# DEVELOPMENT AND APPLICATION OF SAFETY CULTURE MATRIX FOR UNDERGROUND METAL MINES AND COMPARISON OF TWO COMPANIES

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

AHMET ŞEN

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN
OCCUPATIONAL HEALTH AND SAFETY

SEPTEMBER 2019

Approval of the thesis:

**DEVELOPMENT AND APPLICATION OF SAFETY CULTURE MATRIX FOR UNDERGROUND METAL MINES AND COMPARISON OF TWO COMPANIES**

submitted by **AHMET ŞEN** in partial fulfillment of the requirements for the degree of **Master of Science in Occupational Health and Safety Department, Middle East Technical University** by,

Prof. Dr. Halil Kalıpçılar
Dean, Graduate School of **Natural and Applied Sciences** _____

Prof. Dr. Mahmut Parlaktuna
Head of Department, **Petroleum and Natural Gas Eng.** _____

Prof. Dr. Türker Özkan
Supervisor, **Psychology, METU** _____

**Examining Committee Members:**

Assist. Prof. Dr. Yeşim Üzümcüoğlu Zihni
Psychology, TOBB ETÜ _____

Prof. Dr. Türker Özkan
Psychology, METU _____

Assist. Prof. Dr. Onur Gölbaşı
Mining Eng., METU _____

Date: 04.09.2019

**I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.**

Name, Surname: Ahmet Şen

Signature:

# ABSTRACT

## DEVELOPMENT AND APPLICATION OF SAFETY CULTURE MATRIX FOR UNDERGROUND METAL MINES AND COMPARISON OF TWO COMPANIES

Şen, Ahmet
Master of Science, Occupational Health and Safety
Supervisor: Prof. Dr. Türker Özkan

September 2019, 98 pages

This study aims to prepare a safety culture matrix in the mining industry and apply it to see the differences and similarities at two different mines in Turkey. The first part of the study contains the creation of the matrix by applying semi-structured interviews with experienced miners in three underground metal mines (Company B, Company C and Company D). In the second part, the application of the matrix is carried out in two underground metal mines (Company A and Company B). 13 employees of underground metal mines participated in the first study. In the first study, for the creation of the matrix which includes 5 steps (generative, proactive, bureaucratic, reactive and pathologic) and 14 dimensions (OHS Training, Work Accident – Near Miss Notification and Reporting, Worker's Commitment to OHS, Top Management's Commitment to OHS, Technical Management's Commitment to OHS, Management's Supervision on Subcontractors, Emergency Management and Mine Rescue, OHS Priority to Production and Production Pressure, Ventilation, Ground Support, Mechanization, Planning, Internal Audit) and total of 70 cells, at least 2 to 5 semi-structured questions per cell asked to each participant. 111 employee of underground metal mines participated in the second study. At each time, 5 card which includes the information about 5 steps of 1 dimension is given randomly to the participant. They

are expected to choose the card that reflects their company the best. After that, ANOVA and correlation analysis are carried out. Results showed that Company A has a higher safety culture maturity level than Company B for all dimensions. Moreover, engineers evaluate technical management's commitment to safety significantly higher than underground workers. Another result is that employees with more than 10 years of experience evaluated the worker's commitment to safety significantly higher that employees with less than 4 years of experience. Employees that have at least one accident evaluated communication, emergency management and mine rescue, and planning significantly lower than others. Finally, the results, limitations, suggestions, and implications of the study were discussed.

Keywords: Mine Safety, Safety Culture, Organizational Culture, Safety Culture Matrix, Safety Culture Tool

# ÖZ

## YERALTI METAL MADENLERİ İÇİN GÜVENLİK KÜLTÜRÜ MATRİSİ GELİŞTİRİLMESİ, UYGULANMASI VE İKİ ŞİRKETİN KARŞILAŞTIRILMASI

Şen, Ahmet
Yüksek Lisans, İş Sağlığı ve Güvenliği
Tez Danışmanı: Prof. Dr. Türker Özkan

Eylül 2019, 98 sayfa

Bu çalışmada, madencilik sektörü için bir güvenlik kültürü matrisi hazırlamak ve farklılıkları ile benzerliklerini görme amacıyla bu matrisi Türkiye'deki iki madende uygulamak amaçlanmıştır. Çalışmanın ilk kısmı, üç farklı yeraltı metal madeninde (Şirket B, Şirket C ve Şirket D) tecrübeli madencilerle kısmen hazırlanmış görüşmeler yaparak matrisin hazırlanmasını içermektedir. İkinci kısımda ise matris iki yeraltı metal madeninde uygulanmıştır (Şirket A ve Şirket B). İlk çalışmaya 13 yeraltı metal madeni çalışanı katılmıştır. İlk çalışmada, 5 basamak (patalojik, reaktif, bürokratik, proaktif ve üretken) ve 14 hücre (İletişim, İSG Eğitimi, İş Kazası – Ramak Kala Bildirimi ve Raporlanması, Çalışanın İSG'ye Bağlılığı, Üst Yönetimin İSG'ye Bağlılığı, Teknik Yönetimin İSG'ye Bağlılığı, Yönetimin Taşeron Denetimi, Acil Durum Yönetimi ve Tahlisiye, İSG'nin Üretime Göre Önceliği ve Üretim Baskısı, Havalandırma, Tahkimat, Mekanizasyon, Planlama, İç Denetim) olmak üzere toplam 70 hücreden oluşan matrisin oluşturulması için en az 2 ila 5 önceden hazırlanmış soru katılımcılara sorulmuştur. İkinci çalışmaya 111 yeraltı metal madeni çalışanı katılmıştır. Her seferde, 1 boyutun 5 ayrı basamağına ait bilgileri içeren 5 kart karışık olarak katılımcılara verilmiştir. Katılımcılardan, şirketlerini en iyi yansıtan kartı seçmeleri beklenmiştir. Sonrasında ANOVA ve korelasyon analizleri yapılmıştır.

Sonuçlara göre Şirket A'nın güvenlik kültürü olgunluk seviyesi tüm boyutlarda Şirket B'den yüksek çıkmıştır. Ayrıca, mühendislerin, teknik yönetimin güvenliğe bağlılıklarını yer altı çalışanlarına göre daha yüksek değerlendirdikleri görülmüştür. Bir diğer sonuç, 10 yıldan fazla tecrübesi olan çalışanların, çalışanın güvenliğe bağlılığını 4 yıldan az tecrübesi olan çalışanlara göre daha yüksek seçmesidir. En az bir kaza geçirmiş olan çalışanlar, iletişim, acil durum yönetimi ve tahlisiye ve planlama boyutlarını diğerlerine göre daha düşük seçmiştir. Son olarak bulgular, kısıtlar, öneriler ve çıkarımlar tartışılmıştır.

Anahtar Kelimeler: Maden Güvenliği, Güvenlik Kültürü, Kurum Kültürü, Güvenlik Kültürü Matrisi, Güvenlik Kültürü Aracı

To my family

## ACKNOWLEDGEMENTS

First and foremost, I owe my wife Duygu Öcal Şen a great appreciation for her help and contribution throughout all levels of this study. Her physical and motivational supports make this challenging study sufferable for me.

I would like to express my sincere gratitude to my supervisor Prof. Dr. Türker Özkan for his continuous support, patience, guidance and immense knowledge.

Besides my supervisor, I would like to thank the rest of my thesis committee Assist. Prof. Dr. Yeşim Üzümcüoğlu Zihni and Assist. Prof. Dr. Onur Gölbaşı for insightful comments and encouragement.

I also want to thank İbrahim Öztürk for his support, valuable feedbacks and contributions from beginning to the end of the study.

I thank my colleagues Ercemal Atasoy and Levent Yılmaz for their discussions and support especially in the site parts of the study

## TABLE OF CONTENTS

## LIST OF TABLES

TABLES

## LIST OF FIGURES

FIGURES

## LIST OF ABBREVIATIONS

| ABBREVIATIONS | |
|---|---|
| UMeMSaF | Underground Metal Mining Safety Framework |
| OHS | Occupational Health and Safety |
| TL | Turkish Lira |
| ILO | International Labour Organization |

# CHAPTER 1

# INTRODUCTION

## 1.1. General Information on Safety Culture

### 1.1.1. Technology, Systems, and Culture

Safety science aims to decrease the number of accidents in the workplace. According to Leveson (2004), safety is the absence of accidents, where an accident is an event involving an unplanned and unacceptable loss.

In the study of decreasing accidents, there are some steps in terms of accident rates. In the first step, safety precautions are quite shallow. Equipment safety, engineering, personal protection, etc. are examples of the first step. The second step is much deeper and contains complicated works such as risk assessment, safety integration, etc. Hollnagel (2014) defines safety as "*safety is the system property or quality that is necessary and sufficient to ensure that the number of events that could be harmful to workers, the public, or the environment is acceptably low*". As it can be seen from the examples, the contribution of people in an organization increases from step one to two.

For example, safety protection can be pointed out and a protection method can be suggested, or multiple problems can be found by systematic approaches such as workplace risk assessment. However, there is still a question about the application of that protections: are they going to be applied by the end-user? This question brings us a new step that includes the safety perception and attitude of end-user or in other words workers.

Hudson (2007) states that both technology (first step) and systems (second step) approaches finish at some point in time and there becomes a plateau at their effects on decreasing the number of accidents (Figure 1.1.).

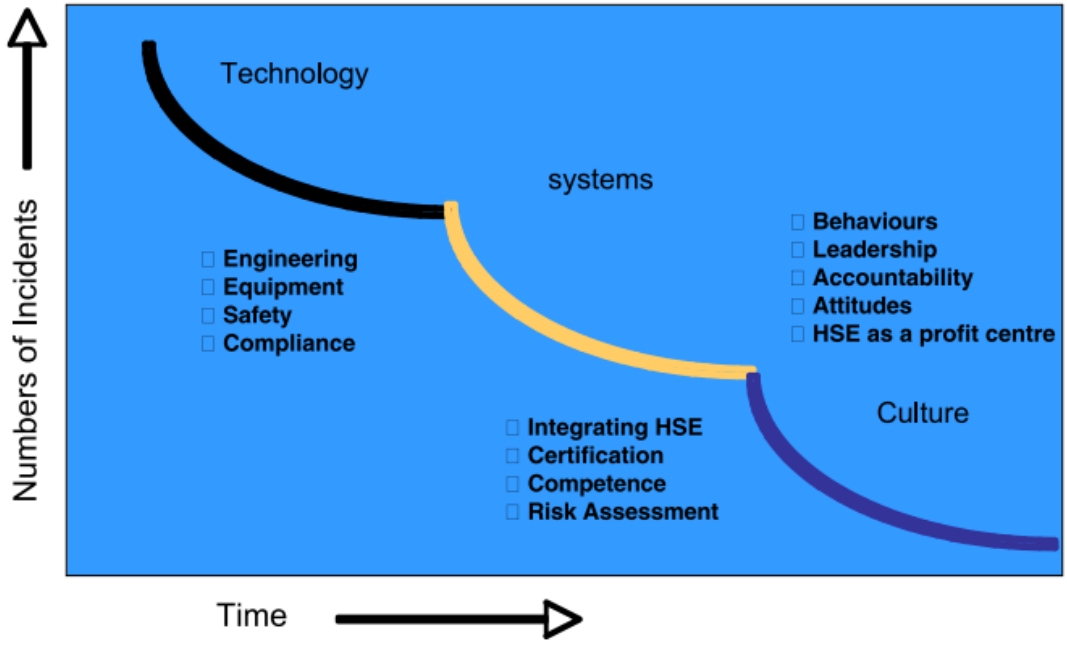



*Figure 1.1* Plateau effect of safety studies (Hudson, 2007)

### 1.1.2. Safety Culture Definition

The term "safety culture" is commonly used among safety experts and others who are related to safety. Guldenmund (2010) states that people use this term for everything related to safety that they cannot explain in other ways, in other words, an all-purpose explaining tool. Most of the accident analysis discussions or interviews after accidents that are reflected in the press include "safety culture" and most of them also contain the term "lack of safety culture". These expressions are just like every social problem's common solution: education. Everybody says that education is very important; however, nobody says about how it should be organized or applied. Reason (1997) also states about the trend of using the term "safety culture" that "*Few phrases occur more frequently in discussions about hazardous technologies than safety culture. Few things are so sought after and yet so little understood*" (p.191).

Safety culture term is first used in the International Atomic Energy Agency (International Nuclear Safety Advisory Group) Summary Report on the Post-Accident Review Meeting on the Chernobyl Accident (1986). After that, lots of definitions

made by experts for safety culture and climate. There is a consensus on the importance of safety culture and climate; however, the context of safety culture and climate is still indistinct (Guldenmund, 2000).

In 2000, Guldenmund studied the definitions of safety culture and climate. In that study, sixteen definitions are analyzed. Guldenmund correlated safety culture with attitudes and safety climate with perception (Guldenmund, 2000).

From the information above, it can be said that;

a. safety culture has a lot of definition and some serious studies made on the definition of safety culture,
b. it is hard to make a clear definition of safety culture because the disputes are not finished yet (just like the term "culture"),
c. the most distinct data about the definition of safety culture is that it includes "attitude" and the definition of safety climate includes "perception" (Guldenmund, 2000).

### 1.2. The Aim of the Study

Assessment of safety culture – like the definition of safety culture – is a complicated subject. There are massive efforts on defining the safety culture; however, there are a very limited number of studies to make safety culture research a tool for safety science. Guldenmund (2000) states that "*while the importance of the concept of safety climate or culture is stressed by most authors, very few have attempted to support their claim by reporting an indication of its construct validity or predictive validity*".

Even though the arguments on measuring the safety culture, there are studies on assessment of safety culture (Öcal Şen, 2019, Pekpak Fındıkçıoğlu, 2018, Yazici, 2015, Parker et al 2006). In this study, it is aimed to create a tool for measuring the safety culture in underground metal mines, make an application for two mine sites of similar properties and different locations in Turkey and finally to compare these two measurements.

Lee et al. (2019) state that safety culture can be measured by deep group or individual interviews. This study consists of two parts. In the first part, it is aimed to create a tool for assessment of safety culture in underground metal mines with the help of individual interviews. In the second part, it is aimed to see a helicopter view on the safety culture level of two similar underground metal mining companies and compare two companies on a safety culture assessment basis.

Finally, the answer to the question of "what is this study is for?" is to create a tool for the experts who want to see their organization's status on safety culture and to understand the safety culture of two very important underground metal mining company of Turkey.

### 1.3. Description of Companies

Study 1 and study 2 are carried out on a total of four different companies (Company A, Company B, Company C, and Company D). These companies are in different locations in Turkey. There are neither economical nor managerial relations among these four companies. This part includes some descriptive information about the companies. For a better understanding of which company is a part of which study and quick review about the location and production information of the companies, given Table 1.1. can be used as a guide.

Table 1.1 *Company Descriptions*

| Company | Location | Ore | Study 1 | Study 2 |
|---|---|---|---|---|
| **Company A** | Kastamonu | Copper | X | X |
| **Company B** | Elazığ | Chromium | | X |
| **Company C** | Artvin | Copper | X | |
| **Company D** | Rize | Copper | X | |

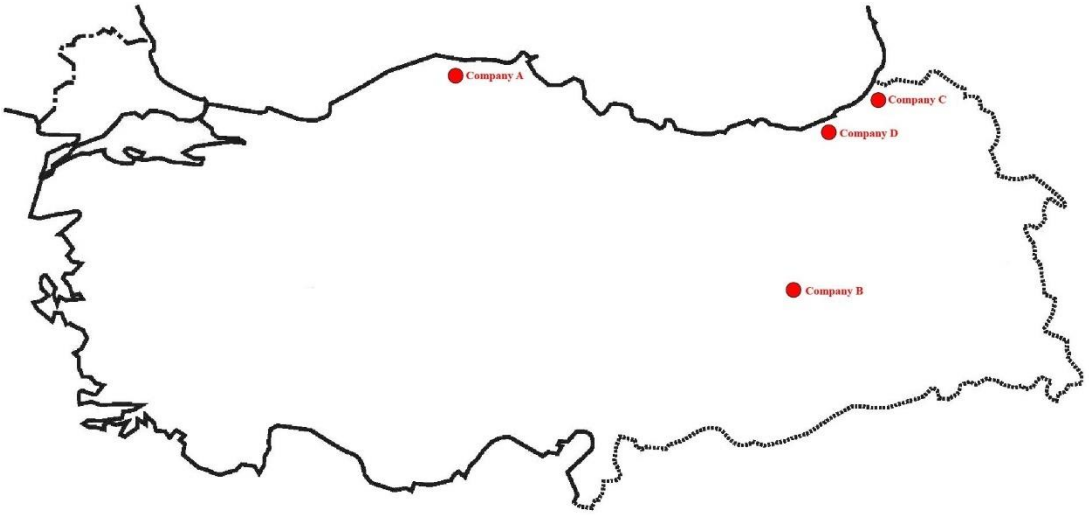



*Figure 1.2* Locations of Companies on Map of Turkey

### 1.3.1. Companies Visited on Study 1

As mentioned before three mine sites are visited for the first study which is on creating the UMeMSaF. Company B is visited both for study 1 and study 2. There will be further information about Company B in heading 1.3.2.2.

Company C is located in Artvin province which is in the East – Karadeniz region of Turkey. Company C is another establishment of the owner of Company A and it is an underground copper mine. Company C is a considerably small mine site; however, the content of the ore includes a great amount (about 6 to 7 times of a normal copper mine with a processing plant) of copper which does not require any processing and directly sends to metallurgical plant. Mine site of Company C is still in the development stage and normal planned production has not started yet. At the exploration and contract stage, Company C suffered from environmental protests of locals which is reflected in the press. There are still ongoing protests and the whole work of Company C is followed by locals, environmental activists and even some members of the parliament. Therefore, Company C safety is number one in the order of importance because if there was a major accident happen, it would be the end of Company C.

Company D is in Rize province which is also in the East – Karadeniz region of Turkey. Company D is also a copper mine. Company D is owned by a famous international mining company. Company D is founded in 1983 as a governmental mine site. In 2004 its privatization is completed. Company D became a model mine site for both mining and safety. In 2015, they reach 578 days without a lost-time injury. The lifetime of the mine site of Company D is nearly completed and it is cogitated to make the mine site work as a school for miners.

### 1.3.2. Companies Visited on Study 2

In study 2, two mine sites are visited for the application of UMeMSaF.

#### 1.3.2.1. General Information About Company A

Company A is the largest copper mine in Turkey. It is located in Kastamonu province which is in the West – Karadeniz region of Turkey. Every year, approximately 1.3 million ton run of mine copper is produced in Company A. Company A has its own metallurgical plant and produces pure copper. Sulfur and cobalt are subsidiary products of Company A.

The mine site region is quite familiar with mining operations because production is started in 1968 by the government and the largest income of the region comes from the copper mine. Therefore, there is no protests or campaign against the firm even the area of operation is forest land. After the production started in 1968 by the government, its privatization was made in 2004.

In Company A, 387 employees are working in underground operations and 398 employees are working for other operations on the surface. A total of 785 people are employed in Company A.

Sublevel stoping with backfill method is used for underground operations. In this method, at each level, drifts are created through the end of the orebody and at the end of these drifts, sublevels are produced by blasting. After the production is finished, the gap is filled with waste rock, cemented waste rock or a paste that produced from the

remaining of the process plant. Minimum measures of any opening of the mine are 5 meters in height and 5 meters in width. Remote control machinery is used by operators for all underground operations and manpower is only used for operating the machinery.

According to the Turkish Revenue Administration, the company tax of Company A in 2017 is approximately 40 million TL.

#### 1.3.2.2. General Information About Company B

Company B is the largest chromium mine in Turkey and the second largest chromium mine in the world. It is located in Elazığ province which is in the East – Anatolia region of Turkey. Every year, approximately 450 thousand tons run of mine chromium is produced in Company B. Company B has its own metallurgical plant and produces ferrochromium which is a mid product.

Company B started its production in 1936 as a governmental enterprise. This region is also very familiar with mining operations. Moreover, most of the region contains the community of Zazas, and they live with very strong family bonds. The subcontractor application is very complicated and mostly forbidden in Turkish Law; however, it is very hard to solve these issues in the region because of this sociological situation. Even the mining method of the orebody is selected in response to this situation. The subcontractors are the same families for years even the time that mine sites were operated by the government. The privatization of Company B is made in 2004.

In Company B, 728 employees are working in underground operations and 254 employees are working for other operations on the surface. Total of 982 people employed in Company B.

Even if the conventional mining methods that require a lot of manpower are the main habit of work in Company B, the need for more machine powered work emerged due to the more production requirements in the modern world. Old mine sites of Company

B use manpower mostly with lower production and higher accident rates. However, new plans include modern mining techniques that use mostly machine power. According to recent engineering studies that are made in Company B, cut and fill stoping is going to be used for a new production site. In old mine sites, maximum opening is about 2 meters in height and 2 meters in width and minimum openings could be down to 0.5 meters in height and 0.5 meters in width. However, it is planned that in the new production site minimum opening will be 5 meters in height and 5 meters in width.

According to the Turkish Revenue Administration, the company tax of Company B in 2017 is approximately 100 million TL. Company A is at 43$^{rd}$ place at the 100 highest taxpayer list of Turkey in 2017.

# CHAPTER 2

# STUDIES

## 2.1. STUDY 1: Development of UMeMSaF

### 2.1.1. The Evolution of Safety Culture Steps

The importance of safety culture assessment is conspicuous; however, in order to assess something, reference points are needed for this assessment to be understandable and comparable. Guldenmund (2018) defines safety culture assessment as cumbersome and descriptive. Westrum (1993) suggests three levels of organizational culture for information dimension (Figure 2.1.).

| PATHOLOGICAL | BUREAUCRATIC | GENERATIVE |
|---|---|---|
| Don't want to know | May not find out | Actively seek information |
| Messengers are shot | Listened if they arrive | Messengers are trained |
| Responsibility is shirked | Responsibility is compartmentalized | Responsibility is shared |
| Bridging is discouraged | Allowed but neglected | Bridging is rewarded |
| Failure is punished or covered up | Organization is just and merciful | Inquiry and redirection |
| New ideas are actively crushed | New ideas present problems | New ideas are welcomed |

*Figure 2.1* How Organizations Treat Information (Westrum, 1993)

These three steps could be used for all dimensions of safety culture. Furthermore, Reason (1997) adds two more levels to Westrum's original model which are reactive

and proactive. After Reason's retouch, five main steps of safety culture determined: pathological, reactive, bureaucratic, proactive and generative (Figure 2.2.).

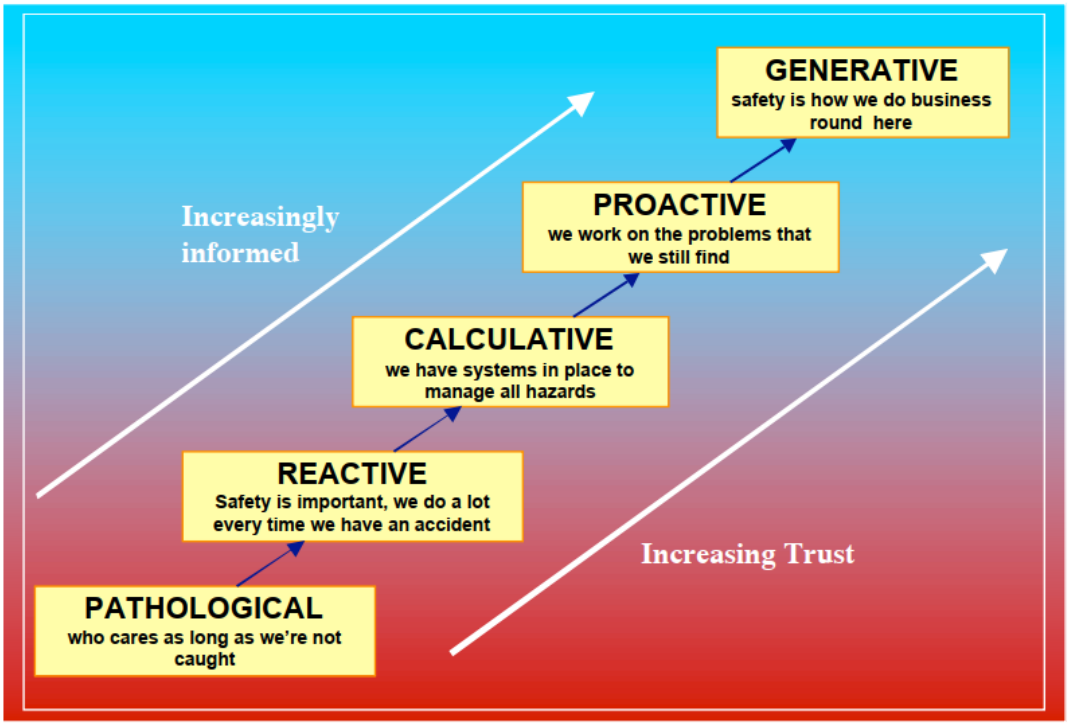



*Figure 2.2* The Evolution of Safety Culture (Hudson, 2003)

### 2.1.2. Specifying the Dimensions

According to Parker et al. (2006), it is possible that the safety culture to be more improved in an organization's some parts than others in modern organizations. In order to increase the resolution of the assessment of the safety culture level, these parts should be conscientiously specified.

The dimensions are the other arm of the safety culture assessment tool. These dimensions should be selected according to literature, expert's opinion, root causes of previous accidents in the sector, etc.

In this study, there are 9 base dimensions and two of these base assumptions have a total of 7 sub-dimensions; therefore, the total number of dimensions is 14. These dimensions are detailed in Table 2.1.

Table 2.1 *UMeMSaF Dimensions*

| Dimension Number | | Dimension Name |
|---|---|---|
| **D1** | | Communication |
| **D2** | | OHS Training |
| **D3** | | Work Accident – Near Miss Notification and Reporting |
| **D4** | Management's Commitment to OHS | Worker's Commitment to OHS |
| **D5** | | Top Management's Commitment to OHS |
| **D6** | | Technical Management's Commitment to OHS |
| **D7** | | Management's Supervision on Subcontractors |
| **D8** | | Emergency Management and Mine Rescue |
| **D9** | | OHS Priority to Production and Production Pressure |
| **D10** | Mining Method and Application | Ventilation |
| **D11** | | Ground Support |
| **D12** | | Mechanization |
| **D13** | | Planning |
| **D14** | | Internal Audit |

Yazici (2015) determined 10 dimensions which are safety system, management commitment to safety, emphasis on productivity versus safety, physical condition of workplace and ergonomics, work equipment or machines, communication and participation, employee education and training and safety applications, working

behavior, reward and punishment and employee commitment to safety. Pekpak Fındıkçıoğlu (2018) determined 10 dimensions which are continuous improvement of occupational health and safety, priority of occupational health and safety, occupational accidents /near misses and reporting such incidents, investigation of occupational accidents /near misses, communication and feedback systems, occupational health and safety trainings, occupational safety in regular tasks, equipment and general state of the plant and preparedness for emergency cases. Öcal Şen (2019), determined 9 dimensions which are communication system, OHS trainings, accident/near miss reporting, machines/equipment safety, workers' commitment to safety, management commitment to safety, emergency preparedness, priority given to OHS and ergonomics. Similar dimensions are chosen in these studies. For example, communication, OHS training, OHS priority, and accident – near-miss reporting dimensions are used in all four studies. Issues related to work equipment safety are evaluated in the mining method and application dimension. Worker's commitment and management commitment dimensions are used in Öcal Şen (2019), Yazici (2015) and this study. Emergency management dimension is used in Öcal Şen (2019), Pekpak Fındıkçıoğlu (2018) and this study. Only the internal audit dimension is not used in any other study.

Communication, OHS training, work accident – near miss notification and reporting, worker's commitment to OHS, management's commitment to OHS, emergency management, OHS priority to production, mining method and application and internal audit dimensions are the base dimensions of UMeMSaF. There are two topics added to Emergency Management and OHS Priority to Production dimensions which are directly related to mining operations: Mine Rescue and Production Pressure.

Mine rescue is one of the main elements in mine safety in the reactive side of accidents. It can be said that it does not affect the occurrence of the accident; however, it affects the negative outcomes of the accident. As it is known that mining is one of the most dangerous industries, creating a mine rescue team is crucial for mine safety.

After Soma underground coal mine accident in 2014, production pressure became a matter of debate in Turkey. It is a polemical issue that the production pressure's effect of safety; therefore, production pressure takes part in this study (Cumhuriyet Gazetesi Web Site, 2015).

Management's Commitment to OHS and Mining Method and Application dimensions are separated into sub-dimensions. In management's commitment to OHS dimension, management is separated into two branches: top management and technical management. Top management refers to non-technical executive officers and technical management refers to chief engineers, specialists or technicians who work in an administrative position in the organization's hierarchy. The aim of this separation is to see the effect of technical management on management commitment because of top management's knowledge and effects on technical issues related to safety are limited. Therefore, even if their commitment to safety is at a desired level, it may not be transferred to front line operations. Another sub-dimension of management's commitment to OHS dimension is management's supervision on subcontractors. Since the subcontractors have great effects in both safety and production for the organizations in the mining industry, management needs to control the effects of subcontractors on safety issues. As it is mentioned above, management's commitment to OHS dimension has three sub-dimensions: Top Management's Commitment to OHS, Technical Management's Commitment to OHS and Management's Supervision on Subcontractors

Underground mining operations include different production works that are directly related to safety. Applying the mining method and application dimension to this study without separation would make it very hard to understand and use in the second study. In the mining method and application dimension, these works are treated as different sub-dimensions. Mine ventilation is one of the most important parts of mining. Without proper ventilation, it is impossible to work in underground mines. Considering a mine site that operates fully mechanized and without any personnel in underground, air is still needed for diesel equipment to work. Moreover, ventilation is

also important for safety precautions such as toxic gas removal or thermal comfort conditions, etc. Another safety-related work is ground support. Proper support is required for both sustaining the production and maintaining the safety of personnel. The mechanization of mine site both determines the workforce and production rate. As it can easily be seen that a minimum workforce makes it easier to maintain safety in an organization. Planning of mining activities also contains both safety and production points. In order to show the importance of planning from a safety point of view, Ermenek underground mine accident (2014) can be given as an example (yapı.com.tr, 2014). As it is mentioned above, the mining method and application dimension have four sub-dimensions: Ventilation, Ground Support, Mechanization, Planning.

It should be noted that as it is explained before, these dimensions are selected for underground metal mines and the usage of UMeMSaF in underground coal mines without any modification is not recommended. Some of the dimensions (for example ventilation) may require more detailed research while some of them (for example management's supervision on subcontractors) may not for underground coal mines. On the other hand, obviously, there are some similarities in both underground metal and underground coal mines. Therefore, in order to use UMeMSaF in underground coal mines, it should be modified for the area of application.

### 2.1.3. Method of Development of UMeMSaF

Guldenmund (2017) suggests a model that includes five steps for the development of safety culture (Figure 2.3) and states that the development of safety culture is a continuous cycle except the exchanging and formalizing steps. However, there is no information on how to understand the safety culture. People inside an organization already know about their culture and transforms it into new people. If anyone wants to affect the culture, he must understand it first.

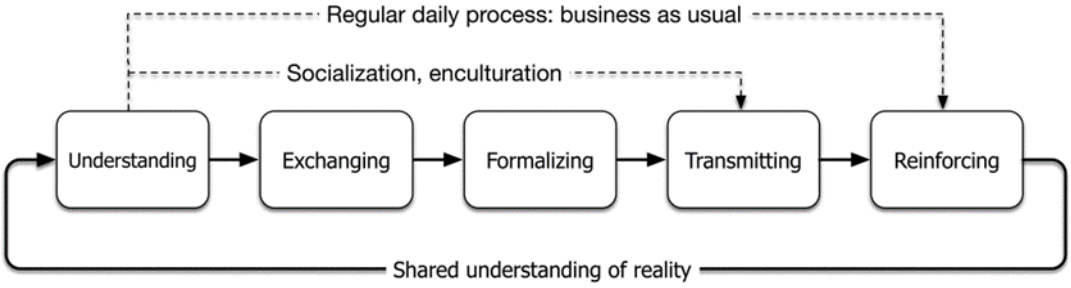



*Figure 2.3* The Development of Safety Culture (Guldenmund, 2018)

The main purpose of the whole concept of safety culture research is to make positive changes in safety culture and of course decrease the number of accidents by changing the safety behavior of the members of an organization. The aim of the assessment of the safety culture is to understand the current status of safety culture in an organization in different dimensions.

For this purpose, three mine sites are visited for gathering information about safety culture assessment of underground metal mines in different dimensions. In this there visit, some interviews carried out with members of the organization to create a sectorial matrix tool which is called Underground Metal Mining Safety Framework (UMeMSaF) for assessment of safety culture in underground metal mines. This tool is expected to use in all underground metal mines in the world. Therefore, the dimensions are selected, and the interview questions are prepared for general application.

After creating the tool, two mine sites are visited for application. In the application stage, each cell of the matrix tool is given to some members of the organizations. They are asked to choose which cell reflects most of their organization in different dimensions. Demographic information of participants also collected to specify the results of the study. Demographic information of participants contains age, gender, company experience, total experience, accident history, near-miss history and over time.

After two arms of the UMeMSaF matrix are specified (Table 2.2.), the next step of Study 1 is to determine the properties of an organization for each dimension and steps; in other words, assigning the contents of the matrix cells. All research studies made with the ethical permission of METU Applied Ethics Research Center (Appendix A)

Table 2.2 *Empty UMeMSaF Matrix*

| Dimensions | Pathological | Reactive | Bureaucratic | Proactive | Generative |
|---|---|---|---|---|---|
| **OHS Training** | | | | | |
| **Work Accident – Near Miss Notification and Reporting** | | | | | |
| **Worker's Commitment to OHS** | | | | | |
| **Top Management's Commitment to OHS** | | | | | |
| **Technical Management's Commitment to OHS** | | | | | |
| **Management's Supervision on Subcontractors** | | | | | |
| **Emergency Management and Mine Rescue** | | | | | |
| **OHS Priority to Production and Production Pressure** | | | | | |
| **Ventilation** | | | | | |
| **Ground Support** | | | | | |
| **Mechanization** | | | | | |
| **Planning** | | | | | |
| **Internal Audit** | | | | | |

In order to carry out the Study 1, a previous study which was made for the oil industry by Parker *et al*. (2006) is taken as an example. There are similarities and differences between this study and the current research. For example, the positions of interviewees in the organization are different. In Parker *et al.* (2006), senior oil and gas company executives attended the interviews; however, in this study, it is aimed to get information from all parts of the three different company as explained in the introduction section. Another difference is the number of researchers that carried out the study which is 2 in Parker *et al.* (2006), and 1 in this study. The interviews cannot be recorded because of company policies. On the other hand, in both studies, the interviews took 60 – 90 minutes and a written summary of the interviews was prepared by the researcher.

### 2.1.4. Interviews

In order to gather information for each dimension of each step of the UMeMSaF, interviews are carried out. These interviews are semi-structured; therefore, some questions in the interviews are asked from an available questions list (Table 2.3).

Table 2.3 *Interview Questions List*

| | |
|---|---|
| **COMMUNICATION** | 1. Is there any communication system related to OHS? / Can employees transmit their complaints to relevant people (OHS specialist, foreman, shift supervisor, manager, employer)?<br>2. How is the participation ensured in OHS related works?<br>3. Do the employees warn each other and management in OHS related topics?<br>4. Is there any record-keeping about communication? If so, are the records evaluated?<br>5. How does the information transfer is ensured between shifts? |

| | |
|---|---|
| **OHS TRAINING** | 1. Is there any OHS training provided in the mine? If so, who gives it and how often is it provided?<br>2. Are the trainings useful for employees? Are lessons learned overlap with real situations?<br>3. How does participation occur in the trainings?<br>4. What do your coworkers think about these trainings?<br>5. What does management think about the necessity of these trainings? |
| **WORK ACCIDENT – NEAR MISS NOTIFICATION AND REPORTING** | 1. What will be the reaction of the employees in a work accident / near miss / dangerous attitude-behavior situation?<br>2. Are these situations reported? If so, to whom these situations are reported?<br>3. What is the aim of reporting these situations? |
| **WORKER'S COMMITMENT TO OHS** | 1. Are your coworkers informed and aware of OHS issues? / Is there a common perception of OHS?<br>2. Do your coworkers use the protective equipment which is supplied to them? (PPE etc.)<br>3. According to your coworkers, is the OHS a part of the work or a burden?<br>4. Do your coworkers report and keep track of this report about a work accident / near miss etc. situation? |
| **MANAGEMENT'S COMMITMENT TO OHS** | **Top Management's Commitment to OHS (Company Owner/s, CEO, Operations Manager, etc.)**<br>1. What is the level of interest of the employer about OHS related topics? Does the employer care about OHS and follow OHS rules? |

2. Does the employer determine policy about OHS? Does the employer have someone to prepare documents such as procedures, guides, etc.?
3. Does the employer allocate the budget for OHS? If so, what is the level of the budget? To what extent does the employer meet the needs of employees regarding OSH?
4. Does the employer set a goal about OHS? What does the employer do when this goal achieved or not?

**Technical Management's Commitment to OHS (Operations Manager and Engineers)**

1. If available, does the technical management follow the employer's directive about OHS? What is the level of their support to the employer on determining these directives?
2. How much does technical management encourage the employees about OHS related topics?
3. How much does the technical management know about OHS and open to learning about OHS?
4. How much is the OHS important according to technical management?

**Management's Supervision on Subcontractors**

1. Does the management ask OHS professionals' opinions about subcontractor selection?

| | |
|---|---|
| | 2. Does the management determine OHS criterions in subcontractor selection? If so, what is the level of these criterions?<br>3. How often does the management inspect subcontractors?<br>4. Does the management punish the subcontractor's employees and managers for unsafe acts? If so, what is the level of these punishments? |
| **EMERGENCY MANAGEMENT AND MINE RESCUE** | 1. Are the emergency preparedness and planning works and safety drills carried out in the mine? If so, what is the level of this works and drills?<br>2. Are the emergency teams organized, team members educated, and definitions of their duties made in the mine?<br>3. Is there a mine rescue team in the mine?<br>4. Are the employees tracked and monitored in the mine? If so, how are they tracked and monitored?<br>5. What is the level of technological equipment such as the tracking system in the mine? |
| **OHS PRIORITY TO PRODUCTION AND PRODUCTION PRESSURE** | 1. According to employees, is the OHS prior to production in the mine?<br>2. According to technical management, is the OHS prior to production in the mine?<br>3. According to top management, is the OHS prior to production in the mine?<br>4. Is there any production pressure on the employees?<br>5. Are the bonuses and rewards given to employees related to OHS or production? |

| | |
|---|---|
| **MINING METHOD AND APPLICATION** | **<u>Ventilation</u>**<br>1. What is the importance of ventilation in the mine? Is there a sufficient amount of air?<br>2. Are the gas measurements carried out in the mine? If so, how and why are these measurements are carried out?<br>3. What does happen when the fans are broken?<br>**<u>Ground Support</u>**<br>1. On what grounds are ground supports made in the mine?<br>2. Are the collapses evaluated and the reasons for the collapse investigated?<br>3. What kind of support system is used in the mine?<br>**<u>Mechanization</u>**<br>1. What is the level of mechanization in the production?<br>2. What are the points to be considered when new equipment is purchased in the mine?<br>3. Is the production carried out primarily on manpower or machine power?<br>**<u>Planning</u>**<br>1. What is the level of planning in production?<br>2. What is the level of OHS issues in planning? |
| **INTERNAL AUDIT** | 1. What is the level of safety audits in the mine?<br>2. If available, what is the level of enforcement of these audits?<br>3. Are the audits carried out regularly?<br>4. Are the audits effective? |

Members of all possible types of work such as underground workers, managers, and office workers are listened to in the interviews for gathering more definitive information about safety culture. At the beginning of each interview, Voluntary Participation Form (Appendix C) is given to the interviewee, and a necessary time is given to read and fill the form. It is explained that if they have any drawbacks, it is not mandatory to join, and nothing will happen to those who attend or not attend the study. Moreover, it is not mandatory to sign the form or give their names to attend the study. After receiving the written or verbal consent of the interviewee, safety culture steps are defined, and they are asked to imagine an organization different than their own for each safety culture step. At the end of the interview, Post-Research Information Form (Appendix D) is given to the interviewee.

A written summary is systematically prepared by the researcher during the interview. The number of interviews is not determined before the study. The aim is to gather the most information possible. As the interviewees start to answer all questions with almost the same words with previous interviewees, this means that the study is reached the saturation point and the quantity and quality of the information are good enough to evaluate the results of the study. At that point, no more interviews are carried out.

### 2.1.5. Filling the Cells

As mining is a regional sector and carried out in mining basins, language is one of the most important barriers of creating the UMeMSaF. The main reason that Study 1 is carried out in 3 different companies is to eliminate the language problems in creating UMeMSaF.

After acquiring enough amount of knowledge from the interviews, each summary of interviews was read cell by cell and common statements of the interviewees are tried to be detected and constructed. Language differences are paid attention to the determination of common statements.

## 2.2. STUDY 2: Application of UMeMSaF

### 2.2.1. Method of Application

UMeMSaF is a matrix tool that shows the specifications of underground metal mine companies for each safety culture step and dimension. In Study 2, the application of UMeMSaF is carried out in 2 different companies in order both to see the results for each company separately and to compare these measurements. Besides the application of UMeMSaF, demographic information of the participants is collected in Study 2.

Each cell of UMeMSaF is written with an easily readable font on one side of a small size card. A code that determines the content of the card is written on the other side of the card. This code does not mean anything to participants and is only required for the researcher. All cells of UMeMSaF prepared in this way and a total of 70 cards were produced. In order to save time, 7 sets of 70 cards are prepared.

Participants are invited to an empty room with enough tables and chairs. In the beginning, a brief information about the study is given and Personal Information and Data Collection Sheet (Appendix E) is distributed to the participants. After the forms are filled, they are given the cards that contain the UMeMSaF. At each time 5 cards of the same dimension are given randomly to the participants and they are asked to choose the one that reflects the company most. Each selection is recorded to the back of the Personal Information and Data Collection Sheet. After the participants finish 14 dimensions of UMeMSaF, another group is invited to do the same cycle.

### 2.2.2. UMeMSaF Application in Company A

In Company A, all operations are carried out by the company itself; therefore, the main work is not subcontracted to the different companies. Thus, planning of the application of UMeMSaF becomes easier. The managerial building of the mine that contains necessary facilities for the meeting such as the room, copy machine, etc. is very close to the underground entrance and main shaft entrance.

All participants of Company A completed the application in one day. A total of 55 employees have attended the study in Company A.

### 2.2.3. UMeMSaF Application in Company B

In Company B, all main mining operations are subcontracted. Each level of mine site is given to another company; however, all operations are controlled by the management of Company B. Therefore, organization and planning of the application of UMeMSaF require a serious amount of workforce. Transportation of the workers from the underground is the most important problem because the managerial building is about 40 kilometers away from the mine entrances.

It took almost 1 week to complete the applications. A total of 56 employees have attended the study from 4 subcontractors of Company B. Therefore, the participants were classified under B1, B2, B3, and B4 for different subcontractors.

### 2.2.4. Participants

For the purpose of defining the safety culture of companies and comparing their results, 111 participants were selected and attended the study. 49.55% of the participants ($N$ = 55) worked at Company A, 6.31% of them ($N$ = 7) worked at Company B1, 9.01% of them ($N$ =10) worked at Company B2, 12.61% of them ($N$ =14) worked at Company B3 and 22.52% of them ($N$ =25) worked at Company B4. The distribution of the participants according to companies is shown in Figure 2.4.

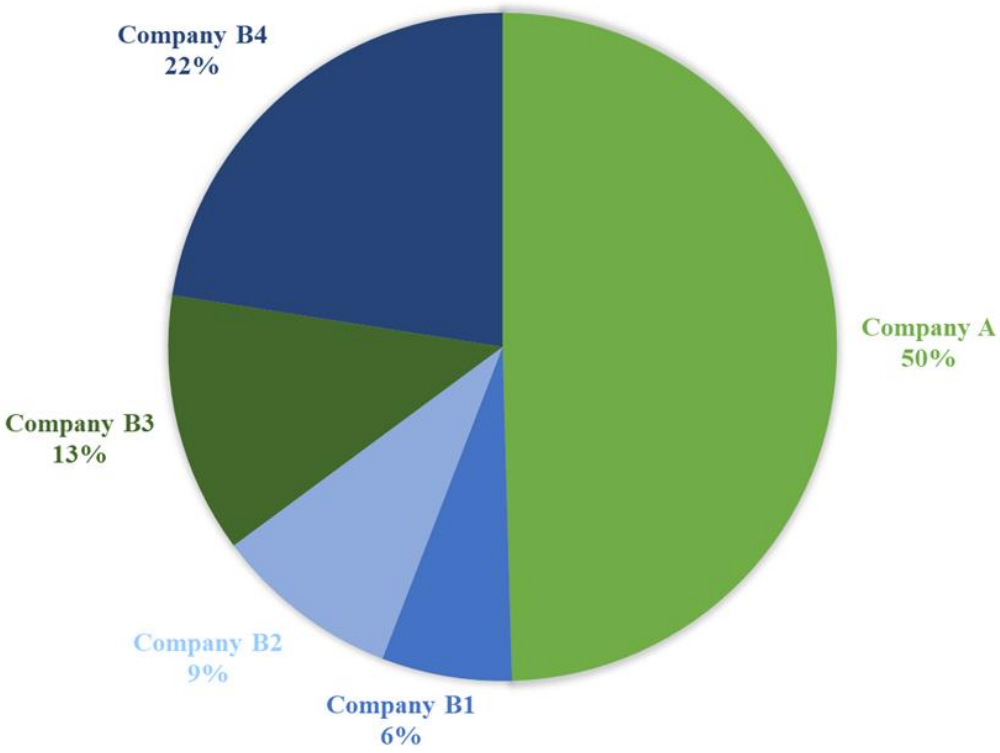



*Figure 2.4* Company Distribution of Participants

Additionally, the majority of the participants worked underground (*N* = 79, 71%). The rest worked as surface worker (*N* = 15, 14%) and engineer (*N* = 17, 15%). The distribution of work type of participants was given in Figure 2.5.

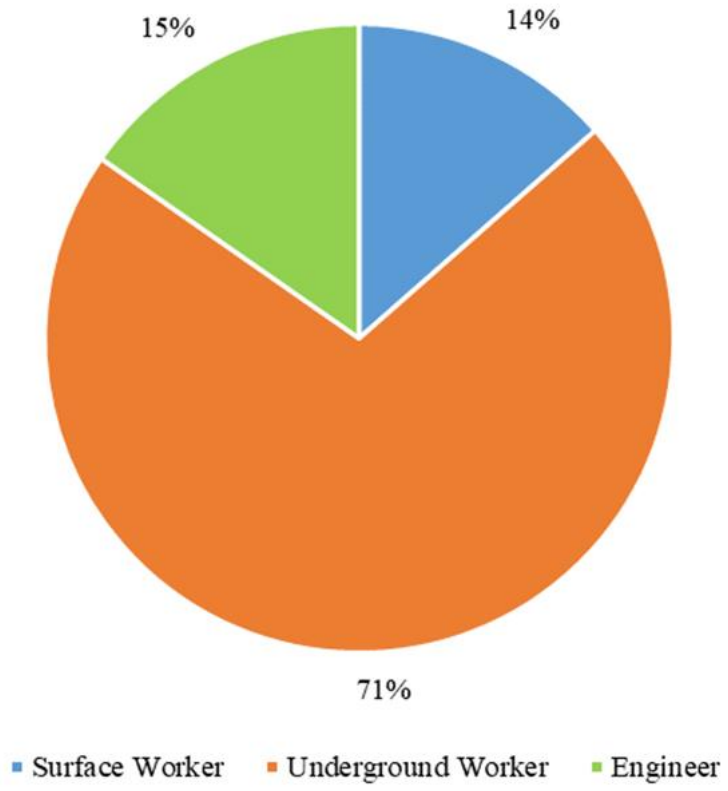



*Figure 2.5* Work Type of The Participants

Majority of the participants graduated from secondary school (*N* = 33, 29.73%) and high school (*N* = 36, 32.43%). 19.82% of them (*N* = 22) graduated from preliminary school and 13.51% of them (*N* = 15) graduated from university. The education information of them was given in Figure 2.6.

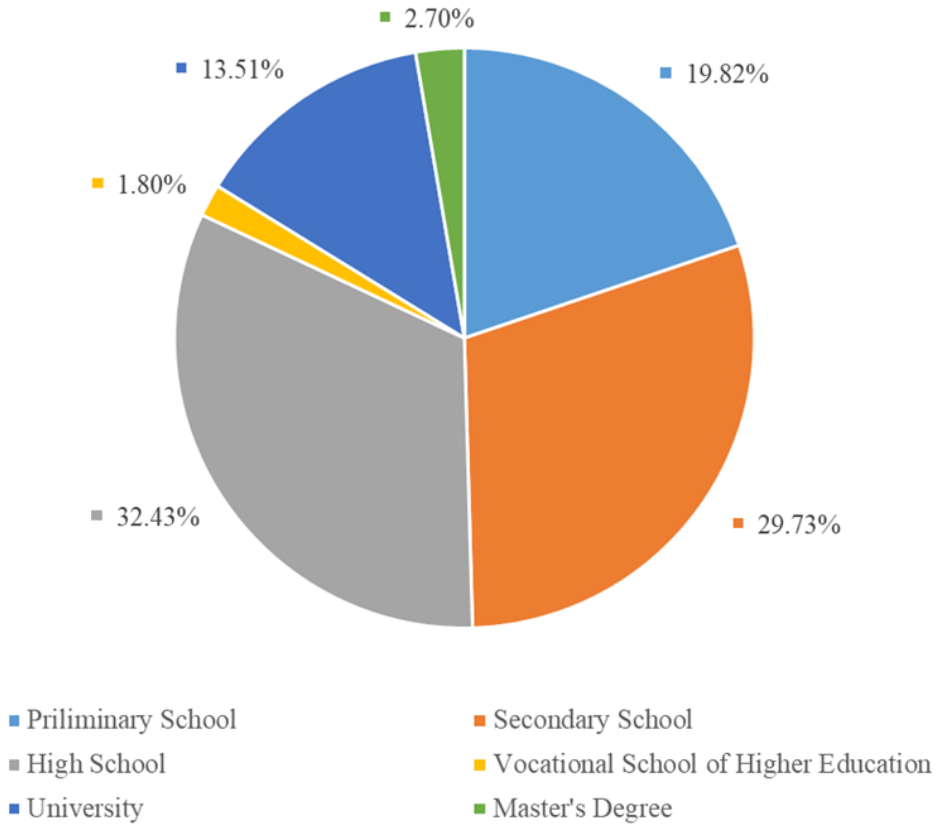



*Figure 2.6* Education Information of Participants

Moreover, 27.93% (*N* = 31) of the participants had less than 4 years of company experience and 10.81% (*N* = 12) of them had less than 4 years of total experience. A close percentage of participants had both company (*N* = 48, 43.24%) and total (*N* = 38, 34.23%) experience of 4 – 10 years. Lastly, 28.83% (*N* = 32) of the participants had more than 10 years of company experience and 54.95% (*N* = 61) of them had more than 10 years of total experience. The distribution of both the company and the total experience of the participants was given in Figure 2.7.

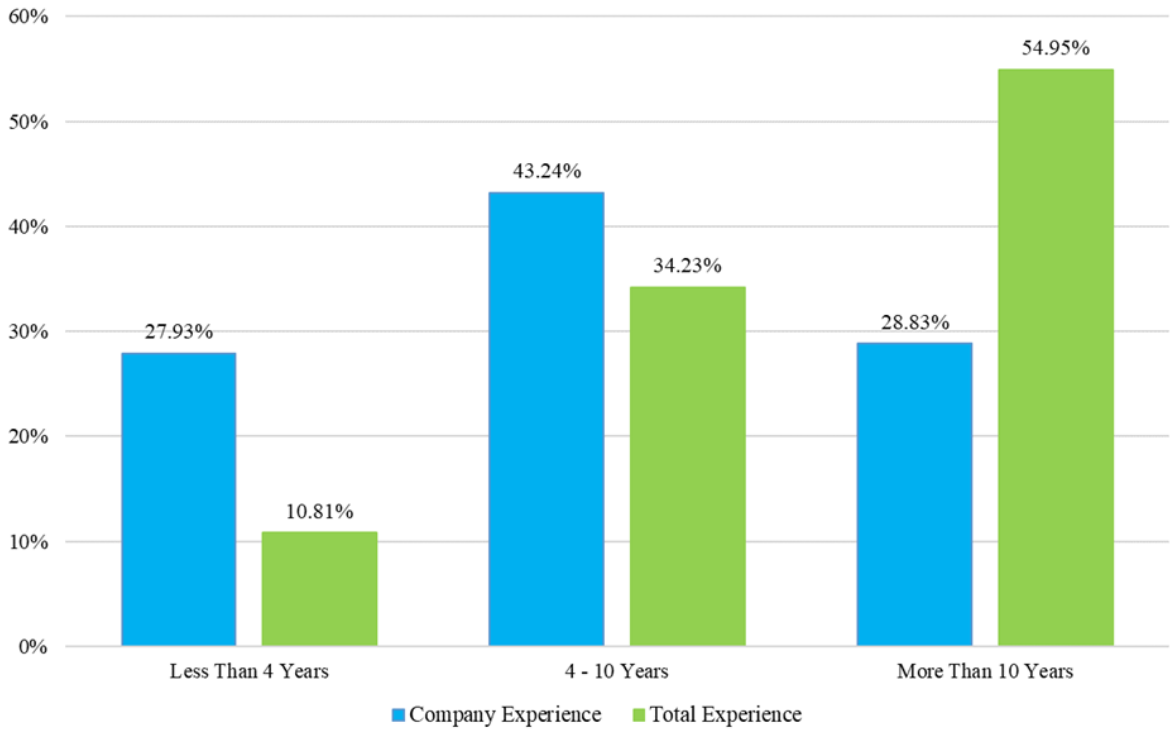



*Figure 2.7* Experience Distribution of the Participants

Last but not least, 85.59% (N = 95) of the participants never had a work accident and 14.41% (N = 16) of them had an accident. Similarly, 81.08% (N = 90) of the participants never had near miss and 18.92% (N = 21) of them had near miss. The distribution of the work accident and near-miss history were given in Figures 2.8 and 2.9.

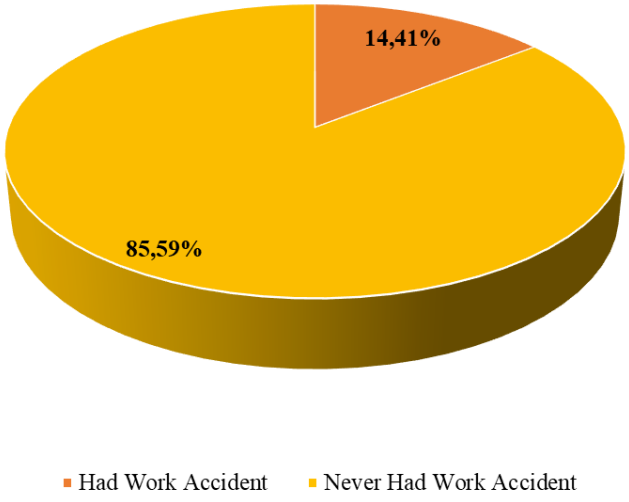



*Figure 2.8* Work Accident History of the Participants

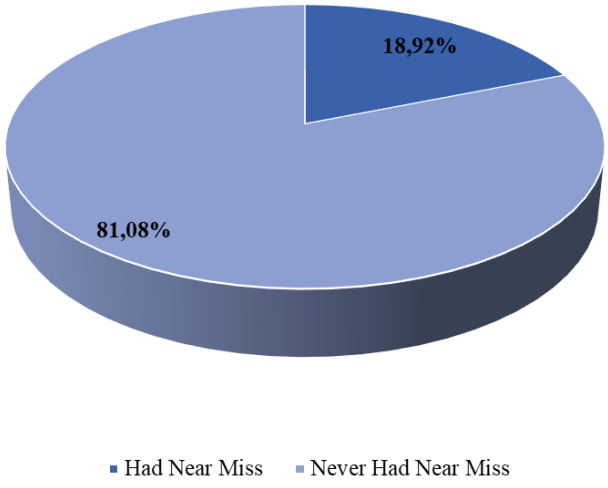



*Figure 2.9* Near Miss History of Participants

# CHAPTER 3

# RESULTS

## 3.1. Introduction

The results of this thesis study include the results of study 1 and study 2. The first part of the results covers the development of the UMeMSaF matrix with all its dimensions and maturity levels. In the second part of the study, firstly the correlation analysis was conducted. After that company comparisons in terms of safety culture dimensions were made. Finally, safety culture dimension differences based on company experience, employees' ages, employees' organizational positions were studied. Moreover, the relationships of work accident and safety culture dimensions and near misses and safety culture dimensions were examined. *p* values below .05 value was accepted as the indicator of a significant difference in ANOVAs.

## 3.2. Results of Study 1

As it is explained in the studies section, study 1 is carried out for the development of a safety culture matrix in the underground metal mining sector. The matrix includes 14 dimensions and 5 levels, a total of 70 cells. The matrix is called UMeMSaF and the form of the matrix is given in Figure 3.1. Detailed explanations of the matrix are given in Appendix B. UMeMSaF is created to be used for every company in the underground metal mining sector.

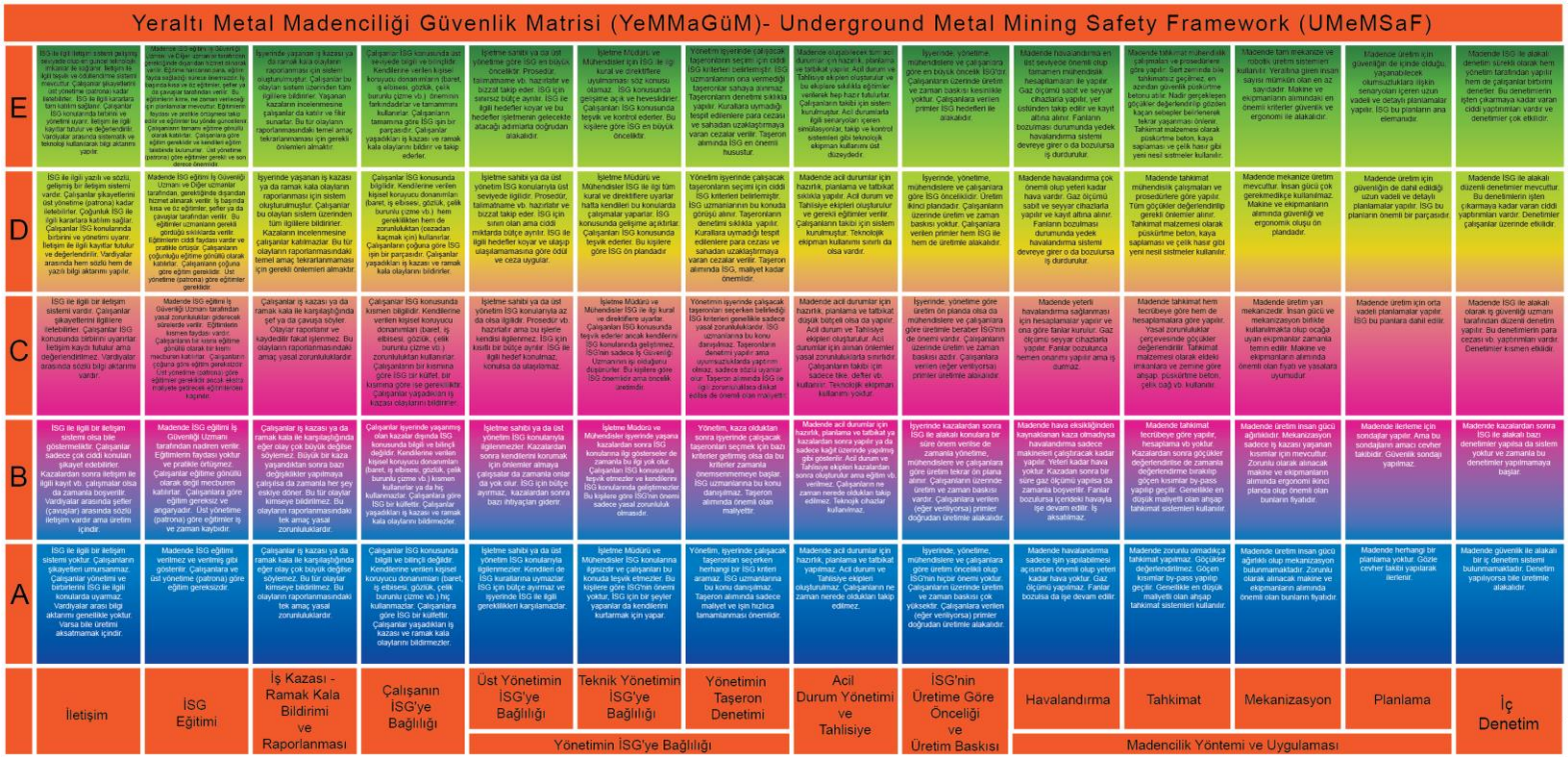



*Figure 3.1* UMeMSaF

### 3.3. Results of Study 2

The mean results of study 2 is given in Table 3.1 according to the participants' organizational position. For detailed results of Study 2 see Appendix F.

Table 3.1 *The mean results of study 2 according to the participants' organizational position*

| Dimensions | Company A | | | Company B | | |
|---|---|---|---|---|---|---|
| | Underground Workers | Surface Worker | Engineer | Underground Workers | Surface Workers | Engineer |
| **D1** | 4.68 | 4.00 | 4.90 | 2.71 | 4.14 | 3.29 |
| **D2** | 4.41 | 4.00 | 4.50 | 3.49 | 3.71 | 3.57 |
| **D3** | 4.84 | 5.00 | 4.90 | 3.03 | 4.00 | 4.00 |
| **D4** | 4.68 | 3.00 | 4.40 | 3.69 | 4.29 | 3.71 |
| **D5** | 4.57 | 5.00 | 4.40 | 2.94 | 4.00 | 4.00 |
| **D6** | 4.11 | 4.00 | 4.60 | 3.23 | 3.93 | 4.00 |
| **D7** | 4.55 | 4.00 | 4.30 | 2.34 | 3.79 | 2.57 |
| **D8** | 4.91 | 4.00 | 4.80 | 3.37 | 3.86 | 3.43 |
| **D9** | 4.11 | 4.00 | 4.30 | 3.03 | 3.57 | 3.57 |
| **D10** | 4.57 | 4.00 | 4.80 | 2.77 | 3.79 | 3.43 |
| **D11** | 4.84 | 5.00 | 5.00 | 2.83 | 3.71 | 2.29 |
| **D12** | 4.32 | 4.00 | 4.50 | 2.86 | 3.43 | 1.86 |
| **D13** | 4.52 | 4.00 | 4.60 | 2.69 | 3.29 | 2.86 |
| **D14** | 4.30 | 3.00 | 4.50 | 2.89 | 3.86 | 3.00 |

#### 3.3.1. Correlations

For the study variables, bivariate correlations were computed and shown in Table 3.2. Age was coded as 1 equals to ages between 18 and 25, 2 equals to ages between 26 and 35 and 3 equals to ages 36 and higher. Company experience was coded as 1 equals to experience lower than 1 year, 2 equals to experience between 1 to 3 years, 3 equals

to experience between 4 to 10 years and 4 equals to experience higher than 10 years. Total-experience was coded as 1 equals to experience lower than 1 year, 2 equals to experience between 1 to 3 years, 3 equals to experience between 4 to 10 years and 4 equals to experience higher than 10 years. Accident was coded as 1 equals to yes and 2 equals to no. Near miss was coded as 1 equals to yes and 2 equals to no.

Age was negatively correlated with all dimensions except technical management's commitment to OHS and positively correlated with both company ($r$ = .253, $p$ < .01) and total experience ($r$ = .433, $p$ < .01). Company experience was positively correlated with total experience ($r$ = .584, $p$ < .01) and negatively correlated with only internal audit dimension. Total experience was positively correlated with all dimensions except internal audit ($r$ = -.187, $p$ < .05). Accident history is positively correlated with communication ($r$ = .282, $p$ < .01), OHS training ($r$ = .194, $p$ < .05), work accident – near miss notification and reporting ($r$ = .201, $p$ < .05), top management's commitment to OHS ($r$ = .201, $p$ < .05), emergency management and mine rescue ($r$ = .225, $p$ < .05), ventilation ($r$ = .224, $p$ < .05), mechanization ($r$ = .207, $p$ < .05) and planning ($r$ = .263, $p$ < .01) dimensions.

Finally, all 14 dimensions were positively correlated with each other and $r$ values ranged between .243 and .708 which means none of them are weak correlations.

Table 3.2 *Correlations*

| | Age | Company Experience | Total Experience | Accident | Near Miss | D1 | D2 | D3 | D4 | D5 | D6 | D7 | D8 | D9 | D10 | D11 | D12 | D13 | D14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Age | 1 | | | | | | | | | | | | | | | | | | |
| Company Experience | ,253** | 1 | | | | | | | | | | | | | | | | | |
| Total Experience | ,433** | ,584** | 1 | | | | | | | | | | | | | | | | |
| Accident | -,003 | -,095 | -,047 | 1 | | | | | | | | | | | | | | | |
| Near Miss | ,090 | -,072 | -,101 | ,064 | 1 | | | | | | | | | | | | | | |
| D1 | -,313** | ,072 | -,051 | ,282** | -,068 | 1 | | | | | | | | | | | | | |
| D2 | -,230* | ,151 | -,119 | ,194* | -,099 | ,565** | 1 | | | | | | | | | | | | |
| D3 | -,309** | ,063 | -,099 | ,201* | -,046 | ,708** | ,527** | 1 | | | | | | | | | | | |
| D4 | -,268** | ,199* | ,128 | ,086 | -,032 | ,475** | ,336** | ,528** | 1 | | | | | | | | | | |
| D5 | -,271** | -,012 | -,085 | ,201* | -,060 | ,541** | ,379** | ,639** | ,400** | 1 | | | | | | | | | |
| D6 | -,129 | ,025 | -,024 | ,119 | -,076 | ,448** | ,321** | ,293** | ,273** | ,447** | 1 | | | | | | | | |
| D7 | -,260** | ,171 | ,027 | ,066 | -,086 | ,628** | ,528** | ,595** | ,426** | ,562** | ,442** | 1 | | | | | | | |
| D8 | -,273** | ,137 | ,050 | ,225* | -,107 | ,686** | ,387** | ,641** | ,478** | ,598** | ,467** | ,580** | 1 | | | | | | |
| D9 | -,215* | ,029 | ,033 | ,180 | ,061 | ,512** | ,259** | ,451** | ,243* | ,382** | ,265** | ,428** | ,436** | 1 | | | | | |
| D10 | -,328** | ,033 | -,054 | ,224* | -,091 | ,670** | ,364** | ,650** | ,393** | ,645** | ,420** | ,590** | ,678** | ,506** | 1 | | | | |
| D11 | -,323** | ,030 | -,109 | ,185 | -,132 | ,621** | ,399** | ,598** | ,415** | ,570** | ,443** | ,596** | ,695** | ,412** | ,662** | 1 | | | |
| D12 | -,285** | ,057 | -,108 | ,207* | -,083 | ,499** | ,407** | ,540** | ,266** | ,439** | ,271** | ,485** | ,576** | ,297** | ,497** | ,620** | 1 | | |
| D13 | -,320** | ,063 | -,075 | ,263** | -,044 | ,686** | ,481** | ,621** | ,374** | ,543** | ,383** | ,591** | ,602** | ,545** | ,608** | ,562** | ,521** | 1 | |
| D14 | -,258** | -,172 | -,187* | ,150 | -,087 | ,614** | ,283** | ,548** | ,336** | ,433** | ,323** | ,495** | ,476** | ,391** | ,593** | ,502** | ,390** | ,596** | 1 |

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

### 3.3.2. Company Comparison in terms of Safety Culture Dimensions

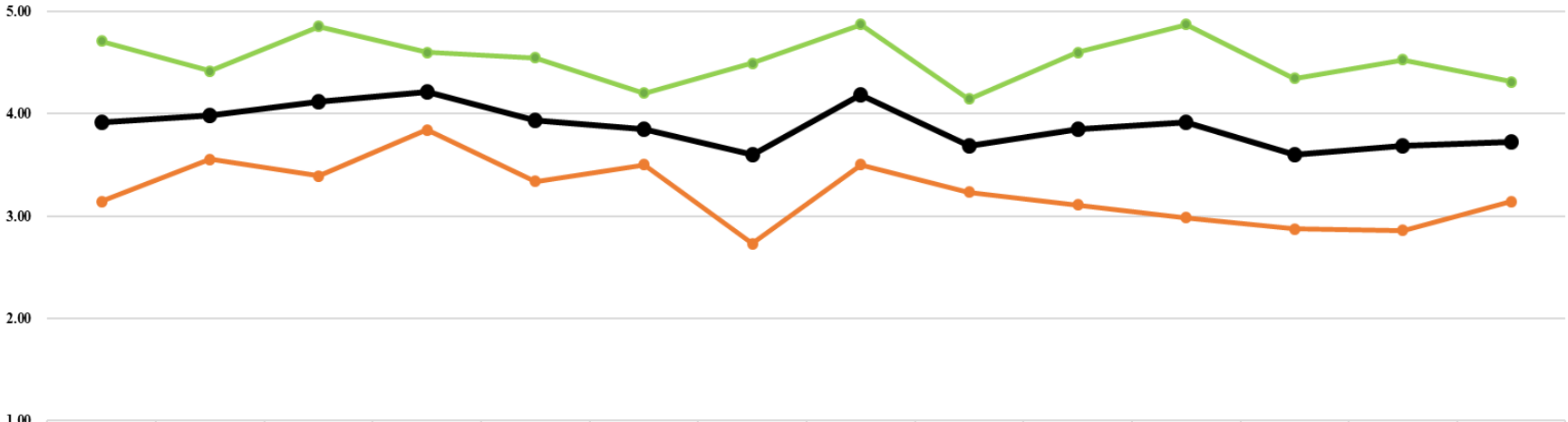
Company comparison through safety culture dimensions showed that employees at Company A evaluated all 14 dimensions higher than employees at Company B. Descriptive of safety culture dimensions for both companies is given in Table 3.3 and Figure 3.2.

Table 3.3 *Descriptive of Safety Culture Dimensions Based on Two Companies*

| Dimensions | df | F | p | Company A | | Company B | |
|---|---|---|---|---|---|---|---|
| | | | | M | SD | M | SD |
| Communication | 1,109 | 71.2 | .000 | 4.71 | .53 | 3.14 | 1.27 |
| OHS Training | 1,109 | 23.74 | .000 | 4.42 | .76 | 3.55 | 1.08 |
| Work Accident – Near Miss Notification and Reporting | 1,109 | 55.61 | .000 | 4.85 | .36 | 3.39 | 1.41 |
| Worker's Commitment to OHS | 1,109 | 17.03 | .000 | 4.6 | .74 | 3.84 | 1.16 |
| Top Management's Commitment to OHS | 1,109 | 31.39 | .000 | 4.55 | .77 | 3.34 | 1.4 |
| Technical Management's Commitment to OHS | 1,109 | 15.97 | .000 | 4.2 | .52 | 3.5 | 1.19 |
| Management's Supervision on Subcontractors | 1,109 | 67.44 | .000 | 4.5 | .81 | 2.7 | 1.37 |

Table 3.3 *Descriptive of Safety Culture Dimensions Based on Two Companies (Continued)*

| Dimensions | df | F | P | Company A | | Company B | |
|---|---|---|---|---|---|---|---|
| | | | | M | SD | M | SD |
| Emergency Management and Mine Rescue | 1,109 | 64.69 | .000 | 4.87 | .34 | 3.5 | 1.22 |
| OHS Priority to Production and Production Pressure | 1,109 | 16.09 | .000 | 4.15 | .99 | 3.23 | 1.37 |
| Ventilation | 1,109 | 50.85 | .000 | 4.6 | .68 | 3.1 | 1.4 |
| Ground Support | 1,109 | 106.94 | .000 | 4.87 | .43 | 2.98 | 1.29 |
| Mechanization | 1,109 | 66.35 | .000 | 4.35 | .52 | 2.88 | 1.24 |
| Planning | 1,109 | 65.62 | .000 | 4.5 | .5 | 2.9 | 1.45 |
| Internal Audit | 1,109 | 28.06 | .000 | 4.3 | .69 | 3.14 | 1.29 |




| | Communication | OHS Training | Work Accident – Near Miss Notification and Reporting | Worker's Commitment to OHS | Top Management's Commitment to OHS | Technical Management's Commitment to OHS | Management's Supervision on Subcontractors | Emergency Management and Mine Rescue | OHS Priority to Production and Production Pressure | Ventilation | Ground Support | Mechanization | Planning | Internal Audit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Company A | 4.71 | 4.42 | 4.85 | 4.60 | 4.55 | 4.20 | 4.49 | 4.87 | 4.15 | 4.60 | 4.87 | 4.35 | 4.53 | 4.31 |
| Company B | 3.14 | 3.55 | 3.39 | 3.84 | 3.34 | 3.50 | 2.73 | 3.50 | 3.23 | 3.11 | 2.98 | 2.88 | 2.86 | 3.14 |
| Grand Mean | 3.92 | 3.98 | 4.12 | 4.22 | 3.94 | 3.85 | 3.60 | 4.18 | 3.68 | 3.85 | 3.92 | 3.60 | 3.68 | 3.72 |

*Figure 3.2* Mean Values of Safety Culture Dimensions of Two Companies

### 3.3.3. Safety Culture Dimension Differences Based on Company Experience

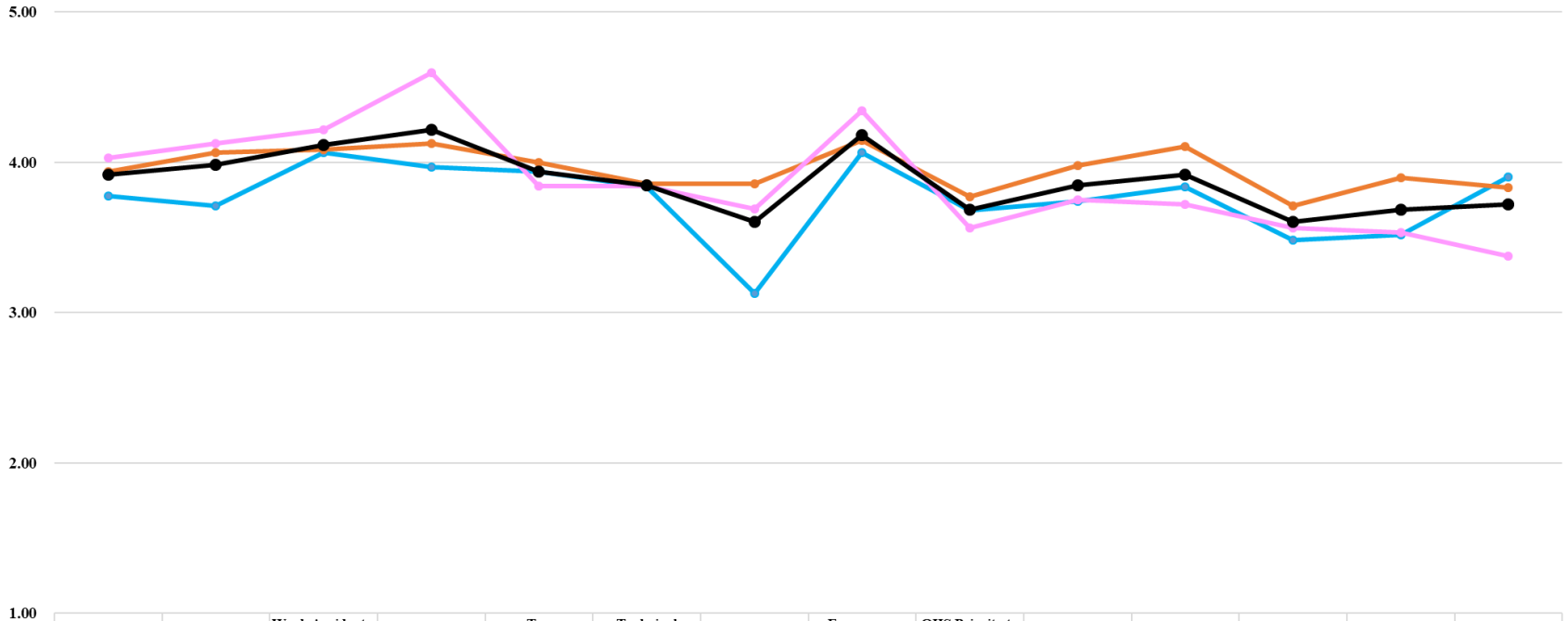
In the following analysis the company experience levels were divided into three as less than 4 years ($N$ = 31), 4 – 10 years ($N$ = 48), and more than 10 years ($N$ = 32). The company experience differences were significant for worker's commitment to safety ($F(2,108) = 3.32$, $p = .040$). According to pairwise comparison, employees with less than 4 years of experience were significantly different from employees with more than 10 years ($p = .040$). Employees with more than 10 years of experience evaluated worker's commitment to safety significantly higher than employees with less than 4 years of experience. There was no significant difference between groups but that one. On the other hand, other dimensions than worker's commitment were not significantly different in terms of company experience; communication ($F(2,108) = .34$, $p = .714$), OHS training ($F(2,108) = 1.56$, $p = .214$), work accident – near miss notification and reporting ($F(2,108) = .15$, $p = .865$), top management's commitment to OHS ($F(2,108) = .14$, $p = .869$), technical management's commitment to OHS ($F(2,108) = .00$, $p = .998$), management's supervision on subcontractors ($F(2,108) = 2.58$, $p = .081$), emergency management and mine rescue ($F(2,108) = .52$, $p = .559$), OHS priority to production and production pressure ($F(2,108) = .26$, $p = .778$), ventilation ($F(2,108) = .42$, $p = .662$), ground support ($F(2,108) = .86$, $p = .427$), mechanization ($F(2,108) = .35$, $p = .705$), planning ($F(2,108) = 1$, $p = .368$), internal audit ($F(2,108) = 1.67$, $p = .197$). The descriptive is given in Table 3.4 and Figure 3.3.

Table 3.4 *Descriptive of Safety Culture Dimensions based on Three Company Experience Levels*

| Dimensions | df | F | p | Less than 4 Years | | 4 – 10 Years | | More Than 10 Years | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | M | SD | M | SD | M | SD |
| Communication | 2, 108 | .34 | .714 | 3.77 | 1.26 | 3.94 | 1.33 | 4.03 | 1.15 |
| OHS Training | 2, 108 | 1.56 | .214 | 3.71 | 1.16 | 4.06 | .99 | 4.13 | .91 |
| Work Accident – Near Miss Notification and Reporting | 2, 108 | .15 | .865 | 4.06 | 1.29 | 4.08 | 1.27 | 4.20 | 1.26 |
| Worker's Commitment to OHS | 2, 108 | 3.32 | .040 | 3.97 | 1.11 | 4.13 | 1.1 | 4.60 | .76 |
| Top Management's Commitment to OHS | 2, 108 | .14 | .869 | 3.94 | 1.18 | 4 | 1.3 | 3.84 | 1.37 |
| Technical Management's Commitment to OHS | 2, 108 | .00 | .998 | 3.84 | .82 | 3.85 | 1.01 | 3.84 | 1.11 |
| Management's Supervision on Subcontractors | 2, 108 | 2.58 | .081 | 3.13 | 1.57 | 3.85 | 1.37 | 3.69 | 1.31 |

Table 3.4 *Descriptive of Safety Culture Dimensions based on Three Company Experience Levels (Continued)*

| Dimensions | df | F | p | Less than 4 Years | | 4 – 10 Years | | More Than 10 Years | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | M | SD | M | SD | M | SD |
| Emergency Management and Mine Rescue | 2, 108 | .52 | .559 | 4.06 | 1.03 | 4.15 | 1.22 | 4.34 | 1.1 |
| OHS Priority to Production and Production Pressure | 2, 108 | .26 | .778 | 3.68 | 1.22 | 3.77 | 1.31 | 3.56 | 1.32 |
| Ventilation | 2, 108 | .42 | .662 | 3.74 | 1.39 | 3.98 | 1.23 | 3.75 | 1.44 |
| Ground Support | 2, 108 | .86 | .427 | 3.84 | 1.34 | 4.1 | 1.22 | 3.72 | 1.53 |
| Mechanization | 2, 108 | .35 | .705 | 3.48 | 1.31 | 3.71 | 1.24 | 3.56 | 1.05 |
| Planning | 2, 108 | 1 | .368 | 3.52 | 1.57 | 3.9 | 1.26 | 3.53 | 1.32 |
| Internal Audit | 2, 108 | 1.65 | .197 | 3.9 | 1.35 | 3.83 | 1.14 | 3.38 | 1.43 |




| | Communication | OHS Training | Work Accident – Near Miss Notification and Reporting | Worker's Commitment to OHS | Top Management's Commitment to OHS | Technical Management's Commitment to OHS | Management's Supervision on Subcontractors | Emergency Management and Mine Rescue | OHS Priority to Production and Production Pressure | Ventilation | Ground Support | Mechanization | Planning | Internal Audit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Less than 4 Years | 3.77 | 3.71 | 4.06 | 3.97 | 3.94 | 3.84 | 3.13 | 4.06 | 3.68 | 3.74 | 3.84 | 3.48 | 3.52 | 3.90 |
| 4 - 10 Years | 3.94 | 4.06 | 4.08 | 4.13 | 4.00 | 3.85 | 3.85 | 4.15 | 3.77 | 3.98 | 4.10 | 3.71 | 3.90 | 3.83 |
| More Than 10 Years | 4.03 | 4.13 | 4.22 | 4.59 | 3.84 | 3.84 | 3.69 | 4.34 | 3.56 | 3.75 | 3.72 | 3.56 | 3.53 | 3.38 |
| Grand Mean | 3.92 | 3.98 | 4.12 | 4.22 | 3.94 | 3.85 | 3.60 | 4.18 | 3.68 | 3.85 | 3.92 | 3.60 | 3.68 | 3.72 |

*Figure 3.3* Mean Values of Safety Culture Dimensions in terms of Company Experience

### 3.3.4. Safety Culture Dimension Differences Based on Employee's Ages

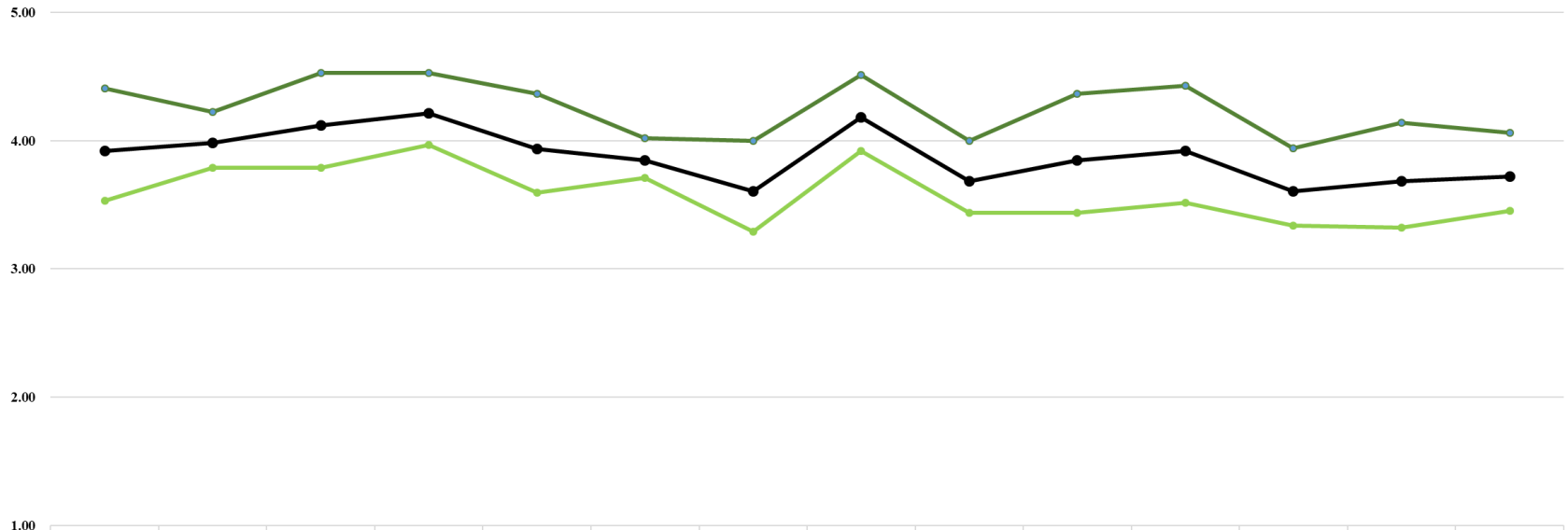
In the following analysis, the ages of the employees were divided into two as more than 36 and less than 36 years old. The mentioned age separation was made in order to gather similar sample sizes for analysis. According to analysis, all dimensions except from technical management's commitment to OHS ($F(1,109) = 2.78$, $p = .099$) were significantly different in terms of employees ages. For the dimensions namely, communication ($F(1,109) = 15.13$, $p < .001$), OHS training ($F(1,109) = 5.08$, $p = .026$), work accident – near miss notification and reporting ($F(1,109) = 10.19$, $p = .002$), worker's commitment to OHS ($F(1,109) = 8.59$, $p = .004$), top management's commitment to OHS ($F(1,109) = 10.78$, $p = .001$), management's supervision on subcontractors ($F(1,109) = 7.13$, $p = .009$), emergency management and mine rescue ($F(1,109) = 7.96$, $p = .006$), OHS priority to production and production pressure ($F(1,109) = 5.55$, $p = .020$), ventilation ($F(1,109) = 15.18$, $p < .001$), ground support ($F(1,109) = 13.99$, $p < .001$), mechanization ($F(1,109) = 7.22$, $p = .008$), planning ($F(1,109) = 10.7$, $p = .001$)and internal audit ($F(1,109) = 6.37$, $p = .013$) employees younger than 36 years old evaluated higher than employees older than 36 years old. The descriptive is given in Table 3.5 and Figure 3.4.

Table 3.5 *Descriptive of Safety Culture Dimensions based on Employees' Ages*

| Dimensions | df | F | p | Less than 36 Years Old | | More than 36 Years Old | |
|---|---|---|---|---|---|---|---|
| | | | | Mean | SD | Mean | SD |
| Communication | 1, 109 | 15.13 | .000 | 4.41 | .81 | 3.53 | 1.4 |
| OHS Training | 1, 109 | 5.08 | .026 | 4.22 | .94 | 3.79 | 1.06 |
| Work Accident – Near Miss Notification and Reporting | 1, 109 | 10.19 | .002 | 4.53 | .84 | 3.79 | 1.14 |
| Worker's Commitment to OHS | 1, 109 | 8.59 | .004 | 4.37 | 1.05 | 3.6 | 1.35 |
| Top Management's Commitment to OHS | 1, 109 | 10.78 | .001 | 4.02 | .83 | 3.71 | 1.08 |
| Technical Management's Commitment to OHS | 1, 109 | 2.78 | .099 | 4 | 1.35 | 3.29 | 1.42 |
| Management's Supervision on Subcontractors | 1, 109 | 7.13 | .009 | 4.51 | .87 | 3.92 | 1.25 |

Table 3.5 *Descriptive of Safety Culture Dimensions based on Employees' Ages (Continued)*

| Dimensions | df | F | p | Less than 4 Years | | 4 – 10 Years | |
|---|---|---|---|---|---|---|---|
| | | | | Mean | SD | Mean | SD |
| Emergency Management and Mine Rescue | 1, 109 | 7.96 | .006 | 4.51 | .87 | 3.92 | 1.25 |
| OHS Priority to Production and Production Pressure | 1, 109 | 5.55 | .020 | 4 | 1.15 | 3.44 | 1.33 |
| Ventilation | 1, 109 | 15.18 | .000 | 4.37 | 1.01 | 3.44 | 1.41 |
| Ground Support | 1, 109 | 13.99 | .000 | 4.43 | 1.02 | 3.52 | 1.45 |
| Mechanization | 1, 109 | 7.22 | .008 | 3.94 | 1.05 | 3.34 | 1.25 |
| Planning | 1, 109 | 10.7 | .001 | 4.14 | 1.08 | 3.32 | 1.47 |
| Internal Audit | 1, 109 | 6.37 | .013 | 4.06 | 1.11 | 3.45 | 1.38 |




| | Communication | OHS Training | Work Accident – Near Miss Notification and Reporting | Worker's Commitment to OHS | Top Management's Commitment to OHS | Technical Management's Commitment to OHS | Management's Supervision on Subcontractors | Emergency Management and Mine Rescue | OHS Priority to Production and Production Pressure | Ventilation | Ground Support | Mechanization | Planning | Internal Audit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Less than 36 Years Old | 4.41 | 4.22 | 4.53 | 4.53 | 4.37 | 4.02 | 4.00 | 4.51 | 4.00 | 4.37 | 4.43 | 3.94 | 4.14 | 4.06 |
| More than 36 Years Old | 3.53 | 3.79 | 3.79 | 3.97 | 3.60 | 3.71 | 3.29 | 3.92 | 3.44 | 3.44 | 3.52 | 3.34 | 3.32 | 3.45 |
| Grand Mean | 3.92 | 3.98 | 4.12 | 4.22 | 3.94 | 3.85 | 3.60 | 4.18 | 3.68 | 3.85 | 3.92 | 3.60 | 3.68 | 3.72 |

*Figure 3.4* Mean Values of Safety Culture Dimensions in terms of Employees' Ages

### 3.3.5. Safety Culture Dimension Differences Based on Employees' Organizational Position

There are 15 employees that worked at the surface of the mine and 17 employees that were engineers. In order to complete ANOVA, a similar number of sample sizes are required. So, 20 employees were randomly selected between underground workers. The distribution of them was given in Figure 3.5.

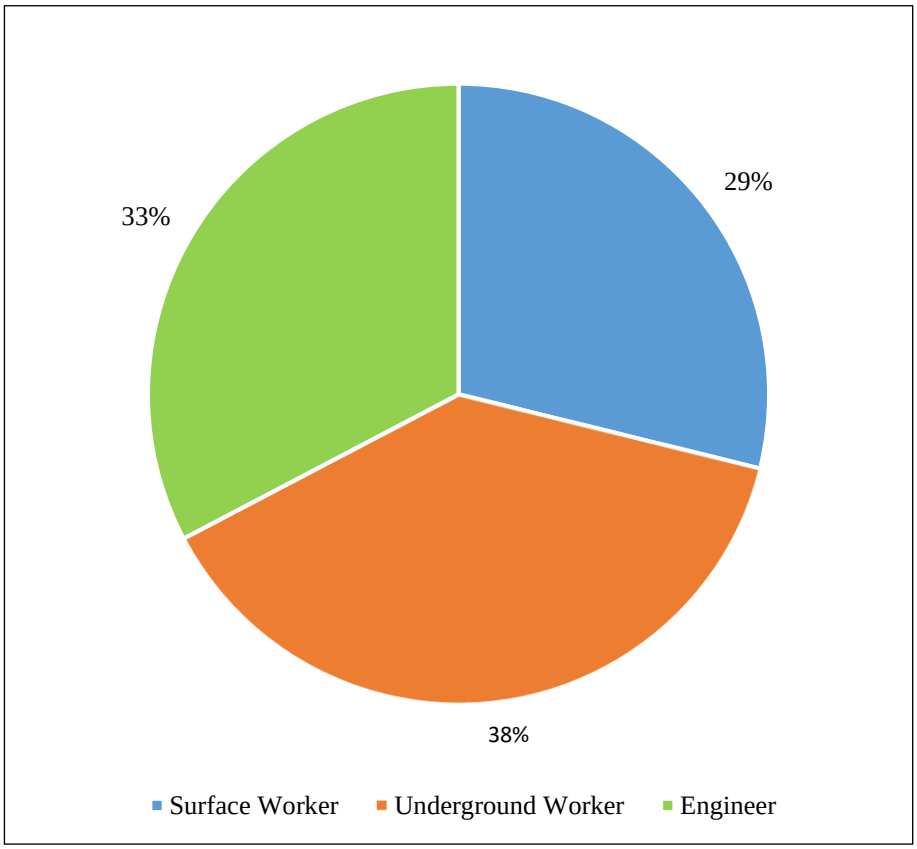



*Figure 3.5* Distribution of Employees' Organizational Position

The organizational position differences were significant only for Technical Management's Commitment to OHS dimension ($F(2,49) = 4.65$, $p = .017$). According to multiple comparisons, underground workers evaluated the dimension significantly different from engineers ($p = .011$). Engineers evaluated Technical Management's Commitment to OHS dimension significantly higher than underground employees. There was no significant difference between any group besides this one. Other

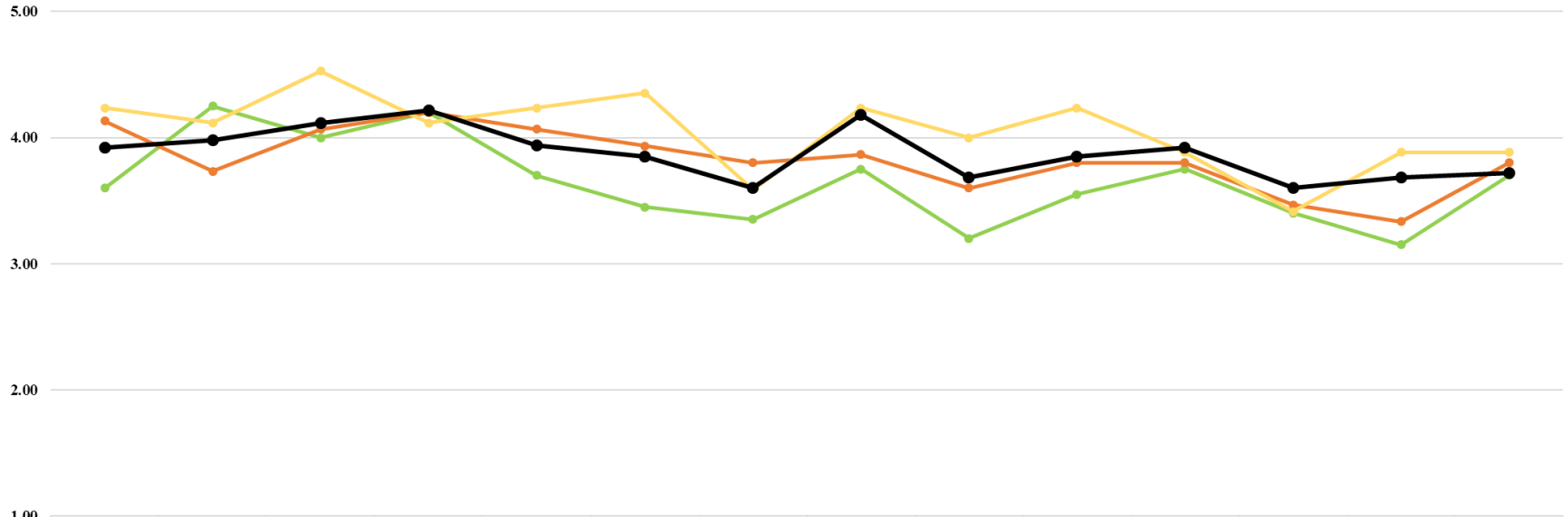
dimensions than Technical Management's Commitment to OHS were not significantly different based on employees' organizational positions in the mines, for descriptive see Table 3.6 and Figure 3.6.

Table 3.6 *Descriptive of Safety Culture Dimensions based on Employees' Organizational Positions*

| Dimensions | df | F | p | Underground | | Surface | | Engineer | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Mean | SD | Mean | SD | Mean | SD |
| Communication | 2 | 1.53 | .228 | 3.6 | 1.5 | 4.13 | .74 | 4.24 | 1.09 |
| OHS Training | 2 | 1.31 | .279 | 4.25 | .97 | 3.73 | .96 | 4.12 | .93 |
| Work Accident – Near Miss Notification and Reporting | 2 | 1.17 | .320 | 4 | 1.3 | 4.07 | 1.28 | 4.53 | .62 |
| Worker's Commitment to OHS | 2 | .05 | .955 | 4.2 | 1.15 | 4.2 | .77 | 4.12 | .7 |
| Top Management's Commitment to OHS | 2 | 1.03 | .36 | 3.7 | .9 | 4.1 | 1.16 | 4.24 | .75 |
| Technical Management's Commitment to OHS | 2 | 4.65 | .014 | 3.45 | 1.15 | 3.93 | .7 | 4.35 | .7 |
| Management's Supervision on Subcontractors | 2 | .45 | .638 | 3.35 | 1.5 | 3.8 | 1.08 | 3.59 | 1.5 |

Table 3.6 *Descriptive of Safety Culture Dimensions based on Employees' Organizational Positions (Continued)*

| Dimensions | df | F | p | Underground | | Surface | | Engineer | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Mean | SD | Mean | SD | Mean | SD |
| Emergency Management and Mine Rescue | 2 | .82 | .448 | 3.75 | 1.37 | 3.87 | .99 | 4.24 | 1.09 |
| OHS Priority to Production and Production Pressure | 2 | 1.66 | .2 | 3.2 | 1.44 | 3.6 | 1.4 | 4 | 1.12 |
| Ventilation | 2 | 1.48 | .24 | 3.55 | 1.43 | 3.8 | 1.21 | 4.24 | .9 |
| Ground Support | 2 | .04 | .958 | 3.75 | 1.29 | 3.8 | 1.37 | 3.88 | 1.45 |
| Mechanization | 2 | .01 | 988 | 3.4 | 1.35 | 3.47 | .92 | 3.41 | 1.54 |
| Planning | 2 | 1.25 | .3 | 3.15 | 1.5 | 3.33 | 1.5 | 3.88 | 1.32 |
| Internal Audit | 2 | .1 | .904 | 3.7 | 1.3 | 3.8 | 1.15 | 3.88 | 1.22 |




| | Communication | OHS Training | Work Accident – Near Miss Notification and Reporting | Worker's Commitment to OHS | Top Management's Commitment to OHS | Technical Management's Commitment to OHS | Management's Supervision on Subcontractors | Emergency Management and Mine Rescue | OHS Priority to Production and Production Pressure | Ventilation | Ground Support | Mechanization | Planning | Internal Audit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Underground | 3.60 | 4.25 | 4.00 | 4.20 | 3.70 | 3.45 | 3.35 | 3.75 | 3.20 | 3.55 | 3.75 | 3.40 | 3.15 | 3.70 |
| Surface | 4.13 | 3.73 | 4.07 | 4.20 | 4.07 | 3.93 | 3.80 | 3.87 | 3.60 | 3.80 | 3.80 | 3.47 | 3.33 | 3.80 |
| Engineer | 4.24 | 4.12 | 4.53 | 4.12 | 4.24 | 4.35 | 3.59 | 4.24 | 4.00 | 4.24 | 3.88 | 3.41 | 3.88 | 3.88 |
| Grand Mean | 3.92 | 3.98 | 4.12 | 4.22 | 3.94 | 3.85 | 3.60 | 4.18 | 3.68 | 3.85 | 3.92 | 3.60 | 3.68 | 3.72 |

*Figure 3.6* Mean Values of Safety Culture Dimensions in terms of Employees' Organizational Positions

### 3.3.6. Work Accident and Safety Culture Dimensions

There were 16 employees that had at least one accident and 95 employees that never had an accident. In order to complete ANOVA, similar number of sample sizes are required; therefore, 20 employees were randomly selected between the employees those never had an accident. The distribution of employees' work accident history that was used in analysis was given in Figure 3.7.

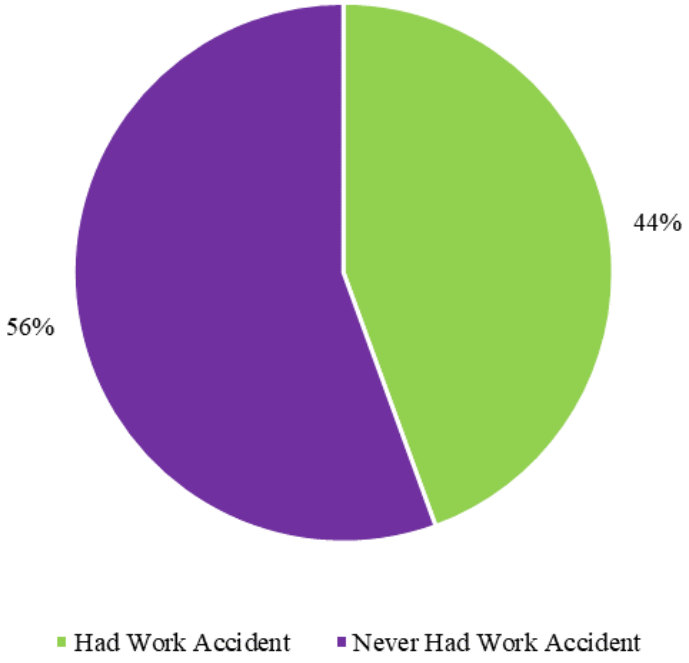



*Figure 3.7* Distribution of Employees' Work Accident History

Fourteen different ANOVAs were conducted for employees that had at least one accident ($N$ = 16) and those never had an accident ($N$ = 20) for 14 safety culture dimensions. As a result, the differences between employees that had an accident and those did not have any accident were significantly different in terms of communication ($F(1,34) = 6.69$, $p = .014$), emergency management and mine rescue ($F(1,34) = 7.58$, $p = .009$) and planning ($F(1,34) = 6.31$, $p = .017$) dimensions. Employees that did not have any accident evaluated communication, emergency management and mine rescue and planning dimensions significantly higher than employees that had accident.

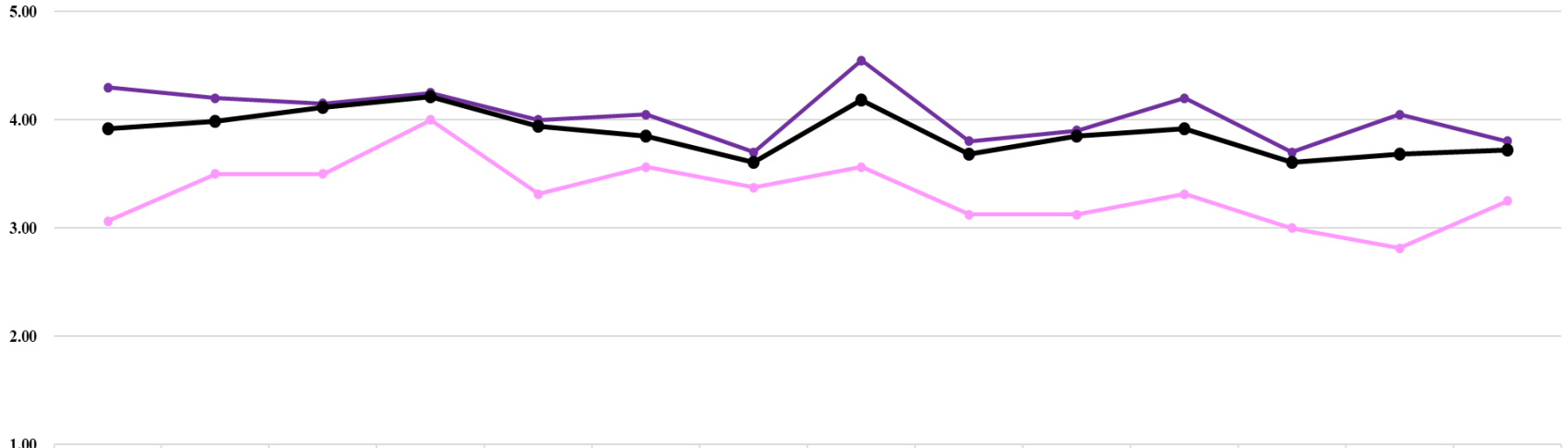
On the other hand, OHS training ($F(1,34) = 3.6$, $p = .067$), work accident – near miss notification and reporting ($F(1,34) = 1.76$, $p = .193$), worker's commitment to OHS ($F(1,34) = .6$, $p = .446$), top management's commitment to OHS ($F(1,34) = 2.49$, p = .124), technical management's commitment to OHS ($F(1,34) = 2.89$, $p = .098$), management's supervision on subcontractors ($F(1,34) = .42$, $p = .521$), OHS priority to production and production pressure ($F(1,34) = 2.34$, $p = .136$), ventilation ($F(1,34) = 2.77$, $p = .105$), ground support ($F(1,34) = 3.11$, $p = .087$), mechanization ($F(1,34) = 2.31$, $p = .138$), internal audit ($F(1,34) = 1.34$, $p = .255$) dimensions employees that never had and those had accidents were not significantly different from each other. The mean and standard deviations were given in Table 3.7 and Figure 3.8.

Table 3.7 *Descriptive of Safety Culture Dimensions based on Work Accidents*

| Dimensions | df | F | p | Had Accident | | Never Had Accident | |
|---|---|---|---|---|---|---|---|
| | | | | Mean | SD | Mean | SD |
| Communication | 1 | 6.69 | .014 | 3.06 | 1.73 | 4.3 | 1.13 |
| OHS Training | 1 | 3.6 | .067 | 3.5 | 1.37 | 4.2 | .83 |
| Work Accident – Near Miss Notification and Reporting | 1 | 1.76 | .193 | 3.5 | 1.67 | 4.15 | 1.27 |
| Worker's Commitment to OHS | 1 | .6 | .446 | 4 | .89 | 4.25 | 1.02 |
| Top Management's Commitment to OHS | 1 | 2.49 | .124 | 3.31 | 1.4 | 4 | 1.21 |
| Technical Management's Commitment to OHS | 1 | 2.89 | .098 | 3.56 | 1.03 | 4.05 | .69 |
| Management's Supervision on Subcontractors | 1 | .42 | .521 | 3.38 | 1.41 | 3.7 | 1.56 |

Table 3.7 *Descriptive of Safety Culture Dimensions based on Work Accidents (Continued)*

| Dimensions | df | F | p | Had Accident | | Never Had Accident | |
|---|---|---|---|---|---|---|---|
| | | | | Mean | SD | Mean | SD |
| Emergency Management and Mine Rescue | 1 | 7.58 | .009 | 3.56 | 1.31 | 4.55 | .83 |
| OHS Priority to Production and Production Pressure | 1 | 2.34 | .136 | 3.13 | 1.63 | 3.8 | 1.01 |
| Ventilation | 1 | 2.77 | .105 | 3.13 | 1.41 | 3.9 | 1.37 |
| Ground Support | 1 | 3.11 | .087 | 3.31 | 1.62 | 4.2 | 1.4 |
| Mechanization | 1 | 2.31 | .138 | 3 | 1.46 | 3.7 | 1.3 |
| Planning | 1 | 6.31 | .017 | 2.81 | 1.56 | 4.05 | 1.39 |
| Internal Audit | 1 | 1.34 | .255 | 3.25 | 1.53 | 3.8 | 1.32 |




| | Communication | OHS Training | Work Accident – Near Miss Notification and Reporting | Worker's Commitment to OHS | Top Management's Commitment to OHS | Technical Management's Commitment to OHS | Management's Supervision on Subcontractors | Emergency Management and Mine Rescue | OHS Priority to Production and Production Pressure | Ventilation | Ground Support | Mechanization | Planning | Internal Audit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Had Accident | 3.06 | 3.50 | 3.50 | 4.00 | 3.31 | 3.56 | 3.38 | 3.56 | 3.13 | 3.13 | 3.31 | 3.00 | 2.81 | 3.25 |
| Never Had Accident | 4.30 | 4.20 | 4.15 | 4.25 | 4.00 | 4.05 | 3.70 | 4.55 | 3.80 | 3.90 | 4.20 | 3.70 | 4.05 | 3.80 |
| Grand Mean | 3.92 | 3.98 | 4.12 | 4.22 | 3.94 | 3.85 | 3.60 | 4.18 | 3.68 | 3.85 | 3.92 | 3.60 | 3.68 | 3.72 |

*Figure 3.8* Mean Values of Safety Culture Dimensions based on Work Accidents

### 3.3.7. Near Miss and Safety Culture Dimensions

There were 21 employees that had at least one near miss and 90 employees that never had one. In order to complete ANOVA, similar number of sample sizes are required; therefore, 20 employees were randomly selected between the employees those never had a near miss. The distribution of employees' near miss history that was used in analysis was given in Figure 3.9.

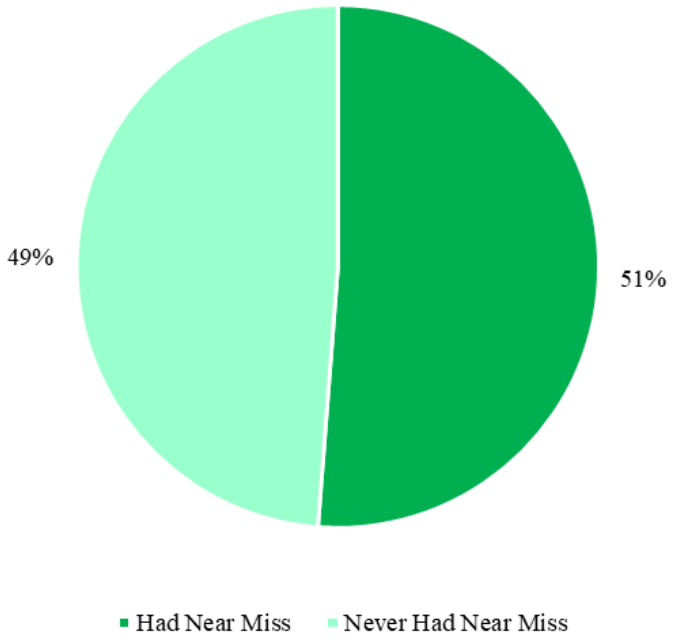



*Figure 3.9* Distribution of Employees' Near Miss History

Fourteen different ANOVAs were conducted for employees who had been a near miss ($N$ = 21) and never had been one ($N$ = 21) for 14 safety culture dimensions. Consequently, the difference for the safety culture dimensions based on near miss experience indicated that none of the difference was significant in terms of communication ($F(1,39) = .95$, $p = .337$), OHS training ($F(1,39) = .46$, $p = .501$), work accident – near miss notification and reporting ($F(1,39) = .11$, $p = .739$), worker's commitment to OHS ($F(1,39) = .07$, $p = .801$), top management's commitment to OHS ($F(1,39) = .99$, $p = .326$), technical management's commitment

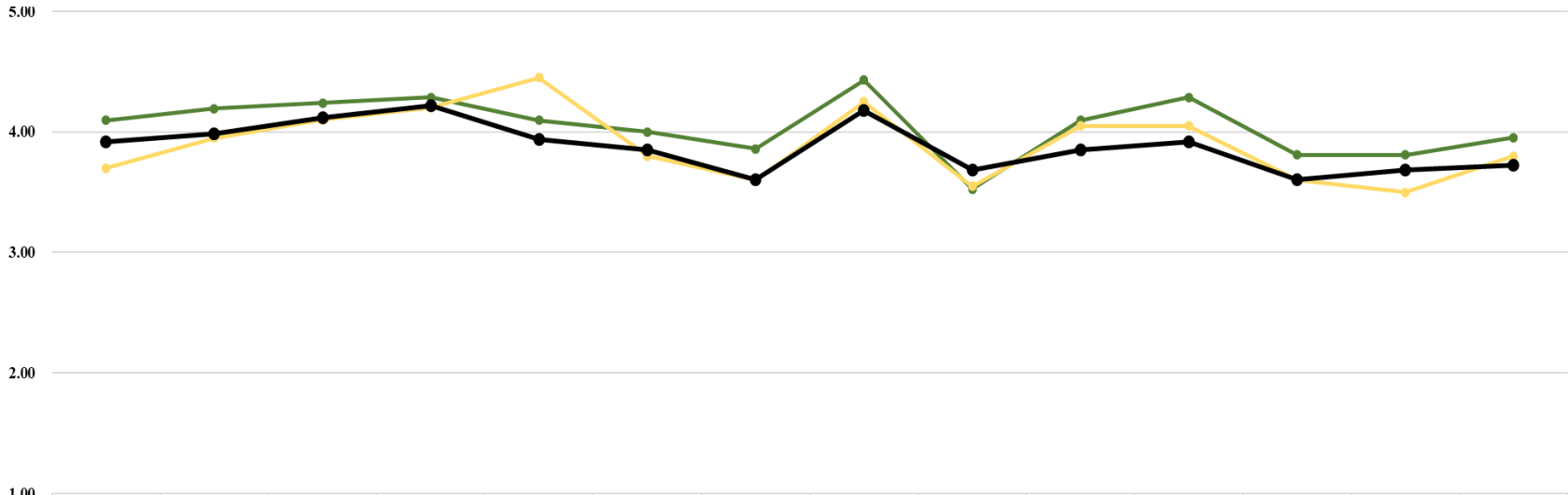
to OHS ($F(1,39) = .51$, $p = .478$), management's supervision on subcontractors ($F(1,39) = .33$, $p = .572$), emergency management and mine rescue ($F(1,39) = .37$, $p = .549$), OHS priority to production and production pressure ($F(1,39) = .004$, $p = .948$), ventilation ($F(1,39) = 01$, $p = .910$), ground support ($F(1,39) = .31$, $p = .580$), mechanization ($F(1,39) = .33$, $p = .572$), planning ($F(1,39) = .47$, $p = .499$) and internal audit ($F(1,39) = .16$, p = .692). For descriptive see Table 3.8 and Figure 3.10.

Table 3.8 *Descriptive of Safety Culture Dimensions based on Near Miss Experience*

| Dimensions | df | F | p | Had Near Miss | | Never Had Near Miss | |
|---|---|---|---|---|---|---|---|
| | | | | Mean | SD | Mean | SD |
| Communication | 1 | .95 | .337 | 4.1 | 1.37 | 3.7 | 1.22 |
| OHS Training | 1 | .46 | .501 | 4.19 | 1.08 | 3.95 | 1.19 |
| Work Accident – Near Miss Notification and Reporting | 1 | .11 | .739 | 4.24 | 1.22 | 4.1 | 1.41 |
| Worker's Commitment to OHS | 1 | .07 | .801 | 4.29 | 1.01 | 4.2 | 1.15 |
| Top Management's Commitment to OHS | 1 | .99 | .326 | 4.11 | 1.26 | 4.45 | 1 |
| Technical Management's Commitment to OHS | 1 | .51 | .478 | 4 | .84 | 3.8 | .95 |
| Management's Supervision on Subcontractors | 1 | .33 | .572 | 3.86 | 1.42 | 3.6 | 1.47 |

Table 3.8 *Descriptive of Safety Culture Dimensions based on Near Miss Experience (Continued)*

| Dimensions | df | F | p | Had Near Miss | | Never Had Near Miss | |
|---|---|---|---|---|---|---|---|
| | | | | Mean | SD | Mean | SD |
| Emergency Management and Mine Rescue | 1 | .37 | .549 | 4.43 | 1.03 | 4.25 | .85 |
| OHS Priority to Production and Production Pressure | 1 | .004 | .948 | 3.52 | 1.29 | 3.55 | 1.28 |
| Ventilation | 1 | .01 | .910 | 4.1 | 1.3 | 4.05 | 1.23 |
| Ground Support | 1 | .31 | .580 | 4.29 | 1.39 | 4.05 | 1.32 |
| Mechanization | 1 | .33 | .572 | 3.81 | 1.08 | 3.6 | 1.27 |
| Planning | 1 | .47 | .499 | 3.81 | 1.36 | 3.5 | 1.54 |
| Internal Audit | 1 | .16 | .692 | 3.95 | 1.12 | 3.8 | 1.32 |




| | Communication | OHS Training | Work Accident – Near Miss Notification and Reporting | Worker's Commitment to OHS | Top Management's Commitment to OHS | Technical Management's Commitment to OHS | Management's Supervision on Subcontractors | Emergency Management and Mine Rescue | OHS Priority to Production and Production Pressure | Ventilation | Ground Support | Mechanization | Planning | Internal Audit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Had Near Miss | 4.10 | 4.19 | 4.24 | 4.29 | 4.10 | 4.00 | 3.86 | 4.43 | 3.52 | 4.10 | 4.29 | 3.81 | 3.81 | 3.95 |
| Never Had Near Miss | 3.70 | 3.95 | 4.10 | 4.20 | 4.45 | 3.80 | 3.60 | 4.25 | 3.55 | 4.05 | 4.05 | 3.60 | 3.50 | 3.80 |
| Grand Mean | 3.92 | 3.98 | 4.12 | 4.22 | 3.94 | 3.85 | 3.60 | 4.18 | 3.68 | 3.85 | 3.92 | 3.60 | 3.68 | 3.72 |

*Figure 3.10* Mean Values of Safety Culture Dimensions based on Near Miss Experience

# CHAPTER 4

# DISCUSSION

## 4.1. General Overview

The present study aims to create a safety culture matrix for underground metal mines, to apply a safety culture assessment to two similar mine sites and compare these assessments. In Study 1, UMeMSaF is developed by in-depth interviews with members of underground metal mine organizations. In Study 2, UMeMSaF is applied in two companies. Finally, the information gathered from Study 2 is analyzed.

The analysis contains the comparison of Company A and Company B according to mean safety scores, company experience, employers' ages, employers' organizational position, accident, and near-miss history.

## 4.2. Discussion of the Results

### 4.2.1. Comparison of Two Companies According to Company Scores

Employees at Company A evaluated all 14 dimensions higher than employees at Company B. There may be several reasons for this result.

At the beginning of the production period, each mine site was under the control of the government. As it is explained in the introduction section, both companies started managing the mine site in 2004. After the privatization of this mine site, there was a mine fire that happened in Company A and 17 miners died in this tragic accident. After that, the whole technical staff has changed in Company A by new top management. For example, top management put a mining engineer who worked in an international mining company as an operations manager in charge and let him create his own technical crew. Meanwhile in Company B, even the top management has changed; however, sub-contractors have not changed, and they are still working on

the mine site. Technical management of Company A is constantly changing in a 6-12 months period because of the disagreements of head engineers with sub-contractors. These changes might lead to improvement in Company A and cause the stationary state in Company B.

Another aspect that causes the difference of the safety culture maturity level of these companies may be the sociological restrictions in Company B. As it is mentioned in the introduction section, Company B is in a region that contains Zazas mostly. Their family bonds make it impossible to change anything in the production and management of Company B. Any effort on change meets a serious amount of resistance. The main problem is that the resistance is social rather than individual. The resource of the social bonding of the employers is not only the workplace but also their social life.

Company tax of Company A and Company B is 40 million TL and 100 million TL respectively. Company tax is directly related to the taxable income of the company. There is no study found about the relationship between safety and income. However, there is a bias of some safety experts especially in the mining sector that some companies (especially gold mines) earn more; therefore, their safety investment rises according to their income. This result says opposite to this bias i.e. even the income of Company B is higher and yet the mean safety culture score is lower than Company A.

### 4.2.2. Employees' Evaluation of Workers Commitment to Safety According to Experience

Employees with more than 10 years of experience evaluated the worker's commitment to safety significantly higher than employees with less than 4 years of experience.

Underground mining has its own context of safety because of the surrounding conditions are not natural (artificial light, mechanized ventilation, dirty places, noise of equipment, the taste of dust, etc.) It is stated by ILO that miners are exposed to a constantly changing combination of workplace circumstances (ILO, 2015). Therefore,

mining is quite different than any other industry. This result may be interpreted as more experienced employees may evaluate the working conditions in the mining sector better and see themselves clearer than less experienced employees.

### 4.2.3. Engineers' Evaluation of Technical Management's Commitment to OHS

Engineers evaluated Technical Management's Commitment to OHS dimension significantly higher than underground employees.

The main reason for this result may be the incoherent applications of technical management in underground operations. Zohar (2010) states that, if technical management (or supervisors) makes inconsistent practices, this leads to a divergence between group and organization level safety climates. Furthermore, the communication between supervisors and frontline workers will be a problem because supervisors are not aware of this negative situation. Clarke (1999) states that the supervisor's behavior reflects the management and their policies in the eyes of the staff. Therefore, if this is the main reason for this result, the situation may cause bigger problems to both Company A and Company B according to the safety culture perspective.

### 4.2.4. Employees' Evaluation of All Dimensions According to Age

For all dimensions except technical management's commitment, employees younger than 36 years old evaluated higher than employees older than 36 years old.

### 4.2.5. Employees' Evaluation of Communication, Emergency Management and Mine Rescue, and Planning According to Accident History

Employees who did not have any accident evaluated communication, emergency management and mine rescue, and planning dimensions significantly higher than employees that had at least one accident.

Employees who had at least one accident before had a chance to test the emergency management of the company. Therefore, it can be assumed that the group of employees that had accident have more experience than employees that did not. This

makes the evaluation of emergency management and mine rescue by employees that had accidents more reliable. Furthermore, both communication and planning dimensions (like other dimensions) are related to accidents. However, it is hard to make an argument on these results.

### 4.3. Limitations of the Study

It should be highlighted that all data collection procedure was completed by the researcher who is also a government OHS inspector. Although this fact is hidden, some of the participants (especially engineers) were aware of the researcher's occupation which may affect the responses and it is a social desirability issue. For example, participants may evaluate their work environment higher than their true evaluation to draw a better picture to the inspector. However, it should be also mentioned that each participant was informed about the study and were ensured anonymity, so it is expected that participants gave their true evaluation about the safety culture of the company which they were working for.

The participant’s knowledge about the safety issues for both general principals and the company status perspective is also quite important. Some degree of knowledge about OHS is a prerequisite for this study. For example, any participant should not ask “What is OHS?” question to the researcher. UMeMSaF has a cell that includes “There is no training for OHS” sentence in the OHS Training dimension’s Pathological step. Therefore, if the company actually is in that step for the OHS Training dimension, this becomes a paradox and it is very difficult to apply UMeMSaF. However, this limitation can be eliminated by a short explanation of the study that made to participants prior to the application.

## 4.4. Suggestions for Further Studies

### 4.4.1. Suggestions for Study 1

As it is known that the first study is made for the underground metal mining sector. There are other studies such as Öcal Şen (2019) for the automotive sector, Pekpak Fındıkçıoğlu (2018) for coal and mineral processing plants and Yazici (2015) for the food industry. There is a need for a safety culture matrix development for the remaining industries. The first suggestion to those who want to carry out a safety culture study in the future is to build a safety culture matrix tool for remaining industries.

UMeMSaF can be applied to every underground metal mine in a country. After this application, a safety culture map can be created and used for introducing safety regulations in that country. With this study, governments can make great progress in the occupational health and safety policy in their countries.

### 4.4.2. Suggestions for Study 2

Brief information about the safety culture matrix which is given prior to application may increase the efficiency of the study. This briefing may eliminate the questions asked in the middle of the application and save time for more participation. Besides, a consensus can be achieved for the concepts in the cells of the matrix. For example, in the UMeMSaF application – which is Study 2 -, planning becomes a complicated issue for some of the participants because they understand planning as technical planning and geographical studies. Technical plans and mapping are a must to carry out any mining project. Therefore, they confused about this topic. It is inappropriate to make any change on the matrix because the words in the cells come from the participants of Study 1. Any intervention that is made by the researcher affects the purity of the study. Afterward, from that point, all participants are informed about what is meant by the term planning in Study 2.

As it is explained in section 4.2.5 communication, emergency management and mine rescue and planning dimensions are correlated with the accident history of the participants. However, safety drills may affect the participants' experience in these dimensions. Therefore, participants' attendance to safety drill can be asked in demographic information sheets. This may show both the relation between safety drills and communication, emergency management and mine rescue and planning dimensions and the efficiency of the safety drills.

A safety culture maturity level and company income relation study can be carried out by comparing more companies and the results found about the mean scores of two companies in this study can be used.

In order to see the relations between behaviors and the culture dimensions, negative or aberrant behaviors in the underground metal mining industry can be retrieved from previous accidents and an aberrant behavior questionnaire can be applied as in Yazici (2015).

## 4.5. Implications

### 4.5.1. Implications for Both Company A and Company B

The results discussed in section 4.2.3 shows that engineers evaluated technical management's commitment to OHS dimension significantly higher than underground employees. Possible reasons for this result are discussed in section 4.2.3. From this discussion, it can be implicated that both Company A and Company B needs to understand the communication between supervisors and frontline workers. The practicability of the procedures should also be evaluated, and necessary transactions should be applied. Especially the supervisors should be aware that their thoughts about their commitment to safety may not reflect reality.

### 4.5.2. Implications for Company A

The comparison of two companies according to all 14 dimensions shows that in all safety culture dimensions, the safety culture score of Company A is greater than

Company B. This does not mean that the management of Company A has nothing to do for their improvements in safety culture maturity. For example, the safety culture score of Company A in OHS priority to production and production pressure shows that there is a balance between safety and production; however, there is an indistinction about the production bonuses.

Study 2 also shows that the effects and especially the results of internal audits in Company A is an indistinct concept for employees.

OHS training is another subject that is not accurate for employees. Some employees think that the cost of training given by a third-party company is an important issue for the management and if the cost is high, management may avoid paying for it.

### 4.5.3. Implications for Company B

As it is stated in 4.2.1, the safety culture maturity level of Company B is lower than Company A. There are two main differences between the companies according to their management systems. The first one is the sub-contractor system used in Company B and the second one is the inconsistent changes in the technical management in Company B. These changes should be finished, and the management should analyze and make solid decisions about their safety system in Company B.

Management's supervision on sub-contractors dimension has the lowest safety culture maturity level in Company A. According to evaluations, sub-contractors are selected mostly considering the cost factor and OSH is not a selection criterion. Therefore, a proper system on sub-contractor management should be ensured by the management.

All of the mining method and application sub-dimensions are evaluated lower than other dimensions except for the management's supervision on sub-contractors dimension. This means that there is a gap between engineering and safety studies in Company B. Maybe increased communication in engineering and safety departments will be the solution to this problem. The engineering department should receive the

safety department's opinions at every stage in order to improve the safety culture maturity level of Company B according to the mining method and application.

### 4.6. Unique Contribution

According to the literature search made during this study, UMeMSaF is the first safety culture measurement tool for underground metal mines in the world. Moreover, interviews that explained in the studies section are carried out without any change in three different companies instead of one for the first time in the history of safety culture research. This allows both interviews and the UMeMSaF matrix can be applicable to any underground metal mines without a language barrier. Another contribution of this study is the comparison of two similar companies with respect to the maturity of safety culture. This comparison is also made for the first time in the world.

There are very important studies on safety culture measurement; however, UMeMSaF has detailed dimensions for the mining sector and more specific applications which increases the resolution of the results. Thus, it allows the specialist to see a clearer picture of the current situation.

There are general dimensions that made a place in literature for the measurement of safety culture. In this study, both these general dimensions and specific dimensions related to mining operations are used. Sub-dimension application is also first used in this study which allows researchers to see the situation in some more detailed area of work of mining operations.

Above all, the core mechanism of a very important tool for measuring the safety culture maturity for underground metal mines, which is UMeMSaF, is provided. Hereupon, any safety culture maturity measurement in underground metal mines can be made with UMeMSaF.

## REFERENCES


Clarke, S., (1999) Perceptions of organizational safety: implications for the development of safety culture. Journal of Organizational Behavior, 185–198.

Cumhuriyet Gazetesi Web Site (2015). Soma davasında üretim baskısı itirafı. Retrieved September 05, 2019, from http://www.cumhuriyet.com.tr/haber/turkiye/451768/Soma_davasinda_uretim_baskisi_itirafi.html

Guldenmund, F. (2000). The nature of safety culture: A review of theory and research. Safety Science, 215-257.

Guldenmund, F. (2017), Are Safety Culture Assessments Really Necessary? Advances in Safety Management and Human Factors pp 101-110

Hollnagel, E., (2014) Safety-I and Safety-II, the past and future of safety management. CRC Press.

Hudson, P., (2003), Safety Management and Safety Culture - The Long Hard Winding Road

Hudson, P., (2007). Implementing a safety culture in a major multi-national. Safety Science 45(6), 697–722.

International Labour Organization (2015). Mining: a hazardous work. Retrieved August 28, 2019, from https://www.ilo.org/global/topics/safety-and-health-at-work/areasofwork/hazardous-work/WCMS_356567/lang--en/index.htm

International Nuclear Safety Advisory Group. Summary Report on the Post-Accident Review Meeting on the Chernobyl Accident. Report No. 75-INSAG-1, Safety Series, (1986)

Lee, J., Huang, Y., Cheung, J.H., Chen, Z., (2019), A systematic review of the safety climate intervention literature. Past trends and future directions. Journal of Occupational Health Psychology 66 – 91

Leveson, N., (2004), A new accident model for engineering safer systems. Safety Science, 237 – 270.

Öcal Şen, D., (2019). Examination of organizational safety culture of an automotive company. (Unpublished master thesis, Middle East Technical University).

Parker, D., Lawrie, M., & Hudson, P. (2006). A framework for understanding the development of organizational safety culture. Safety Science, 551-562.

Pekpak Fındıkçıoğlu, E., (2018). Investigation of workplace accidents in coal and mineral processing plants: unsafe acts, safety culture and safety leadership. (Unpublished doctoral dissertation, Middle East Technical University).

Reason, J., (1997). Managing the Risks of Organizational Accidents. Ashgate, Aldershot.

Westrum, R., (1993). Cultures with requisite imagination. In: Wise, J., Stager, P., Hopkin, J. (Eds.), Verification and Validation in Complex Man–Machine Systems. Springer, New York.

Yapi.com.tr Web Site (2014). Ermenek'teki Kazanın Nedeni Planlama Hatası. Retrieved September 05, 2019, from http://www.yapi.com.tr/haberler/-ermenekteki-kazanin-nedeni-planlama-hatasi_125864.html

Yazici, G., (2015). The relationship between safety culture, aberrant behaviors and safety consequences. (Unpublished master thesis, Middle East Technical University).

Zohar, D., (2010) Thirty years of safety climate research: Reflections and future directions. Accident Analysis and Prevention, 1517–1522.

# APPENDICES

## A. Ethical Permission

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

DUMLUPINAR BULVARI 06800
ÇANKAYA ANKARA/TURKEY
T: +90 312 210 22 91
F: +90 312 210 79
ueam@metu.edu.tr
www.ueam.metu.edu.tr

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
MIDDLE EAST TECHNICAL UNIVERSITY

Sayı: 28620816 /587

11 ARALIK 2018

Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Prof.Dr. Türker ÖZKAN

Danışmanlığını yaptığınız Ahmet ŞEN'in **"Yeraltı Metal Madenciliği Sektöründe Güvenlik Kültürü Seviyesi Analizi"** başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülerek gerekli onay **2018-SOS-207** protokol numarası ile araştırma yapması onaylanmıştır.

Saygılarımla bilgilerinize sunarım.

Prof. Dr. Tülin GENÇÖZ
Başkan

Prof. Dr. Ayhan SOL
Üye

Prof. Dr. Ayhan Gürbüz DEMİR
Üye

Prof.Dr. Yaşar KONDAKÇI (4.)
Üye

Doç. Dr. Ali Emre TURGUT
Üye

Doç. Dr. Emre SELÇUK
Üye

Doç.Dr. Üyesi Pınar KAYGAN
Üye

## B. Underground Metal Mine Safety Culture Matrix Details

Boyut 1: İletişim

| | |
|---|---|
| A | İSG ile ilgili bir iletişim sistemi yoktur. Çalışanların şikayetleri umursanmaz. Çalışanlar yönetimi ve birbirlerini İSG ile ilgili konularda uyarmaz. Vardiyalar arası bilgi aktarımı genellikle yoktur. Varsa bile üretimi aksatmamak içindir. |
| B | İSG ile ilgili bir iletişim sistemi olsa bile göstermeliktir. Çalışanlar sadece çok ciddi konuları şikayet edebilirler. Kazalardan sonra iletişim ile ilgili kayıt vb. çalışmalar olsa da zamanla boşverilir. Vardiyalar arasında şefler (çavuşlar) arasında sözlü iletişim vardır ama üretim içindir. |
| C | İSG ile ilgili bir iletişim sistemi vardır. Çalışanlar şikayetlerini ilgililere iletebilirler. Çalışanlar İSG konusunda birbirini uyarırlar. İletişim kaydı tutulur ama değerlendirilmez. Vardiyalar arasında sözlü bilgi aktarımı vardır. |
| D | İSG ile ilgili yazılı ve sözlü, gelişmiş bir iletişim sistemi vardır. Çalışanlar şikayetlerini üst yönetime (patrona) kadar iletebilirler. Çoğunluk İSG ile ilgili kararlara katılım sağlar. Çalışanlar İSG konularında birbirini ve yönetimi uyarır. İletişim ile ilgili kayıtlar tutulur ve değerlendirilir. Vardiyalar arasında hem sözlü hem de yazılı bilgi aktarımı yapılır. |
| E | İSG ile ilgili iletişim sistemi gelişmiş seviyede olup en güncel teknolojik imkanlar ile sağlanır. İletişim ile ilgili teşvik ve ödüllendirme sistemi mevcuttur. Çalışanlar şikayetlerini üst yönetime (patrona) kadar iletebilirler. İSG ile ilgili kararlara tam katılım sağlanır. Çalışanlar İSG konularında birbirini ve yönetimi uyarır. İletişim ile ilgili kayıtlar tutulur ve değerlendirilir. Vardiyalar arasında sistematik ve teknoloji kullanılarak bilgi aktarımı yapılır. |

| | Boyut 2: İş Sağlığı ve Güvenliği Eğitimi |
|---|---|
| A | Madende İSG eğitimi verilmez ve verilmiş gibi gösterilir. Çalışanlara ve üst yönetime (patrona) göre eğitim gereksizdir. |
| B | Madende İSG eğitimi İş Güvenliği Uzmanı tarafından nadiren verilir. Eğitimlerin faydası yoktur ve pratikle örtüşmez. Çalışanlar eğitime gönüllü olarak değil mecburen katılırlar. Çalışanlara göre eğitim gereksiz ve angaryadır. Üst yönetime (patrona) göre eğitimler iş ve zaman kaybıdır. |
| C | Madende İSG eğitimi İş Güvenliği Uzmanı tarafından yasal zorunlulukları giderecek sürelerde verilir. Eğitimlerin kısmen faydası vardır. Çalışanların bir kısmı eğitime gönüllü olarak bir kısmı mecburen katılırlar. Çalışanların çoğuna göre eğitim gereksizdir. Üst yönetime (patrona) göre eğitimler gereklidir ancak ekstra maliyete getirecek eğitimlerden kaçınılır. |
| D | Madende İSG eğitimi İş Güvenliği Uzmanı ve Diğer uzmanlar tarafından, gerektiğinde dışarıdan hizmet alınarak verilir. İş başında kısa ve öz eğitimler, şefler ya da çavuşlar tarafından verilir. Bu eğitimler uzmanların gerekli gördüğü sıklıklarda verilir. Eğitimlerin ciddi faydası vardır ve pratikle örtüşür. Çalışanların çoğunluğu eğitime gönüllü olarak katılırlar. Çalışanların çoğuna göre eğitim gereklidir. Üst yönetime (patrona) göre eğitimler gereklidir. |
| E | Madende İSG eğitimi İş Güvenliği Uzmanı ve Diğer uzmanlar tarafından, gerektiğinde dışarıdan hizmet alınarak verilir. Eğitime harcanan para, eğitim fayda sağladığı sürece önemsizdir. İş başında kısa ve öz eğitimler, şefler ya da çavuşlar tarafından verilir. Bu eğitimlerin kime, ne zaman verileceği için planlamalar mevcuttur. Eğitimlerin faydası ve pratikle örtüşmesi takip edilir ve eğitimler bu yönde güncellenir. Çalışanların tamamı eğitime gönüllü olarak katılırlar. Çalışanlara göre eğitim gereklidir ve kendileri eğitim talebinde bulunurlar. Üst yönetime (patrona) göre eğitimler gerekli ve son derece önemlidir. |

| | Boyut 3: İş Kazası ve Ramak Kala Olaylarının Bildirimi ve Raporlanması |
|---|---|
| A | Çalışanlar iş kazası ya da ramak kala ile karşılaştığında eğer olay çok büyük değilse söylemez. Bu tür olaylar kimseye bildirilmez. Bu olayların raporlanmasındaki tek amaç yasal zorunluluklardır. |
| B | Çalışanlar iş kazası ya da ramak kala ile karşılaştığında eğer olay çok büyük değilse söylemez. Büyük bir kaza yaşandıktan sonra bazı değişiklikler yapılmaya çalışılsa da zamanla her şey eskiye döner. Bu tür olaylar kimseye bildirilmez. Bu olayların raporlanmasındaki tek amaç yasal zorunluluklardır. |
| C | Çalışanlar iş kazası ya da ramak kala ile karşılaştığında şef ya da çavuşa söyler. Olaylar raporlanır ve kaydedilir fakat işlenmez. Bu olayların raporlanmasındaki amaç yasal zorunluluklardır. |
| D | İşyerinde yaşanan iş kazası ya da ramak kala olayların raporlanması için sistem oluşturulmuştur. Çalışanlar bu olayları sistem üzerinden tüm ilgililere bildirirler. Kazaların incelenmesine çalışanlar katılmazlar. Bu tür olayların raporlanmasındaki temel amaç tekrarlanmaması için gerekli önlemleri almaktır. |
| E | İşyerinde yaşanan iş kazası ya da ramak kala olayların raporlanması için sistem oluşturulmuştur. Çalışanlar bu olayları sistem üzerinden tüm ilgililere bildirirler. Yaşanan kazaların incelenmesine çalışanlar da katılır ve fikir sunarlar. Bu tür olayların raporlanmasındaki temel amaç tekrarlanmaması için gerekli önlemleri almaktır. |

Boyut 4: Çalışanların İş Sağlığı ve Güvenliği'ne Bağlılığı

| | |
|---|---|
| A | Çalışanlar İSG konusunda bilgili ve bilinçli değildir. Kendilerine verilen kişisel koruyucu donanımları (baret, iş elbisesi, gözlük, çelik burunlu çizme vb.) hiç kullanmazlar. Çalışanlara göre İSG bir külfettir. Çalışanlar yaşadıkları iş kazası ve ramak kala olaylarını bildirmezler. |
| B | Çalışanlar işyerinde yaşanmış olan kazalar dışında İSG konusunda bilgili ve bilinçli değildir. Kendilerine verilen kişisel koruyucu donanımları (baret, iş elbisesi, gözlük, çelik burunlu çizme vb.) kısmen kullanırlar ya da hiç kullanmazlar. Çalışanlara göre İSG bir külfettir. Çalışanlar yaşadıkları iş kazası ve ramak kala olaylarını bildirmezler. |
| C | Çalışanlar İSG konusunda kısmen bilgilidir. Kendilerine verilen kişisel koruyucu donanımları (baret, iş elbisesi, gözlük, çelik burunlu çizme vb.) zorunluluktan kullanırlar. Çalışanların bir kısmına göre İSG bir külfet, bir kısmına göre ise gerekliliktir. Çalışanlar yaşadıkları iş kazası olaylarını bildirirler. |
| D | Çalışanlar İSG konusunda bilgilidir. Kendilerine verilen kişisel koruyucu donanımları (baret, iş elbisesi, gözlük, çelik burunlu çizme vb.) hem gereklilikten hem de zorunluluktan (cezadan kaçmak için) kullanırlar. Çalışanların çoğuna göre İSG işin bir parçasıdır. Çalışanlar yaşadıkları iş kazası ve ramak kala olaylarını bildirirler. |
| E | Çalışanlar İSG konusunda üst seviyede bilgili ve bilinçlidir. Kendilerine verilen kişisel koruyucu donanımların (baret, iş elbisesi, gözlük, çelik burunlu çizme vb.) öneminin farkındadırlar ve tamammını kullanırlar. Çalışanların tamamına göre İSG işin bir parçasıdır. Çalışanlar yaşadıkları iş kazası ve ramak kala olaylarını bildirir ve takip ederler. |

| | Boyut 5: Üst Yönetimin İş Sağlığı ve Güvenliği'ne Bağlılığı |
|---|---|
| A | İşletme sahibi ya da üst yönetim İSG konularıyla ilgilenmezler. Kendileri de İSG kurallarına uymazlar. İSG için bütçe ayırmaz ve işyerinde İSG ile ilgili gereklilikleri karşılamazlar. |
| B | İşletme sahibi ya da üst yönetim İSG konularıyla ilgilenmezler. Kazalardan sonra kendilerini korumak için önlemler almaya çalışsalar da zamanla onlar da yok olur. İSG için bütçe ayırmaz, kazalardan sonra bazı ihtiyaçları giderir. |
| C | İşletme sahibi ya da üst yönetim İSG konularıyla az da olsa ilgilidir. Prosedür vb. hazırlatır ama bu işlerle kendisi ilgilenmez. İSG için kısıtlı bir bütçe ayrılır. İSG ile ilgili hedef konulmaz, konulsa da ulaşılamaz. |
| D | İşletme sahibi ya da üst yönetim İSG konularıyla üst seviyede ilgilidir. Prosedür, talimatname vb. hazırlatır ve bizzat takip eder. İSG için sınırı olan ama ciddi miktarda bütçe ayrılır. İSG ile ilgili hedefler koyar ve ulaşıp ulaşılamamasına göre ödül ve ceza uygular. |
| E | İşletme sahibi ya da üst yönetime göre İSG en büyük önceliktir. Prosedür, talimatname vb. hazırlatır ve bizzat takip eder. İSG için sınırsız bütçe ayrılır. İSG ile ilgili hedefler koyar ve bu hedefler işletmenin gelecekte atacağı adımlarla doğrudan alakalıdır. |

Boyut 6: Teknik Yönetimin İş Sağlığı ve Güvenliği'ne Bağlılığı

| | |
|---|---|
| A | İşletme Müdürü ve Mühendisler İSG konularına ilgisizdir ve çalışanları bu konuda teşvik etmezler. Bu kişilere göre İSG'nin önemi yoktur, İSG için bir şeyler yapanlar da kendilerini kurtarmak için yapar. |
| B | İşletme Müdürü ve Mühendisler işyerinde yaşana kazalardan sonra İSG konularına ilgi gösterseler de zamanla bu ilgi yok olur. Çalışanları İSG konusunda teşvik etmezler ve kendilerini İSG konularında geliştirmezler. Bu kişilere göre İSG'nin önemi sadece yasal zorunluluk olmasıdır. |
| C | İşletme Müdürü ve Mühendisler İSG ile ilgi kural ve direktiflere uyarlar. Çalışanları İSG konusunda teşvik ederler ancak kendilerini İSG konularında geliştirmez, İSG'nin sadece İş Güvenliği Uzmanının işi olduğunu düşünürler. Bu kişilere göre İSG önemlidir ama öncelik üretimdir. |
| D | İşletme Müdürü ve Mühendisler İSG ile ilgi tüm kural ve direktiflere uyarlar hatta kendileri bu konularda çalışmalar yaparlar. İSG konusunda gelişime açıktırlar. Çalışanları İSG konusunda teşvik ederler. Bu kişilere göre İSG ön plandadır. |
| E | İşletme Müdürü ve Mühendisler için İSG ile ilgi kural ve direktiflere uyulmaması söz konusu olamaz. İSG konusunda gelişime açık ve heveslidirler. Çalışanları İSG konusunda teşvik ve kontrol ederler. Bu kişilere göre İSG en büyük önceliktir. |

Boyut 7: Yönetimin Taşeron Denetimi

| | |
|---|---|
| A | Yönetim, işyerinde çalışacak taşeronları seçerken herhangi bir İSG kriteri aramaz. İSG uzmanlarına bu konu danışılmaz. Taşeron alımında sadece maliyet ve işin hızlıca tamamlanması önemlidir. |
| B | Yönetim, kaza olduktan sonra işyerinde çalışacak taşeronları seçmek için bazı kriterler getirmiş olsa da bu kriterler zamanla önemsenmemeye başlar. İSG uzmanlarına bu konu danışılmaz. Taşeron alımında önemli olan maliyettir. |
| C | Yönetimin işyerinde çalışacak taşeronları seçerken belirlediği İSG kriterleri genellikle sadece yasal zorunluluklardır. İSG uzmanlarına bu konu danışılmaz. Taşeronların denetimi yapılır ama uyumsuzluklarda yaptırım olmaz, sadece sözlü uyarılar olur. Taşeron alımında İSG ile ilgili zorunluluklara dikkat edilse de önemli olan maliyettir. |
| D | Yönetim işyerinde çalışacak taşeronların seçimi için ciddi İSG kriterleri belirlemiştir. İSG uzmanlarının bu konuda görüşü alınır. Taşeronların denetimi sıklıkla yapılır. Kurallara uymadığı tespit edilenlere para cezası ve sahadan uzaklaştırmaya varan cezalar verilir. Taşeron alımında İSG, maliyet kadar önemlidir. |
| E | Yönetim işyerinde çalışacak taşeronların seçimi için ciddi İSG kriterleri belirlemiştir. İSG uzmanlarının ona vermediği taşeronlar sahaya alınmaz. Taşeronların denetimi sıklıkla yapılır. Kurallara uymadığı tespit edilenlere para cezası ve sahadan uzaklaştırmaya varan cezalar verilir. Taşeron alımında İSG en önemli husustur. |

Boyut 8: Acil Durum Yönetimi ve Tahlisiye

| | |
|---|---|
| A | Madende acil durumlar için hazırlık, planlama ve tatbikat yapılmaz. Acil durum ve Tahlisiye ekipleri oluşturulmaz. Çalışanların ne zaman nerede oldukları takip edilmez. |
| B | Madende acil durumlar için hazırlık, planlama ve tatbikat ya kazalardan sonra yapılır ya da sadece kağıt üzerinde yapılmış gibi gösterilir. Acil durum ve Tahlisiye ekipleri kazalardan sonra oluşturulur ama eğitim vb. verilmez. Çalışanların ne zaman nerede oldukları takip edilmez. Teknojik cihazlar kullanılmaz. |
| C | Madende acil durumlar için hazırlık, planlama ve tatbikat düşük bütçeli olsa da yapılır. Acil durum ve Tahlisiye ekipleri oluşturulur. Acil durumlar için alınan önlemler yasal zorunluluklarla sınırlıdır. Çalışanların takibi için sadece tike, defter vb. kullanılır. Teknolojik ekipman kullanımı yoktur. |
| D | Madende acil durumlar için hazırlık, planlama ve tatbikat sıklıkla yapılır. Acil durum ve Tahlisiye ekipleri oluşturulur ve gerekli eğitimler verilir. Çalışanların takibi için sistem kurulmuştur. Teknolojik ekipman kullanımı sınırlı da olsa vardır. |
| E | Madende oluşabilecek tüm acil durumlar için hazırlık, planlama ve tatbikat yapılır. Acil durum ve Tahlisiye ekipleri oluşturulur ve bu ekiplere sıkılıkla eğitimler verilerek hep hazır tutulurlar. Çalışanların takibi için sistem kurulmuştur. Acil durumlarla ilgili senaryoları içeren simülasyonlar, takip ve kontrol sistemleri gibi teknolojik ekipman kullanımı üst düzeydedir. |

| | Boyut 9: İş Sağlığı ve Güvenliği'nin Üretime Göre Önceliği – Üretim Baskısı |
|---|---|
| A | İşyerinde, yönetime, mühendislere ve çalışanlara göre üretim öncelikli olup İSG'nin hiçbir önemi yoktur. Çalışanların üzerinde üretim ve zaman baskısı çok yüksektir. Çalışanlara verilen (eğer veriliyorsa) primler doğrudan üretimle alakalıdır. |
| B | İşyerinde kazalardan sonra İSG ile alakalı konulara bir süre önem verilse de zamanla yönetime, mühendislere ve çalışanlara göre üretim tekrar ön plana alınır. Çalışanların üzerinde üretim ve zaman baskısı vardır. Çalışanlara verilen (eğer veriliyorsa) primler doğrudan üretimle alakalıdır. |
| C | İşyerinde, yönetime göre üretim ön planda olsa da mühendislere ve çalışanlara göre üretimle beraber İSG'nin de önemi vardır. Çalışanların üzerinde üretim ve zaman baskısı azdır. Çalışanlara verilen (eğer veriliyorsa) primler üretimle alakalıdır. |
| D | İşyerinde, yönetime, mühendislere ve çalışanlara göre İSG önceliklidir. Üretim ikinci plandadır. Çalışanların üzerinde üretim ve zaman baskısı yoktur. Çalışanlara verilen primler hem İSG ile hem de üretimle alakalıdır. |
| E | İşyerinde, yönetime, mühendislere ve çalışanlara göre en büyük öncelik İSG'dir. Çalışanların üzerinde üretim ve zaman baskısı kesinlikle yoktur. Çalışanlara verilen primler İSG hedefleri ile alakalıdır. |

Boyut 10: Havalandırma

| | |
|---|---|
| A | Madende havalandırma sadece işin yapılabilmesi açısından önemli olup yeteri kadar hava yoktur. Gaz ölçümü yapılmaz. Fanlar bozulsa da işe devam edilir. |
| B | Madende hava eksikliğinden kaynaklanan kaza olmadıysa havalandırma sadece makineleri çalıştıracak kadar yapılır. Yeteri kadar hava yoktur. Kazadan sonra bir süre gaz ölçümü yapılsa da zamanla boşverilir. Fanlar bozulursa içerideki havayla işe devam edilir. İş aksatılmaz. |
| C | Madende yeterli havalandırma sağlanması için hesaplamalar yapılır ve ona göre fanlar kurulur. Gaz ölçümü seyyar cihazlarla yapılır. Fanlar bozulunca hemen onarımı yapılır ama iş durmaz. |
| D | Madende havalandırma çok önemli olup yeteri kadar hava vardır. Gaz ölçümü sabit ve seyyar cihazlarla yapılır ve kayıt altına alınır. Fanların bozulması durumunda yedek havalandırma sistemi devreye girer o da bozulursa iş durdurulur. |
| E | Madende havalandırma en üst seviyede önemli olup tamamen mühendislik hesapllamaları ile yapılır. Gaz ölçümü sabit ve seyyar cihazlarla yapılır, yer üstünden takip edilir ve kayıt altına alınır. Fanların bozulması durumunda yedek havalandırma sistemi devreye girer o da bozulursa iş durdurulur. |

Boyut 11: Tahkimat

| | |
|---|---|
| A | Madende zorunlu olmadıkça tahkimat yapılmaz. Göçükler değerlendirilmez. Göçen kısımlar by-pass yapılıp geçilir. Genellikle en düşük maliyetli olan ahşap tahkimat sistemleri kullanılır. |
| B | Madende tahkimat tecrübeye göre yapılır, hesaplama vb yoktur. Kazalardan sonra göçükler değerlendirilse de zamanla değerlendirme bırakılıp göçen kısımlar by-pass yapılıp geçilir. Genellikle en düşük maliyetli olan ahşap tahkimat sistemleri kullanılır. |
| C | Madende tahkimat hem tecrübeye göre hem de hesaplamalara göre yapılır. Yasal zorunluluklar çerçevesinde göçükler değerlendirilir. Tahkimat malzemesi olarak eldeki imkanlara ve zemine göre ahşap, püskürtme beton, çelik bağ vb. kullanılır. |
| D | Madende tahkimat mühendislik çalışmaları ve prosedürlere göre yapılır. Tüm göçükler değerlendirilip gerekli önlemler alınır. Tahkimat malzemesi olarak püskürtme beton, kaya saplaması ve çelik hasır gibi yeni nesil sistmeler kullanılır. |
| E | Madende tahkimat mühendislik çalışmaları ve prosedürlere göre yapılır. Sert zeminde bile tahkimatsız geçilmez, en azından güvenlik püskürtme betonu atılır. Nadir gerçekleşen göçükler değerlendirilip gözden kaçan sebepler belirlenerek tekrar yaşanması önlenir. Tahkimat malzemesi olarak püskürtme beton, kaya saplaması ve çelik hasır gibi yeni nesil sistmeler kullanılır. |

Boyut 12: Mekanizasyon

| | |
|---|---|
| A | Madende üretim insan gücü ağırlıklı olup mekanizasyon bulunmamaktadır. Zorunlu olarak alınacak makine ve ekipmanların alımında önemli olan bunların fiyatıdır. |
| B | Madende üretim insan gücü ağırlıklıdır. Mekanizasyon sadece iş kazası yaşanan kısımlar için mevcuttur. Zorunlu olarak alınacak makine ve ekipmanların alımında ergonomi ikinci planda olup önemli olan bunların fiyatıdır. |
| C | Madende üretim yarı mekanizedir. İnsan gücü ve mekanizasyon birlikte kullanılmakta olup ocağa uyan ekipmanlar zamanla temin edilir. Makine ve ekipmanların alımında önemli olan fiyatı ve yasalara uyumudur. |
| D | Madende mekanize üretim mevcuttur. İnsan gücü çok gerekmedikçe kullanılmaz. Makine ve ekipmanların alımında güvenliği ve ergonomik oluşu ön plandadır. |
| E | Madende tam mekanize ve robotik üretim sistemleri kullanılır. Yeraltına giren insan sayısı mümkün olan en az sayıdadır. Makine ve ekipmanların alımındaki en önemli kriterler güvenlik ve ergonomi ile alakalıdır. |

Boyut 13: Planlama

| | |
|---|---|
| A | Madende herhangi bir planlama yoktur. Gözle cevher takibi yapılarak ilerlenir. |
| B | Madende ilerleme için sondajlar yapılır. Ama bu sondajların amacı cevher takibidir. Güvenlik sondajı yapılmaz. |
| C | Madende üretim için orta vadeli planlamalar yapılır. İSG bu planlara dahil edilir. |
| D | Madende üretim için güvenliğin de dahil edildiği uzun vadeli ve detaylı planlamalar yapılır. İSG bu planların önemli bir parçasıdır. |
| E | Madende üretim için güvenliğin de içinde olduğu, yaşanabilecek olumsuzluklara ilişkin senaryoları içeren uzun vadeli ve detaylı planlamalar yapılır. İSG bu planların ana elemanıdır. |

Boyut 14: İç Denetim

| | |
|---|---|
| A | Madende güvenlik ile alakalı bir iç denetim sistemi bulunmamaktadır. Denetim yapılıyorsa bile üretimle alakalıdır. |
| B | Madende kazalardan sonra İSG ile alakalı bazı denetimler yapılsa da sistem yoktur ve zamanla bu denetimler yapılmamaya başlar. |
| C | Madende İSG ile alakalı olarak iş güvenliği uzmanı tarafından düzenli denetim yapılır. Bu denetimlerin para cezası vb. yaptırımları vardır. Denetimler kısmen etklidir. |
| D | Madende İSG ile alakalı düzenli denetimler mevcuttur. Bu denetimlerin işten çıkarmaya kadar varan ciddi yaptırımları vardır. Denetimler çalışanlar üzerinde etkilidir. |
| E | Madende İSG ile alakalı denetim sürekli olarak hem yönetim tarafından yapılır hem de çalışanlar birbirini denetler. Bu denetimlerin işten çıkarmaya kadar varan ciddi yaptırımları vardır ve denetimler çok etkilidir. |

## C. Voluntary Participation Form

### YERALTI METAL MADENCİLİĞİ SEKTÖRÜ-GÜVENLİK KÜLTÜRÜ MATRİSİ ANKETİ

**ARAŞTIRMAYA GÖNÜLLÜ KATILIM FORMU**

Orta Doğu Teknik Üniversitesi, İş Sağlığı ve Güvenliği yüksek lisans öğrencisi Ahmet ŞEN, İş Sağlığı ve Güvenliği programı öğretim görevlisi Doçent Doktor Türker ÖZKAN denetiminde iş güvenliği hakkında bilimsel çalışma yürütmektedir. Bu form sizi araştırma koşulları hakkında bilgilendirmek için hazırlanmıştır.

**Çalışmanın Amacı Nedir?**

Bir iş yerlerinde çalışmanın ne derece güvenli olduğu temel olarak güvenlik kültüründen etkilenmektedir. Güvenlik kültürü bir işyerinde tüm çalışanlar tarafından iş güvenliği ile ilgili paylaşılan kanaat ve benimsenen tavırların bütünüdür. Bu çalışmanın amacı Yeratı Metal Madenciliği Sektöründe güvenlik kültürü olgunluk seviyelerini belirlemek ve güvenlik kültürü gelişimine katkıda bulunmaktır.

**Bize Nasıl Yardımcı Olmanızı İsteyeceğiz?**

Araştırma sizinle birebir görüşme yapılarak gerçekleştirilecektir. Görüşmenin içeriği şu anda çalışmakta olduğunuz işyerinden ziyade bu sektörde çalıştığınız, ziyaret ettiğiniz, gördüğünüz, iş çevrenizde duymuş olduğunuz tüm iş yerlerini ve genel olarak yeraltı metal madenciliği sektöründe çalışmakla ilgili fikirlerinizi kapsamaktadır.

**Katılımınızla ilgili bilmeniz gerekenler:**

Bu çalışmaya katılmak tamamen gönüllülük esasına dayalıdır. Herhangi bir yaptırıma veya cezaya maruz kalmadan çalışmaya katılmayı reddedebilir veya çalışmayı bırakabilirsiniz. Araştırma esnasında cevap vermek istemediğiniz sorular olursa boş bırakabilirsiniz.

Araştırmaya katılanlardan toplanan veriler tamamen gizli tutulacak, veriler ve kimlik bilgileri herhangi bir şekilde eşleştirilmeyecektir. Katılımcıların isimleri bağımsız bir listede toplanacaktır. Ayrıca toplanan verilere sadece araştırmacılar ulaşabilecektir. Bu araştırmanın sonuçları bilimsel ve profesyonel yayınlarda veya eğitim amaçlı kullanılabilir, fakat katılımcıların kimliği gizli tutulacaktır.

**Araştırmayla ilgili daha fazla bilgi almak isterseniz:**

Çalışmayla ilgili soru ve yorumlarınızı araştırmacıya sen.ahmet@metu.edu.tr adresinden iletebilirsiniz.

***Yukarıdaki bilgileri okudum ve bu çalışmaya tamamen gönüllü olarak katılıyorum.***

(İmzalamanız yalnızca çalışmaya gönüllü katıldığınızı göstermekte olup zorunlu değildir)

| Adı Soyadı: | Görevi | Tarih | İmza |
|---|---|---|---|
| ……. | …… | …/…/….. | …… |

**BU ANKET TAMAMEN GİZLİ TUTULACAK OLUP KİŞİSEL BİLGİLER PAYLAŞILMAYACAKTIR.**

**ARAŞTIRMA ÇALIŞMA HAYATININ DAHA GÜVENLİ BİR HALE GELMESİNE KATKIDA BULUNMAK ÜZERE KULLANILACAKTIR.**

## D. Post-Research Information Form

### ARAŞTIRMA SONRASI BİLGİLENDİRME FORMU

Öncelikle bu araştırmaya katıldığınız için teşekkür ederiz.

Bu çalışma daha önce de belirtildiği gibi Orta Doğu Teknik Üniversitesi İş Sağlığı ve Güvenliği yüksek lisans öğrencisi Ahmet Şen tarafından iş sağlığı ve güvenliği programı öğretim görevlisi Prof. Dr. Türker Özkan denetiminde iş güvenliği kültürü hakkında yürütülen yüksek lisans tez araştırmasıdır.

Bu çalışmanın amacı çalıştığınız şirketteki güvenlik kültürünün çeşitli boyutlar için ölçülmesidir. İşyerlerinde güvenlik kültürünün ölçülmesi, işyerinin incelenen boyutlarda çalışanların genel algısında göre ne seviyede olduğunu göstermektedir. Bunun sonucunda ise işyerinin iyileştirmeye açık yönler ortaya çıkmakta ve ilerleme kaydedilmesine olanak sağlanmaktadır.

Elde edilen bilgiler bilimsel araştırma ve yazılarda kullanılacaktır. Çalışma ile ilgili ek bilgi almak ya da sonuçları öğrenmek istediğinizde sen.ahmet@metu.edu.tr adresinden Orta Doğu Teknik Üniversitesi İş Sağlığı ve Güvenliği Bölümü yüksek lisans öğrencisi Ahmet Şen ile iletişime geçebilirsiniz.

## E. Personal Information and Data Collection Sheet

☐ Yeraltı Çalışanı ☐ Yerüstü Çalışanı ☐ Mühendis

| | | | | | |
|---|---|---|---|---|---|
| **Yaşınız** | ☐ 18-25 | ☐ 26-35 | ☐ 36 ve üzeri | | |
| **Cinsiyetiniz** | ☐ Kadın | ☐ Erkek | | | |
| **En Son Mezun Olduğunuz Okul** | ☐ İlkokul<br>☐ Yüksekokul<br>☐ Yüksek Lisans | ☐ Ortaokul<br>☐ Üniversite<br>☐ Doktora | ☐Lise | | |
| **Bu Şirketteki Tecrübeniz** | ☐ 1 Yıldan Az<br>☐ 10 Yıldan Fazla | ☐ 1-3 Yıl | ☐ 4-10 Yıl | | |
| **Toplam İş Tecrübeniz** | ☐ 1 Yıldan Az<br>☐ 10 Yıldan Fazla | ☐ 1-3 Yıl | ☐ 4-10 Yıl | | |
| **Daha Önce İş Kazası Geçirdiniz Mi?** | ☐ Evet | ☐ Hayır | | | |
| **Kıl Payı (Ramak Kala) Yaşadınız Mı?** | ☐ Evet | ☐ Hayır | | | |
| **Ayda Kaç Saat Fazla Mesai Yapıyorsunuz?** | ☐ 1-3 Saat | ☐ 3-8 Saat | ☐ 8-11 Saat | | |

| | | A | B | C | D | E |
|---|---|---|---|---|---|---|
| **1** | İLETİŞİM | | | | | |
| **2** | İSG EĞİTİMİ | | | | | |
| **3** | İŞ KAZASI / RAM. KALA RAPOR. | | | | | |
| **4** | ÇALIŞAN BAĞLILIĞI | | | | | |
| **5** | ÜST YÖNETİMİN BAĞLILIĞI | | | | | |
| **6** | TEKNİK YÖNET. BAĞLILIĞI | | | | | |
| **7** | TAŞERON DENETİMİ | | | | | |
| **8** | ACİL DURUMLAR ve TAHLİSİYE | | | | | |
| **9** | İSG – ÜRETİM ÖN. ÜRETİM BASKISI | | | | | |
| **10** | HAVALANDIRMA | | | | | |
| **11** | TAHKİMAT | | | | | |
| **12** | MEKANİZASYON | | | | | |
| **13** | PLANLAMA | | | | | |
| **14** | İÇ DENETİM | | | | | |

## F. Study 2 Results

1. Communication Dimension Results

| Companies | A01 | B01 | C01 | D01 | E01 | Total |
|---|---|---|---|---|---|---|
| **Company A** | | | 2 | 12 | 41 | 55 |
| **Company B1** | | | | 6 | 1 | 7 |
| **Company B2** | 2 | 3 | 2 | 2 | 1 | 10 |
| **Company B3** | | 3 | 2 | 5 | 4 | 14 |
| **Company B4** | 6 | 5 | 4 | 10 | | 25 |
| **Grand Total** | **8** | **11** | **10** | **35** | **47** | **111** |

2. OHS Training Dimension Results

| Companies | A02 | B02 | C02 | D02 | E02 | Total |
|---|---|---|---|---|---|---|
| **Company A** | | 2 | 3 | 20 | 30 | 55 |
| **Company B1** | | | 1 | 4 | 2 | 7 |
| **Company B2** | | 3 | 3 | 3 | 1 | 10 |
| **Company B3** | 1 | 1 | 3 | 8 | 1 | 14 |
| **Company B4** | 1 | 5 | 4 | 9 | 6 | 25 |
| **Grand Total** | **2** | **11** | **14** | **44** | **40** | **111** |

3. Work Accident – Near Miss Notification and Reporting Dimension Results

| Companies | A03 | B03 | C03 | D03 | E03 | Total |
|---|---|---|---|---|---|---|
| **Company A** | | | | 8 | 47 | 55 |
| **Company B1** | | | | 2 | 5 | 7 |
| **Company B2** | 2 | 3 | 1 | 2 | 2 | 10 |
| **Company B3** | 1 | | 3 | 6 | 4 | 14 |
| **Company B4** | 4 | 7 | 6 | 2 | 6 | 25 |
| **Grand Total** | **7** | **10** | **10** | **20** | **64** | **111** |

4. Worker's Commitment to OHS Dimension Results

| Companies | A04 | B04 | C04 | D04 | E04 | Total |
|---|---|---|---|---|---|---|
| **Company A** | 1 | | 2 | 14 | 38 | 55 |
| **Company B1** | | | | 3 | 4 | 7 |
| **Company B2** | | 2 | 1 | 2 | 5 | 10 |
| **Company B3** | | | 5 | 6 | 3 | 14 |
| **Company B4** | 3 | 2 | 6 | 6 | 8 | 25 |
| **Grand Total** | **4** | **4** | **14** | **31** | **58** | **111** |

5. Top Management's Commitment to OHS Dimension Results

| Companies | A05 | B05 | C05 | D05 | E05 | Total |
|---|---|---|---|---|---|---|
| **Company A** | | 3 | | 16 | 36 | 55 |
| **Company B1** | | 1 | 1 | | 5 | 7 |
| **Company B2** | 1 | 2 | 4 | 2 | 1 | 10 |
| **Company B3** | | | 5 | 3 | 6 | 14 |
| **Company B4** | 4 | 12 | | 3 | 6 | 25 |
| **Grand Total** | **5** | **18** | **10** | **24** | **54** | **111** |

6. Technical Management's Commitment to OHS Dimension Results

| Companies | A06 | B06 | C06 | D06 | E06 | Total |
|---|---|---|---|---|---|---|
| **Company A** | | | 3 | 38 | 14 | 55 |
| **Company B1** | | | 1 | 5 | 1 | 7 |
| **Company B2** | | 2 | 3 | 3 | 2 | 10 |
| **Company B3** | | | 4 | 6 | 4 | 14 |
| **Company B4** | 5 | 3 | 7 | 5 | 5 | 25 |
| **Grand Total** | **5** | **5** | **18** | **57** | **26** | **111** |

7. Management's Supervision on Subcontractors Dimension Results

| Companies | A07 | B07 | C07 | D07 | E07 | Total |
|---|---|---|---|---|---|---|
| **Company A** | 1 | | 5 | 14 | 35 | 55 |
| **Company B1** | | | 1 | 2 | 4 | 7 |
| **Company B2** | 3 | 2 | 3 | 2 | | 10 |
| **Company B3** | 3 | 1 | 3 | 5 | 2 | 14 |
| **Company B4** | 7 | 12 | 2 | 3 | 1 | 25 |
| **Grand Total** | **14** | **15** | **14** | **26** | **42** | **111** |

8. Emergency Management and Mine Rescue Dimension Results

| Companies | A08 | B08 | C08 | D08 | E08 | Total |
|---|---|---|---|---|---|---|
| **Company A** | | | | 7 | 48 | 55 |
| **Company B1** | | | 1 | 3 | 3 | 7 |
| **Company B2** | 1 | 1 | 4 | 2 | 2 | 10 |
| **Company B3** | | 4 | 2 | 4 | 4 | 14 |
| **Company B4** | 3 | 3 | 7 | 7 | 5 | 25 |
| **Grand Total** | **4** | **8** | **14** | **23** | **62** | **111** |

9. OHS Priority to Production and Production Pressure Dimension Results

| Companies | A09 | B09 | C09 | D09 | E09 | Total |
|---|---|---|---|---|---|---|
| **Company A** | 1 | 3 | 8 | 18 | 25 | 55 |
| **Company B1** | | | 2 | | 5 | 7 |
| **Company B2** | | 3 | 4 | 1 | 2 | 10 |
| **Company B3** | 1 | 4 | 3 | 1 | 5 | 14 |
| **Company B4** | 3 | 11 | 3 | 3 | 5 | 25 |
| **Grand Total** | **5** | **21** | **20** | **23** | **42** | **111** |

10. Ventilation Dimension Results

| Companies | A10 | B10 | C10 | D10 | E10 | Total |
|---|---|---|---|---|---|---|
| **Company A** | | | 6 | 10 | 39 | 55 |
| **Company B1** | | | 2 | 1 | 4 | 7 |
| **Company B2** | 3 | 3 | 1 | | 3 | 10 |
| **Company B3** | 1 | | 6 | 4 | 3 | 14 |
| **Company B4** | 7 | 3 | 8 | 5 | 2 | 25 |
| **Grand Total** | **11** | **6** | **23** | **20** | **51** | **111** |

11. Ground Support Dimension Results

| Companies | A11 | B11 | C11 | D11 | E11 | Total |
|---|---|---|---|---|---|---|
| **Company A** | | | 2 | 3 | 50 | 55 |
| **Company B1** | 1 | | 1 | 2 | 3 | 7 |
| **Company B2** | 2 | 4 | 1 | 2 | 1 | 10 |
| **Company B3** | 1 | 3 | 5 | 2 | 3 | 14 |
| **Company B4** | 5 | 5 | 6 | 9 | | 25 |
| **Grand Total** | **9** | **12** | **15** | **18** | **57** | **111** |

12. Mechanization Dimension Results

| Companies | A12 | B12 | C12 | D12 | E12 | Total |
|---|---|---|---|---|---|---|
| **Company A** | | | 1 | 34 | 20 | 55 |
| **Company B1** | | | 4 | 3 | | 7 |
| **Company B2** | 6 | 1 | 2 | | 1 | 10 |
| **Company B3** | 4 | | 6 | 3 | 1 | 14 |
| **Company B4** | 2 | 4 | 10 | 6 | 3 | 25 |
| **Grand Total** | **12** | **5** | **23** | **46** | **25** | **111** |

13. Planning Dimension Results

| Companies | A13 | B13 | C13 | D13 | E13 | Total |
|---|---|---|---|---|---|---|
| **Company A** | | | | 26 | 29 | 55 |
| **Company B1** | 1 | | | 2 | 4 | 7 |
| **Company B2** | 4 | 4 | | 1 | 1 | 10 |
| **Company B3** | 3 | 4 | | 6 | 1 | 14 |
| **Company B4** | 4 | 9 | 3 | 6 | 3 | 25 |
| **Grand Total** | **12** | **17** | **3** | **41** | **38** | **111** |

14. Internal Audit Dimension Results

| Companies | A14 | B14 | C14 | D14 | E14 | Total |
|---|---|---|---|---|---|---|
| **Company A** | | | 7 | 24 | 24 | 55 |
| **Company B1** | | | 1 | 1 | 5 | 7 |
| **Company B2** | 4 | 4 | | 1 | 1 | 10 |
| **Company B3** | 1 | 3 | 6 | 1 | 3 | 14 |
| **Company B4** | 5 | 4 | 5 | 4 | 7 | 25 |
| **Grand Total** | **10** | **11** | **19** | **31** | **40** | **111** |