

Safety risk culture at a coal logistics company: A perspective from the coalface

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PREFACE

This mini-dissertation is the final deliverable for the Master of Commerce (MCom) in Applied Risk Management. The mini-dissertation was written in article format and consists of three sections: Chapter 1: Introduction (Research project overview); Chapter 2: Article; and Chapter 3: Conclusions, limitations and recommendations (Reflection).

This mini-dissertation is the student's work. The student was responsible for the final concept, set up, execution of the research project and writing of the mini-dissertation. The members of the supervisory team contributed in an advisory and technical support capacity to study conception and design, analysis and interpretation of data and critical revision of the manuscript. The mini-dissertation was language edited before submission.

The main study supervisor gave the student permission to submit this mini-dissertation for examination.

ABSTRACT

Achieving zero harm in heavily mechanised industries seems unattainable if a weak safety risk culture prevails. Embedding safety risk indicators in an organisation strengthens safety risk culture and improves safety performance. Academic literature focuses on safety culture that acknowledges compliance with safety policies and procedures; it omits safety risk culture which, in this study, is defined as the perceived level of inclusion of safety risk in decision-making. This study assessed the perceived safety risk culture at a coal logistics company, using a questionnaire-based survey for data collection. The study targeted a population of 518 employees. With a 36% response rate ($n = 188$), this study revealed a misalignment in safety risk culture perceptions between management and non-management, and across departments. This result contradicts the outcomes of two-yearly safety culture surveys conducted in-house by the company that indicated alignment and maturity of its safety culture. However, with distribution scores of 4.2 and 3.8 out of 5 for management and non-management, respectively, an overall high level of perceived safety risk integration in decision-making was established. Higher perceptions in the General Management, Finance, Engineering, and Health, Safety, Environment and Compliance departments compared to Human Resources, Operations and Maintenance reinforce the misalignment in safety risk culture. Company and contractor management are aligned on safety risk culture, with similar safety risk integration score of 4.2 out of 5. The workforce is aligned with high levels of comfort with own safety risk management roles. Operations and Maintenance had the highest return of “I do not know” responses. There is no collective, shared safety risk culture in the organisation. To strengthen the organisation’s safety risk culture, accountability for including safety risk in decision-making, communication, shared understanding and inclusion of safety risk in decision-making must be improved, prioritising Operations and Maintenance. Future research on safety risk culture perceptions at the coalface can incorporate non-English-speaking contractors at operator level, excluded in this study, who represent approximately 40% of the workforce.

Keywords: Risk culture; safety risk culture; perceptions; decision-making; safety risk integration; accountability.

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CHAPTER 1: INTRODUCTION (RESEARCH PROJECT OVERVIEW)

1.1 What to expect of the dissertation

Companies continue to invest in safety risk mitigation strategies; however, the goal of zero injuries remains difficult to achieve if a weak safety culture prevails which negatively impacts the organisational safety outcomes. According to Grahn, Peacock, Larsson, and Lackman (2017), the main obstacle to achieving this aim is an impaired safety culture, which creates conditions that contribute to work-related injuries and fatalities. A strengthened safety culture can improve safety performance (Grahn et al., 2017). The coal logistics company studied here is in a heavily mechanised industry sector; there is both mechanical and manual work conducted by employees. Operating a safety management programme since 2002, an extensive process intended to manage safety fundamentals in the workplace and prevent work-related injuries, the safety performance of the organisation has been improving for the past decade to achieve a Lost Time Injury Frequency Rate (LTIFR) of 0.11 as of 31 August 2019. The LTIFR is the number of work-related injuries within a given period relative to one million hours worked in that period, which result either in death, disability, or the employee not being able to report for normal work after the day on which the injury occurred (Safe Work Australia, 2019). The LTIFR has, however, plateaued for the past 5 years despite the implementation of focused safety improvement strategies.

The purpose of the research reported here is to develop an understanding of the perceived safety risk culture at the company. A quantitative study was conducted to assess the perceived safety risk culture at the company. The UARM Risk Culture Scale (UARM RCS-2019), developed using a decision-focused view of risk culture as the basis for the development and testing of its items, was used to collect the data. The target population was 518 employees, including company management, contractor management and company non-management personnel, across all six departments.

1.2 How does this study fit in the field of risk management?

Risk is the effect of uncertainty on objectives (ISO, 2018a). Hofstede, Hofstede, and Minkov (2010) describe culture as “the collective programming of the mind which distinguishes the members of one group or category of people from another.” It is considered a relatively unchanging feature of an organisation; it is maintained even if group members change (Hoogervorst, 2004). Zaiman, Van der Flier, and Born (In progress) describe risk culture as the perceived level of inclusion of risk in decision-making, and represents how much a group values managing risk. Dahl and Kongsvik (2018) assert that safety culture in the workplace involves the perceptions about the policies, practices and procedures shared by the employees. Safety risk culture has not been defined in the academic literature reviewed for this study, and this marks a gap in it. For the purpose of the study reported here, safety risk culture is defined as the perceived level of inclusion of safety risk in decision-making;

it represents how much a group values managing safety risk. An organisation may or may not have a collective risk culture.

1.3 Why did the student decide to study this specific topic?

Studying an organisation's safety culture facilitates an understanding of specific safety risk indicators within the enterprise; it facilitates the implementation of safety risk strategies and provides the foundation for actions to mitigate minor and major safety incidents (Guldenmund, 2000); and (Choudhry, Fang, & Mohamed, 2007). Therefore, when the safety culture of an organisation is not managed appropriately, there is the potential for misdirecting strategies to improve safety risk. The purpose of the study is to develop an understanding of the perceived safety risk culture at the coal logistics company by assessing the perceptions of safety risk culture of employees at management and non-management levels, and across all its departments. This study aims at gaining insight into the effect of safety risk culture on an organization's safety improvement strategies.

1.4 Intended audience

The Centre for Applied Risk Management at North-West University will use this study as a novel contribution within the Optentia Enhancing Risk Culture research programme. The findings reported here will support the Board of Directors of the coal logistics company to understand the perceived level of safety risk integration in its decision-making. The executives, management, risk and safety professionals of the organisation will use the outcomes of the study to enhance safety risk strategies aimed at reducing the risk of safety incidents at work. The study will also add to the body of knowledge in which academic literature on safety risk culture could not be established.

1.5 Selected journal

The *Journal of Safety Research* is selected for this article because it is an integrative publication that provides a platform for the conversations through research experience in areas of safety and health. It is a peer-reviewed journal with an impact factor of 2.401. Articles published in it discuss topics related to safety risks, risk perceptions, safety culture and decision-making. The majority of articles it publishes use a questionnaire survey method, of the kind on which my research method was based. The guidelines for authors can be accessed on this link:

<https://www.elsevier.com/journals/journal-of-safety-research/0022-4375/guide-for-authors#20920>.

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CHAPTER 2: ARTICLE

Safety risk culture at a coal logistics company: A perspective from the coalface

2.1 Abstract

Achieving zero harm in heavily mechanised industries seems unattainable if a weak safety risk culture prevails. Embedding safety risk indicators in an organisation strengthens safety risk culture and improves safety performance. Academic literature focuses on safety culture that acknowledges compliance with safety policies and procedures; it omits safety risk culture which, in this study, is defined as the perceived level of inclusion of safety risk in decision-making. This study assessed the perceived safety risk culture at a coal logistics company, using a questionnaire-based survey for data collection. The study targeted a population of 518 employees. With a 36% response rate ($n = 188$), this study revealed a misalignment in safety risk culture perceptions between management and non-management, and across departments. This result contradicts the outcomes of two-yearly safety culture surveys conducted in-house by the company that indicated alignment and maturity of its safety culture. However, with distribution scores of 4.2 and 3.8 out of 5 for management and non-management, respectively, an overall high level of perceived safety risk integration in decision-making was established. Higher perceptions in the General Management, Finance, Engineering, and Health, Safety, Environment and Compliance departments compared to Human Resources, Operations and Maintenance reinforce the misalignment in safety risk culture. Company and contractor management are aligned on safety risk culture, with similar safety risk integration score of 4.2 out of 5. The workforce is aligned with high levels of comfort with own safety risk management roles. Operations and Maintenance had the highest return of “I do not know” responses. There is no collective, shared safety risk culture in the organisation. To strengthen the organisation’s safety risk culture, accountability for including safety risk in decision-making, communication, shared understanding and inclusion of safety risk in decision-making must be improved, prioritising Operations and Maintenance. Future research on safety risk culture perceptions at the coalface can incorporate non-English-speaking contractors at operator level, excluded in this study, who represent approximately 40% of the workforce.

Keywords: Risk culture; safety risk culture; perceptions; decision-making; safety risk integration; accountability.

2.2 Introduction

Safety culture and its relationship with organisational culture and safety outcomes in work environments has been widely researched over the past three decades (N. F. Pidgeon (1991); N. Pidgeon (2001); Cooper (2000); Guldenmund (2010a); Guldenmund (2010b); Zhang, Wiegmann, Von Thaden, Sharma, and Mitchell (2002); Fernández-Muñiz, Montes-Peón, and Vázquez-Ordás (2007); Wiegmann, Zhang, Von Thaden, Sharma, and Gibbons (2004); Nordlöf, Wiitavaara, Winblad, Wijk, and Westerling (2015)). This body of research demonstrates that the safety culture of a company is reflected in its organisational culture and safety performance.

Workers around the world are exposed to work-related safety risks, and others succumb to associated accidents (Nordlöf et al., 2015). Companies invest in risk mitigation strategies, through improved engineering, training and awareness raising (ILO, 2018); these investments have resulted in a gradual decline of occupational injuries globally (Kim, Park, & Park, 2016). However, the goal of zero work-related accidents that many organisations aspire to seems beyond reach. According to Grahn et al. (2017), the main obstacle to achieving this aim can be an eroded and weakened safety culture which creates conditions conducive to work-related safety incidents. A safety incident is an undesired event during the course of work, which results in a potential or actual injury or fatality (ISO, 2018b).

Management's commitment to safety influences the way employees regard, interpret and understand safety, which in turn affects the reduction in occupational safety incidents (O'Toole, 2002). Choudhry et al. (2007) confirm that safety culture has an effect on organisational safety outcomes. Guldenmund (2010a) concurs that a weak safety culture has been recognised as a cause of unsafe practices, and thus results in an organisation's weak safety performance. Studying a business's safety culture facilitates an understanding of specific safety risk indicators within the enterprise; it facilitates the implementation of safety risk strategies and provides the foundation for actions to mitigate safety incidents (Guldenmund, 2000). Therefore, when the safety culture of an organisation is not properly managed, there is the potential for misdirecting safety improvement strategies. Although the academic literature is focused on safety culture and safety climate, it does not refer to, or define safety risk culture. I believe researchers refer to safety culture, safety climate and safety risk culture as similar concepts. The absence of research on safety risk culture therefore marks a gap in the academic literature. Safety culture surveys, conducted every two years by the Health, Safety, Environment and Compliance (HSEC) department of the company reported on here, did not focus on safety risk culture. These surveys have been conducted using the Fleming's safety culture maturity model described by Foster and Hoult (2013) as a self-assessment tool that allows the business to understand its own level of safety culture maturity. This study is therefore unique in that, in contrast to the in-house safety culture surveys conducted by the company, it provides new insights about the perceived level of inclusion and prioritising safety risks in decision-making processes in the organisation.

The study reported here focused on perceptions of safety risk culture held by a particular workforce; the results provided an insight into the effect of safety risk culture on the organisation's safety risk improvement strategies. The primary research question that guided this study was: "What is the perceived safety risk culture within a coal logistics company?" Schwatka, Hecker, and Goldenhar (2016) indicate that studies defined perceptions as non-management based, but few reflected perceptions as experienced by both management and non-management. However, for the purpose of this study, the first of its kind conducted at the company, "perceived safety risk culture" is defined as the perceived level of inclusion of safety risk in decision-making.

The basis of the findings of this research was a quantitative study on perceptions of a sample of 518 employees and contractors, at different levels, on safety risk culture at the coal logistics company. Quantitative studies are relatively simple to use in cross-sectional comparisons, and straightforward to implement in different organisations (Wiegmann et al., 2004). The expected outcome of the study was based on the following hypotheses:

- Null hypothesis ($H_{1,0}$): safety risk culture perceptions at management level are aligned with those at non-management level. The basis for this hypothesis is that the outcomes of in-house safety culture surveys conducted by the company every two years have demonstrated an overall maturity and alignment at different levels of the company on measured attributes of safety culture.
- Alternative hypothesis ($H_{1,1}$): safety risk culture perceptions at management level are higher than at non-management level.
- Null hypothesis ($H_{2,0}$): safety risk culture perceptions of the workforce are the same across different departments in the organisation.
- Alternative hypothesis ($H_{2,1}$): safety risk culture perceptions of the workforce are misaligned across different departments in the organisation.

The organisation studied has been a strategic hub of economic importance in the South African coal industry for more than 40 years, with its primary purpose to service the majority of coal-mining companies who export coal to global markets in Asia, Africa and Europe. It forms part of the coal value chain, and has a reputation for a safe, reliable and efficient coal logistics service. A set of 100-wagon trains from the mines, fully loaded with coal, are railed to, and offloaded at, the company; the coal is stockpiled and loaded onto vessels for shipping as instructed by the coal-mining companies. It is a medium-sized business with approximately 866 employees including contractors, and is highly operational in nature. The organisation has implemented a matured safety management programme since 2002, and has recently been certified to ISO 45001:2018 occupational health and safety management system. The safety of both employees and contractors of the company is administered under this safety management programme. Safety risks associated with the organisation's operations include, but are not limited to, high-voltage equipment, high-speed conveyor belts, and railway safety. The safety performance of the organisation, in terms of the lost-time injury frequency

rate (LTIFR), is in the 8th position out of 23 international coal logistics companies. The LTIFR is the number of work-related injuries within a given period relative to one million hours worked in that period, which result either in death, disability, or the employee not being able to report for normal work after the day on which the injury occurred (Safe Work Australia, 2019). The company recorded an LTIFR rating of 0.11 as at 31 August 2019, inclusive of contractors. This statistic is considered unacceptable in the industry that aspires to zero harm. A common phrase used in the mining industry, “at the coalface” refers to an exposed surface of the mine; when reference is made to the “perspectives from the coalface” of the organisation, it is about the thoughts and actions of the people who are actually doing the job.

UARM will use this study as a novel contribution within the Optentia Enhancing Risk Culture research programme. It will support the coal logistics company’s Board of Directors to understand the perceived level of safety risk integration in decision-making in the organisation. The company’s executives, management and safety professionals will use the outcomes of the study to enhance safety strategies aimed at reducing occupational safety incidents. The significance of the study to the organisation, and as a contribution to scholarship, is to understand how safety risk culture in the coal logistics company is perceived at different management and non-management levels and across different departments in the organisation, with a view to future improvements.

2.3 Background

Risk culture

Risk is the effect of uncertainty on objectives (ISO, 2018a). Culture, according to Hofstede et al. (2010), is “the collective programming of the mind which distinguishes the members of one group or category of people from another.” Hoogervorst (2004) avers that culture is a collection of values and beliefs that act as guidance for a certain behaviour. They view culture at work as something the organisation has, and results from learned responses of group members to environmental conditions and stimuli. It is considered a relatively stable attribute of an organisation that is preserved even if group members change (Hoogervorst, 2004). Ring, Bryce, McKinney, and Webb (2016) conclude that there can be many sub-cultures in an organisation, each with its own impacts and consequences for the company.

According to Bozeman and Kingsley (1998), risk culture is the organisation’s inclination to consider risk as preferred and addressed by its managers. Risk culture is also the perceived level of inclusion of risk in decision-making, and represents how much a group values managing risk (Zaaiman et al., In progress). For the purpose of this study, safety risk was used as the specific risk type investigated and formed the basis of the data collection.

Safety culture

Safety culture is one of many cultures within an organisational culture, and should be developed within this framework to ensure uniformity of its dimensions (Frazier, Ludwig, Whitaker, & Roberts, 2013). Hoogervorst (2004) describes organisational culture as based on particular beliefs and assumptions. According to Probst, Goldenhar, Byrd, and Betit (2019), safety culture is defined as the employees' perceptions regarding an organisation's policies, practices and procedures, that indicate the value and the importance of safety at the workplace. It is a reflection of the extent to which the employees perceive that safety is prioritised at work as compared to productivity and other business indicators. Dahl and Kongsvik (2018) assert that safety culture in the workplace involves the perceptions about the policies, practices and procedures shared by the employees. According to Choudhry et al. (2007), Fernández-Muñiz et al. (2007), (Guldenmund, 2000) and Mearns and Flin (1999), safety culture is a set of values, perceptions, attitudes and patterns of behaviour with regard to safety shared by members of an organisation. They elaborate that it reflects a high level of concern for, and collective commitment to, the prevention of work-related safety risks. Cooper (2000) describes safety culture as a component of organisational culture, which affects the attitudes and behaviours of the workforce towards safety performance. He avers that safety culture coexists with other operational and organisational attributes. Safety culture, according to Nordlöf et al. (2015), is characterised by five indicators, namely, acceptance of risks, individual responsibility for safety, trade-off between productivity and safety, the importance of communication and external conditions.

For the purpose of the study reported here, safety risk culture is defined as the perceived level of inclusion of safety risk in decision-making.

Perceptions of safety culture

A key characteristic of an organisation's mature safety culture is common perceptions among managers and staff regarding the importance of safety, and there can be misalignment of how different levels of the organisation recognize this importance (Clarke, 1999). Therefore, a mutual understanding that each organisational level recognizes the importance of safety facilitates a resilient safety culture in the company (Clarke, 1999).

According to O'Toole (2002), organisations have limited resources to help reduce occupational injuries. They struggle with how best to focus the limited resources in order to achieve their strategic safety goals. Kim et al. (2016), however, report that work-related injuries have declined over the past decade through engineering controls, safer machinery and processes, and better adherence to regulations. They point out that these systems are not effective unless augmented by a strong safety culture in the workplace. Management's commitment to safety is the contributor to a heightened level of safety culture as perceived by employees; and in order to realise a high level of safety, managers need to be constantly cautious towards the management of safety risks (Fruhen, Flin, & McLeod, 2014).

Dimensions of safety culture

The academic literature on safety culture reveals it as comprising many characteristics, although not all examples incorporate the essential safety culture features. According to Frazier et al. (2013), four important features of safety culture are management concern for safety, personal responsibility, peer support, and the presence of a safety management system. Dahl and Kongsvik (2018) agree with these attributes being important, adding competence regarding safety, and a low perception of work pressure to the list. Alruqi, Hallowell, and Techera (2018) included supervisory safety rules and safety procedures in the list. They all assert that the most important safety culture dimension is safety leadership. The Risk Culture Indicator model of Zaaiman (2019) used in this study is based on 10 interlinked risk culture indicators, notably more than those previously identified in the literature; it is the foundation of the study reported here.

Quantitative research

Research based on a quantitative survey focuses on establishing a representation of what the participants think about an issue using validated quantitative analysis tools to ensure the objectivity and reliability of the data collected and interpreted (Barnham, 2015). The UARM Risk Culture Scale (UARM RCS-2019) (Appendix 1) used in this study is a 44-item 6-point Likert scale that has been developed and piloted over three years (2016–2018) at the Centre for Applied Risk Management of North-West University. There were two types of responses on the 6-point Likert scale, from “strongly disagree” to “strongly agree”; and the other was from “not at all” to “perfectly”, plus these were preceded with an “I do not know” option as well.

The scale is now mature and can be regarded as valid, as its items are reliable and consistent across sectors, functions and management levels. The scale also shows a high Cronbach’s α reliability coefficient of 0.97. It measures the two risk culture-related factors, namely, perceived level of integration of risk in decision-making processes, and comfort with own risk management role. For the purpose of this study, safety risk was the specific risk type measured in the culture-related factors.

2.4 Method

Research instruments

To answer the research question, a quantitative study was conducted to assess the perceived safety risk culture of the organisation using the UARM RCS-2019, which focused participants on safety risk. The survey consisted of seven demographic items followed by 44 items related to safety risk. Response options included “I do not know” and “I do not understand the statement” to mitigate

possible unauthentic effects of respondents who truly did not know the answer to an item. The “I do not know” answers were not included in the scale’s factor analysis, and only participants with fewer than 30% of such answers per factor were included in the calculation of the factor scores. In addition, the full set of this study’s “I do not know” answers was analysed separately, thereby providing valuable information on the levels of uncertainty about features related to safety risk culture in the questionnaire that could indicate possible safety-risk-related knowledge in the study population.

The two additional diagnostic questions included in the survey allowed the respondents to suggest the way forward to improve the safety risk culture of the company. The two questions are: “Which organisational characteristic assists you most to include safety risk when you make decisions?”

“To improve the inclusion of safety risk in decision-making in the organisation, I believe that we must start with improving.....”

The scale was delivered online via Research.net [SurveyMonkey’s professional (Premier) plan]. The Cronbach’s alpha of 0.97 indicates that the scale was reliable for this study’s sample.

Participants and procedure

The target population for the study was the company’s workforce of 518 employees out of a staff complement of 866, consisting of the chief executive officer, 5 general managers, 24 senior managers, 49 junior managers, 389 operators and 50 contractor site managers. Only contractors at operator level were excluded from the study due to their inadequate English language proficiency and low levels of education; the UARM RCS-2019 has not yet been validated at the lowest job levels. The sample was spread across the various departments of the company, namely, General Management, Human Resources, Finance, Operations, Maintenance, Engineering, and Health, Safety, Environment and Compliance (HSEC). Only respondents who provided informed consent to participate were included in the study.

With an acceptable response rate of 34% for online questionnaires, according to Shih and Fan (2008), a minimum of 177 responses out of the targeted study population of 518 employees for this study would suffice for statistical analyses of the results. In practice, 188 responses were received from the survey, corresponding to a 36% response rate, which is above the acceptable minimum response rate of 34%. In total, 185 responses were included in the Factor 1 inferential analysis and 184 responses were included in the Factor 2 inferential analysis. For Factor 1, 3 respondents and for Factor 2, 4 respondents provided more than 30% “I do not know” responses.

The three employee categories used for statistical analyses of the respondents’ answers were company management, contractor management and company non-management. The demographic profile of the population represents the company’s workforce at the coalface, as indicated in Table 1.

Table 1: Study population breakdown.

Employee category	Level of responsibility	Population	General Management	Human Resources	Departments				
					Finance	Operations	Maintenance	Engineering	HSEC
Company management	Chief executive officer	1	1						
	General managers	5	5						
	Senior managers	24		4	4	3	4	8	1
	Junior managers	49		2	7	9	11	17	3
Contractor management	Contractor site managers	50							
Company non-management	Operators	389		14	27	161	157	21	9
		518	6	20	38	173	172	46	13

Ethical considerations

A letter to the chief executive officer of the organisation was written to request permission to do the research and was co-signed by the researcher and her supervisor. The letter outlined the purpose of the research, confirmed the confidentiality and anonymity of information and that of participants, and protection of the reputation of participants and the company studied. The NWU Ethics Committee EMS-REC approved the study (ethics number NWU-00400-19-A4).

The cover page of the survey instrument, UARM RCS-2019, included an explanation of the objective of the study. The questionnaire sought the consent to participate in the study, clarifying to the participants that it was an anonymous survey; this meant that the participants and company could not be identified as participants subsequently. To ensure anonymity, the data would only be presented in aggregated format, meaning that individual responses would not be reported, the organisation would not be identified in the research report, and anonymised general results of the study might be published in an academic journal subject to permission from the company. Participation was voluntary, and those involved could withdraw from the survey at any stage without completing it. Only participants who had provided informed consent to contribute were included in the study.

Data collection

After ethical clearance for the study and formal permission from the company to apply the UARM RCS-2019 had been obtained, the survey instrument was electronically distributed to the potential participants, via Research.net on SurveyMonkey's professional online survey platform. An anonymous e-mail address, created by the company's IT department specifically for this study, was

used for the distribution of the scale. The survey was opened on 2 July 2019 and closed on 26 July 2019.

Each item of the scale was set up for anonymous data capturing. Printed copies of the questionnaire were distributed manually by the risk department for those potential respondents who did not have access to a computer. The researcher did not participate in this manual process, to avoid her possible undue influence on participants. A drop box for submitting filled-in questionnaires was provided in the risk department, and the researcher captured responses electronically on the same online platform, for statistical analysis.

The respondents were given an opportunity to complete the survey during working hours without penalty to the researcher or study participants. The distribution of the questionnaire was closed after four weeks; during this period, four reminders were sent to all potential participants via the anonymous e-mail address to complete the survey. Anyone who had already completed and tendered their responses also received the reminders given that the submissions were anonymous; the reminders requested them not to resubmit. Data gathering, as well as the housing and analysis of data sets were conducted by the statistician at the Centre for Applied Risk Management.

Data analysis

The statistical analysis of the survey responses was conducted by the statistician using the most recent version of SAS analytical software when the study data became available. Statistical tests were selected according to the research objectives, the scale format and distribution of the data. Descriptive and inferential statistical analyses were performed. Tests for data normality were applied as part of the test selection process. Normality of the score distributions could not be assumed, so statistically significant differences were identified using non-parametric tests. Significant differences between company management, contractor management and company non-management responses were tested at the 95% confidence level, using the Kruskal-Wallis test.

The surveys that were incomplete were discarded. Surveys with more than 30% "I do not know" responses per factor were not included in the inferential statistical analyses. Study-relevant data results were provided to the researcher in analysed, aggregated format; and she was responsible for the interpretation of the results of the research instrument in the context of the research objectives and questions, considering that:

- Using the scale employed, only group responses needed to be recorded; the individual's factor score may not be used as an indication of that person's "safety risk culture" as culture is always a group concept.
- Levels of the measured factor could be inflated by response biases (e.g. a positive response bias and influence of social desirability).
- The scale may be used to provide indications of where issues related to safety risk culture lie in the organisation, but was not designed to identify micro-level issues such as availability and use of personal protective equipment by the workforce.

The UARM RCS-2019 assessed two aspects of the safety risk culture in the company, namely:

- Factor 1: The perceived level of safety risk integration in decision-making in the organisation.
- Factor 2: The perceived comfort with own safety risk management role.

Maturity scores of the risk culture were obtained by calculating the average of the items per factor.

Limitations

This study was limited by the following factors:

- Lack of a prior research study on “safety risk culture”. The academic literature reviewed focuses on “safety culture” and “safety climate”. The company’s previous in-house surveys on safety also focused on safety culture.
- The research time was restricted by being conducted over four months, which included the collection of data, the analysis of results and writing the report.
- The study excluded approximately 348 contractors at operator level, which is 40% of the workforce, due their inadequate command of English and low levels of education.

2.5 Results and Discussion

The results of the study are presented in the following sections, with focus on demographics, factor distributions, response bias, tests of hypotheses, analysis of “I do not know” responses, organisational characteristics that assisted respondents to include safety risk in decision-making, and what needs to be done to improve the inclusion of safety risk in decision-making.

2.5.1 Demographics of the study respondents

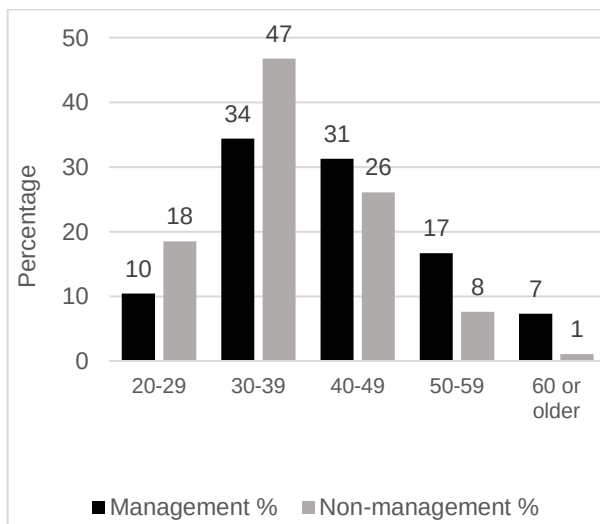


Figure 1: Age distribution of respondents.

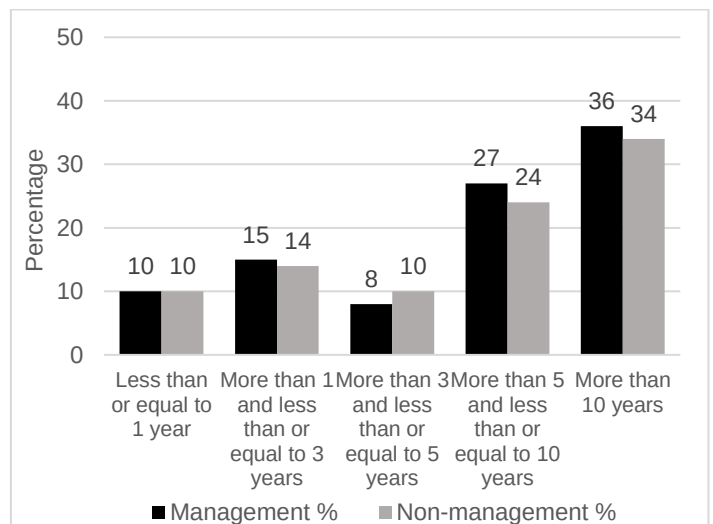


Figure 2: Working experience of respondents at the company.

Figure 1 shows the distribution of the ages of the survey population, which ranged from 20 years to more than 60. The majority of respondents (81%) were aged between 30 and 59 years. The working

experience at the company for this majority was likely to be between 5 years and more than 10 years, as indicated in Figure 2. These demographics do not necessarily indicate the age and working experience distribution within the company, as they represent only 21% of the workforce. Nevertheless, these statistics represent a fair balance of age and working experience between management and non-management among the respondents who represent the workforce at the coalface, and will contribute to understanding their perception of safety risk in the company. The work experience of the majority of respondents suggests that they are conversant with the safety risk management policies and procedures of the company. These demographics are therefore representative of the company's workforce, and can be used in confidence.

2.5.2 Factor distribution

Forty-two items were included in the two-factor analysis. The preliminary analysis confirmed that the data were suitable for factor analysis. Factor 1 comprised 24 items related to the respondents' perceived level of integration of safety risk in decision-making in the organisation, whereas Factor 2 contained 18 items related to the respondents' perceived comfort with their own safety risk management role. Table 2 provides a rating scale of factor scores as described in UARM RCS-2019 of 7 September 2019 (Appendix 1), which is used in this analysis.

Table 2: Rating scale of factor scores from UARM RCS-2019 (Zaaiman & Pretorius, 2019).

		UARM RCS-2019 (FS = Factor Score)				
		1.0 ≤ FS < 1.5	1.5 ≤ FS < 2.5	2.5 ≤ FS < 3.5	3.5 ≤ FS < 4.5	4.5 ≤ FS ≤ 5.0
	<i>Item response options related to the level provide an indication of group perception associated with the level</i>	<i>Very low level: Never and Not at all</i>	<i>Low level: Infrequently and Not well</i>	<i>Medium level: Sometimes and Moderately well</i>	<i>High level: Well and Usually</i>	<i>Very high level: Always and Perfectly</i>
Factor 1	Perceived level of integration of risk in decision-making processes	Very low level of perceived integration	Low level of perceived integration	Medium level of perceived integration	High level of perceived integration	Very high level of perceived integration
Factor 2	Comfort with own risk management role	Very low level of comfort	Low level of comfort	Medium level of comfort	High level of comfort	Very high level of comfort

According to ISO (2018a), integration of risk in decision-making involves risk management through risk assessment processes. Therefore, in the context of ISO (2018a), Factor 1 measures the perceived level of assessing safety risks, and using the outcomes as inputs into safety risk mitigation strategies. The risk management role, according to ISO (2018a), is the acceptance of risk accountability; those individuals who have fully accepted risk accountability must be adequately skilled, and have sufficient resources to check and improve controls, monitor risks, and ensure effective risk communication with internal and external stakeholders. Factor 2, in the context of ISO (2018a), assesses the comfort of individuals with their own safety risk accountabilities.

Factor distribution at management and non-management levels

Table 3 presents correlations between factors at company management, contractor management and company non-management categories.

Table 3: Factor scores at management and non-management levels.

Employee category	Factor scores	
	Weighted average Factor 1	Weighted average Factor 2
Company management	4.2	4.2
Contractor management	4.2	4.3
Company non-management	3.8	4.0

Factor 1: Perceived level of safety risk integration in decision-making in the organisation

Table 3 shows a high level of perceived safety risk integration in decision-making among company management, contractor management and company non-management. Although the average Factor 1 score for company non-management employees is slightly lower than that of management and contractor management personnel, the value of 3.8 is within the range of a high level of perceived safety risk integration in decision-making (Table 2). This difference implies that the perceptions of non-management employees about the level of safety risk integration in decision-making are not as positive as those of management. Non-management employees are not as confident as management about the level implementation of safety risk mitigation strategies in the organisation.

Comparison of Factor 1 results for company and contractor management, however, shows an alignment and a high level of perceived safety risk integration in decision-making. According to Bahn (2013), including company and contractor employees in the same safety management programme improves focus on safety risks by the latter due to the convenience of their sharing a similar safety management process, and trust in its robustness. Focus on safety risks improves the frequency at which work-related injuries occur, supervisors' clarity of their safety risk management roles, and active monitoring of contractor employees to ensure they worked safely and proactively to mitigate the hazards they experience (Bahn, 2013). Therefore, the results that show alignment between company and contractor management on company's safety risk culture.

Factor 2: Perceived comfort within own safety risk management role

Table 3 confirms that company management, contractor management and company non-management have a high level of perceived comfort with their own safety risk management role. The higher average score for Factor 2 than Factor 1 for company non-management characterizes optimism bias. Caponecchia and Sheils (2011) describe optimism bias as the inclination to think that the probability of undesirable events happening to oneself is more unlikely than believing they will happen to someone else. It is an element of personal risk perception, and as such can result in reduced focus on the application of mitigating controls to safety risks. Optimism bias demonstrated by the workforce may become a significant problem of complacency towards safety risk awareness

in an organisation. The higher average score for Factor 2 than for Factor 1 for company non-management may also indicate the existence of a self-enhancement and superiority bias, which is a tendency to see oneself in a more favourable light than is realistic (Hoorens, 1993).

A generally low safety risk culture perception expressed by non-management employees indicates that they consistently rate themselves and the company lower for both Factors 1 and 2 than management employees.

Factor distribution at departmental level

Table 4 presents the distribution of weighted factor scores across all departments in the company.

Table 4: Factor scores for different departments.

Department	Factor scores	
	Weighted average Factor 1	Weighted average Factor 2
General Management	4.7	4.6
Human Resources	3.9	4.1
Finance	4.4	4.3
Operations	3.9	4.0
Maintenance	3.9	4.1
Engineering	4.0	4.1
HSEC	4.3	4.4

Factor 1: Perceived level of safety risk integration in decision-making in the organisation

Factor 1 results show a high level of perceived safety risk integration in decision-making across all departments. The exceptionally high scores recorded for General Management are expected since this department sets the strategic direction, risk management policy, and risk management framework for the company. The General Management department is accountable for setting the tone for the organisation's safety risk culture. Factor 1 scores are also relatively high for the Finance and HSEC departments; the possible explanation for these results is that the two departments are the traditional custodians of enterprise-wide risk management and compliance in the company, hence their high perception of safety risk integration in decision-making. However, Maintenance, Operations and Human Resources, the majority of whose employees work at the coalface, have relatively lower Factor 1 scores. The possible explanation for these results is that Operations and Maintenance have high intrinsic safety risks and prevalence of safety incidents compared to other departments, therefore employees in these departments perceive the efforts for the implementation of safety risk mitigation strategies as inadequate. The Human Resources department participates in matters relating to the well-being of employees, hence their Factor 1 score is aligned with those of Operations and Maintenance. Even though there is a high level of perceived safety risk integration in decision-making across all departments, the distinct variation of these scores indicates a difference in perceived level of safety risk integration in decision-making across departments.

Factor 2: Perceived comfort within own safety risk management role

Factor 2 scores in Table 4 demonstrate that personnel in all departments have a generally high level of comfort with their own safety risk management roles. This result is consistent with Factor 2 scores for company management, contractor management and company non-management depicted in Table 3.

2.5.3 Response bias

Response bias signifies conditions that prevail during the process of responding to a survey questionnaire, which can influence the way respondents provide their answers. Figures 3 and 4 show an overall high positive response bias for both Factors 1 and 2 scores, respectively. The high levels of perceived safety risk integration in decision-making (Figure 3) and perceived comfort with own safety risk management role (Figure 4) imply the survey population's positive response bias. Factor 2's positive response bias is greater than that of Factor 1; this outcome presents a socially desirable response bias, which is the tendency for people to portray themselves favourably in questionnaires (van de Mortel, 2008). According to Lavrakas (2008), respondents who tend to agree with survey statements irrespective of their content are driven by acquiescence bias. Such bias may exist for both Factors 1 and 2 due to social norms that value politeness. Since safety is one of the organisation's values, respondents probably know what the "right" answer should be and cannot be seen to respond otherwise.

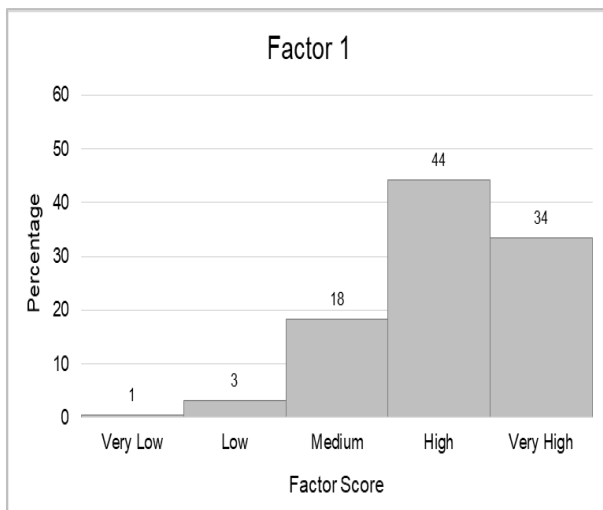


Figure 3: Factor 1 positive response bias.

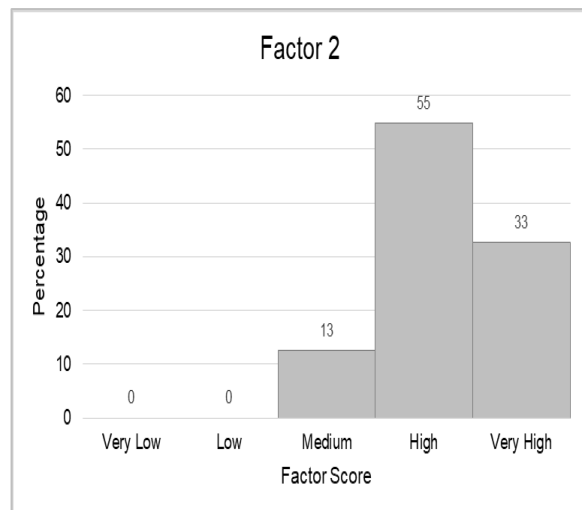


Figure 4: Factor 2 positive response bias.

2.5.4 Tests of hypotheses

The null and alternative hypotheses are mutually exclusive statements about the company's workforce. The rank-based non-parametric Kruskal-Wallis and Mann-Whitney tests were used to

compare the distributions of management and non-management levels, to determine whether to reject the null hypotheses.

Null hypothesis ($H_{1,0}$): safety risk culture perceptions at management level are aligned with those at non-management level. The basis for this hypothesis is that the outcomes of in-house safety culture surveys conducted by the company every two years have demonstrated an overall maturity and alignment at different levels in the company on measured attributes of safety culture.

Alternative hypothesis ($H_{1,1}$): safety risk culture perceptions at management level are higher than at non-management level.

Alignment of safety risk perceptions at management and non-management levels

The Kruskal-Wallis test results depicted in Table 5 compare Factor 1 and Factor 2 scores for company management, contractor management and company non-management.

Table 5: Kruskal-Wallis tests for comparison of management and non-management levels.

Employee category	n	Wilcoxon mean score	Chi-squared test statistic	p value	Significant difference at α = 0.05
Factor 1: Perceived level of safety risk integration in decision-making in the organisation					
Company management	52	104	17.939	<0.001	Yes
Contractor management	44	114			
Company non-management	89	76			
Factor 2: Perceived comfort with own safety risk management role					
Company management	52	96	7.041	0.030	Yes
Contractor management	44	108			
Company non-management	88	83			

The results in Table 5 show the p value of less than 0.05 for both Factors 1 and 2 at company management, contractor management and company non-management categories. Factors 1 and 2 results suggest misalignment in perceived level of safety risk integration at management and non-management levels. In order to determine which of the three levels differ from one other, pairwise Mann-Whitney tests were conducted, with the results depicted in Table 6.

Table 6: Mann-Whitney tests for comparison of company management, contractor management and company non-management.

Pairwise Mann-Whitney tests						
Employee category	n	Wilcoxon mean score	Chi-squared test statistic	p value	Adjusted p value	Significant difference at α = 0.05
Factor1: Perceived level of safety risk integration in organisation						
Company management	52	86	11.386	0.001	0.002	Yes
Company non-management	89	62				
Contractor management	44	83	11.794	0.001	0.002	Yes
Company non-management	89	59				
Factor 2: Perceived comfort with own safety risk management role						
Contractor management	44	79	6.591	0.010	0.031	Yes
Company non-management	88	60				

Mann-Whitney test results show the p value of less than the significance level of 0.05 for Factor 1 between company management and company non-management categories. A similar result is observed at contractor management and company non-management categories for Factor 1. These results indicate that safety risk culture perceptions among company non-management differ from those of both company management and contractor management for Factor 1.

Table 7: Mann-Whitney test for comparison of management and non-management levels.

Mann-Whitney tests					
Level of role	n	Wilcoxon mean score	Chi-squared test statistic	p value	Significant difference at $\alpha = 0.05$
<i>Factor1: Perceived level of safety risk integration in organisation</i>					
Management	96	109	17.17	<.0001	Yes
Non-management	89	76			
<i>Factor 2: Perceived comfort with own safety risk management role</i>					
Management	96	102	5.82	0.016	Yes
Non-management	88	83			

The p values of less than 0.05 for Factor 2 at contractor management and company non-management categories are observed in both Tables 6 and 7. These results show that the perceived comfort with own safety risk management role differs between management and non-management.

Factor 1: Perceived level of safety risk integration in decision-making in the organisation

Table 5 depicts a distinctive difference between company management, contractor management and company non-management for Factor 1, with a p value of less than 0.05. The difference in

perceptions about the level of safety risk integration held by these groups of employees is illustrated by Mann-Whitney test results comparing the distributions of management and non-management levels in Table 6. The results show a significant difference in perceptions at company non-management category than at company management and contractor management categories regarding the degree of safety risk integration in decision-making in the organisation. The Mann-Whitney test results in Table 7 further confirm the significant difference at management and non-management levels. The null hypothesis is therefore rejected, in support of the alternative hypothesis that the perceived level of safety risk integration in decision-making is higher among management than among non-management.

Factor 2: Perceived comfort within own safety risk management role

The p values of less than 0.05 for Factor 2 in Table 5 indicate that there is a significant difference between company management, contractor management and company non-management on perceived level of comfort with their own safety risk management roles. Tables 6 and 7 show that these perceptions are different between contractor management and contractor non-management, and between management and non-management, respectively. It is important to note that, despite these differences, Factor 2 distribution scores for company management, contractor management and company non-management imply a high level of comfort with own safety risk management role.

Alignment of safety risk perceptions at departmental levels

The rank-based non-parametric Kruskal-Wallis test was used to compare the distributions at departmental levels to determine whether to reject the null hypotheses.

Null hypothesis ($H_{2,0}$): safety risk culture perceptions of the workforce are the same across different departments in the organisation.

Alternative hypothesis ($H_{2,1}$): safety risk culture perceptions of the workforce are misaligned across different departments in the organisation.

Kruskal-Wallis tests were conducted for Factors 1 and 2 to determine whether there are statistically significant differences between the various departments regarding the perceived level of safety risk culture. The results are presented in Table 8.

Table 8: Kruskal-Wallis test for comparison of median referral scores in all departments.

Level of role	n	Wilcoxon mean score	Chi- squared test statistic	p value	Significant difference at $\alpha = 0.05$
<i>Factor1: Perceived level of safety risk integration in organisation</i>					
General Management	5	150	14.35	0.026	Yes
Human Resources	6	78			
Finance	13	122			
Operations	55	83			
Maintenance	64	88			
Engineering	24	92			
HSEC	18	111			
<i>Factor 2: Perceived comfort with own safety risk management role</i>					
General Management	5	143	11.67	0.070	No
Human Resources	6	88			
Finance	13	108			
Operations	55	82			
Maintenance	63	90			
Engineering	24	88			
HSEC	18	116			

Factor 1: Perceived level of safety risk integration in decision-making in the organisation

Kruskal-Wallis test results show the p value of less than 0.05 for Factor 1 for the different departments. These results indicate that there is a significant difference between departments in perceived level of safety risk integration in decision-making. They therefore imply the rejection of null hypothesis in favour of the alternative hypothesis that safety risk culture perceptions of the workforce are misaligned across the different departments.

Factor 2: Perceived comfort within own safety risk management role

The similarity in high Factor 2 scores across different departments reported in Table 4 corresponds to the Kruskal-Wallis test results in Table 8 for Factor 2 across all departments. These results, with the p value greater than 0.05 for Factor 2, confirm the alignment of employees' perceived comfort with their own safety risk management roles, across different departments.

2.5.5 Analysis of "I do not know" responses

Figure 5 presents "I do not know" responses from company management, contractor management and company non-management.

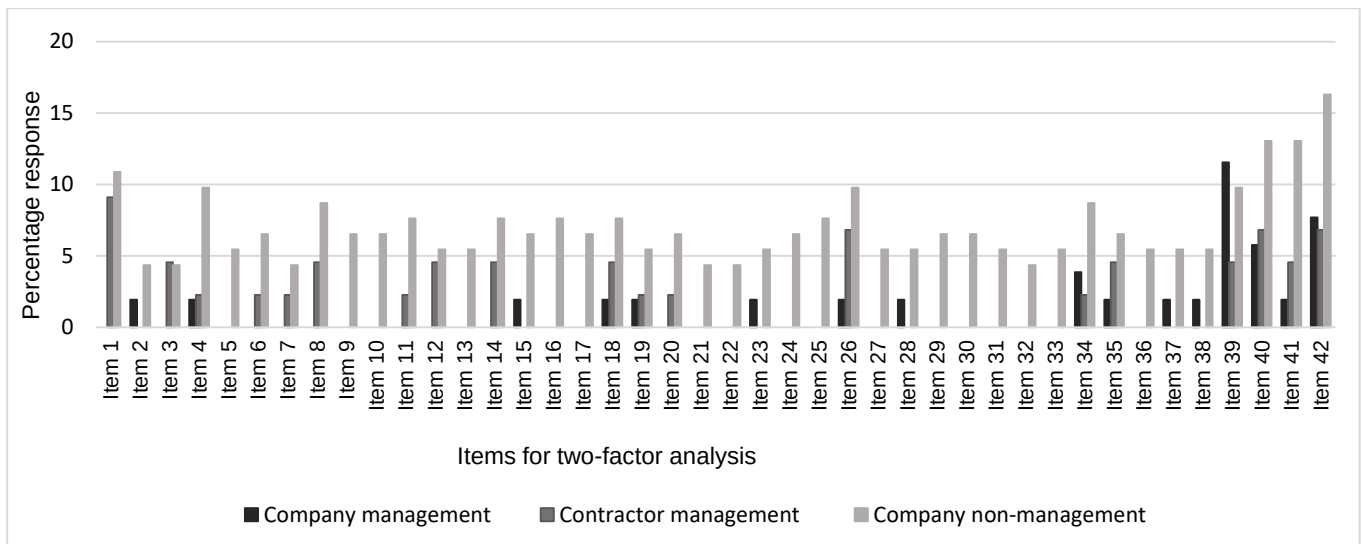


Figure 5: “I do not know” responses at different management levels.

The company’s non-management personnel exhibited an overall highest prevalence of “I do not know” responses compared to company management and contractor management. The high record of “I do not know” responses at company management on item 39, which sought to identify whether “the organisation rewards staff members who take responsible safety risks”, was unexpected. Company management are policymakers and should be aware of the rewards linked to safety risk and other risk culture indicators. According to Zaiman (2019), risk-based incentives are linked to other risk culture indicators. The unawareness of company management about safety risk-based incentives indicates a gap in safety risk communication in the organisation. Other Factor 1 items with a high rate of “I do not know” responses are listed in Table 9.

Table 9: Prevalence of “I do not know” responses at company non-management level.

Factor 1 items	Percentage
Item 39: The organisation rewards staff members who take responsible safety risks.	10
Item 40: The organisation punishes staff members who take irresponsible safety risks.	13
Item 41: Managers treat staff fairly when a safety risk materialises (i.e. when a safety risk event occurs).	13
Item 42: Managers use safety risk management as a criterion when evaluating the performance of staff members.	16

The “I do not know” responses are predominantly associated with Factor 1. The highest return of “I do not know” responses was for item 42, which is related to performance management. Items 39, 40 and 41 elicited markedly high “I do not know” responses and are associated with rewards, discipline and objectivity, respectively. The high number of “I do not know” responses could possibly be ascribed to rewards, penalties and fair treatment policies not being well understood, the survey

population not having much experience of how these policies are actually executed and a company culture where rewards and penalties are kept confidential. This may present a gap in safety risk communication in the company.

Figure 6 represents the spread of “I do not know” responses at departmental level. The results show a notably high return of these responses at Operations and Maintenance compared to other departments, which complement the perspectives of the workforce in those two departments with relatively low levels of perceived safety risk inclusion in decision-making processes in the organisation.

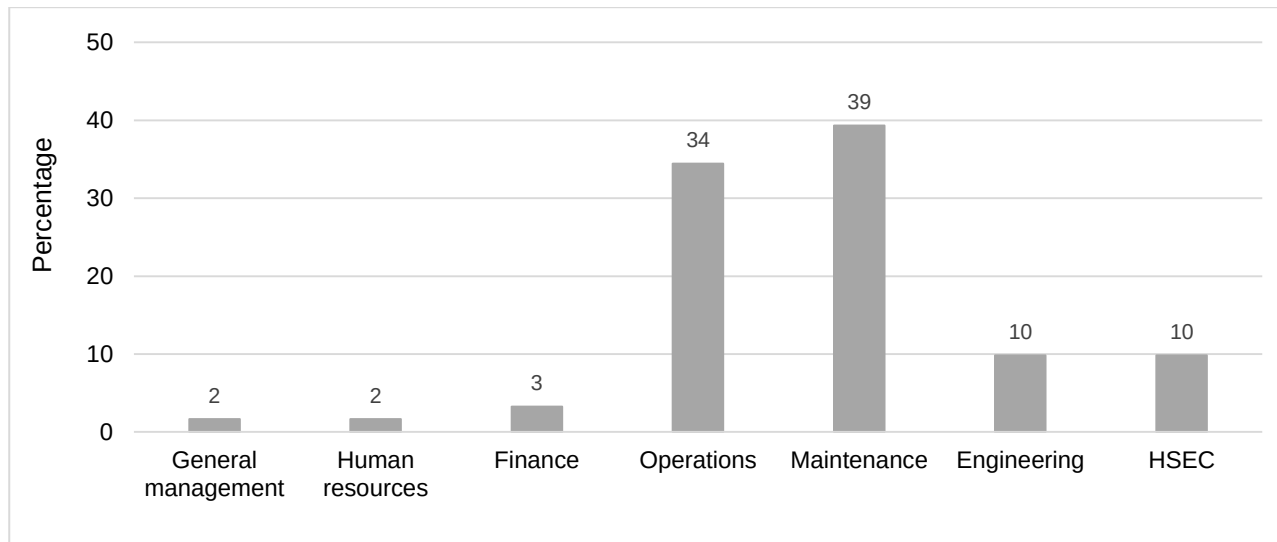


Figure 6: “I do not know” responses at departmental level.

2.5.6 Which organisational characteristic assisted you most to include safety risk when you make decisions?

This was the first diagnostic question included in the questionnaire, which allowed the survey population to reflect on the organisational traits that have contributed to the safety risk culture of the company. Table 10 presents the corresponding responses of respondents in numerical order.

Table 10: Organisational characteristics that assisted respondents most to include safety risk when making decisions.

Organisational characteristics	Percentage of respondents
Accountability for including safety risk when making decisions	26
Shared understanding of safety risk	19
Safety risk communication	16
Leadership: tone from the top about actively including safety risk when making decisions	11
Safety risk management framework (risk: appetite statement, limits, functions, systems, processes, data)	8
Quality of safety-risk-related information	7
How safety risk is included in decision-making in different groups in the organisation (group dynamics)	5
Leadership: tone in the middle about actively including safety risk when making decisions	3
Safety-risk-based rewards (e.g. remuneration, succession planning and talent development)	2
Safety risk challenge when decisions are made	2
Safety-risk-related role clarity	1

The respondents' overall declarations were that "accountability for including safety risk when making decisions", "shared understanding of safety risk" and "safety risk communication" were the organisational characteristics that assisted them most to include safety risk in decision-making. Figure 7, however, indicates that "leadership: tone from the top about actively including safety risk when making decisions" was a characteristic that helped company management more than "safety risk communication".

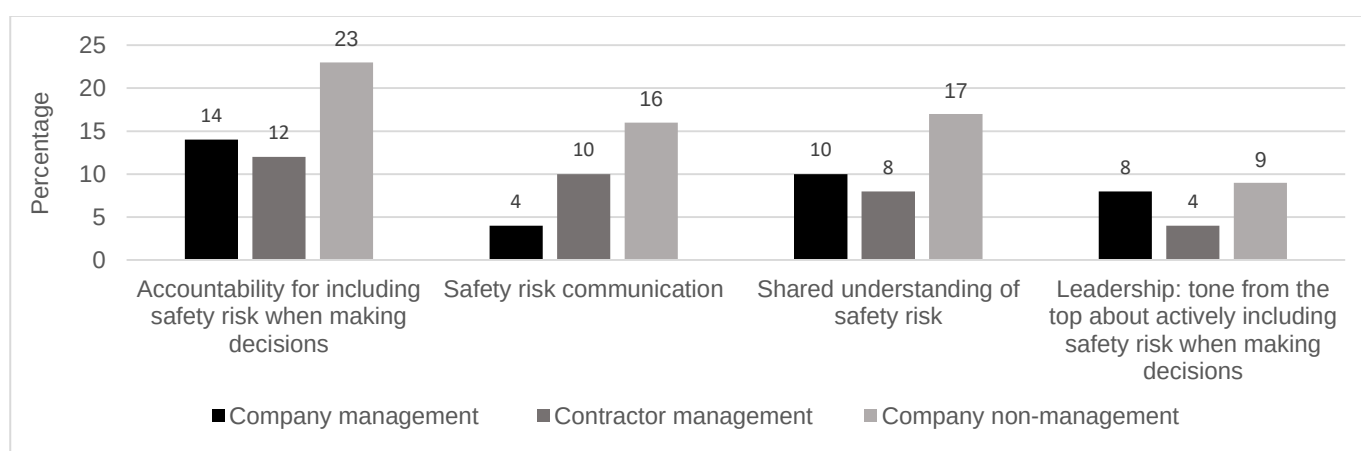


Figure 7: Organisational characteristics which assisted the workforce to include risk in decision-making.

2.5.7 What needs to be done to improve the inclusion of safety risk in decision-making?

This was the second additional diagnostic question included in the survey, which encouraged the employees to suggest ways to improve the safety risk culture in the company.

Table 11: What needs to be done to improve the inclusion of safety risk in decision-making?

Organisational characteristics	Percentage of respondents
Accountability for including safety risk when making decisions	18
Safety risk communication	13
How safety risk is included in decision-making in different groups in the organisation (group dynamics)	12
Quality of safety-risk-related information	11
Shared understanding of safety risk	11
Leadership: tone in the middle about actively including safety risk when making decisions	7
Leadership: tone from the top about actively including safety risk when making decisions	6
Safety risk challenge when decisions are made	6
Safety risk management framework (risk: appetite statement, limits, functions, systems, processes, data)	6
Safety-risk-based rewards (e.g. remuneration, succession planning and talent development)	5
Safety-risk-related role clarity	5

Table 11 shows that 18% of respondents averred that “accountability for including safety risk when making decisions” as the primary area of focus for management to improve on. They asserted also that “safety risk communication” and “how safety risk is included in decision-making in different groups” are further areas requiring focus to improve safety risk culture in the company. Figure 8 shows that “shared understanding of safety risk” is more important to contractor management than “safety risk communication” and “how safety risk is included in decision-making in different groups in the organisation”. These results indicate that while “accountability for including safety risk when making decisions”, “safety risk communication” and “shared understanding of safety risk” are organisational characteristics that the workforce believes are well-entrenched, they suggest that inclusion of safety risk in decision-making in group dynamics needs to improve.

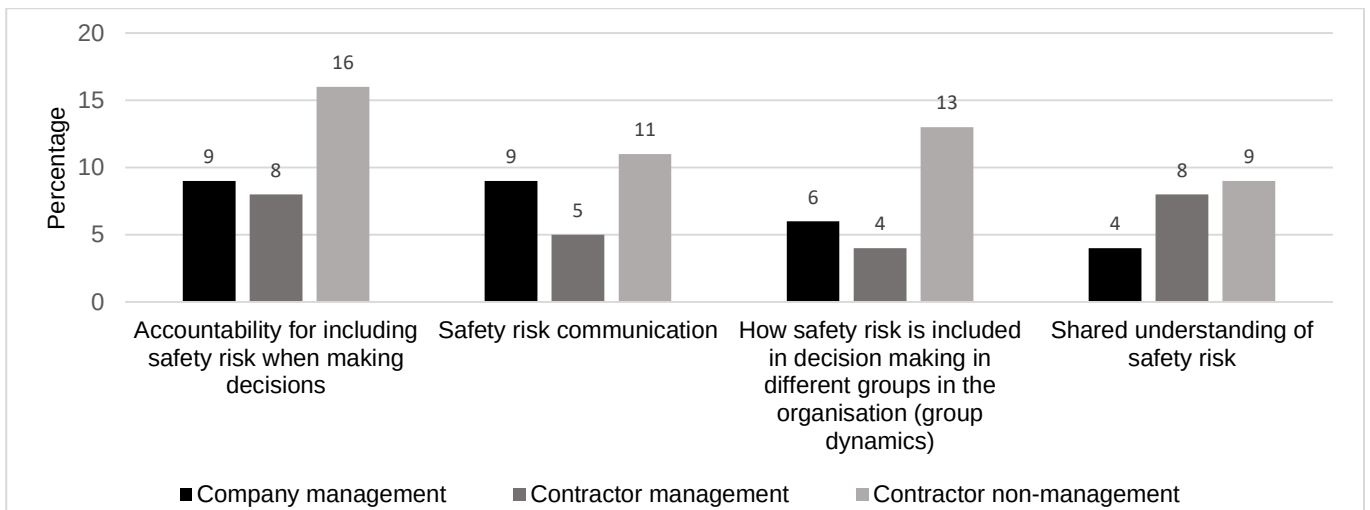


Figure 8: Organisational characteristics that need to improve for inclusion of safety risk in decision-making.

2.6 Conclusion

Overall, there is a high level of perceived safety risk integration in decision-making in the company; moreover, management's perception of this integration is higher than that of non-management. There is however a significant difference between departments in perceived level of safety risk integration in decision-making. The difference in perceptions on safety risk culture between management and non-management, and across departments, was unexpected due to the outcomes of safety culture surveys conducted in-house by the company that indicated alignment and developed safety culture in the company. The alignment of company and contractor management on perceived level of safety risk integration in decision-making was expected due to the company's established safety management programme, which includes contractors.

The high level of comfort with own safety risk management roles for management and non-management presents optimism bias, which signals possible complacency towards safety risks, and application of risk mitigation controls. With the majority of respondents having work experience of between five and more than 10 years, complacency that may inhibit safe behaviours and attitudes is probable. Operations and Maintenance demonstrated lower perceptions of safety risk integration in decision-making than other departments; this result indicates a perception of inadequate safety risk mitigating strategies by employees at the coalface.

Decision-making in the organisation is perceived to incorporate safety risks, and employees' comfort with their own safety risk accountability is at a satisfactory level, suggesting a well-developed safety risk culture in the organisation. However, the workforce at the coalface continue to get injured and zero harm seems impossible to achieve so far. Strategies to strengthen safety risk culture in the company, and improve safety performance, should focus on accountability for including safety risk when making decisions, improved communication, inclusion of safety risk in group dynamics, and

shared understanding of safety risk. Priority must be given to Operations and Maintenance. The exclusion of approximately 40% of contractors at operator level from participating in the survey, because UARM RCS-2019 is not validated at these lowest job levels, is an opportunity for further research to expand on safety risk culture perceptions at the coalface.

Surprisingly, this study does not reinforce the conclusions reached in the safety culture surveys conducted in-house by the company every two years; the UARM RCS-2019 used in this study introduced the concept of “risk” in the survey, which brought in specific emphasis on the level of including safety risk in decision-making. This study shifted focus away from a narrow definition of safety culture, which is based on compliance with safety policies and procedures only, and instead explored specific safety risk culture indicators, and how safety risk is integrated in decision-making processes. In so doing, it integrated the views about safety risk culture into the overall risk culture of the organisation, which is the perceived level of inclusion of risk in decision-making representing how much a group values managing risk (Zaaiman, 2019). The insights provided by this study into the safety risk perceptions at the coalface, underpin the level of assessing safety risks and using the outcomes as contributions towards safety risk mitigation strategies. This study marks the difference between safety culture, which is a general feature of an organisation, and safety risk culture, about which decisions give priority to safety risks.

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CHAPTER 3: REFLECTION, PERSONAL LEARNINGS AND APPENDICES

REFLECTION

Before engaging on this journey, I had been approaching the topic of safety risk culture from a “safety culture” and a “safety climate” perspective. It has been since this study that I have learnt to differentiate between “safety culture” and “safety risk culture”. This was a learning opportunity for me and for the company. This study integrated leadership and organisational characteristics; leadership tone is important for embedding safety risk culture.

During the course of this research, the organisation incurred three significant lost-time injuries 29 days apart; two employees were electrocuted, and another one fell approximately 8 metres from a height. These incidents were near-fatalities. They confirm the view that the goal of zero harm is seemingly unattainable in heavily mechanised industries due to a weakened safety risk culture. The relevance and usefulness of this study to the company reported on here is confirmed.

Survey data were collected when the business was going through wage negotiations. Even though the researcher was part of the management wage negotiations team, the anonymity of her participation in the survey could not have negatively influenced the participants. This reflects a company with a mature organisational culture, which was not influenced by wage negotiations. The company’s internet connection to SurveyMonkey’s professional online survey platform on Research.net, which delivered the research scale to potential participants, was extremely slow. The sluggish internet connection could have influenced the response rate and response time of the participants. The intervention by the risk department in distributing printed copies of the questionnaire, beyond those potential respondents without access to a computer, mitigated the response rate; however, some potential contributors had already concluded their participation in the survey. This technical glitch assisted the IT department to reassess the adequacy of the company’s bandwidth to business needs; this is already work-in-progress. Going forward, I will check the internet connection over again to see that there are minimal technical glitches.

PERSONAL LEARNINGS

Throughout this research journey, I learnt to exercise patience with myself and allow the learning process to take place. I now have a better understanding of my strengths and weaknesses, and this could not have been a better opportunity to study. I have learnt that a “work–study–life” balance does not exist; studying while working for me meant putting on hold my family and social life in order to ensure my work output was not compromised, while striving hard to succeed in my studies. This was tough – however, staying true to myself and the research journey brings the best rewards.

APPENDICES

Appendix 1: UARM Risk Culture Scale (UARM RCS-2019)

UARM Risk Culture Scale (UARM RCS-2019)

An Overview

Hermien Zaaiman and Hedré Pretorius

Aims

This document provides a summary of the North-West University (NWU)'s Centre of Applied Risk Management (UARM) Risk Culture Scale (UARM RCS). Current approaches to risk culture tend to be qualitative, using a general view of what risk culture is. Where risk culture questionnaires are applied, it is important to ascertain the validity and reliability of the resulting information against the broad construct of risk culture. The UARM Risk Culture Scale (UARM RCS) was developed to meet the need for an academically validated instrument to measure the risk culture in organisations.

Approach

Multiple definitions of risk culture exist in regulatory papers and risk standards. One of the more comprehensive definitions is that of the Basel Committee on Banking Supervision (BCBS) defining risk culture as: "A bank's norms, attitudes and behaviors related to risk awareness, risk-taking and risk management, and controls that shape decisions on risks. Risk culture influences the decisions of management and employees during the day-to-day activities and has an impact on the risks they assume" (BCBS, 2015, p. 2).

However, applying such broad definitions to evaluate and improve the risk cultures of organisations is complex. This process requires the development of instruments to assess and measure specific aspects of risk culture. The UARM RCS was developed using our decision-focused view of risk culture as basis for the development and testing of its items:

'The risk culture of an organisational group is manifested by the importance given to considering risk when the group makes decisions. The level of explicit inclusion of risk in decision-making represents the implicit, subjective value afforded to risk by the group.'

The scale items were therefore developed to represent aspects of the integration of items in risk culture based on our Risk Culture Indicator (RCI) model, described by Zaaiman in the Appendix: 'Risk Culture Indicator Model – An Overview'.

Status

The UARM RCS provides three sets of results that can be used to assess the:

1) Two risk-culture-related factors

The 42-item five-point Likert scale has been developed and piloted over 3 years (2016-2018). The scale is now mature and can be regarded as valid, as the scale items map to the RCI model and has been shown in 13 studies to work well across sectors, functions and management levels (content validity). The scale also shows a high Cronbach α reliability coefficient of 0.97 (internal consistency). This mini-dissertation study forms part of further testing of the scale.

The scale measures two risk-culture-related factors:

- Perceived level of integration of risk in decision-making processes (24 items)
Note: Although the items cover the indicators in the RCI Model, only one factor is found in the answer data. This can be ascribed to the interlinked nature of the indicators and provides an indication of the validity of the scale for the study of this focused view of risk culture.
- Comfort with own risk management role (18 items)

The factor scores are calculated as the average of the responses over the items making up the factor. This translates to the following scale for the decision-based view of risk culture used in this study.

		UARM RCS-2019 (FS = Factor Score)				
		1.0 $\leq$ FS < 1.5	1.5 $\leq$ FS < 2.5	2.5 $\leq$ FS < 3.5	3.5 $\leq$ FS < 4.5	4.5 $\leq$ FS $\leq$ 5.0
	<i>Item response options related to the level provide an indication of group perception associated with the level</i>	Very low level: Never and Not at all	Low level: Infrequently and Not well	Medium level: Sometimes and Moderately well	High level: Well and Usually	Very high level: Always and Perfectly
Factor 1	Perceived level of integration of risk in decision-making processes	Very low level of perceived integration	Low level of perceived integration	Medium level of perceived integration	High level of perceived integration	Very high level of perceived integration
Factor 2	Comfort with own risk management role	Very low level of comfort	Low level of comfort	Medium level of comfort	High level of comfort	Very high level of comfort

2) The I-do-not-know/I-do-not-understand-the-statement answer option

Item response options include an 'I do not know' or "I do not understand the statement" option to mitigate possible spurious effects of respondents who truly do not know the answer to an item. The I-do-not-know answers were not included in the scale's factor analysis, and only participants with fewer than 30% of I-do-not-know answers (per factor) are included in the calculation of the factor scores. This means that the participant has to have answered at least

16 of the items in factor 1 and 12 items in factor 2 to be included in the calculation of the factor score.

In addition, the full set of the study's I-do-not-know answers is analysed separately, thereby providing possibly valuable information on the levels of uncertainty about risk-culture-related aspects in the study sample(s) that could be indicative of possible risk-related knowledge in the study population(s).

1) Two further diagnostic questions

The scale also contains two further RCI model-based diagnostic questions:

'Which organisational characteristic assists you most to include risk when you make decisions?'

'To improve the inclusion of risk in decision-making in the organisation, I believe that we must start with improving....'

The options to these responses correspond to the risk culture indicators in the UARM risk culture indicator model. These options are presented in alphabetical order.

Evaluating the responses to these questions allow for suggestions on the way forward on improving the risk culture of the organisation.

Scale application

This is an online scale housed on Research.net (SurveyMonkey's professional (Premier) plan). Data gathering is done by UARM and the data sets are housed and analysed by us. Each instance of the scale is set up for anonymous data capturing, meaning that the respondents cannot be identified. After formal permission to apply the scale has been obtained from the organisation and NWU ethics clearance for the study, a suitable project sponsor in the studied organisation sends out the weblink to the scale (not the student doing the study). The scale is closed after a maximum of two reminders to complete the survey. Study-relevant data results are provided to the student (and organisational project sponsor, if requested) in analysed, aggregated format.

Interpretation of results

Scale results have to be interpreted in the context of the study for which the results were obtained.

To keep in mind when analysing and interpreting the scale results:

1) In a scale like this, only the group response makes sense and the individual's factor score cannot be used as an indication of the individual's 'risk culture' as culture is always a group concept.

2) Levels of the measured factor could be inflated by response biases (e.g. positive response bias and social desirability influence).

3) The results of the scale are valid at factor level. A scale-based factor is based on the coherence for the group of items that make up the factor. These items were designed based on the measurement aims of the scale but do not contain every possible item that could have been used. Other items that refer to the construct may have shown the same result, implying that focusing on differences at item level could divert the user's attention to inadequately tested aspects of the underlying construct, while not considering the validated construct. The scale may be used to provide indications of where risk culture-related issues lie in the organisation, but was not designed to identify micro-level issues. Other scales and research methods are required to do detailed follow-up investigations.

For more information on the UARM RCS, please contact: Hermien Zaaiman at

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