Safety Culture TDGI

Laurens Johannes Cornelis Jans
152121206

Dissertation written under the supervision of professor Rute Xavier

Dissertation submitted in partial fulfilment of requirements for the MSc in Management with specialization in Strategy, Entrepreneurship & Impact, at the Universidade Católica Portuguesa, 30-12-2022.

Table of Contents

Acknowledgements *4*

Abstract *5*

Resumo *6*

Introduction *7*

1. TDGI – Tecnologia de Gestão de Imóveis, S.A. **7**

Literature Review *9*

2. Facility Management **9**

2.1 History 9

2.2 Safety culture & climate 10

2.3 Occupational Safety and Health (OSH) 11

2.4 Behavioural Safety 13

Methodology *14*

3. Research Design **14**

3.1 Participants 14

3.2 Tools 15

3.3 Procedure 15

3.4 Data Collection 16

Data Analysis Part 1 ..... *16*

4. Results from interviews **16**

4.1 The current safety culture at TDGI 17

4.2 The current OSH practices and its bottlenecks at TDGI 19

Data Analysis Part 2 ..... *24*

5. Results from questionnaire **24**

5.1 safety behaviour technicians 25

5.2 safety climate technicians 27

5.3 Safety leadership directors & managers 30

5.4 Safety leadership supervisors 32

Data Analysis Part 3 ..... *34*

6. Results from questionnaire **34**

6.1 Ranking Supervisor Management Role 35

6.2 Ranking Directors & Managers Management Role 36

6.3 Ranking Safety Officer Management Role 38

Recommendations *40*

Conclusion *42*

Limitations *43*

Appendix *44*

Bibliography *48*

List of Figures

Figure 1 Safety Behaviour Technicians 26

Figure 2 Safety Culture Technicians 28

Figure 3 Leadership Directors & Managers 31

Figure 4 Leadership Supervisors 33

Figure 5 Ranking Supervisors 36

Figure 6 Ranking Directors & Managers 37

Figure 7 Ranking Safety Officer 39

List of Tables

Table 1. Codebook Interviews 44

Table 2. Hierarchical Structure Safety Department TDGI 46

Table 3. Treemap codes from interview transcriptions 47

Acknowledgements

Firstly, I would like to thank my supervisor, Professor Rute Xavier, for her supervision during the dissertation process. Her feedback and insights have been very useful for my dissertation. She gave me great academic support and taught me how to be a better consultant. At any moment she made time for me when I had questions and gave me great guidance throughout my dissertation. I can definitely recommend Professor Rute Xavier to other students that will be doing their dissertation in the future.

Secondly, I would like to thank my colleagues at TDGI Ms Rosário Pereira Mendes and Mr Marcelo Vicente Serra for being my "project sponsors". They have been of great help to me from the start of my dissertation making my research much easier. They both helped me translate the questionnaire to Portuguese, arrange all the interview meetings, and invited me to visit project sites. Without the help and support of you both, I would not have been able to do my research as I have done now.

Thirdly, I would like to thank both the university Católica Lisbon School of Business and Economics and TDGI for making this consulting project possible.

Lastly, I would like to thank all the employees at TDGI who participated in my research being the interviews conducted, the questionnaires and visiting the project sites. It was great meeting such lovely people and I had a great time working with you.

Abstract

This paper aims to find out how TDGI – Tecnologia de Gestão de Imóveis, S.A. can improve their safety culture in facility management. International clients of TDGI have high safety standards and are becoming more demanding regarding safety requirements. At the same time local Portuguese clients have lower safety requirements and are less demanding. There is a big contrast between the safety practices for these International Large Accounts (ILA) and local Portuguese clients making it difficult for TDGI to have a high standards of safety practices for all their clients. The facility management (FM) industry is becoming more competitive and there is a need to change the safety culture at TDGI to stay competitive in the market. The objective of this research is to come up with feasible solutions that are not capital intensive in order to improve the safety culture at TDGI. For this research 9 interviews were conducted, 1 project site was visited and 3 questionnaires were sent out to the employees of TDGI in which 113 people participated. This research concludes that there are multiple factors affecting the safety culture negatively that should be enhanced. These factors can be divided into 5 categories: safety training, internal communication, project site visits, clear job descriptions and safety evaluation performance.

Key words: International Large Accounts (ILA), Safety culture, Occupation Safety and Health (OSH), Local Portuguese clients, Safety training, Communication

Resumo

Este trabalho tem como objetivo descobrir como a TDGI – Tecnologia de Gestão de Imóveis, S.A. pode melhorar a sua cultura de segurança na gestão de facilities. Os clientes internacionais da TDGI têm altos padrões de segurança e estão se tornando mais exigentes quanto aos requisitos de segurança. Ao mesmo tempo, os clientes locais portugueses têm requisitos de segurança mais baixos e são menos exigentes. Existe um forte contraste entre as práticas de segurança para estas Grandes Contas Internacionais (ILA) e os clientes locais portugueses, tornando difícil para a TDGI ter elevados padrões de práticas de segurança para todos os seus clientes. A indústria de gerenciamento de instalações (FM) está se tornando mais competitiva e há uma necessidade de mudar a cultura de segurança na TDGI para se manter competitiva no mercado. O objetivo desta pesquisa é apresentar soluções viáveis e não intensivas em capital para melhorar a cultura de segurança em TDGI. Para esta pesquisa foram realizadas 9 entrevistas, visitada 1 obra e enviados 3 questionários aos funcionários da TDGI, dos quais participaram 113 pessoas. Esta pesquisa conclui que existem múltiplos fatores que afetam negativamente a cultura de segurança que devem ser melhorados. Esses fatores podem ser divididos em 5 categorias: treinamento de segurança, comunicação interna, visitas ao local do projeto, descrições de trabalho claras e desempenho da avaliação de segurança.

Key words: International Large Accounts (ILA), Safety culture, Occupation Safety and Health (OSH), Local Portuguese clients, Safety training, Communication

Introduction

1. TDGI – Tecnologia de Gestão de Imóveis, S.A.

This paper aims to research the current state of the occupational safety and health (OSH) practices at TDGI - Tecnologia de Gestão de Imóveis, S.A. with the objective to improve the safety culture at the company. TDGI is a member of the Teixeira Duarte Group which is a conglomerate in the civil construction and public works sector. At TDGI, the firm specialises in the facility management of buildings, compounds, industrial and technical facilities. The company currently employs over 500 people at TDGI Portugal and is present in 9 countries. Founded in the year 2000, the Portuguese firm has become a trusted partner for its clients in the conservation, maintenance, and management of their assets with the clear objective of "full customer satisfaction" (TDGI, 2022).

Currently, TDGI intends to improve the quality of their safety practices to comply with the demands of their clients and to expand their customer portfolio. The company believes they are the best among the competition, nevertheless, they want to improve their safety practices more to comply with the most demanding international clients referred to as International Large Accounts (ILA) such as Nestlé, Philip Morris and Johnson & Johnson as well as to improve their safety practices for their local Portuguese clients.

Culture has a big impact on company's practices and is extremely important in accomplishing the organizational goals of an enterprise. It drives employee engagement and satisfaction and affects the quality of work in all facets of a business. Given the notion of safety culture, the main research question of this study is as follows: 'how can TDGI improve their safety culture in facility management'?

In addition, facility management often requires technicians to perform dangerous activities that require heavy physical work resulting in injuries. At TDGI, most accidents involve musculoskeletal injuries resulting from physical effort or impact with objects (TDGI, 2022). The relationship between serious accidents, minor accidents, near misses is well depicted in the "safety triangle" of Herbert William Heinrich. The model concludes that the high severity occupational safety and health (OSH) incidents are preceded by numerous lower severity incidents and near misses (Yorio & Moore, 2018).

The full cost of workplace illnesses and injuries are often greater than one might first think, which is well depicted on the infographic called “The Iceberg Impact”. This infographic states that most costs paid by the businesses due to workplace injuries are not visible at first sight but may impact the business significantly in the long run. This demonstrates the importance of safe execution of the health and safety practices at an enterprise and why there is a need to research the safety culture at TDGI.

To answer the main research question, two sub research questions will be answered. The sub research questions are: (1) ‘which management role at TDGI has the greatest impact on workers safety’?; (2) ‘what are currently the underperforming dimensions of safety leadership, safety culture and safety behaviour at TDGI’? By answering these two sub questions a framework will be designed that will be tailor fitted to the situation at TDGI which the firm can use in practice to improve their safety culture. Given the limited resources and capabilities at TDGI, the intention of this research is to come up with feasible and practical recommendations that are not capital intensive that TDGI can implement easily.

The large international accounts (ILA) such as Nestlé, Philip Morris and Johnson & Johnson are clients that have high standards regarding safety in facility management and demand high quality of safety practices especially compared to the local Portuguese clients which do not have these high safety standards. This is often due to a difference in safety culture and discipline toward safety practices. The problem that TDGI is currently facing, is that the company is aware of most of their current health and safety insufficiencies, however, does not know the best practices on how to improve this.

Nevertheless, incentives by TDGI are being implemented to make the employees at the company more aware of the importance of safety. The incentives include monthly toolbox talks or safety moments, meetings between managers and technicians, monthly safety moments with the board of directors and initial safety training to new technicians.

However, not all incentives are seen as sufficient due to a lack of focus on the importance of safety. Safety is still seen largely as the responsibility of the safety department rather than the responsibility of each and every employee. At the moment, the safety culture at TDGI is reactive and not proactive. This means that after an accident has happened additional training and information is given to the employees instead of doing this beforehand.

Safety is not yet seen as a factor of competitiveness but rather seen as a cost item. The focus at TDGI is primarily on the compliance with safety requirements out of obligation rather than the administrative council (board of directors), directors, managers, supervisors and technicians all being committed to doing what needs to be done to improve the overall safety practices. There is a need for a change is mindset and discipline towards safety. This will be required if the company wants to move from good to great.

Literature Review

2. Facility Management

2.1 History

The history of the construction industry dates back to the Palaeolithic age, between 40,000 and 12,000 B.C., when people lived in caves or built simple structures. The first written account concerning safety management dates back to 2,200 B.C., when King Hammurabi of Babylon passed a law designating punishments for houses falling down and killing their inhabitants (Zhou, Goh, & Li, 2015).

Nowadays, facility management is seen as a needed support in the operational environment to enhance an organization's core business activities and processes which have evolved over the past 150 years or so. According to the International Facility Management Association (IFMA), facility management (FM) is "an organizational function which integrates people, place and process within the built environment with the purpose of improving the quality of life of people and the productivity of the core business" (International Facility Management Association, 2022).

FM has its origins since the 1800s, when American railroad enterprises thought it was better to not merely provide the buildings but to provide the utility of facilities. Another 150 years later in the 1950s, facility management became synonymous with the efficient and effective coordination of services used holistically to improve an organization's performance. The

collective procedures we recognize today have therefore developed relatively slowly (Brooks & Atkin, 2021).

Present day, FM is a service sector in its own right and has helped to establish a new professional discipline with its own technical jargon, standards, processes, codes, principles and concepts.

2.2 Safety culture & climate

In-depth study of safety culture and climate is a result of the discovery that both social and organizational elements affect safety performance. It is generally acknowledged that safety culture and safety climate are excellent predictors of safety-related outcomes (such as accidents and injuries) in both Western and Eastern societies, even if a clear consensus on both dimensions has yet to developed (Vinodkumar & Bhasi, 2010).

Safety culture, which is seen as the foundation of enterprise safety management, is the culmination of a company's corporate view on safety values and its safety behaviour guidelines. The meaning and importance of corporate safety culture, as well as its role in achieving enterprise safety performance, are becoming increasingly significant (Wu et al., 2015).

The notion of safety culture is valuable for every organization because it helps maintain safe operations. When personnel from all levels of the company take safety serious, business operations can be conducted in a safe and responsible manner. The definition of safety culture has been widely debated in recent decades. Both scholars and organizations have defined over 50 definitions for the concept of safety culture according to the literature (Fang et al., 2020). According to Tear et al., (2020) the notion is referred to as the shared perceptions, values and attitudes towards safety held by organisational groups, whereby safety culture is assumed to be both the product and driver of risk-related practices (Tear et al., 2020).

The notion of safety culture was first introduced after the Chernobyl nuclear explosion and the space shuttle Challenger disaster (Bisbey et al., 2021; Feng & Trinh, 2019; Tear et al., 2020). Since then, the concept of safety culture has attracted much research attention and has

become an integral part of organizational risk management in many industries (Bisbey et al., 2021; Tear et al., 2020).

In addition to the concept of safety culture, it is important to mention the notion of safety climate. According to Wu et al., (2015) the notion of safety climate is defined and accepted as the sum of common perceptions regarding the safety shared by employees. Cultivating a good safety climate is critical to the improvement of safety performance.

Both safety culture and safety climate impact safety performance and both concepts are multi-level depending on site employees' job positions. Safety climate is included in the safety culture of an organization, which involves both explicit and implicit social cognitions (Han, et al., 2019).

According to Fung et al., (2005) and Choudhry et al., (2007), safety culture consists of three levels: frontline worker, supervisory personnel, and top management (Fung et al., 2005; Choudhry, Fang, & Mohamed, 2007). It is found that by systematically responding to irregular and regular threats organizations can develop resilient safety culture (Feng & Trinh, 2019). However, factors that compose safety culture and the factors that are a consequence of safety culture vary (Bisbey et al., 2021).

Hence, there are some key differences between safety climate and safety culture that are worth mentioning. According to Huan et al., (2019) safety climate focuses on workers' attitudes towards safety and their perception of the role of safety in the workplace. Safety culture addresses safety management and is a top-down organizational attribute approach (Huan et al., 2019). Safety culture could be best described by safety incentives for safe performance, as well as disincentives for unsafe behaviours, safety commitment, and safety dedication and accountability. Safety climate reflects safety culture and can measure safety culture, which has a direct effect on the safety performance of a company (Huan et al., 2019).

2.3 Occupational Safety and Health (OSH)

According to the International Labour Organization estimates, there are over 317 million non-fatal work accidents and 2.3 million fatal work accidents each year. The estimated yearly financial costs are estimated to be equal to 4 percent of the global GDP (ILO, 2016). These

figures demonstrate the continued need to address the root causes of workplace accidents and injuries and to develop efficient treatment to reduce them (Clarke & Taylor, 2018).

In the field of facility management, maintenance personnel are at constant risk of falls, cuts and bruises, electricals shocks and crushing and because of this have a much higher illness and injury rate than the national average. Buildings are increasingly becoming more complex, making the role of facility management staff critical for the managing, maintenance, and planning of these complex facilities. Technicians are at high risk of injuries due to the repair and maintenance requirements of these facilities and the time pressures associated with the job (Wetzel & Thabet, 2015).

Moreover, employees are responsible for being aware of any possible safety concerns, even if Occupational Safety and Health Administration (OSHA) laws compel businesses to provide their workers with safe and healthy working conditions (Karakhan et al., 2018). As briefly mentioned in the introduction, Herbert William Heinrich has produced with the “safety triangle” one of the most influential and longest lasting theories in the Occupational Safety and Health (OSH) discipline.

The safety pyramid assumptions can be looked at from three levels: the individual level, the establishment level, and the regulatory level. At the individual level, competencies, skills, and knowledge can be improved by practicing risk analysis and mitigation skills for low and lower severity incidents. At the establishment level, communicating, monitoring, tracking the analysis of less severe OSH incidents can be used to enhance collective awareness required for organized action and overall system performance. At the regulatory level, metrics related to low-severity OSH events may be used to determine the efficacy of OSH management at a specific establishment as well as the degree(s) and nature(s) of industrial hazards to which employees are exposed (Yorio & Moore, 2018).

Aiming to mitigate and prevent the risks caused by occupational hazards in the FM, research in facility management has been highly focused on enhancing and predicting safety performance, building frameworks and models of safety culture and climate, as well as exploring effective safety management programs. Multiple studies suggested formal safety programs, training, or education to be enforced to all site participants including the management to minimize risks associated with occupational accidents and hazards (Han, et al., 2019).

2.4 Behavioural Safety

Up to 80% of work-related injuries were shown to be caused by employee behaviour in the form of acts or omissions. According to the Institution of Occupation Safety and Health (IOSH 2015), implementing a behavioural safety approach and reducing risky behaviours are two ways to improve safety performance. Safety behaviours provide tangible evidence of an employee's commitment to safety compared to other aspects.

Accidents involving electrocution, falls, caught-in-between, and struck-by, which are all considered as "Focus 4 Hazards" (OSHA 2011) that might occur as a result of dangerous behaviours such as inadequately wearing personal protective equipment (PPE) (Han et al., 2020).

Furthermore, the concept of Leadership-Culture-Behaviour (LCB) approach places strong emphasis on the role of safety leadership in reducing unsafe behaviour both directly and by fundamentally altering the causes of unsafe behaviour through the creation of a safety culture, ultimately achieving the goal of sustainably reducing unsafe behaviours and preventing accidents. Numerous railway and construction projects in Singapore, China, and mainland Hong Kong SAR have used the LCB technique (Fang, et al., 2020).

The LCB strategy involves repeatedly inspecting, diagnosing, and intervening with the three aspects to bring about a coordinated and sustained improvement. In conclusion, the research demonstrates that the LCB strategy more fully and successfully than before contributes to the enhancement of safety behaviour, safety culture, and safety leadership of all stakeholders. It places a strong emphasis on raising people's safety cognition and awareness via safety culture and safety leadership, enabling improvement of behaviour change with lasting impact (Fang, et al., 2020).

Lastly, agent-based modelling which is based on a range of empirical and theoretical evidence, prove to be an efficient method for examining the traits and patterns of FM workers' safety behaviour and evaluating safety management strategies. The outcome of this research demonstrates that inspections and regular safety training are necessary to maintain high level performance. It shows that management teams should emphasize and foster supervisors' leadership roles and that to influence entire project teams to act more safely, senior managers should regularly participate in safety activities. Finally, senior managers

should also be able to articulate a clear safety goal to subordinates and shown genuine concern and support for the achievement of that goal (Zhang et al., 2019).

Methodology

3. Research Design

During a period of four months, project site observations were made, interviews with personnel were conducted and three questionnaires were sent out to collect data regarding the safety culture at TDGI. The tools and methods used to design this research were aimed to lay out the current safety culture at TDGI, to find out the bottlenecks in the safety practices, and to use this information to come up with feasible suggestions to improve the safety culture at TDGI. A triangular approach was used by crosschecking multiple data sources of information and collection procedures, being the directors & managers, supervisors, and technicians to ensure that the data was as valid and free of bias as possible.

3.1 Participants

The participants for this research consisted of three target groups: the directors & managers, the supervisors, and the technicians. In total 9 interviews were conducted with directors, managers, supervisors, and technicians. Interviews with people from different sectors such as International Large Accounts (ILA), Exteriors, and Retail were conducted to better understand the different safety related problems that occur in each sector. Also, the interview participants differed in tenure years (ranging from 1 to 15 years) and organizational position (ranging from technicians to directors) to create a more comprehensive picture of the current safety culture at TDGI. Furthermore, during this research there was continuous supervision and collaboration with the colleagues and project sponsors (from TDGI) Rosário Pereira Mendes and Marcelo Vicente Serra from the Quality Health and Safety Environment (QHSE) department who also gave a lot of new insights on the current safety practices within the organization.

3.2 Tools

The platforms “Web of Science” and “Chartered Association of Business Schools” (CABS) were used to search for scholarly peer-reviewed articles. Both platforms offer access to peer-reviewed journals, articles, book chapters and open access content. To indicate the measure of the scientific influence of scholarly journals SCImago Journal Rank (SJR) was used. The SJR indicator is a numeric value that represents a journal’s average number of weighted citations received during a selected year. A higher SJR indicator value means greater journal prestige. Only top academic journals with the highest ranking “quartile 1” were used in this academic writing.

Moreover, the cloud-based software survey tool SurveyMonkey was used to create the questionnaire. The reason for choosing SurveyMonkey is because TDGI already has a premium subscription on this platform. In addition, the qualitative data analysis computer software package called NVivo was used to help organize, analyse and uncover richer insights and produce clearly articulated findings from the interviews conducted.

Lastly, Microsoft Excel was used to do descriptive statistics, perform reliability tests (Cronbach’s alpha), and calculate p-values based on the data from the questionnaires.

3.3 Procedure

Firstly, a literature review was conducted to find common elements about existing theories and models regarding the notion of safety culture and safety climate, the history of FM, OSH practices in FM, and behavioural safety that are already in existence. In addition to the literature review, multiple interviews were conducted with employees. The reason for conducting interviews was to retrieve assumptions that shape employee perceptions and motivate their behaviour with regards to safety practices at the company, which can only be exposed through targeted investigation, such as qualitative analysis of interviews. In essence, this approach entails an outsider (someone that is not familiar with the culture of the company) aiding in the debunking of presumptions by asking insightful questions.

Lastly, 3 different questionnaires were sent out to the directors & managers, supervisors, and technicians of TDGI. The aim of this survey was to evaluate the safety leadership at TDGI, assess the safety culture at TDGI, and to assess the safety behaviour of the technicians at TDGI. All the questionnaires were measured by a five-point Likert scale indicating (1) I strongly disagree, (2) I disagree, (3) I neither agree nor disagree, (4) I agree, and (5) I strongly agree. Most of the people working at TDGI do not feel comfortable answering the survey in English, and because of this the questionnaire was translated to Portuguese with the help of my project sponsors Rosário Pereira Mendes and Marcelo Vicente Serra.

3.4 Data Collection

During the interviews, transcriptions were made to review what was said during the conversation. Based on the interviews a thematic analysis was conducted that focused on searching across the dataset of the transcriptions from in-depth interviews and focus groups to try to identify, analyse and report repeated patterns. NVivo software was used for the analysis of the interview transcripts.

Furthermore, observations were made on the project site of Campus da Justiça, in Parque das Nações. Observations are a way to gain a better understanding of the day to day working practices of the technicians and to recognize the workplace safety hazards.

At last, data collected from the questionnaires will be used in Microsoft Excel to perform statistical analysis to help answer the sub research questions and ultimately answer the main research question of this paper.

Data Analysis Part 1

4. Results from interviews

Using NVivo software, theoretical saturation was reached after 9 interviews, indicated by the fact that no new codes related to a higher-level theme were established. The duration of the

interviews differed from 30 minutes to more than 1 hour. The transcripts yielded a total of 129 individual codes and 119 references. In the final coding framework, these codes allocated into 23 subcategories, which were synthesised into 8 main themes: Clients, Communication, Employees, Leadership, Occupational Health and Safety Procedures, Safety Culture, Subcontractors, and Time shown in Table 1.

In total 9 employees were interviewed of which 3 directors, 2 managers, 2 supervisors, and 1 technician. 1 director works in the cost center Retail, 1 director works in the cost center Exteriors, and 1 director works in the cost center ILA (International Large Accounts). 1 manager works in the cost center Exteriors, and 1 manager works in the cost center Retail. 1 supervisor works in the cost center Retail, and 1 supervisor works in the cost center Exteriors. Lastly, the only technician that was interviewed works in the cost center Exteriors.

The sub headers used in this chapter "Data Analysis Part 1" are a reference to the codes used for the interview analysis also shown in Table 1. The coding structure shown in Table 1 is divided into codes indicated by the yellow colour and subcodes indicated by the white colour.

4.1 The current safety culture at TDGI

International Large Accounts and Local Portuguese Clients

The facility management maintenance structure at TGDI can be divided in 7 cost centers: Industrial, ITE (specialized works), Lagoas Park, Exteriors, Health Care, Retail, and International Large Accounts (ILA), see the hierarchical structure of the safety department at TDGI in Table 2. The safety related accidents that occur differ in each sector because of the different nature of the FM works. The client portfolio of TDGI can be divided in local Portuguese clients such as Campus de Justiça and International Large Accounts (ILA) such as Johnson and Johnson, Microsoft and Philip Morris.

The participants say the following about the clients of TDGI with regards to safety:

> "Local clients do not care about safety; they just want to get the job done. There is no cooperation from the client's side, and they have demanding tasks. When project site personnel from TDGI share their feedback to the local clients, their advice is listened to and accepted, however they are not proactive in their approach. Local Portuguese clients do not have strict

> safety guidelines, there is a difference in mentality between local Portuguese clients and ILA. Clients from International Large Accounts are a lot more on the field to try to understand the difficulties and are much more focused on the people. They implement lean management tools such as 'Gemba walk' to comply with safety procedures, implement behaviour observation systems (BOS) which helps to be more engaged with safety, take a picture debrief and make a correction and health plan, and make checklists for health KPR (key performance result)".

According to the coding structure in Table 1, the code "clients" is cited 10 times and is mentioned during 6 interviews. The most referred to subcode is "client demands" also cited 10 times and cited during 5 interviews. Both the subcodes "international large accounts" and "local Portuguese clients" are mentioned during 3 interviews and cited 9 and 7 times in total, see Table 1. The sub code "client standards" is referred to the least with a total of 5 references during 4 interviews.

The significance of each code is well represented in Table 3, displaying a treemap hierarchy chart whereby the size of each code is determined by the number of citations shown in Table 1, meaning the higher the number in Table 1 the larger the rectangle in the treemap in Table 3. The treemap shows the topic "clients" in the colour blue including the subcodes and is third largest in size.

Changing Safety Culture at TDGI

Nonetheless, participants mention the positive change in the safety practices at TDGI since the foundation of the company in 2000:

> "We are now more aware and alert of safety. I see a positive change throughout my career at TDGI. In the past, safety was not a topic that was much talked about, but now we have a lot of toolboxes and safety talks. In safety we are now one of the best in Portugal".

Yet, there is still much room for improvement, for example the evaluation of workers in safety behaviour:

> "Every year we evaluate the workers on their safety behaviour, however this is not effective. There are 6 criteria: follow safety rules and procedures, achieve the expected results, to be responsible, to be part of teamwork, punctuality, and the ability to learn. Be that as it may, this evaluation report is ineffective because only 1 criterion is focused on safety and the reward is based on all 6 criteria".

The subcode “evaluation safety behaviour” is cited just 1 time and only talked about during 1 interview, see Table 1. Codebook Interviews. Nevertheless, this is still an important finding and is worth mentioning. If the evaluation criteria for safety is not sufficient it is not possible to evaluate the safety performance for each worker properly.

The topic of “safety culture” is the most cited topic during the interviews with a total of 31 references, see Table 1. The significance of this topic is also displayed in Table 3, whereby “safety culture” is displayed in a red colour being the largest in size on the treemap.

The most important factor within the safety culture at TDGI is related to the discipline and mentality, which are referred to 18 and 19 times and mentioned in 8 interviews, see Table 1. The root of the safety culture problem is related to the mentality and discipline towards safety.

The participants say the following about the difference in safety culture between ILA and local Portuguese cost centers at TDGI:

> “We are not very aligned with the safety procedures; it is a process. We need to be completely aligned with the guidelines, the board of directors need to change the culture and from there it will be very easy to implement this to the local Portuguese client. We need to embrace the good guidelines from the clients of ILA. The mentality of the people working at the project site of the local Portuguese clients is primary focused on getting the job done compromising the safety of the workers. Situations happen when project site personnel do not have all the required tools and equipment to perform their job in a safe manner however, to get the job done anyway, workers improvise with the tools they have putting themselves and/or their colleagues in unsafe situations. Safety at TDGI is because you have to do it, but not because safety is a top priority. Safety is sometimes seen as an obstacle and not as a factor of competitiveness at TDGI. The way people plan does not take into account safety, there is a lack of focus on the topic of safety”.

4.2 The current OSH practices and its bottlenecks at TDGI

Safety Training

To start with one of the most important elements of OSH practices which is the safety training given to the employees. According to 2021 annual report from TDGI, the total number of training hours given to workers has decreased significantly since 2019. In 2019 the total number of training hours equalled to 8151 training hours, in 2020 equalled to 3751 training hours, and in 2021 equalled to 2083,5 training hours (TDGI, 2021). That is a decrease of 74.44% in total training hours in 2021 compared to 2019, while at the same time giving

training to almost the exact same number of workers, 466 workers in 2019 compared to 449 workers in 2021.

The justification given for this decrease in training hours by TDGI is as follows:

> "Due to the COVID-19 pandemic there was no possibility of increasing the number of actions in face-to-face format, making it difficult to maintain the intended number of hours. The company was not prepared for online training as stated in the report" (TDGI, 2021).

Participants say the following about the safety training at TDGI:

> "The initial training given is not sufficient enough. It is around 4 hours of training and then you have to go to work. There is a lack of training to employees, the workers are supposed to know everything, but no one knows everything. At the moment the culture is reactive, we don't have a training plan for each worker. After an accident happens the workers do get all the information, but not beforehand. We should be more proactive and give training beforehand. Also, we need more practical training on site, most training given is technical and is not focused on the practicality you need on the project sites. People are not trained enough and competent to do their full job on site. The right equipment and tools should be given to execute the job and educate people on how to use these tools and have the right people to do the job. This training should be given by an external company".

The subcode "training" was referred to 13 times which is the third most cited subcode and was mentioned during 6 interviews. Table 3 shows that the topic "occupational safety and health procedures" is second largest in size indicated by the green colour with the subcode "training" being the most dominant subcode.

Also, managers express their concern for the lack of appropriate safety procedures to the board of directors, however employees are not sufficiently listened to. Participants say the following about the safety meetings with the board:

> "After 2019 we have a monthly safety meeting with the board of directors, but it was not easy to implement and not sufficient. A lot of times technicians and management are so focused on doing the job, they don't consider safety. The management should talk more about safety; it should be a recurrent message"

The topic "occupational safety and health procedures" is referred to 8 times and mentioned during 6 interviews as shown in Table 1 of which the subcode "safety protocols & procedures" is cited 7 times and the subcode "safety moments" cited 6 times both mentioned during 4 interviews.

Leadership

During this research and while conducting the interviews, there was also some critique towards the management:

> "There is a lack of sensibility of the side of the management towards the workers. There should be more focus on stress psychological risks such as high pressure and the company needs to refocus the safety aspect of their operations. The firm should refresh their governance since there is no concrete strategy now. The solution to improving the safety culture is related to the mindset of the people, you should guarantee that people are focused on the strategy and go from there".

According to the participants, if TDGI wants to change their safety strategy it should come from the top of the organization:

> "It should be a top-down approach and pass this to the ground team, there should be proximity and lead by example so that people see leadership and will follow".

The topic of leadership is cited 9 times and mentioned during 6 interviews of which the subcode "strategy" was most referred to with 8 references, see Table 1. Leadership is displayed in the hierarchical treemap chart with the colour yellow, Table 3.

Employees

In addition to the lack of sufficient training and lack of leadership, participants also acknowledge the problem of high employee turnover and explain the reasons why people leave:

> "We don't have enough people to do our work, we are very aware of the consequences if someone is sick for example. It is very difficult to keep young people, they leave for a better remuneration elsewhere".

The main theme "employees" is not as much referred to during the interviews as the previous topics with 5 references during 3 interviews, see Table 1. The most referred to subcode in the theme is "personnel shortage" with 5 references during 4 interviews. The subcode

"remuneration" is referred to 4 times and mentioned during 3 interviews. The topic "employees" is displayed in the colour grey in the treemap chart in Table 3.

This problem at TDGI is confirmed when looking at the employee turnover number in 2021 which equalled to 22%. In total 70 new people were recruited during the year 2021, however 101 people left the company in the same year. The justification from the company is as follows:

"There are more companies to choose from nowadays, there is an increased offer in the market" (TDGI, 2021).

> "The result of the high employee turnover is that most of the workers are of older age and are not used to change. Whereas the new people are eager to learn and adapt easily, it is more difficult for senior employees to transition to the new safety culture and go to the project site without proper safety knowledge. They sometimes think that safety is something that slows the process, they need supervision. The older workers should be given more training".

The subcode "employee turnover" is referred to 4 times and mentioned in 3 interviews.

When asking the participants about how the workers condition has been changed over the years, they say the following:

> "The situation is getting worse, there is not enough appreciation towards the workers and because of this there are less and less professionals. Technicians make long hours and clients have high demands, technicians are not paid enough and because of this they get frustrated and irritated, and this affects the quality of work".

Based on the company's 2021 annual report, TDGI wants to tackle this problem by investing in employee loyalty through actions that promote retention such as training, employee experience, compensation, and benefits and by attributing new conditions/benefits to fixed-term contract workers (TDGI, 2021).

Communication

The topic of communication is a very important topic, and which is much talked about during the interviews. Table 1 shows that "communication" is referred to 16 times which is the second most of all the topics and is mentioned during 8 interviews. In the treemap chart in Table 3, "communication" is displayed in an orange colour.

Participants explain their main communication platforms and explain their safety communication procedures.

"The main communication platform we use is Microsoft Teams, in addition to this we use WhatsApp and Email. There is a monthly toolbox or safety moment, and the management has weekly meetings with technicians. When a contract is renewed, the directors talk to the technicians about the safety topics in the contract, however 20% of the technicians do not know these topics. Furthermore, every week the managers have a meeting to monitor technicians' performance, to check the working hours to see if this is justified and whether all the work that is scheduled has been done or not, however safety is not included in these meetings. Most meetings are done online because of the complicated logistics in facility management. Workers cover a very large area and travel great distances".

Moreover, advice has been given by the participants on how to improve the internal communication:

"Internal communication is important, TDGI needs an internal communication plan each year focusing on safety, the firm needs to incorporate quality and safety topics to the clients to communicate clearly".

Also, participants explain the current incident reporting situation at TDGI:

"People do not report that much, only when something bad has happened the company shows interest. Nevertheless, people are not afraid to report, they report but only in person and not online. We managers need to talk a lot about safety to make the technicians aware of the problems and safety on the project site. You will need patience and explain why, you need to talk to the technicians how to do better and what they are doing wrong.

There is a great discrepancy between the accident reporting in the ILA cost center and the local Portuguese cost centers. This difference has a negative impact of the safety practices at TDGI and is something the company would like to improve. In 2021 the total number of notifications of hazardous situations identified amounted to 156 of which 117 notifications came from ILA and 39 came from all the other cost centers combined. (TDGI, 2021).

"The focus of ILA client is completely different; they have high standards also for their employees so there is more to maintain such as a great work environment. ILA clients are more concerned with safety and want you to report NSP (dangerous situation reporting), near misses (minor accident), and severe accidents".)

"Accident reporting" is a very important topic which is referred to 7 times and is mentioned during 5 interviews, see Table 1.

Time and Subcontractors

The topic of "time" was often mentioned during the interviews as an excuse for not being able to do certain tasks, due to the constraint of time. The topic "time" was referred to 7 times and mentioned during 7 interviews, see Table 1.

> "Time is very relative, if affects our performance but I don't think this is the root of the problem. It is not time what is the problem but the focus on the topic of safety what is the problem, safety does not have a high priority. We have not had a serious accident in our 22 years existence, and it does not help us realize and prioritize our safety culture. The solution should guarantee that the people are focused on the safety strategy and then go from there. Nonetheless, technicians do make long days and some sectors such as retail cover large territories where workers need to travel long distances. They need to be at the site at 8am leave their homes at 5am and be home again at 8pm. There are not enough people and so you have a plan, but it is changing every day. Some projects just have 1 person that is not always available, so you have to change the schedule. The workers are always running, they have to fulfil papers, but don't have time for this. This lack of time leads to multitasking which also leads to accidents".

Lastly the topic of "subcontractors" is not much talked about during the interviews with just 2 references and mentioned in 2 interviews, see Table 1. This is also shown by the small size of subcontractors in the treemap chart in Table 3 displayed by the brown colour.

Participants say the following with regards to subcontractors:

> "When there is an emergency because there is lack of manpower or TDGI does not have the certificate for specialized works, subcontractors are hired. These subcontractors are often small companies that do not comply with the safety procedures of company. TDGI should control the subcontractor hierarchy and should think about the management of safety and risks, however this is difficult due to the lack of subcontractors".

Data Analysis Part 2

5. Results from questionnaire

The questionnaire sent to all the participants consists of 2 parts. The first part of the questionnaire will be discussed in this section and is designed to answer the sub research question; 'what are currently the underperforming dimensions of safety leadership, safety culture and safety behaviour at TDGI?'. The questionnaire differed based on the job position

of the respondent. This means that different questions were asked to directors & managers, supervisors, and technicians. In total 113 respondents participated in the first part of the questionnaire.

5.1 safety behaviour technicians

The safety behaviour questionnaire was used to assess what are the current underperforming dimensions of safety behaviour at TDGI according to the technicians. All the questionnaires were measured by a five-point Likert scale indicating (1) I strongly disagree, (2) I disagree, (3) I neither agree nor disagree, (4) I agree, and (5) I strongly agree. More specifically, the higher the score on the measurement scale, the higher the degree of agreement with the question.

The error bar in Figure 1 represents a 95% confidence interval, meaning that there is only 5% chance that the true value is not included within the span of the error bar. The number displayed in the bar chart represents the mean of the answers given for each question item. In total 60 technicians answered this questionnaire. The results of this questionnaire are shown in Figure 1.

The Cronbach's alpha, which measures the reliability of the questionnaire, is equal to 0,83 indicating very good level of reliability. In addition, there is no statistical significant difference between the local Portuguese cost centers and International Large Accounts (ILA). The p-value is 0,0673 which is above the 0,05-significance level, indicating strong evidence for the null hypotheses; $H_{0:}$ "there is no significant difference between the local Portuguese cost centers and International Large Accounts (ILA)".

As shown in Figure 1**,** the most underperforming dimension in the safety behaviour of technicians is "I am proactive in looking for solutions to make work safer" with an average score of 4,50. This is related to the Portuguese culture that scores 99 on the Hofstede dimension of uncertainty avoidance, indicating a very high preference for avoiding

uncertainty. In the Portuguese culture there is an emotional need for rules, and innovation may be resisted, which might explain the lower score on this question item (Hofstede Insights, 2022).

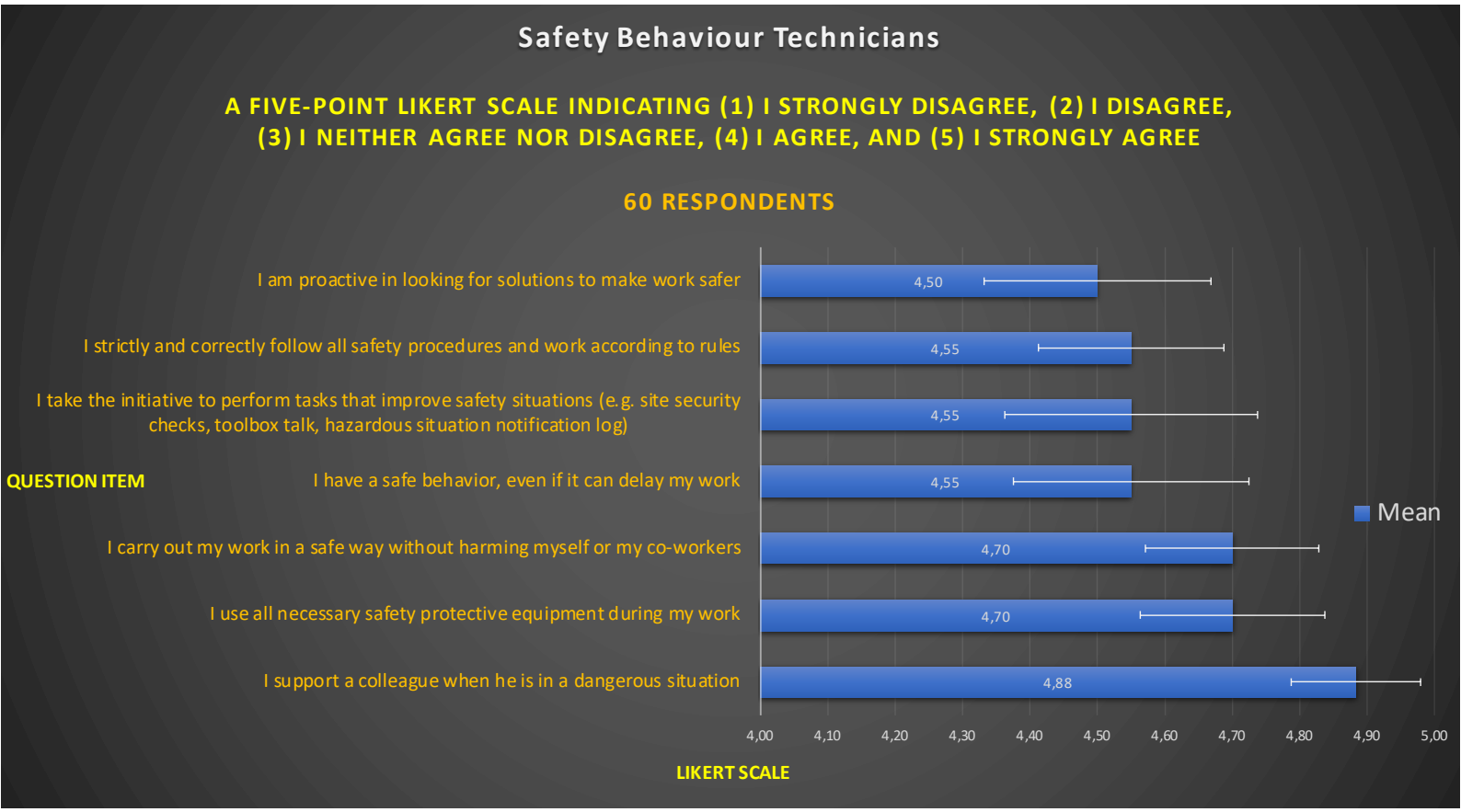


Figure 1 Safety Behaviour Technicians

Furthermore, the average score of 4,55, shown in Figure 1 on three question items "I strictly and correctly follow all safety procedures and work according to rules", "I take the initiative to perform tasks that improve safety situations", and "I have a safe behaviour, even if it can delay my work", might indicate that the workers are more focused on doing the job and getting this done quickly rather than applying the right safety behaviour which is in correspondence with the findings of the interviews.

The highest average score of 4,88 with regards to the safety behaviour of the technicians is "I support a colleague when he is in a dangerous situation". This is related to the strong collective culture at TDGI which matches the Hofstede model of Portugal being a collectivist country scoring 27 on the dimension on individualism (Hofstede Insights, 2022).

5.2 safety climate technicians

The safety climate questionnaire was used to assess what are the current underperforming dimensions of safety climate at TDGI according to the technicians. All the questionnaires were measured by a five-point Likert scale indicating (1) I strongly disagree, (2) I disagree, (3) I neither agree nor disagree, (4) I agree, and (5) I strongly agree. More specifically, the higher the score on the measurement scale, the higher the degree of agreement with the question.

The error bar in Figure 2 represents a 95% confidence interval, meaning that there is only 5% chance that the true value is not included within the span of the error bar. The number displayed in the bar chart represents the mean of the answers given for each question item. In total 60 technicians answered this questionnaire. The results of this questionnaire are shown in Figure 2.

The Cronbach's alpha, which measures the reliability of the questionnaire, is equal to 0,91 indicating excellent level of reliability. In addition, there is no statistical significant difference between local Portuguese cost centers and International Large Accounts (ILA). The p-value is 0,1048 which is above the 0,05-significance level, indicating strong evidence for the null hypotheses; H_0: "there is no significant difference between the local Portuguese cost centers and International Large Accounts (ILA)".

When analysing what are currently the underperforming dimensions of safety culture at TDGI according to the technicians, there is one question item that scores significantly lower than the other question items which is "emergency drills are carried out with the teams" with an average score of 3,25, see Figure 2. This score could suggest that no emergency drills are being carried out, or if there are emergency drills, they are not done sufficiently.

The second lowest score on the technicians' safety culture questionnaire, is "the upper management listens and acts upon feedback from the team" with an average score of 4,15, as shown in Figure 2. This was also mentioned in the 2019 safety culture diagnosis report

examining TDGI's safety culture profile done by Paradoxo Humano based on the safety excellence model developed by the University of Manchester, UK (Paradoxo Humano, 2019). The 2019 report says the following:

"The management does not listen adequately to the employees. Safety is a top-down process with insufficient involvement of operational teams and management does not really listen to employee contributions to improved safety".

Figure 2 Safety Culture Technicians

This observation is correlated with the Portuguese culture that scores 63 on the dimension of power distance according to Hofstede (Hofstede Insights, 2022). This score reflects that hierarchical distance is accepted and those holding the most powerful positions are admitted to having privileges for their position. Negative feedback is very distressed so for the employee it is more than difficult to provide his or her boss with negative information (Hofstede Insights, 2022). The people in higher positions need to be conscious of this difficulty and search for little signals to discover the real problems.

The third lowest score is "safety rules and procedures are capable of preventing or mitigating all types of accidents" with an average score of 4,17, see Figure 2. This might indicate that the

technicians do not perceive the current safety rules and procedures of much importance. This corresponds to the findings of the 2019 safety culture diagnosis report from Paradoxo Humano about TDGI and with the interviews conducted with the employees.

> "Compliance with safety requirements is done more out of obligation rather than because there is a strong awareness of the value of safety".

Workers are more focused of doing the job and getting it done quickly at the expense of compliance with the safety rules and regulations. This has to do with the mindset and mentality towards safety which is talked about is the section called: 4.1 the current safety culture at TDGI.

Subsequently, the low average score of 4,18 on the question item "safety rules and procedures are reviewed and updated in a timely and regular basis" is strictly correlated with the previous question item. This finding strongly suggests that either the current safety rules and procedures are not up to date or are not seen as contributing to worker's safety. This is a very important finding given that the highest average score of 4,67 is given to the question item "safety rules and procedures can ensure staff safety", see Figure 2.

There seems to be a strong need for clear safety rules and procedures, however it looks like there are no clear safety rules and procedures or if they exist are poorly communicated to the technicians. The need for clear rules is strongly reflected in the Hofstede model on the dimension of uncertainty avoidance where Portugal has a score of 99. A characteristic of a culture with high uncertainty avoidance is the need for rules, and whereby security is an important element in individual motivation (Hofstede Insights, 2022).

Furthermore, another unperforming dimension with an average score of 4,22 is "the entire team understands the current and relevant safety legislation" which is again closely related to the previous question items, followed by an average score of 4,23 for question item "safety rules and procedures are followed", see Figure 2.

The next underperforming dimension is "all actively report accidents and potentially dangerous situations" with an average score of 4,27, as shown in Figure 2. This lack of NSP (dangerous situation) reporting is a point of concern to TDGI which the company really wants to improve. As of November 2022, the total NSP reporting for 2022 is 84, with 64 NSP's just coming from the ILA cost center and the remaining 20 NSP's coming from all the other cost

centers combined (TDGI, 2021). This again shows the difference in mentality towards safety between ILA and all the other cost centers.

Lastly, another underperforming dimension with an average score of 4,30 is the question item "visits by the safety team are very useful to improve the safety of workers and workplaces". This is quite remarkable given the results of the ranking questionnaire where conducting site visits is ranked as management role number 1 for safety officer, see Figure 2. There might be a need to further investigate why there is a lower score on this dimension and how to improve the quality of the site visits.

5.3 Safety leadership directors & managers

The safety leadership questionnaire was used to assess the underperforming dimensions of safety leadership according to the directors and managers. All the questionnaires were measured by a five-point Likert scale indicating (1) I strongly disagree, (2) I disagree, (3) I neither agree nor disagree, (4) I agree, and (5) I strongly agree. More specifically, the higher the score on the measurement scale, the higher the degree of agreement with the question.

The error bar in Figure 3 represents a 95% confidence interval, meaning that there is only 5% chance that the true value is not included within the span of the error bar. The number displayed in the bar chart represents the mean of the answers given for each question item. In total 35 directors and/or managers answered this questionnaire. The results of this questionnaire are shown in Figure 3.

The Cronbach's alpha, which measures the reliability of the questionnaire, is equal to 0,83 indicating good level of reliability. Also, there is a statistical significant difference between local Portuguese cost centers and International Large Accounts (ILA), with a p-value is 0,0003. Therefore, the null hypotheses can be rejected; $H_{0:}$ "there is no significant difference between the local Portuguese cost centers and International Large Accounts (ILA) ".

In order to answer what are currently the underperforming dimensions of safety leadership at TDGI, the lowest performing dimension with average score of 4,00 is "I correct daily needs in terms of employee safety and well-being", as shown in Figure 3. Unfortunately, there is not much that can be concluded from this result given the confusion this question brings. This

question might be interpreted in the wrong way and can lead to ambiguity. Some participants gave the highest Likert score of 5 while other participants gave the lowest Likert score of 1. This is also shown by the large confidence level at 95,0% which equalled 0,416, also indicated by the wide spread of the error bar in Figure 3.

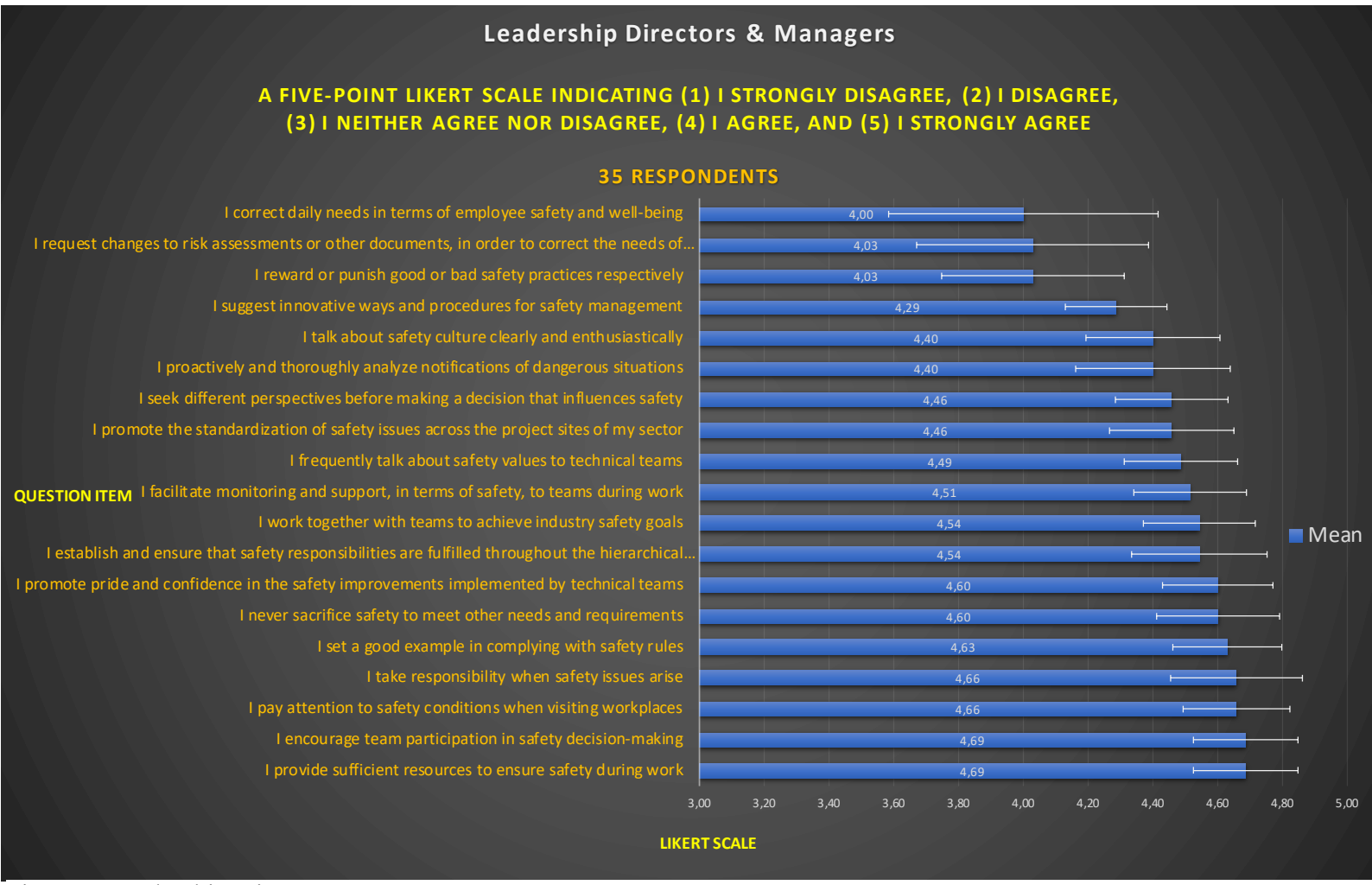


Figure 3 Leadership Directors & Managers

The second lowest average score is “I reward or punish good or bad safety practices respectively” and “I request changes to risk assessments or other documents, in order to correct the needs of the team/activities” both having an average score of 4,03, as shown in Figure 3. One of the criticisms given during the interviews was that good safety behaviour is not rewarded. The current criteria for evaluating technicians consist of 6 components of which safety is just one component, as talked about in section 4.1 of this report. However, this is not effective for evaluating the safety performance of the workers thereby also demotivating the workers to initiate good safety behaviour.

Also, the lack of change in risk assessments or safety procedures is also related to the Portuguese culture. The high uncertainty avoidance in the Portuguese culture on the Hofstede model indicates a resistance to change and lack of innovation, especially for the older people working at TDGI who are more resistant to change.

Lastly, another low performing dimension with an average score of 4,29 is "I suggest innovative ways and procedures for safety management", as shown in Figure 3. This lack of innovation can have negative influence on the safety culture at TDGI whereby people become complacent with their current way of doing things.

5.4 Safety leadership supervisors

The safety leadership questionnaire was used to assess the underperforming dimensions of safety leadership according to the supervisors. All the questionnaires were measured by a five-point Likert scale indicating (1) I strongly disagree, (2) I disagree, (3) I neither agree nor disagree, (4) I agree, and (5) I strongly agree. More specifically, the higher the score on the measurement scale, the higher the degree of agreement with the question.

The error bar in Figure 4 represents a 95% confidence interval, meaning that there is only 5% chance that the true value is not included within the span of the error bar. The number displayed in the bar chart represents the mean of the answers given for each question item. In total 18 supervisors answered this questionnaire. The results of this questionnaire are shown in Figure 4.

The Cronbach's alpha, which measures the reliability of the questionnaire, is equal to 0,23 indicating that the internal consistency is unacceptable with low reliability. This might be because only 18 supervisors answered this questionnaire which is a low number of respondents. Also, there is a statistical significant difference between local Portuguese cost centers and International Large Accounts (ILA), with a p-value of 0,0054. Therefore, the null hypotheses can be rejected; $H_{0:}$ "there is no significant difference between the local Portuguese cost centers and International Large Accounts (ILA)".

According to Figure 4, there are 3 underperforming dimensions with an average score of 4,44 being "explain the purpose of safety actions (training, drills, toolbox talk, etc.)", "encouraging

the entire team to express their views and suggestions on safety", and "set a high standard of safety through your own behaviour".

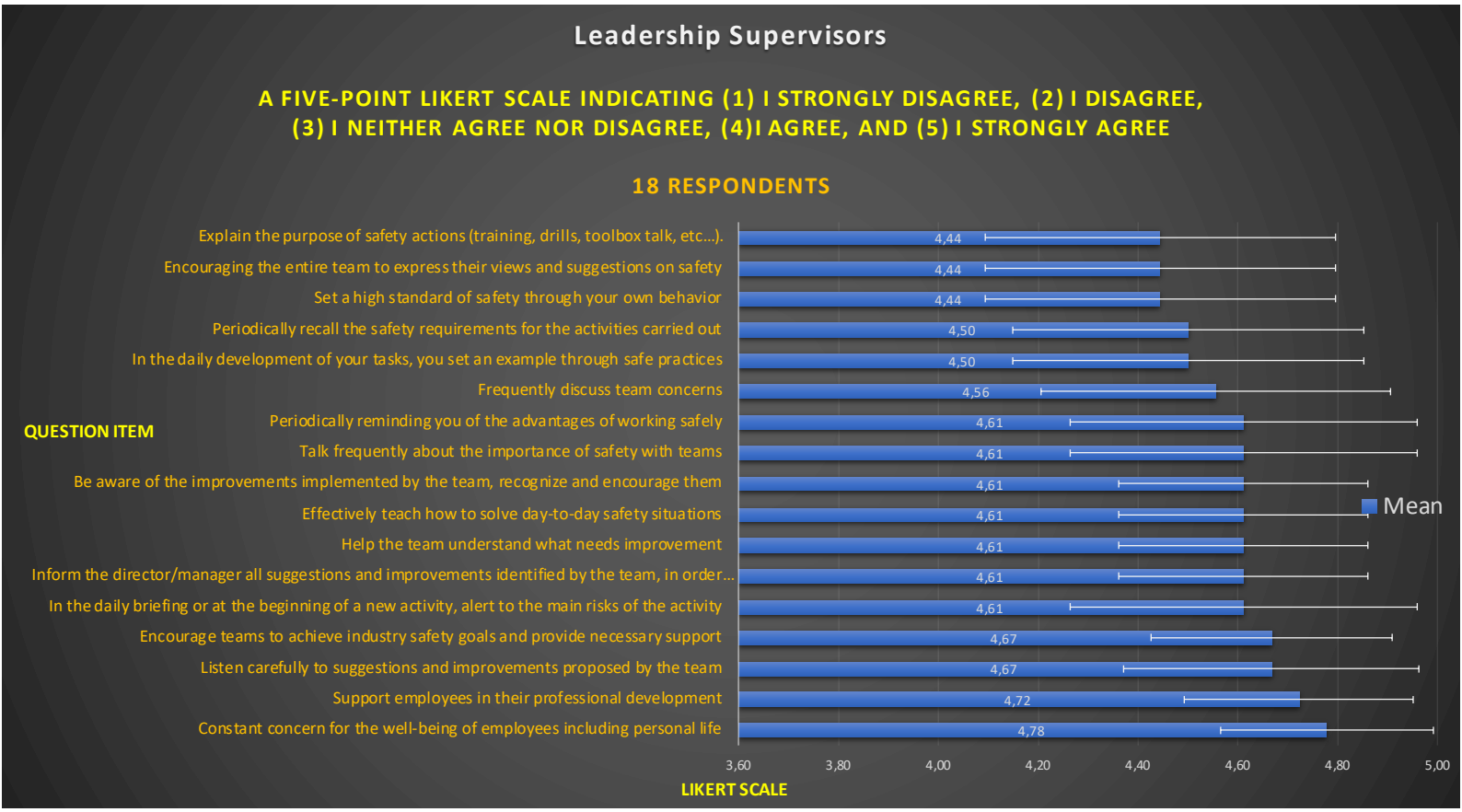


Figure 4 Leadership Supervisors

To begin with: "explain the purpose of safety actions (training, drills, toolbox talk, etc.)", the communication about the importance of having safety actions seems to be insufficient. The lack of focus on the importance of explaining why there are safety actions and why they are necessary creates the wrong mentality, mindset and discipline towards safety. People are not motivated to improve the safety culture because there is not clear goal of safety achievement.

In addition, the next question item "encouraging the entire team to express their views and suggestions on safety" has to do with the cultural dimension of power distance in Portugal as explained previously. TDGI must pay attention to this cultural aspect since this could have a negative impact of the safety performance on the company and employees' motivation.

Furthermore, the lower average score on question item "set a high standard of safety through your own behaviour" is rather surprising. The reason for the lower average score of 4,44 is not clear and there might be a need to do further research on this topic. It might be related to

the lack of training given to the employees with regards to safety behaviour and how to set an example as a leader.

The next underperforming dimension has an average score of 4,50 for both “periodically recall the safety requirements for the activities carried out” and “in the daily development of your tasks, you set an example through safe practices”, see Figure 4.

There seems to be a lack of safety moments and weekly rehearsals of safety talks. This also has to do with the complicated logistics of the project sites that cover the whole of Portugal and the fact that some project sites only have one technician that is always moving from project site to project site.

However, with the digital tools the company uses such as Microsoft Teams, it is still possible to implement a weekly safety moment to discuss last week’s safety problems in case there was an accident, to inform the workers on the progress made on the safety goals, and to update all the workers on the latest safety rules and regulations. Also, the topic of safety should be a recurrent message and should be more visible to the people in order to change the safety culture.

Lastly, the average score of 4,50 for question item “in the daily development of your tasks, you set an example through safe practices” has to do with training in safety behaviour. Technicians would be more willing to change and improve their safety practices when they see that their supervisor is applying the correct safety behaviour.

Data Analysis Part 3

6. Results from questionnaire

This section will analyse the results of the second part of the questionnaire and is designed to answer the other sub research question; ‘which management role at TDGI has the greatest impact on workers’ safety?’ This part of the questionnaire was the same for all the respondents being the directors & managers, supervisors, and technicians and consists of a ranking whereby the participants had to rank the management roles of supervisors, directors & managers, and safety officers according to their degree of impact on workers’ safety. The ranking system is in an ascending order whereby the smallest value is ranked as number 1 and

so contributes most to the workers' safety according to the participants. In total 97 participants answered this part of the questionnaire of which 31 directors and managers, 49 technicians, and 17 supervisors.

6.1 Ranking Supervisor Management Role

First the ranking of the supervisors will be analysed and commented on. To answer the sub research question 'which management role at TDGI has the greatest impact on workers safety?' the highest ranked management roles for the supervisors will be discussed.

In the ranking of the supervisors' management role there is no significant statistical difference between the technicians, supervisors and directors & managers. For every management role the p-value is above 0.05, indicating strong evidence for the null hypotheses; H_0: "there is no significant difference between the technicians, supervisors and directors & managers". The error bar in Figure 5 represents a 95% confidence interval, meaning that there is only 5% chance that the true value is not included within the span of the error bar.

As shown in Figure 5 all the participants ranked the management role "act as a good example" as number 1. However, according to the supervisors' leadership questionnaire, see Figure 4, this is currently one of the lower scoring dimensions with a score of 4,50. There might be a need to train the supervisors how to act as a good example, to be a leader that motivates the technicians and shows good safety behaviour on the project site. Strong leadership can inspire a safe culture.

Number 2 on the ranking is "ensure workers receive the proper equipment to work safely", see Figure 5. The right equipment is needed to execute the technicians' job in a safe manner and so it is no surprise this management role ranks second.

However, due to the complicated logistics of facility management and the large distances that technicians cover, it is not always possible to provide the right equipment at every project site

The interview participants say the following about this:

> "Some industries like retail are always in movement, with lots of kilometres to cover. We are in our vans and are on the road all the time, but we don't know which equipment to have beforehand. We don't have a workstation, but it will help us if we have".

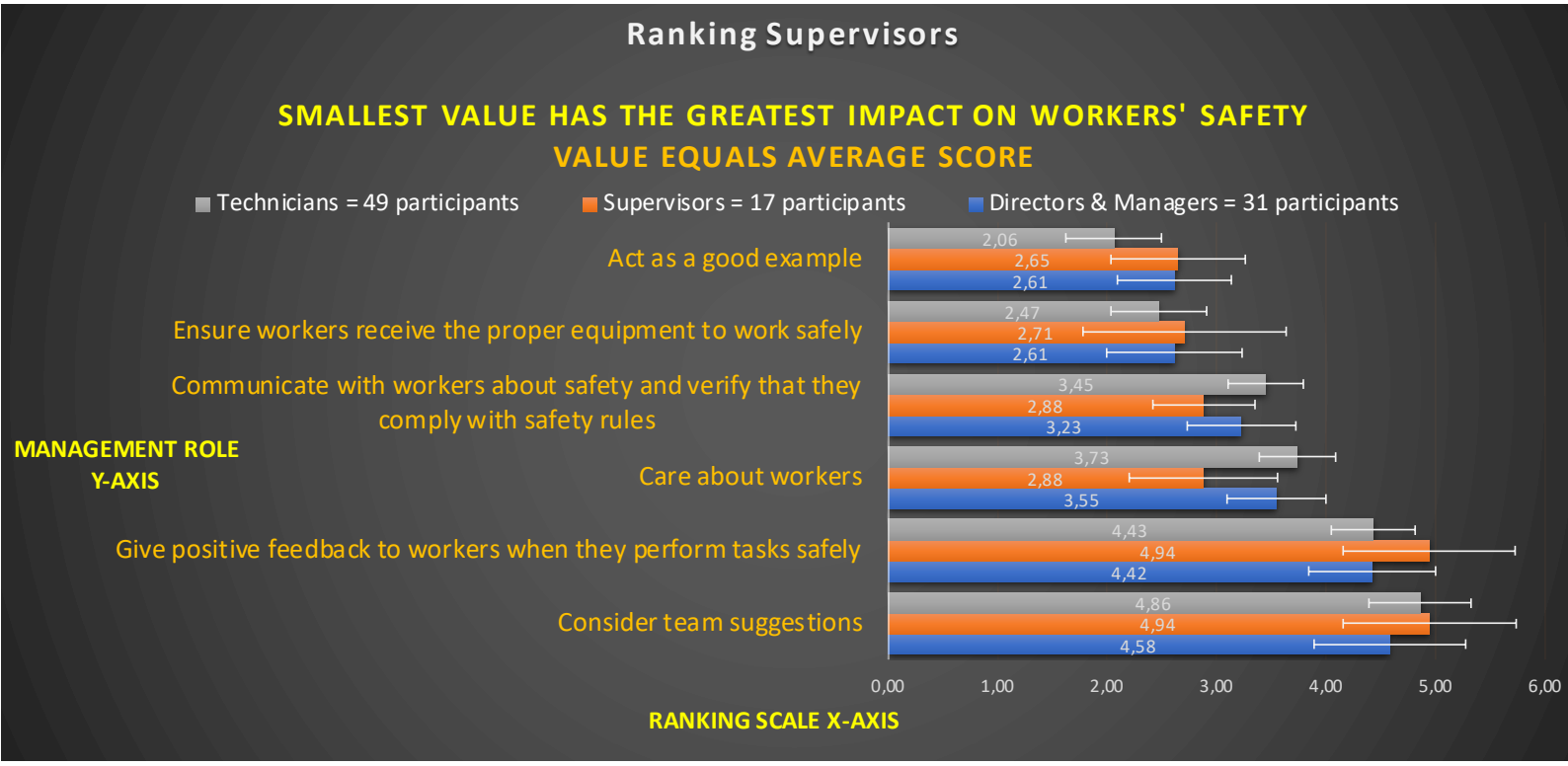


Figure 5 Ranking Supervisors

Number 3 on the ranking is “communicate with workers about safety and verify that they comply with safety rules”, see Figure 5. There seems room for improvement with regards to the internal safety communication from the upper management towards the technicians. As previously explained and shown in Figure 2, the technicians give a lower average score with regards to compliance and understanding the current and relevant safety legislation.

6.2 Ranking Directors & Managers Management Role

To answer the sub research question ‘which management role at TDGI has the greatest impact on workers safety?’ the highest ranked management roles for the directors & managers will be discussed. The directors and managers are different job positions with different tasks and responsibilities and have a different hierarchical status at TDGI, however due to the lack of personnel it happens that the directors also do the job of the managers. The different job positions are very closely related with each other and because of this the directors & managers are bundled together for this questionnaire.

Ranked number 1 is “ensure the implementation of safety rules”, however there is some discrepancy among the participants. There is a statistical significant difference between the supervisors and technicians with a p-value of 0,0041 and there is a statistical significant difference between the directors & managers and technicians with a p-value of 0,0215. Therefore, the null hypotheses can be rejected; H_0: “there is no significant difference between the technicians, supervisors and directors & managers”. The error bar in Figure 6 represents a 95% confidence interval, meaning that there is only 5% chance that the true value is not included within the span of the error bar.

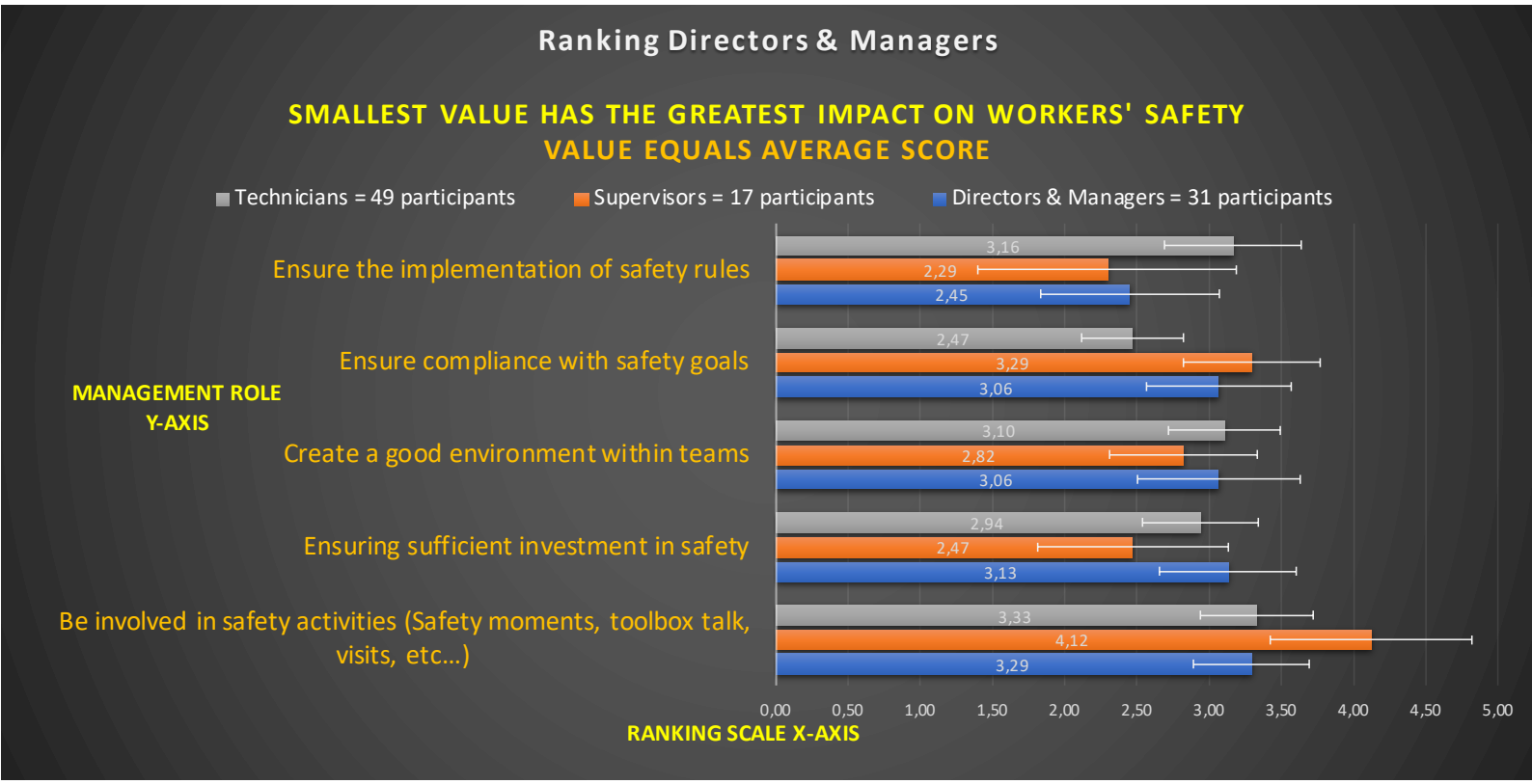


Figure 6 Ranking Directors & Managers

Number 2 on the ranking is “ensure compliance with safety goals”. Here as well there is some discrepancy among the participants. There is a statistical significant difference between the supervisors and technicians with a p-value 0,0397 and there is a statistical significant difference between the directors & managers and technicians with a p-value of 0, 0342.Therefore, the null hypotheses can be rejected; H_0: “there is no significant difference between the technicians, supervisors and directors & managers”.

Lastly, there is also a significant difference between the participants with regards to number 5 on the ranking "be involved in safety activities (safety moments, toolbox talk, visits, etc…)". There is a statistical significant difference between the supervisors and technicians with a p-value of 0,0143 and there is a statistical significant difference between the supervisors and directors & managers with a p-value of 0,0286. Therefore, the null hypotheses can be rejected; $H_{0:}$ "there is no significant difference between the technicians, supervisors and directors & managers".

6.3 Ranking Safety Officer Management Role

The job position of safety officer is not a current job position at TDGI, however can be related to the current 'quality health and safety environment' job position, as shown in Table 2.

The reason for creating a ranking questionnaire for the management role of a safety officer is because there seems to be a need for a more structured hierarchy with regards to safety. The current job responsibilities at TDGI with regards to safety are sometimes mixed which creates confusion. There is a need for a more streamlined safety structure with clear job descriptions for each position. A more balanced structure will bring clarity to all employees and improve the internal communication.

There is no significant statistical difference between the technicians, supervisors and directors & managers for the top 3 ranking with regards to the management role of the safety officer. For every management role in the top 3 ranking the p-value is above 0.05, indicating strong evidence for the null hypotheses; $H_{0:}$ "there is no significant difference between the technicians, supervisors and directors & managers". Also, error bar in Figure 7 represents a 95% confidence interval, meaning that there is only 5% chance that the true value is not included within the span of the error bar.

As depicted in Figure 7, all the participants rank the management role "conduct site visits to ensure workplace safety and verify safety behaviours' as number 1, indicating this management role has the greatest impact on workers' safety. This is in accordance with the findings from the interviews conducted with the managers and directors. As of November 2022, the total number of visits to project sites accounts to 143 for the year 2022. In total 443 hours has been spent visiting the project sites (TDGI, 2021).

Figure 7 Ranking Safety Officer

However, as shown in Figure 2**,** technicians give a relative low average score of 4,30 on question item "visits by the safety team are very useful to improve the safety of workers and workplaces". As briefly mentioned previously, there might be a need to train the employees on their safety behaviour to improve the quality of the site visits.

Number 2 on the ranking is "organize training in the area of safety" as shown in Figure 7. Training is a vital aspect in improving the overall safety performance of the company and is talked about in more detail in the section: 4.2 the current OSH practices and its bottlenecks at TDGI. Number 3 on the ranking is "stay up-to-date on legislation in the field of safety". Knowing what are the current safety legislations and how to comply with the legal requirements is of much importance that should be communicated in a clear, efficient, and structured manner to the lower ranked job positions. This is a top-down communication channel.

Lastly, both the management roles "manage dangerous situation notifications" and "work accident investigation" seem to have the least impact on workers' safety as shown in Figure 7.

Recommendations

The results show that the main bottleneck towards improving the safety culture at TDGI is the lack of the right mindset and discipline towards safety. There is a shortfall of a clear vision and long-term strategy towards safety with unclear safety objectives. Job descriptions are not clear and so people are not held accountable for their actions. There is a lack of priority and focus on the most important safety tasks whereby people are doing someone else's job, resulting is insufficient safety practices. People often give excuses such a having a lack of time or being understaffed for not executing their job responsibilities.

There is a need for a clear long-term safety plan that should come from the top of the organization being the board of directors and communicate this clearly to the lower ranks in the firm. This should be a top-down approach where people should have clear safety objectives to pursue.

To following recommendations are given to help answer the main research question of this report: 'how can TDGI improve their safety culture in facility management'?

- Create clear job description for each job position within the company and put this formally on paper. The most important aspect is that people should be held accountable for their actions and take their responsibility. Create a quarterly report that mentions what each employee has done with regards to their job responsibilities.

- Make an overview of how many people you have for each job position e.g., how many directors, managers, supervisors, technicians etc. and divide the staff accordingly for the north, center and south of Portugal. At the moment employees travel throughout the whole country which is not working. Look at how many project site you have in each area, appoint an area director and make them responsible. The board of directors should make this overview.

- Create an internal communication plan each year focusing on safety. This internal communication plan should communicate to all the employees on the latest rules and regulations with regards to safety. This is also a top-down approach and should come from the board of directors. There should be a weekly meeting with every project site, preferably on a Monday, using Microsoft teams to discuss last week' safety issues,

accident reporting, to listen to the feedback from the supervisors and technicians and write this feedback down, and to discuss next week' safety objectives. It is crucial to listen to the feedback from the workers and to create a more transparent culture where feedback from the employees is valued and appreciated.

- It is strongly recommended to conduct site visits and make this one of the top priorities. The directors should be the one doing this and should be dedicated to improving the safety culture at the project sites. Visit projects site randomly and not only when an accident has happened. Train the directors on how to improve the quality of the safety visits and what they should focus on. The site visits should be conducted with a clear safety objective and not be seen as an outing. The board of directors should communicate the objectives and responsibilities for conducting site visits. Put these objectives and responsibilities on paper and hold people accountable.

- Furthermore, one of the most important aspects that should be improved is safety training. There is lot of room for improvement regarding the safety training given to the employees. The training should be both practical training and informative, however there is a bigger need for more practical training. This training should be given on the project site and should be done by an external company. An external company does not have an emotional connection to the employees of TDGI and can give a more objective training. This is a long-term investment that should be made now to reap the benefits of this investment in the future. Better trained personnel result in better safety practices. Sodexo is a company that can give TDGI this training. TDGI represents Sodexo in Portugal and has the connections to reach out to the company. Sodexo is a world leader in facility management and safety and has the knowledge and skills to educate and train the employees of TDGI.

- Lastly there is a need to create an evaluation performance for the technicians and supervisors solely focused on safety. The criteria for this should be created by the board of directors and include rewards for good safety behaviour to initiate and motivate workers to improve their safety behaviour.

Most of these recommendations are not capital intensive, are practical, and can be applied immediately.

Conclusion

In TDGI's 22-year existence the company has established themselves as one of the market leaders in the facility management industry in Portugal. Since the foundation in the year 2000, there has been a positive change in the safety culture with no serious safety accidents.

However, due to the changing market in which international clients demand higher safety standards and with more competitors employees can choose from, TDGI struggles to maintain its market position and retain their employees. At the same time, the quality of the safety trainings given to their employees has reduced significantly partly due to the COVID-19 pandemic. The combination of these factors have led to both internal and external pressures for TDGI affecting the quality of their safety operations.

There is a need for a change in safety governance focused on a long-term strategy. At the moment TDGI operates with short term policy whereby the safety culture is reactive and not proactive. Safety is not yet seen as a factor of competitiveness whereby the focus is primarily on the compliance with the safety requirements. Safety is still largely seen as the responsibility of the safety department rather than the responsibility of each and every employee, whereby compliance with safety requirements is done more out of obligation rather than because there is a strong awareness of the value of safety.

If TDGI wants to move from good to great, there is a need for change in its safety culture with more transparency, better internal communication, improved safety training, improved quality of visits to project sites, and holding people accountable for their actions. It requires a long-term strategy with clear safety objectives by investing in the present to reap the benefits in the future. TDGI must be careful not to be complacent with their current safety practices, otherwise the company risks losing significant market share.

Limitations

A limitation of this research is the cultural and linguistic barrier between my own culture coming from the Netherlands and the Portuguese culture. The interviews conducted were done in English which is not their mother tongue. This meant that the interview participants could not fully express themselves in the way they can in the Portuguese language, thereby making it harder to understand what was being said. Also, the results from the questionnaire can give a deceptive image of the reality at the company. Participants tend to give a more positive answers than the actual reality, even when the questionnaires were unanimous. This can lead to biased results and makes it harder to find out the actual state of affairs. Lastly, due to the time constraints for this research, it was not possible to interview people from every cost center, thereby limiting the richness of information from different perspectives.

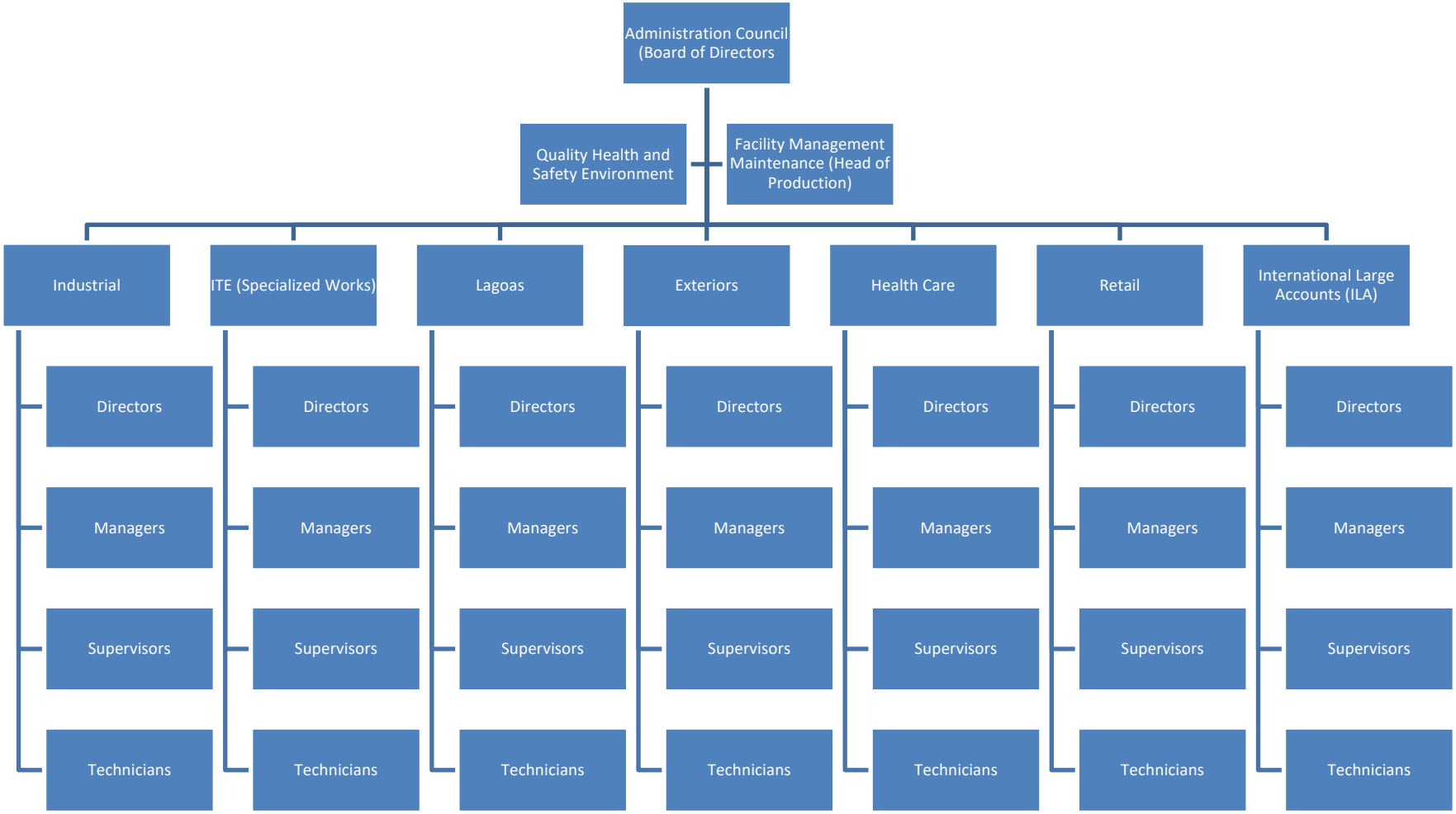
Appendix

Table 1. Codebook Interviews

Main themes (codes + subcodes)	Interviews	References
Clients	6	10
Client Demands	5	10
Client Standards	4	5
International Large Accounts	3	9
Local Portuguese Clients	3	7
Communication	7	16
Accident Reporting	5	7
Stimulating Incentives	1	2
Employees	3	5
Employee Turnover	3	4
High tenure years	2	3
Personnel Shortage	4	5
Remuneration	3	4
Leadership	6	9
Lean Management	1	1

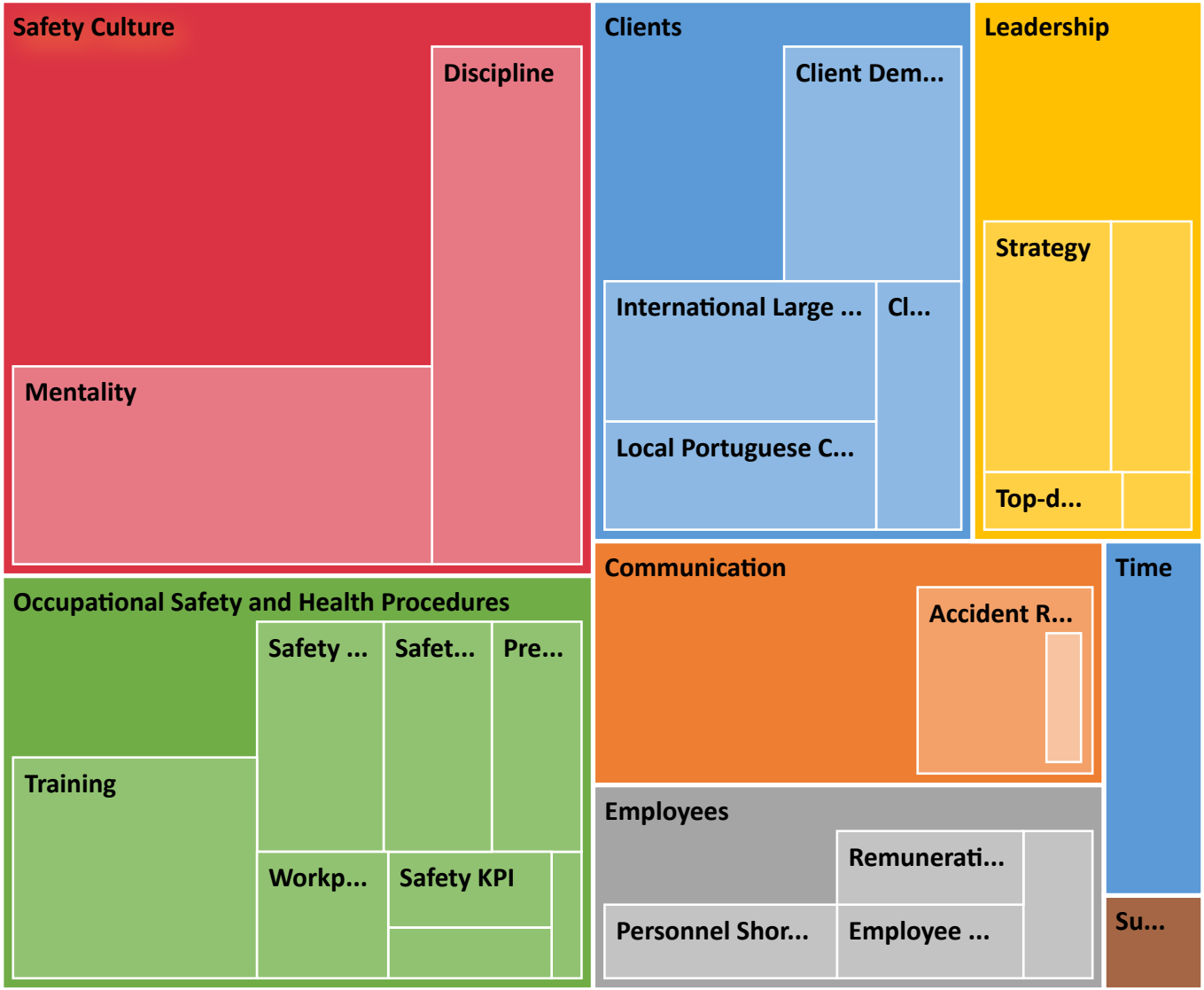
Main themes (codes + subcodes)	Interviews	References
Project Visits	4	5
Strategy	2	8
Top-down Approach	2	2
Occupational Safety and Health Procedures	6	8
Evaluation Safety Behavior	1	1
Preventive Safety Practices	4	5
Safety KPI	2	3
Safety Moment	4	6
Safety Protocols & Procedures	4	7
Toolbox	2	2
Training	6	13
Workplace Accidents	3	4
Safety Culture	8	31
Discipline	8	18
Mentality	8	19
Subcontractors	2	2
Time	7	7

Table 2. Hierarchical Structure Safety Department TDGI



(TDGI, 2022)

Table 3. Treemap codes from interview transcriptions



Bibliography

Bisbey, T. M., Kilcullen, M. P., Thomas, E. J., Ottosen, M. J., Tsao, K., & Salas, E. (2021). Safety Culture: An Integration of Existing Models and a Framework for Understanding Its Development. *Human factors, 63*(1), 88-110.

Brooks, A., & Atkin, B. (2021). *Total Facility Management.* Hoboken: Wiley Blackwell.

Choudhry, R. M., Fang, D., & Mohamed, S. (2007). The nature of safety culture: A survey of the state-of-the-art. *Safety Science, 45*(10), 993-1012.

Clarke, S., & Taylor, I. (2018). Reducing workplace accidents through the use of leadership interventions: A quasi-experimental field study. *Accident Analysis & Prevention, 121*, 314-320.

Fang, D., Huang, Y., Guo, H., & Lim, H. W. (2020). LCB approach for construction safety. *Safety science, 128*, 104761.

Feng, Y., & Trinh, M. T. (2019). Developing Resilient Safety Culture for Construction Projects. *Journal of construction engineering and management, 145*(11), 04019069.

Fung, I. W., Tam, C., Tung, K. C., & Man, A. S. (2005). Safety cultural divergences among management, supervisory and worker groups in Hong Kong construction industry. *International Journal of Project Management, 23*(7), 504-512.

Han, Y., Li, J., Cao, X., & Jin, R. (2020). Structural Equation Modeling Approach to Studying the Relationships among Safety Investment, Construction Employees' Safety Cognition, and Behavioral Performance. *Journal of construction engineering and management, 146*(7), 04020065-04020065.

Han, Y., Yin, Z., Liu, J., Jin, R. R., Painting, N., Gidado, K., . . . Yan, L. (2019). Defining and Testing a Safety Cognition Framework Incorporating Safety Hazard Perception. *Journal of construction engineering and management, 145*(12), 04019081-04019081.

Hofstede Insights. (2022, November 30). *COUNTRY COMPARISON*. Retrieved November 2022, from Hofstede Insights: https://www.hofstede-insights.com/country-comparison/portugal/

Huan, Y., Feng, Z., Zhang, J., Jin, R., & Aboagye-Nimo, E. (2019). Employees' safety perceptions of site hazard and accident scenes. *Journal of construction engineering and management, 145*(1).

International Facility Management Association. (2022, October 31). *What is facility management*. Retrieved October 2022, from IFMA: https://www.ifma.org/about/what-is-fm/

International Labour Organization. (2016). Retrieved October 2022, from Safety and Health at Work: https://www.ilo.org/global/topics/safety-and-health-at-work/lang--en/index.htm

Karakhan, A. A., Rajendran, S., Gambatese, J., & Nnaji, C. (2018). Measuring and Evaluating Safety Maturity of Construction Contractors: Multicriteria Decision-Making Approach. *Journal of Construction Engineering and Management, 144*(7), 04018054.

Paradoxo Humano. (2019). *Security Excellence - Safety Culture Diagnosis Report.* Lisbon: Paradoxo Humano.

TDGI. (2021). *REVISÃO DO SISTEMA 2021.* TDGI.

TDGI. (2022). *TOOLBOX 143.* Retrieved November 2022, from www.tdgiworld.com: www.tdgiworld.com

TDGI. (2022). *The Company*. Retrieved October 2022, from TDGI: https://www.tdgiworld.com/en/about-tdgi/the-company/

Tear, M. J., Reader, T. W., Shorrock, S., & Kirwan, B. (2020). Safety culture and power: Interactions between perceptions of safety T culture, organisational hierarchy, and national culture. *Safety science, 121*, 550-561.

Vinodkumar, M., & Bhasi, M. (2010). Safety management practices and safety behaviour: Assessing the mediating role of safety knowledge and motivation. *Accident Analysis & Prevention, 42*(6), 2082-2093.

Wetzel, E. M., & Thabet, W. Y. (2015). The use of a BIM-based framework to support safe facility management processes. *Automation in Construction, 60*, 12-24.

Wu, X., Liu, Q., Zhang, L., Skibniewski, M. J., & Wang, Y. (2015). Prospective safety performance evaluation on construction sites. *Accident Analysis & Prevention, 78*, 58-72.

Yorio, P. L., & Moore, S. M. (2018). Examining Factors that Influence the Existence of Heinrich's Safety Triangle Using Site-Specific H&S Data from More than 25,000 Establishments. *Risk analysis, 38*(4), 839-852.

Zhang, P., Li, N., Jiang, Z., Fang, D., & Anumba, C. J. (2019). An agent-based modeling approach for understanding the effect of worker- T management interactions on construction workers' safety-related behaviors . *Automation in construction, 97*, 29-43.

Zhou, Z., Goh, Y. M., & Li, Q. (2015). Overview and analysis of safety management studies in the construction industry. *Safety science, 72*, 337-350.