SA7) Safety is usually seen as more important than productivity/operations	There was a significant difference in the scores for 0–10 years in Port (M = 2.22, SD = 0.96) and 11 + years in Port (M = 2.62, SD = 1.01); t(143) = −2.43, p = 0.016 Those staff who worked in the Port for 0–10 years were in greater agreement than those whom has worked in the Port for 11 years or longer that Safety is usually seen as more important than productivity/operations.
	(SA11) The safety procedures and rules are strictly followed in Port	There was a significant difference in the scores for 0–10 years in Port (M = 2.03, SD = 0.97) and 11 + years in Port (M = 2.49, SD = 0.96); t(143) = −2.91, p = 0.004 Those staff who worked in the Port for 0–10 years were in greater agreement than those whom has worked in the Port for 11 years or longer that the safety procedures and rules are strictly followed in Port.
	(SA12) There are always enough people available to get the job done according to procedures/instructions/rules	There was a significant difference in the scores for 0–10 years in Port (M = 2.24, SD = 1.07) and 11 + years in Port (M = 2.76, SD = 1.17); t(145) = −2.84, p = 0.005 Those staff who worked in the Port for 0–10 years were in greater agreement than those whom has worked in the Port for 11 years or longer that there are always enough people available to get the job done according to procedures/instructions/rules.
Reporting Incidents	(RI3) I am confident that any incident that I report would be handled quickly	There was a significant difference in the scores for 0–10 years in Port (M = 1.84, SD = 0.90) and 11 + years in Port (M = 2.15, SD = 0.85); t(145) = −2.15, p = 0.033 Those staff who worked in the Port for 0–10 years were in greater agreement than those whom has worked in the Port for 11 years or longer that they were confident that any incident that they reported would be handled quickly.
	(RI5) I always receive feedback for any report I submit	There was a significant difference in the scores for 0–10 years in Port (M = 2.33, SD = 0.99) and 11 + years in Port (M = 2.76, SD = 0.79); t(144) = −2.88, p = 0.005 Those staff who worked in the Port for 0–10 years were in greater agreement than those whom has worked in the Port for 11 years or longer that they always receive feedback for any report they submit.
	(RI6) If I report an error, I am confident I would be treated in a fair manner	There was a significant difference in the scores for 0–10 years in Port (M = 1.83, SD = 0.81) and 11 + years in Port (M = 2.13, SD = 0.77); t(144) = −2.72, p = 0.025 Those staff who worked in the Port for 0–10 years were in greater agreement than those whom had worked in the Port for 11 years or longer that If they reported an error, they would confident they would be treated in a fair manner.
Incidents & Accidents	(IA2) Appropriate action is taken against people who are involved	There was a significant difference in the scores for 0–10 years in Port (M = 2.13, SD = 0.95 and 11 + years in Port (M = 2.49, SD = 0.87); t(143) = −2.33, p = 0.021 Those staff who worked in the Port for 0–10 years were in greater agreement than those whom has worked in the Port for 11 years or longer that appropriate action is taken against people who are involved.
	(IA3) Near misses are always reported	There was a significant difference in the scores for 0–10 years in Port (M = 2.37, SD = 1.15) and 11 + years in Port (M = 2.81, SD = 0.93); t(143) = −2.47, p = 0.015 Those staff who worked in the Port for 0–10 years were in greater agreement than those whom has worked in the Port for 11 years or longer that near misses are always reported.

being a tick-box exercise)
o Plans to re-develop the existing Risk Register.
- It was felt that while the SOPs are now in place, the key safety messages are not being sufficiently filtered and some of the content has been reported as 'heavy tone', 'not relevant' and not always seen as a support at the operational level.
- Safety Information is primarily communicated via a dedicated IT systems and emails but it appears that these communication mechanism are not reaching everyone, especially staff that are not comfortable with IT.
- Safety Audits are not carried out yet (as it was felt that the company is 'not mature enough yet as audits would only highlight the negative aspects'). Although there are plans to have much more H & S visibility around the port with the introduction of the new H & S Specialist Role.

- A divide ('mistrust') still exists between management & operational staff. In particular those staff that have been employed over a longer period within the company. The presence of this subculture is having somewhat of a negative impact on embedding the H&S vision into the culture of the company.
- Lack of trust in the incident/accident reporting process and staff perceive this to be something that should be used with caution rather than seen as something to be used for organisational learning and proactively managing H & S.
- There is not a feedback loop from incident and accident investigations. Sometimes even if an investigation has been carried out a corrective action put in place this may not always be communicated. The dedicated IT system doesn't facilitate this change. In many instances supervisors do not feedback on the outcomes of an investigation.

Table 5
Summary of key findings.

	Past State (7 years +)	Present State	Facilitators/Challenges	Proposed Recommendations & Expected Impact
Safety Goals	H & S not seen as a priority and there were no clearly articulated goals or policies in relation to H & S. The focus was "very much on getting the job done" and there was no formal H & S training. No formal H & S meetings or committees. Anything related to H & S was carried out in an adhoc manner. Different safety standards and safety goals across different functions. Different safety standards and safety goals across different tenant companies	H & S goals have evolved in the past 5–7 years due to legislation and regulation. New dedicated appointments to H & S roles have had a positive impact on raising H & S awareness. Commitment and focus on developing SOP's, Safety Goals & Safety Practices H & S goals don't seem to be flowing through the companies. A lot of the responsibility for safety is entirely up to the individual.	*Facilitators*: Much more awareness of H & S and acceptability that safety is seen as more of a priority than in previous years. *Challenges*: While the overall H & S goals are defined, not all staff have the same understanding of safety goals (not shared between operational staff & management; not shared between old and newer staff).	Consider how SOP's can be more practical & easily accessible so that staff can get to the information they require and it can be seen as an active support for their tasks. Explore ways to break down silo's between management and operational staffMore effective and tailored communication procedures and protocols (e.g., tool box talks) Video inductions for new staff that addresses port wide issues Dedicated H & S campaigns/H & S blitz
Process (Management & Operational)	No formal H & S committee existed. No formal dedicated H & S roles. No visible presence of H & S. Inadequate H & S Training. Lack of proper PPE equipment when staff joined some companies Training Records were not kept up-to-date. No emphasis on systematic risk assessments. Poor Safety Culture.	A formal H&S Committee established within one company with dedicated H & S Manager & H & S specialist. Meetings take place every 2 months. In the same company each function has a dedicated safety representative & developed H & S League tables to see how managers compared with each other.Ongoing H & S training (PPE, First Aid, Dangerous Equipment) . Most staff wearing high-vis vests. However some staff reported that they hadn't received adequate H & S trainingOngoing Risk Assessments but it was felt that there needs to be priority as not very task needs to be risk assessed (e.g., picking up litter) The port authority have no control or influence over the H & S practices of the port tenants. Quite a lot of 'grey areas' between the port authority & the tenants on who is responsible for what?	*Facilitators*: Much more tangible management and operational processes in place to ensure H & S compliance. *Challenges*: Outcomes & decisions made at committee meetings are not sufficiently communicated.Some staff did not recognise that they had received H & S training (negative & ingrained attitudes) .	More effective and tailored communication procedures and protocols.Increase staff engagement (constant motivation) . H & S needs to be seen as everyone's responsibility. Video Inductions new staff that addresses port wide issues From a strategic management perspective plans to move beyond compliance.
Social Cohesion (Trust & Collaboration)	Highly unionised. Us & Them Mentality between Management & Operational Staff. Lack of trust of management. Lack of trust & 'respect' between port authority and the tenants. Little co-operation from tenants on H & S issues when on site. Reported that not the right culture to have an open Forum on Safety Issues. Longer term employed staff had fairly entrenched ideas.	There has been some progress made in improving trust between the port authority and the tenant companies. Differences in opinion between the longer term employed staff and the newer staff. Older staff have quite engrained views on how things should be done. Some not open to new ideas and complete lack of distrust of management. Divide between management and operational staff. Lack of poor communication from management consistently reported. Lack of trust in management's approach to H & S. Some staff referred to a blame culture 'if you kick up too much about H & S, you would be seen as making trouble … you are better off keeping your head down and saying nothing' Reliance on Unions Some role confusion between different functions.	*Facilitators*: Management are very aware of the lack of trust between management and operational staff. *Barriers*: The necessary social cohesion, trust and levels of collaboration are still not in place. The lack of trust and the lack of openness (to new ideas), particularly from the older staff.	More effective and tailored communication procedures and protocols. Need to enhance collaboration between the port authority & tenants where they share road space. Collaboration for an understanding of the importance of safety – moving things around the port is dangerous. Create a peer learning community. Interface between the port authority and tenants need to be improved. Some good examples of cross tenant collaboration
Information & Knowledge Flows	Standard Operating Procedures (SOPs) were not developed in a	Streamlined the SOP's and made them accessible both in hard and soft copy.	*Facilitators*: SOPs exist all in a standardised format and systematic risk assessments have been conducted.	Targeted, appropriate, applicable information to the right people at the right time.

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Table 5 (continued)

	Past State (7 years +)	Present State	Facilitators/Challenges	Proposed Recommendations & Expected Impact
	standardised or systematic manner. Lack of version control of SOPs different staff members working from different versions of the SOPs. Some SOPs were hand written only.High reliance on informal knowledge and information (word of mouth) . Accident/Incident Reporting in place but not always adequate follow-up & poor feedback to the operational staff. No reporting of Near Misses. IR issues wrapped up as H & S issues.	Mixed views on the usefulness of the SOPs. Staff reported they haven't read SOP's they have only glanced at them. Not everyone willing to sign that they have read SOPs as some distrust as staff felt they will be liable if something goes wrong and they have signed that they have actually read the SOPs Some staff don't check their emails for weeks so don't get the safety information/updates from the safety committee meeting in a timely manner. Staff reluctant to submit incident reports as they are afraid of repercussions – 'fear that our role will be made more difficult'. 'staff don't always trust who they are reporting to' Little or no feedback from incident reports. The loop is not closed. In many instances supervisors do not feed back to the staff what an outcome of an investigation. If they don't get any feedback they assume that nothing has been done about it even though recommendations may have been put in place.If an investigation is carried out after an incident and an action plan put in place this is not always communicated. Supervisors don't always report back to the instigator. High reliance on informal knowledge and information (word of mouth) . No clear protocols for reporting near misses	***Barriers:*** SOPs are not seen as a support for the operational staff the SOP's have a 'heavy weight' tone and are not sufficiently communicated in that key messages are not getting filtered down to the right staff at the right level. Lack of trust in the incident/accident reporting process.The reporting process loop is not complete (no communication/feedback loop back to the originator) .	Handbook of key SOPs as they need to be more practical. Feedback loop from incident/accident report How to integrate safety within the company Important to develop aggregated statistics.Important to look to other safety critical industries (e.g., mining).Ensure staff that are not comfortable using IT (e.g., emails) have other sources to receive H & S information.
Technology	High reliance on old equipment. Poor road markings	A dedicated IT system is the mechanism where safety messages are distributed. Unclear if all staff actually log on and read the information. Q-Pulse acknowledges receipt but no way of knowing if staff have read the SOP The IT system currently doesn't have the functionality to communicate if a corrective action has been put in place following an investigation of an incident/ accident.There are a lot of old machines/equipment (some dating back to the 60's) , there are no drawings, no procedures etc. So many changes to equipment over the years that have not been labelled. These machines/equipment will be phased out but still need to use them in the interim. Poor road markings still reported as a problem as well as poor lighting and poor signage Mobile Phones reported as a huge distraction	***Facilitators:*** The dedicated IT system has the potential to be a much more effective means of communication and learning ***Barriers:*** Not all staff are completely comfortable with IT	Planning to introduce a mobile app where incidents can be reported immediately

- Staff not willing and doesn't trust the organisation to report near misses. No protocols for reporting near misses (except for one reporting system) Some felt that when they had reported hazards or potential hazards that "nothing was done about it", it "fell on deaf ears"…while others felt that it would reflect negatively on them if "they kicked up about any H & S issue".
- The most immediate and pressing concern is to improve the overall communication protocols within the company.
- Require a collaboration for an understanding of the importance of H & S.

6. Discussion

In assessing safety culture in the Port, one of the key questions the research wanted to address is what level of safety cultural maturity has the port reached and at what stage in the CSM Maturity model does the port currently reside? It should be noted here that unfortunately due to the overreliance on one company in terms of interviews, this analysis is somewhat limited. In our experience, research interviews provide more insight and depth of information to supplement the survey. Nevertheless the Cultural Survey Assessment and the interview with the Port Authority did reveal some interesting findings.

The following provides a summary of the key findings from the research under the following headings:

- Health & Safety Awareness & Resources
- Management Commitment & Visibility
- Reporting Culture
- Communications

6.1. Health & safety awareness & resources

The Survey results suggest that there is a high level of Health & Safety Awareness and satisfaction with overall Health & Safety training and support in the companies that participated in this study. For example whereas 81% of respondents agreed that they were confident they had the necessary safety training to do the work they do,55% of respondents agreed that they would like to receive more training on safety and a further 34% were neutral in relation to this question, indicating a somewhat negative response.

The responses in relation to 'Hazard Identification and Risk' there were largely positive.78% of respondents were confident that all their colleagues understand the hazards and risks associated with their work and 95% were confident that they understood how the hazards and risks associated with their work can impact safety.

However when comparing the differences between management and operational grades, a number of interesting findings emerged in that management were more likely to agree: (i) that their colleagues understood the hazards and risks associated with their work compared to operational staff; (ii) that safety procedures and rules are strictly followed compared to operational staff (iii) there are always enough people available to get the job done according to procedures/instructions/rules compared to operational staff.

It is evident that a considerable amount of work has been devoted to improving Health and Safety practices and developing a more positive Safety Culture within the port environment. The port staff are very responsive to working in a safe manner and have a good awareness of current legislation and the various initiatives currently deployed within their respective organisations. All of which provides a solid foundation for further enhancing the overall Safety Culture.

6.2. Management commitment & visibility

It was evident from both the results from the survey and the interviews within the port authority company that there is a vision to move health and safety beyond compliance into a much more proactive and resilient safety culture. As already mentioned the appointments of dedicated H & S specialists at both the operational and management levels has been received very positively within the company.

A positive response was found in relation safety commitment by both Senior Management and Line Management across the port. 82% of respondents agreed that Senior Management take safety seriously and 80% agreed that their line manager is receptive to ideas on how to improve safety. However there was a relatively high level of disagreement (35% & 14% neutral response) to the statement that 'it is not the responsibility of a manager to check for everyone's errors'. More operational staff disagreed with this statement compared to Supervisors. It is very encouraging that management commitment and visibility to Health and Safety is perceived as so positive with the port. However, there does seem to be a trend in the findings where some (particularly operational staff) felt that management should be more hands-on when it comes to overseeing operational tasks and dealing with potential errors.

6.3. Reporting culture

A positive response was found in relation to incident reporting systems, with 84% agreeing that they have a good system for reporting incidents and 82% felt confident that any incident that they reported would be handled quickly. However it should be noted that 15% of staff did feel that they would be afraid to submit a report and a fairly high neutral response (40%) and level of disagreement (12%) was reported in relation to the statement 'I always receive feedback for any report submitted'. Interesting when comparing management, supervisors and operational staff in relation to this statement, significantly more management agreed with this compared to the supervisors and operational staff. Management were also more likely to feel that if staff reported an error they would be treated in a fair manner compared to supervisors and operational staff.

Overall, 52% of respondents either disagreed or held a neutral response when asked if 'near misses were always reported' and management were significantly more likely to report that incidents were always reported compared to operational staff. Some interesting findings also emerged when comparing staff who have worked at the port for less than ten years and those that have worked there for more than ten years. Significantly more staff who had worked at the Port for ten years or less agreed with the following: (i) receive feedback for any report they submit; (ii) near misses were always reported; (iii) confident that any incident reported would be dealt with by the right person compared to staff who worked at the port for more than 10 years.

Therefore overall the efficacy of the reporting systems did seem to produce some contradictory findings. While on the one hand staff felt that the reporting systems were efficient, there was a trend in the findings that indicated feedback was not always timely or followed through. There was also a marked differences in the perceptions of management compared to operational staff in relation to the overall reporting culture.

The interviews revealed a far less positive view regarding the effectiveness of the reporting culture. A number of the staff highlighted that there was a lack of trust in the incident/accident reporting process and perceived this as something that should be used with caution rather than seen as something to be used for organisational learning and proactively managing H & S. Two staff members explicitly highlighted that they were reluctant to submit incident reports as they were afraid of the repercussions, '…fear that our role will be made more difficult…' and '…staff don't always trust who they are reporting to…' Three other staff members highlighted that when they had reported hazards or potential hazards that "nothing was done about it", it "fell on deaf ears"…while others felt that it would reflect negatively on them if "they kicked up about any H & S issue".

The lack of consistent and timely feedback from incident and accident investigations was highlighted as an issue. Sometimes even if an

investigation has been carried out a corrective action put in place this may not always be communicated. Again it was felt that sufficient communication channels were not in place within the company to facilitate the necessary feedback loop (e.g., the dedicated IT system doesn't facilitate this feedback loop).

6.4. Communications

One of the most consistent messages that came from the interviews was that the overall communications protocols needs improvement within the port authority company and much more effective and tailored communication is required going forward. It was felt that while the SOPs are now in place, the key safety messages are not being sufficiently filtered and some of the content has been reported as 'heavy tone', 'not relevant' and not always seen as a support at the operational level. Safety Information is primarily communicated via the dedicated IT system and emails but it appears that these communication mechanisms are not reaching everyone, especially staff that are not comfortable with IT. The lack of consistent feedback from incident and accidents reports was highlighted by all operational staff and it was felt that it depended on the management approach of individual supervisors and managers on what was information was communicated and how this was communication.

6.5. Port cultural safety maturity

Placing these findings in the context of the Cultural Safety Maturity Model, we concluded that the port is moving out of a reactive approach to safety into a more compliant approach to safety culture (see Fig. 5). Clearly, however, the port has more work to do on their journey if they want to target a more resilient approach to safety culture. Nevertheless, the building blocks for this are in place and it would be very interesting to run the Cultural Assessment again in a number of years to benchmark the progress.

As part of the Code of Practice for the Management of Health & Safety in Ports various national agencies are recommending that "A consultation mechanism should be in place to ensure communication of all relevant safety matters between port users, operators and administrators. Safety rules for the port should be circulated to all port users. In

order to foster cooperation between all employers within the port, a central port-wide health and safety committee should be set up to discuss common health and safety issues and to implement common safe systems of work within the port" Guidelines on the Application of the IMO International Safety Management (ISM) Code (2010)).

A common trend across a range a wide range of industries is that they are poor at learning and sharing learning from their own experience and from the experiences of others. All too often, investigations into accidents and incidents highlight that the underlying causes were very similar to previous events. A "learning organisation" is one that not only values and encourages learning from its own experiences, but looks beyond itself for lessons – to similar companies in the same industry and to other industries. In relation to Port Estate there does seem to be an openness and willingness to learn from tenants within the port environment, other port environments and other industrial sectors.

However in order to effectively promote an effective internal learning community and move to the higher level stages of proactiveness and resilience, the port needs to continually build on what they have achieved so far in ensuring carefully cultivated attitudes across all staff levels and that management processes that are actively seen as supporting normal operational practice. The utilisation of much more effective communication and co-ordination mechanisms is also vital in order ensure the following basic elements that enables port staff to contribute to and shape decisions about H&S practices and behaviour in order to a achieve resilient safety culture.

6.6. Future research

As well as ensuring that we are culturally mature according to Foster and Hoult (2013), Ports must be resilient and be able to function as needed under both expected and unexpected conditions. This paper explored some initial steps in a Port's journey towards that state of safety culture maturity. Future research in this area would be prudent to explore not only how resilient the port environment is but how vulnerable it can be in relation to the likely operational, political, environmental changes that we face from both natural and man-made threats. Quantification of such vulnerability is welcomed, as is the appropriate analysis of big data elicited from Port operations, incident analysis, risk assessment and hazard identification. The ability to use
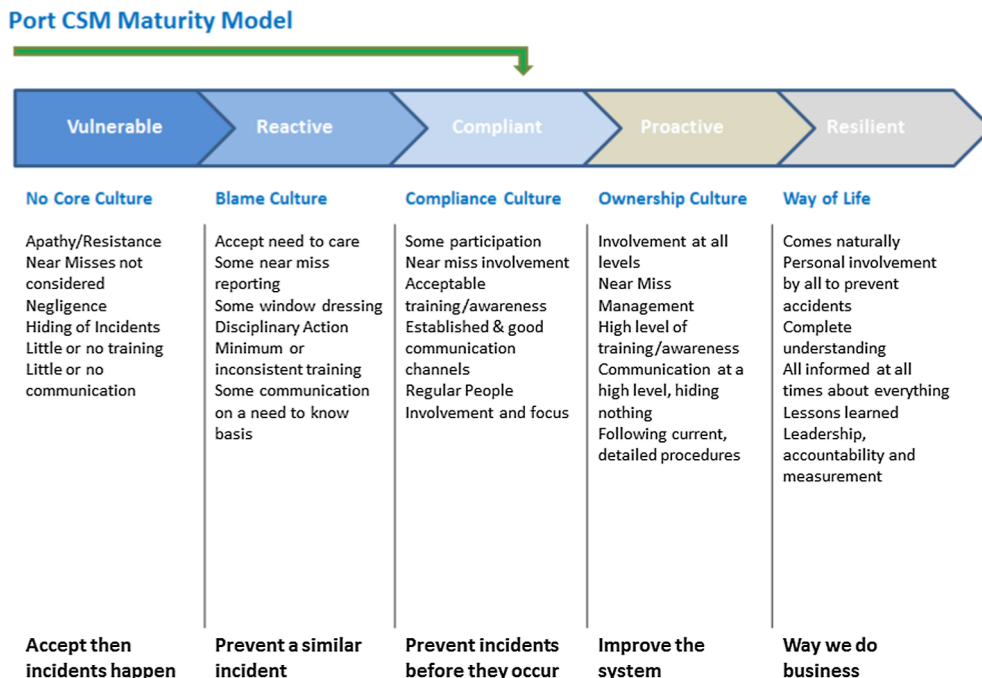

Fig. 5. The port CSM maturity model.

Table 6
Summary of key recommendations.

Recommendation	Proposed Changes	Proposed Actions	Proposed Impact
Effective Port–Wide Communications Strategy	Deliver targeted, appropriate and applicable information to the right people at the right time.	Video inductions for new staff; regular tool-box talks; safety suggestion scheme	Learn key lessons/messages faster and ensure lessons stay learnt
Reporting Culture	Closing the full cycle on reporting from initiation to feedback	Explore the possibility of anonymous reporting; mechanisms to ensure frequent feedback and action plans following an incident; Targeted campaigns to address known human factors that can contribute to incidents/accidents	Improve the trust and confidence in the incident reporting process
Managing Sub-Cultures	Understanding the role played by different sub-cultures and to ensure commitment from all levels	Collective & Collaborative Approach. Identify the values & assumptions of each subculture. Differences are opportunities for learning. Serious Games as way of building bridges between cultures.	A great deal of operational knowledge resides within port operational staff. Multiple means of communicating safety messages and breaking down silos to promote collaboration.
Management Actions	Management need to demonstrate ongoing commitment and visibility to health and safety initiatives	Increased management visibility on the port; dedicated H & S campaigns/blitz; informal communications meetings/talks following safety inspections; benchmarking, trends & statistics	Integration of safety in the organisation.
Co-ordination & Co-operation across the Port	This is an internal recommendation also as effective co-operation is essential	Port Wide Safety Committee	Co-ordinate and share preventative activities & keep each other & respective employees informed about the risks to H & S on the port.
Learning from other industries	The Port environment can learn from other safety critical industries with proactive & well established approaches to H & S	Cross-Industry H & S focused Conference; bi-annual basis to create an active industrial/research collaboration and community of practice	Improve overall port performance when compared with other industries 'best'. Good sharing practice – enhance sharing of ideas and methods; benchmarking – identifying and sharing lessons from other industries; data – improve understanding & learning from trailing and leading indicators

big data effectively is made possible through a thorough application of appropriate socio-technical systems modelling and sense making. Without these, the data is largely quantitative data rendered is useless as it does not have relevance to the day to day operations at the port, nor the embedded safety culture.

7. Conclusions

The ISM Code Implementation has played a critical role in understanding safety and highlighting the importance of safety culture. This code highlights key policies and procedures that are required for a more valuable safety in all areas of shipping and port operations. Therefore this code should provide the platform for safety improvement. However the achievement of a total resilient safety culture need to go beyond just compliance with the ISM Code. The port in this study have made considerable progress in improving their overall safety awareness and they are on their way to moving beyond just safety compliance to a more resilient safety culture. Table 6 provides a high level overview of some of the key recommendations and proposed actions that ports should be considering as a matter of priority on their journey towards a resilient safety culture.

References

ACROSS (Advanced Cockpit for the Reduction of Stress and Workload) EU FP7 2013–2016.

AMPOS (Aircraft maintenance procedure optimising system) EU FP4 1999–2000.

Berg, H.P., 2013. Human factors and safety culture in maritime safety. Int. J Mar. Navigat. Saf. Sea Transp. 7 (3) < http://www.transnav.eu > .

Bauk, S., Schmeink, A., Colomer, J., 2016. An RFID model for improving workers' safety at the seaport in transitional environment. Transport 31 (1), 1–11.

Bauk, S., Schmeink, A., Colomer, J., 2017. Employing wireless networks in enhancing occupational safety at the developing seaport – two proposals. Polish Marit. Res. 24 (1(93)), 115–124.

Carayon, P., Hancock, P., Leveson, N., Noy, Y., Sznelwar, L., van Hootegem, G., 2015. Advancing a sociotechnical systems approach to workplace safety: developing the conceptual framework. http://doi.org/10.1080/00140139.2015.1015623.

Corrigan, S., Mårtensson, L., Kay, A., Okwir, S., Ulfvengren, P., 2015. Implementing collaborative decision making in European airports: challenges & recommendations. J. Cogn. Technol. Work 17(2).

Corrigan, S., McDonald, N., 2014. What makes for successful change: evidence from industrial-based research. J. Airport Manage. 8.

Darbra, R.M., Crawford, J.F.E., Haley, C.W., Morrison, R.J., 2006. Safety culture and hazard risk perception of Australian and New Zealand maritime pilots. Presented at the Asia-Pacific Pilotage Conference 2006, Tuesday 14th–Friday 17th March 2006, Sydney, Australia.

Diaz-Cabrera, D., Hernadez-Fernaud, E., Isla-Diaz, R., 2007. An evaluation of a new instrument to measure organisational safety culture values and practices. Accid. Anal. Prevent. 39, 1202–1211.

Diaz-Cabrera, D., Isla-Diaz, R., Rolo-Gonzalez, G., Villegas-Villasquez, O., Ramos-Sapena, Y., Hernadez-Fernaud, E., 2008. Organisational health and safety from an integrated perspective. Papeles de Psicologo 129 (1), 83–91.

Foster, P., Hoult, S., 2013. The safety journey: using a safety maturity model for safety planning and assurance in the UK coal mining industry. Minerals 3(1), 59–72. http://doi.org/10.3390/min3010059.

Gordon, R., Perrin, E., Kirwan, B., 2007. Measuring safety culture in a research and development centre: a comparison of two methods in the Air Traffic Management domain. Saf. Su, Sci. 45 (6), 669–695. http://dx.doi.org/10.1016/j.ssci.2007.04.004.

Global Risk Reports, 2016. Insight Report, 11th ed. < http://www3.weforum.org/docs/Media/TheGlobalRisksReport2016.pdf > .

Guidelines on the Application of the IMO International Safety Management (ISM) Code 4th Edition 2010 (ICS/ISF).

HILAS (Human Integration into the Lifecycle of Aviation Systems) EU FP6 2005–2009.

Hollnagel, E., 2014. Safety I and Safety II: The Past and Future of Safety Management. Ashgate, Surrey, UK.

Hollnagel, E., 2018. Safety II in Practice: Developing the Resilience Potentials. Routledge, Oxon, UK.

Hosseini, S., Barker, B., 2016. Modeling infrastructure resilience using Bayesian networks: a case study of inland waterway ports. Comput. Ind. Eng. 93 (252–266).

InnHF (Innovation through human factors in risk analysis and management) EU FP7 Marie Curie ITN 2011–2015.

INSAG (International Nuclear Safety Advisory Group), 1996. Report on Defence in Depth in Nuclear Safety. International Atomic Energy Agency, Vienna 1996.

International Shipping Federation, Safety culture is enlightened self-interest, ISF, 2011.

International Maritime Organisation, 2003. MSC77/17 – role of the human element. London IMO.

International Maritime Organisation, 2006. MSC-MEPC.7/Circ.3 – Framework for Consideration of Ergonomics and Work Environment London, IMO, 22nd May 2006.

Lam, J.S.L., Su, S., 2015. Disruption risks and mitigation strategies: an analysis of Asian ports. Marit. Policy Manage. 42, 415–435.

Mansouri, M., Nilchiani, R., Mostashari, A., 2010. A policy making framework for resilient port infrastructure systems. Mar. Policy 34, 1125–1134.

ManuVAR (Manual Work Support Throughout System Lifecycle by Exploiting Virtual and Augmented Reality) EU FP6, 2009–2012.

MASCA (Managing System Change in Aviation). EU FP7 2010–2013.

Mc Donald, N., 2015. The evaluation of change. J. Cogn. Technol. Work 17(2).

McLachlan, M., 2017. Maritime Psychology. Research in Orgnizational & Health Behavior at Sea. Spinger International, Switzerland.

Pant, R., Barker, K., Ramirez-Marquez, J.E., Rocco, C.M., 2014. Stochastic measures of resilience and their application to container terminals. Comput. Ind. Eng. 70, 183–194.

Parker, D., Lawrie, M., Hudson, P., 2006. A framework for understanding the development of organisational safety culture. Saf. Sci. 44 (6), 551–562. http://dx.doi.org/10.1016/j.ssci.2005.10.004.

PROSPERO (Proactive Safety Performance for Operations). EU FP7 2012–2015.

Reason, J., 1997. Managing the Risks of Organisational Accidents. Ashgate, Aldershot, pp. 1840141042.

Robertson, M., Hettinger, L., Waterson, P.Y., Noya, I., Dainoff, M., Leveson, Carayon, P., Courtney, K., 2015. Sociotechnical approaches to workplace safety: research needs and opportunities. Ergonomics 58 (4), 650–658. http://dx.doi.org/10.1080/00140139.2015.1011241.

Stanton, N., Salmon, P., Walker, G., Salas, E., Hancock, P.A., 2017. State-of-science:

situation awareness in individuals, teams and systems. Ergonomics 2017, 1–18. http://dx.doi.org/10.1080/00140139.2017.1278796.

Veiga, J.L., 2002. Safety culture in shipping. WMU J. Marit. Affairs 1, 17–31.

Weick, K.E., 1995. Sensemaking in Organisations. Sage Publications.

Weick, K., Sutcliffe, K., 2001. Managing the Unexpected: Assuring High Performance in an Age of Complexity. Jossey-Bass, San Francisco, CA.

Westrum, R., 1996. Human factors experts beginning to focus on organisational factors in safety. ICAO J. October 1996.

Westrum, R., 2004. A typology of organisational cultures. Qual. Saf. Healthcare 13 (Supp. II) ii22–ii27.