

INVESTIGATION OF THE SURFACE TURKEY MINE WORKERS' ATTITUDES OF TAKING RISKS

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ABSTRACT

The present study is designed to depict the tendency of mine workers to take risks by the help of a structural equation model proposed. For this purpose, a survey consisting of 15 statements was conducted on 150 workers selected randomly from a surface mine. First section of the study is the introduction. Second section gives a literature review. Third section presents the theoretical framework of the structural equation modelling (SEM), and the final section gives the results of the analysis. Results of the analysis indicate that negative affectivity, fatalistic approach and perception of the sufficiency of workplace safety have a significant effect on the tendency of mine workers to take risks. Upon the SEM, the finding that a one unit increase in negative affectivity results in an increase of 0.51 unit in the tendency of workers to take risks was found to be noteworthy.

Keywords: Surface Mines, Workers, Risk Taking Tendency, Structural Equation Modelling

1. INTRODUCTION

Although Turkey does not have sufficient reserves of oil and natural gas, which are important energy resources, it is possible to say that it has sufficient coal reserves. Particularly, it has a considerable amount of lignite reserves. Turkey has 15.4 billion tons of coal reserves, 14.1 billion tons of which is lignite. It has 1.4% of the world's coal reserves. Its lignite reserves make up 4.2% of the world lignite reserves, making Turkey the 4th country with the largest lignite reserves in the world.

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Additionally, Turkey has a high position in coal production as well, and is the 5th largest lignite producer in the world. 96% of the total coal production is lignite and 4% is anthracite coal [18]. According to the 2012 statistics of the Turkish Social Security Authority [19] 141387 workers are employed in the mining industry, 50,949 of which are employed in coal mining. In other words, 36% of the workers in the mining industry are employed in coal mining. Another statistic is that 1.18% of all insured employees in all sectors in Turkey are employed in coal mining [18].

The mining sector is, by its nature, the world's hardest and riskiest branch of industry that contains risks which are linked to each other and may trigger each other in a chain effect, and that requires knowledge, experience, specialization and continuous control to minimize such risks. Particularly in Turkey where the sector is labor-intensive with less use of technology, the existing or potential weaknesses in the chain of knowledge, experience, specialization and control results in the rupture of this chain, leading to work accidents, and especially severe accidents in underground coal mining. Coal mining is at the top of the list in terms of the number of accidents and deaths per worker among all sectors [1].

The numbers of deaths recorded in mining accidents in Turkey by years are shown in Figure 1. The numbers of deaths by years are 113 in 1983 year (Armutçuk: 103, Kozlu: 10), 8 in 1987 (Kozlu: 8), 68 in 1990 (Amasya: 68), 263 in 1992 (Kozlu: 263), 38 in 1995 (Sorgun: 38), 17 in 2003 (Ermenek 10, Aşkale: 7), 19 in 2004 (Küre: 19, Bayat: 3), 18 in 2005 (Gediz: 18), 21 in 2006 (Mengen: 2, Azdayav: 2, Dursunbey: 17), 7 in 2007 (Ermenek: 2, Dursunbey: 3, Kilimli: 2), 19 in 2009 (Mustafakemalpaşa: 19), 50 in 2010 (Odaköy: 17, Karadon: 30, Keşan: 3), 11 in 2011 (Elbistan: 11), 8 in 2013 (Kozlu: 8), 328 in 2014 (Soma: 301, Ermenek: 18, Kemerli: 3, Amasra: 2), 6 in 2015 and 16 in 2016 (Şirvan: 16). The mining disaster that resulted in the the death of 301 people in Soma, Manisa on May 13, 2014 is the largest work accident with the most severe consequences ever in Turkey [16,17,18].

More than 3 thousand people have died in mining accidents in Turkey since 1941. More than 100 thousand people have been injured. The most common causes of mining accidents are firedamp explosion, collapse and fire. In 2008, 127 people per 100 million tons of coal died in China, one of the largest coal producers in the world, and this figure fell to 37 in 2013. In the United States, one of the largest coal producers in the world, 1 to 6 people per 100 million tons of coal died [17].

2. LITERATURE REVIEW

Explosions and accidents in the Turkish mining industry arising from various reasons such as negligence and imprudence result in substantial damages. Therefore, it is quite important to make improvements in the Turkish mining industry. The present study researches the attitudes of mine workers in relation to their risk perceptions. There are various studies on this subject in the literature. The literature on this subject is summarized below. The study researched whether there was a relationship between the safety training received by workers within the last 24 months and their risk tolerance. A survey was conducted to assist in the evaluation of the risk tolerance levels of stone mining workers in Pennsylvania (U.S.) The results show that workplace safety training is not associated with the risk tolerance of a worker, and that as the reported number of hours of non-workplace safety training increases, so does the workers' tolerance for high personal risk situations [2].

The main purpose of risk evaluation is to inform, guide and support relevant people so as to reduce the risk. In reducing psychosocial risks, the only purpose should not be the training, improvement and retention of employees. A way must be found to reduce at source the factors that cause stress. Paragraph d of article 5 of the Law no. 6631 titled "Principles of avoiding risks" directly points out to the origin of psychosocial risks (Paragraph d: To pay attention to the design of workplaces and to the selection of work equipment, mode of working and production methods so as to render the work suitable for the persons, to prevent the adverse effects of monotonous working and production tempo on health and safety or to reduce such effects if they cannot be prevented) [3].

The level of risk perceived by everyone in relation to a given situation is different. The lower the level of hazard perceived by someone in relation to a situation is, the more that person will be willing to take risks relating to that hazard [4]. Another study shows that risk perception does not entail risk behavior and is perceived as behavior affected from risk due to stress effect [5].

This study explored the accident susceptibility differences between underground coal mine workers grouped according to personal and workplace characteristics. Logistic regression model was used for this purpose. According to the results of the case study, there is no significant difference between the accident susceptibility of different age and experience groups, but there are significant differences between the risk of injury of workers grouped according to their occupations and workplace locations [6]. In [7] examined the relationships between the tendency of mine workers to take risks, time pressure and safety commitments made by the management. Significant relationships were found between the specified factors.

This study [8] defined various risk factors in coal mines and analyzed their effects on work accidents within a causal framework. The data were collected from an underground coal mine in India. The model for the relationship of 16 causal factors with work accidents and the power of this model were assessed by structural equation modelling. The necessity of (i) identifying negative individuals, (ii) identifying the negative effects of negative behaviors correctly and (iii) delivering special training through the use of psychological tests in long-term planning was emphasized. In this study [15] sought to examine the role of behavioral factors on the occurrence of mine accidents and injuries through a case study. Data were collected from two neighboring underground coal mines operating under a large public sector organization of India. The case study results show that accident group of workers (cases) are more job dissatisfaction, negatively affected, and highly risk taking compared to the non-accident group of workers (controls). The accident model path analysis shows that negative affectivity, job dissatisfaction, and risk taking behaviors predict an increased number of injuries in mines.

In this study [9] an attempt has been made to identify the various factors responsible for work related injuries in mines and to estimate the risk of work injury to mine workers. The analysis reveals that negatively affected workers are 2.54 times more prone to injuries than the less negatively affected workers and this factor is a more important risk factor for the case-study mines. Long term planning through identification of the negative individuals, proper counseling regarding the adverse effects of negative behaviors and special training is urgently required. Care should be taken for the aged and experienced workers in terms of their job responsibility and training requirements. In [10] proposed a structural equation model to examine the relationship between personal factors causing work accidents in underground coal mines and work accidents and the nature of their successive relationships. This study takes into account variables such as risk-taking, negative affections, work stress and job dissatisfaction.

There are numerous factors that affect accident/injury incidents in mines. It is quite difficult to identify such factors. Studies often focus on the age, experience and profession of the labor. These variables cannot be changed, but variables such as personality, social benefits, safety environment, negative affectivity, workplace threats and job satisfaction are considered to be the alterable variables of a safety system [8].

The literature review shows that determinants of work injuries in mines can be categorized into the following groups: demographic, personality, job stress, job dissatisfaction, safety environment, work hazards, social support, and safe work behavior. This study sought to

explore the effects of **A**: *negative affectivity*, **B**: *fatalistic approach* and **G**: *workplace safety sufficiency perception* of mine workers on their tendency to take risks through the use of a structural equation model proposed. First, the theoretical framework of the SEM will be given in the following section.

3. MATERIALS AND METHODS

Research model and hypotheses

The study proposes a SEM to explore the effects of *D: tendency to take risks*, *A: negative affectivity*, *B: fatalistic approach* and *G: workplace safety sufficiency perception* of mine workers. In the research model, A, B and G were define as exogenous latent variables, whereas D was defined as endogenous latent variable. Negative affectivity refers to the chronic experience of negative emotional states and lack of emotional stability. In their review of negative affectivity This study [11] identified it as a unique personality construct with the following features: chronic negative mood states, feelings of nervousness and worry, pervasive feelings of discomfort, highly introspective, and the tendency to dwell on the negative aspects of the self and the World. In [12] stated that employees high in negative affectivity self-select into or are assigned to more risky and demanding job.

This study [8] identified negative affectivity as a major safety problem in the under ground coal mines, they studied. Risk taking behavior is the voluntary participation in behaviors that contain, or are at least seen to contain, a significant degree of risk. However, a case can be made that certain behaviors are assessed to involve a high degree of risk in comparison with other equivalent behaviors, and also involve a high degree of actual risk as measured by the probability of death, injury, financial loss and so on. It is found that risk taking behaviors significantly led workers to be accident prone.

γ_{DA} in the model on Figure 1 represents the effect of the workers' negative affectivity on their tendency to take risks. γ_{DB} represents the effect of the workers' fatalistic approach on their tendency to take risks, and γ_{DG} represents the workers' perception of the sufficiency of workplace safety on on their tendency to take risks. The alternative hypotheses put forward to explore such effects are given below:

$H_{(1A)}$: Increase in the negative affectivity of mine workers increases their tendency to take risks.

$H_{(2B)}$: Increase in the fatalistic approach of mine workers increases their tendency to take risks.

$H_{(3G)}$: Increase in the workplace safety sufficiency perception of mine workers decreases their tendency to take risks.

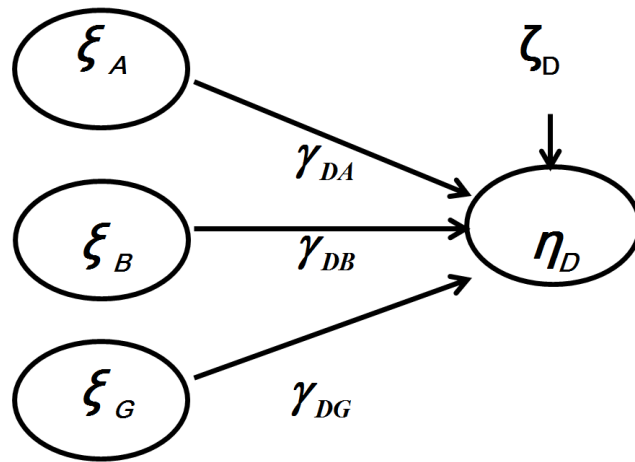


Fig.1. Research model

A: Negative affectivity, B: Fatalistic approach, G: Workplace safety sufficiency perception, D: Tendency to take risks

Structural and measurement models of Figure 1 are given in equations 7, 8 and 9 with matrix rotation:

Structural Model:

$$[\eta_d] = [\eta_d] + [\gamma_{da} \quad \gamma_{db} \quad \gamma_{dg}] \begin{bmatrix} \xi_a \\ \xi_b \\ \xi_g \end{bmatrix} + [\zeta_d] \tag{7}$$

Measurement model endogenous observed variables:

$$\begin{bmatrix} S_{8D} \\ S_{25D} \\ S_{27D} \end{bmatrix} = \begin{bmatrix} \lambda_8^y \\ \lambda_{25}^y \\ \lambda_{27}^y \end{bmatrix} [\eta_d] + \begin{bmatrix} \epsilon_8 \\ \epsilon_{25} \\ \epsilon_{27} \end{bmatrix} \tag{8}$$

Measurement model exogenous observed variables:

$$\begin{bmatrix} S_{1A} \\ S_{2A} \\ S_{7A} \\ S_{12B} \\ S_{16B} \\ S_{39G} \\ S_{40G} \\ S_{41G} \end{bmatrix} = \begin{bmatrix} \lambda_1^x & 0 & 0 \\ \lambda_2^x & 0 & 0 \\ \lambda_7^x & 0 & 0 \\ 0 & \lambda_{12}^x & 0 \\ 0 & \lambda_{16}^x & 0 \\ 0 & 0 & \lambda_{39}^x \\ 0 & 0 & \lambda_{40}^x \\ 0 & 0 & \lambda_{41}^x \end{bmatrix} \cdot \begin{bmatrix} \xi_a \\ \xi_b \\ \xi_g \end{bmatrix} + \begin{bmatrix} \delta_1 \\ \delta_2 \\ \delta_7 \\ \delta_{12} \\ \delta_{16} \\ \delta_{39} \\ \delta_{40} \\ \delta_{41} \end{bmatrix} \tag{9}$$

Data Collection Tool

The data collection tool employed in the study was created drawing on the studies of [6,7,8 and 10]. A 7-point Likert scale was used in the study to address statements of attitude (1: strongly disagree; 7: strongly agree). Initially, in the statistical analysis, the Cronbach's Alpha value was calculated, which indicates the internal consistency coefficient of the data collection tool. Cronbach's Alpha value for the entire data collection tool was found to be 0.796.

Sample

The sample in the study consists of the surface mine workers in a mine located in the Central Anatolia Region. The survey was conducted by face-to-face interview with the mine workers after the necessary legal permission was obtained. Respondents in the sample, 7.3% (f=11) are female and 92.7% (f=139) are male, and 21.3% (f=32) are single and 78.7% (f=118) are married. Regarding the age of the respondents in the sample, 8.0% (f=12) are in the age group 18-25, 25.3% (f=38) in the age group 26-33, 41.4% (f=62) in the age group 34-41, 23.3% (f=35) in the age group 42-49, and 2% (f=3) in the age group 50-57. Regarding the educational background of the workers in the sample, 1.3% (f=2) have primary education, 87.4% (f=131) have secondary education, and 11.3% (f=17) have tertiary education. As to the level of income of the workers in the sample, 3.3% (f=5) earn between 1,000-1,500 TL (250-350 Euro), 38.7% (f=58) between 1,500-2,000 TL (350-450 Euro), and 58.0% (f=87) above 2,000 TL. Regarding the type of accommodation of the workers in the sample, 24.0% (f=36) live in single-detached dwellings, 75.3% (f=113) in apartments and 0.7% (f=1) in an apart hotel. Regarding the home ownership of the workers, 32.0% (f=48) are tenants and 68% (f=102) are homeowners. As to the size of the households of the workers, 37.3% (f=56) live with 1-3 people, 56.7% (f=85) with 4-5 people, 5.3% (f=8) with 6-7 people and 0.7% (f=1) with 8 or more people.

4. RESULTS

Goodness of fit criteria of proposed model were calculated as $\chi^2/df = 1.45$; RMSEA=0.055; GFI=0.94; AGFI=0.90; NFI=0.89; CFI=0.94; SRMR=0.05. An RMSEA and SRMR value equal to 0.05 or less reflects a perfect fit, values under 0.10 indicate an acceptable fit, while those above 0.10 indicate a poor fit. The other measures of fit vary between 0 and 1, and the closer the measure is to 1, the better the model fit [13,14]. Analysis of the cohesion criteria indicates that SEM remains within acceptable boundaries; therefore, it can be deemed a valid model.

The analysis results obtained from the software LISREL are given in Figure 2.

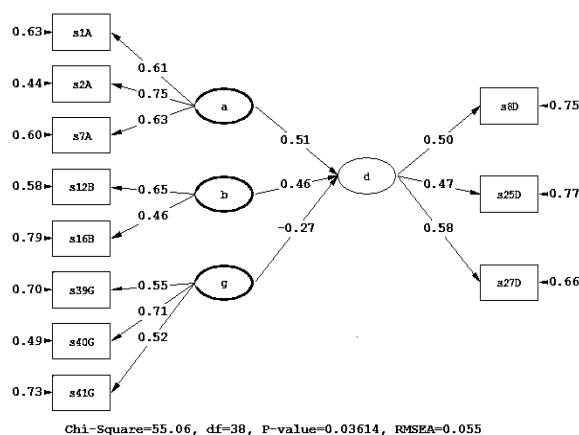


Fig.2. SEM diagram of the model (LISREL 8.80 Output)

Results of the structural model show that all of the three hypotheses are supported. (Figure 2 and Table 1) Figure 2 shows that there are positive and significant relationships between negative affectivity and tendency to take risks, and fatalistic approach and tendency to take risks, and a negative relationship between the perception of the sufficiency of the workplace's safety and tendency to take risks.

Table 1. SEM general results of the research model

<i>Factors and items</i>	<i>standardized loadings</i>	<i>t-value</i>	<i>R²</i>
<i>Factor A: Negative affectivity</i>			
S1A: I feel insecure at work.	0,61	6,77**	0,37
S2A: I feel like the quitting time will never come at work.	0,75	8,22**	0,56
S7A: I feel emotionally exhausted after the working hours.	0,63	7,00**	0,40
<i>Factor B: Fatalistic approach</i>			
S12B: I think I can't do anything to prevent an accident in case of a hazard.	0,65	3,84**	0,42
S16B: Increasing safety measures will not prevent accidents.	0,46	3,45**	0,21
<i>Factor G: Perception of workplace safety and its sufficiency</i>			
S39G: What is the level of sufficiency of the personal protective equipment (steel-toe shoes, helmet, rope, etc.) required for your safety at the workplace?	0,55	5,35**	0,30
S40G: What is the level of sufficiency of the first aid and rescue stations that can be used in case of an accident at your workplace?	0,71	6,33**	0,51
S41G: What is the level of sufficiency of the masks required for your protection from	0,52	5,15**	0,27

hazardous gases at your workplace?

Factor D: Tendency to take risks

S8D: Sometimes I take risks to raise my income.	0,50		0,25
S25D: I take more risk to finish my job and leave at the end of the working hours.	0,47	3,60**	0,23
S27D: I need to violate some of the rules to finish my job on time.	0,58	3,94**	0,34

$$\eta_D = 0,51\xi_A + 0,46\xi_B + 0,27\xi_G + 0,36 \quad 0,64$$

Hypotheses

A→D	0,51	3,42**	Supported
B→D	0,46	2,68**	Supported
G→D	-0,27	-1,98*	Supported

**p<0.01; *p<0.05

5. CONCLUSION

Regarding the SEM results, Figure 2 and Table 1 show that a one unit increase in the negative affectivity of workers results in an increase of 0.51 unit in their tendency to take risks, and a one unit increase in the fatalistic approach of workers results in an increase of 0.46 unit in their tendency to take risks. Furthermore, a one unit increase in the perception of workers regarding the safety of the workplace and its sufficiency results in a decrease of 0.27 unit in their tendency to take risks. Coefficient of determination (R^2) of the structural equation model estimated in the study was calculated to be 0.64. Based on this result, it is possible to say that the 64% of the tendency of workers to take risks is explained by the variables in the model. These findings are parallel to the findings in the study conducted by [10].

Various measures need to be taken to reduce accidents at the workplace, such as the use of personal protective equipment, first aid and rescue stations to respond in case of an accident, a continuous gas system to prevent explosions that may occur due to hazardous gases, and a ventilation system to prevent gas accumulation. These measures will reduce the risk perception and thus the number of work accidents as well.

Employees may exhibit a tendency to take risks by ignoring safety rules for reasons such as finishing a job on time or raising their income. It is believed that such pressures on the workers increase the number of work accidents as they increase their tendency to take risks. Delivering training courses to workers and letting them know what would happen if they were injured in a potential accident will reduce their tendency to take risks. Emotional exhaustion,

one of the aspects of the negative affectivity effect, is associated with the organizational and personal expectations of employees. Increased emotional exhaustion of workers increases their tendency to take risks, resulting in a higher number of work accidents. Hence, the elimination of factors that trigger negative affectivity of workers is crucial in reducing work accidents.

Regarding occupational health and safety, one of the most important issues of work life, necessary measures are not taken sufficiently in Turkey as well as in many other countries. However, the Occupational Health and Safety policies of a country are directly proportional to the level of economic, social and cultural development in that country. In the countries where the economy is vulnerable and the requirements of social state are not met, the development of Occupational Health and Safety is slower than that in the developed countries. The basic purpose of Occupational Health and Safety policies is to identify in advance the factors of work life that may harm the health of employees and to take the necessary measures accordingly, to ensure a comfortable and safe working environment, and to protect the psychological and bodily health of employees against work accidents and occupational diseases. The basic function of a social state is to ensure a safe working environment, protect employees from health and safety risks arising from the working environment, and to ensure and improve the safety, health and welfare of employees [1].

Although the level of development in Turkey is increasing each day, why do not the work accidents decrease in parallel to this development? What is the main reason for this contradiction? It seems that each individual in the country needs to reflect on it and do his/her share to resolve this problem. Everybody has a responsibility to ensure that awareness is raised on the concept of occupational health and safety and the associated procedures are implemented properly in Turkey. The State, employers, trade unions, universities, workers and the public should cooperate and generate ideas to resolve such problems. The State should initiate the cooperation efforts and endeavor to ensure that everybody takes part in this system effectively.

We had difficulty in accessing the death and injury statistics of mining accidents in the study. Different sources give different figures regarding the death statistics of mining accidents. The sources used were checked and confirmed with the newspapers. It would not be right to say that the data on this subject are maintained meticulously and in an orderly manner. The major limitation of the study is the size of the sample. The difficulty of conducting the survey in the field and particularly the fact that the sample consists of mining workers led to this result.

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