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Perception Study On Ergonomics Practices In Malaysian Quarry And Mining Industry

***Norhidayah Mat Sout, [2]Ahmad Rasdan Ismail, [1]Muhamad Arifpin Mansor**

[1]*Faculty of Technology, Universiti Malaysia Pahang, 26300 Gambang, Pahang, Malaysia*

[2]*Faculty of Creative Technology and Heritage Universiti Malaysia Kelantan Beg Berkunci 01, 16300 Bachok, Kelantan, Malaysia*

Corresponding Author: Tel : +6013-5929101; Fax : +609-5492147 ; Email :hidayahsout@gmail.com

Abstract

Ergonomics can be viewed as an approach to reduce injury and illness rates to improve the overall working conditions for employees by addressing risk factor exposure that may occur during manual tasks. The objective of this research was to analyze ergonomics risk factors by associating the perception of employer and employees towards their workplace condition in quarry and mining industry. A Questionnaire on Ergonomics Risk Assessment was used to determine the comparison level awareness and perception analysis among quarry and mining industry in Malaysia. The findings of this research prove that the exposure of ergonomics risk factors towards the workers is in a moderate level with a mean of 3.59 for the overall respondent review about the ergonomics risk among workers at their workplace. Besides, the most concern in ergonomics is about the awkward posture at work. Some 8.8% of them agreed and 6.6% of them totally agreed that they were in awkward posture while doing their work. As a conclusion, assessment of ergonomics in quarry and mining industry will be a platform to provide a safe and healthy working environment.

Keywords:ergonomics, risk factor, quarry and mining

Introduction

Over the past century, there has been a rapid development in every country around the world for the government to increase the quality, health, and safety requirements in several occupations. In the new global economy, Occupational Safety and Health has become a central issue for quarry and mining industry in Malaysia. Recent evidences show that Malaysia's identified mineral resources were barite, bauxite, clay, coal, copper, gold, ilmenite, iron ore, monazite, natural gas, petroleum, silica, silver, struverite (tantalum), tin, and zircon. During the 20th century, mineral production played an important role in Malaysia's national economy, after many years of exploitation. Minerals such as barite, bauxite, copper, ilmenite, iron ore, and tin were either depleted or the capacities to produce them had decreased significantly in recent years. In terms of its contribution to the country's economy, the mining and quarrying sector accounted for 7.0% of the Gross Domestic Product in 2010 compared to the mining and quarrying sector in 2009 (1).

The quarry and mining industry play a very important and necessary role in the development of the country. The industry guarantees adequate and continuous supply of raw materials to the construction, building and manufacturing sectors for the economic development of the country. The Environmental and social impact of quarrying and mining activities may be felt both on and off for a longer period of time. The physical impacts are on land, water, air, wildlife, vegetation, economic, supply and demand, revenues, employment and others. There are also health and safety implications for both individuals and communities. Mining and Quarrying Safety and Health Act 1999(2) stated that quarry is a place on land where operations are carried out continuously or from time to time to produce construction or road building material. Meanwhile the meaning of mine is any of the following places: a place where operations are carried out continuously or from time to time within the boundaries of land the subject of a mining tenure, a place where operations are carried out continuously or from time to time on land adjoining, adjacent to, or contiguous with, the boundaries of land the subject of a mining tenure and within which is a place mentioned in paragraph, a place where operations are carried out continuously or from time to time unlawfully because land at the place is not the subject of a mining tenure, a place that was a mine while works are done to secure it after its abandonment, a place where tourism, education or research related to mining happens that is declared under a regulation to be a mine.

Literature Review

Ergonomics are generally known to be related to humans and their jobs. Te-hsin and Kleiner (3) defined ergonomics as a combination of the words "ergo", a Greek word meaning "work" and "nomics", meaning "study"-the study of work. It also means an applied science that coordinates the design of devices, systems and physical working conditions with the capacities and requirements of the workers. According to the

International Ergonomics Association (4), ergonomics is concerned with understanding interactions among people and other elements of a system to optimize their wellbeing and overall system performance. In other words, ergonomics examines human behavioural, psychological and physiological capabilities and limitations.

In mining industry, the Implementation Guide and Tools from the Department of Health and Human Services (5) state that ergonomic is the scientific discipline concerned with the understanding of interactions among people and other elements of a system to optimize their well-being and overall system performance. The guidelines state that applying ergonomics principle to the design and evaluation of manual tasks involving lifting, pushing, carrying, moving, manipulating, holding, pounding or restraining a person, animal or item. In addition, the other ergonomic principle is related to jobs, products, environment and systems, ensuring that they meet the needs, capabilities and limitations of people. From the whole perspectives, ergonomics can be a third leg of a three pronged risk management approach to reduce musculoskeletal disorder (MSD) rates.

Jaafar N. *et al*.(6) stated that ergonomics is a broad science with a wide variety of working conditions that can affect workers' comfort and health, including factors such as lighting, noise, temperature, vibration, heavy lifting, repetitive motion, workstation design, tool design, machine design, chair design, footwear, etc. NIOSH (7) points out that the risk of musculoskeletal disorder is determined by various physical factors but most notable ones are frequency, duration, and intensity of work activities. International Labour Organization (ILO) (8) claimed that two million workers died every year because of occupational injuries and accidents. In the early 1900's, as many as 3,000 underground coal mine workers died every year. However, there has been a decreasing trend in mine worker fatalities. This trend may be due to the fact that advanced technologies have provided a safer work environment, hence a decrease in the number of workers required to perform tasks (9).

Recently, researchers who have shown increasing interests in new technologies in quarry and mining stated that although new technologies in mining industry may have positively affected workers' tasks and the efficiency of extracting coal, they may not reduce cumulative injuries. Many jobs still expose mine workers to musculoskeletal disorders such as awkward posture, exposure to whole body vibration, forceful exertions and repetitive motions (10). Therefore, the cumulative injuries in underground mining may still be present. Thus, to reduce cumulative injuries, it would be necessary to have a force towards the design of task, equipment and tools. However, the National Institute of Occupational Safety and Health (7) which interacts with mining companies has indicated that many have chosen not to entrust their resources because a clear cost/ benefit has not yet been shown.

Methodology

The aim of this paper was to determine the perception among the workers in mining and quarrying industry. A total of 91 sample questionnaires were distributed among the quarry and mining companies throughout East Coast of Malaysia. The study method was by the use of a set of Likert –type scales multiple choice items (11). The questionnaires were distributed to the subjects individually. Data collection for this study would be obtained from questionnaires to study the level of safety practices in the quarry. Each company was given 50 questionnaires, collected after 3 working days.

The questionnaires consisted of four parts which represented the levels of safety practices implemented in the quarry and mining industry; Part A comprising questions regarding the level of safety awareness in the quarry and mining industry, Part B comprising questions regarding the perception of workers' knowledge on safety and health at workplace, Part C about the perception of carrying out safety and health programme by workers at the workplace, and part D about the ergonomic risk of the workers at the workplace.

The awareness, knowledge and compliance of safety among workers in mining and quarrying industry would indicate the level of safety practices. The data was analyzed by computing the mean of each question answered. The computed mean from the respondents' answer was categorized into the categorizing framework as in Table 1. The range of mean that form the categorizing framework was calculated based on mid – point method (12).

Table 1 : Range of means for safety and health practice

Scale	Lower range	Upper range	Range of mean	Level of practice
1	0	— + 1 = 1.5	0 – 1.5	Very low
2	— - 2 = 1.5	— + 2 =2.5	1.6 – 2.5	Low
3	— - 3 = 2.5	— + 3 = 3.5	2.6 – 3.5	Moderate
4	— - 4 = 3.5	— + 4 = 4.5	3.6 – 4.5	High
5	— - 5 = 4.5	5	4.6 – 5.0	Very high

Results and Discussion

Table 2 explains the characteristic of samples taken among the quarry and mining workers. Reliability measures: Questionnaire reliability was tested using Cronbach alpha (α). Rodeghier (11) found that Cronbach alpha (α) was derived from the average correlations of all the items on the scale. Meanwhile, the reliability test is shown in the Table 3. Out of the total 5 reliability measures done, 3 of them have reliability above 0.7. One item has reliability measure at least 0.506. The result indicates that the reliability measures are high for the safety perception among the quarry and mining industry.

The mean value for safety implementation in this industry is 3.22. This shows that they have implemented the element compulsory in OSHA 1994. These results reflect their level of compliance towards OSHA 1994 since the questions asked in the implementation section referred to OSHA 1994. Mekos (16) in his study in Thessaloniki stated that insufficient rules and regulations keep contributing towards accidents at workplace. Besides, good safety implementation starts with complying with acts and regulations (17).

Moreover, Table 4 also shows that the perception of workers at quarry and mining sector towards ergonomics is moderate with the value of 3.53. A previous study claimed that many jobs still expose mine workers to musculoskeletal disorder such as awkward posture, exposure to whole body vibration, forceful exertions and repetition (10). Therefore, high cumulative injuries in underground mining may still be present. Thus, to reduce cumulative injuries it would be necessary to have a force towards the design of task, equipment and tools. However, the National Institute of Occupational Safety and Health (7) which interacts with mining companies has indicated that many have chosen not to entrust their resources because a clear cost/ benefit has not yet been shown.

Table 2 : Characteristic of the samples

Characteristics	Category	Frequency	Percentage (%)	Mean±SD
Gender	Male	69	75.8	1.24±0.431
	Female	22	24.2	
Age	< 20	1	1.1	33.77±10.359
	20 - 29	41	45.1	
	30 - 39	22	24.2	
	40 - 49	20	21.9	
	>50	7	7.7	
Education	SPM	55	60.4	1.91±1.226
	Certificate	6	6.6	
	Diploma	13	14.3	
	Bachelor degree	17	18.7	
Position	Employer	23	25.3	1.75±0.437
	employee	68	74.7	

Table 4 shows the means for safety and health practices in quarry and mining industry. Based on Table 4, the overall safety awareness among quarry and mines workers is 3.71, which is at the moderate level. This shows that the safety awareness in this industry still has not achieved the satisfaction level. Lack of safety awareness among the quarry and mines workers can cause large disaster to occur (13). This result proves that safety awareness is very important in any job or occupation. Lack of safety awareness may cause accidents at workplace.

Based on Table 4, safety knowledge among quarry and safety workers is 3.38, below the satisfactory level. Safety knowledge is very important in order to create a safe working environment, thus increasing the safety awareness. Lack of knowledge will cause accidents, as stated by Joy (15). Many accidents occur at mines sites either because the mineworkers are unaware of the rules, or they are aware of the rules but do not understand them, or they mistakenly apply the rules, or ignore them, or they are poorly trained or they lack sufficient educational background. Another study by Neal et al. (14) found that safety knowledge is the mediating factor which contributes in creating good safety environment at workplace.

Table 5 highlights the analysis made on the perception towards ergonomics risk at their workplace with 44.0% of them agreeing and 35.2% totally agreeing with the range of movement at their workspace. The next question on the respondents' hands and arms free of the pressure of sharp edge on work surface shows that 41.8% of them agreed and 28.6% totally agreed with the statement. There were 39.6% respondents who agreed and 27.5% of them who totally agreed with the easily adjustable chair and stool suited to the task. The most important element in ergonomics is the body posture while working. A total of 67.0% agreed while 20.9 %

Table 3 : Reliability measures using Cronbach's α for tested factors

Tested factors	Cronbach alpha (α)
The level of safety awareness at the quarry and mining sites	0.829
The perception of workers knowledge on safety and health at workplace	0.506
The perception of carrying out safety and health programme by workers at workplace	0.892
The ergonomic risk of the workers at workplace	0.791

Table 4 : Mean of all parts of the questions

Questions	Mean
Awareness	3.71
Knowledge	3.38
Safety implementation	3.22
Ergonomic	3.53

totally agreed that they could change body posture while working. Almost half of the respondents (48.4%) agreed that all requirements of the task could be reviewed from a comfortable position while 18.7% of them totally agreed with it. Meanwhile, the main concern in ergonomics is awkward posture. There were 8.8% of the respondents who agreed and 6.6% who totally agreed that they were in awkward posture while doing their work. Table 5 shows that the external factors in ergonomics such as thermal comfort, noise and vibration do not affect their body and there were 28.6% of them who agreed and 9.9% who totally agreed with the statement. Findings from this study show that, most of the respondents realized that they were actually exposed to ergonomics risks. Recent evidences indicated that workplace environment is one of the factors affecting job satisfaction (18).

Conclusion

Industrial development seems to be moving toward further globalization, with a rapid growth of quarry and mining industry, an increased flexibility of production and a continuous progress in the future. It is always related to applied ergonomics research projects, addressing specific work problems with researchers or consultants providing information with little control or influence over how to control the ergonomics risk and how to implement the risk control of the ergonomics factors among workers. Other than that, it is such a useful finding for intervention programme on reducing ergonomics hazard in the quarry and mining industry. Hence, the companies must have an important role to play in establishing a balance between ergonomics risk factors and working method and the protection of employees' health and safety.

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Table 5 : The percentage of respondents' distribution on ergonomics risk.

	n	TD (%)	D (%)	NS (%)	A (%)	TA (%)	Mean	SD
I can move in the range of movement in my work space.	91	0.0	0.0	20.9	44.0	35.2	4.14	0.739
My hands and arms are free of the pressure of sharp edges on work surface.	91	2.2	3.3	24.2	41.8	28.6	3.91	0.927
Chair or stool that I use is easily adjustable and suited to the task.	91	1.1	0.0	31.9	39.6	27.5	3.92	0.833
I can change the body posture while working	91	0.0	1.1	11.0	67.0	20.9	4.08	0.601
All requirements of the task can be viewed from a comfortable position.	91	0.0	2.2	30.8	48.4	18.7	3.84	0.749
I work in awkward postures.	91	28.6	30.8	25.3	8.8	6.6	2.34	1.176
External factors such as thermal comfort, noise and vibration Do not affect my body.	91	11.0	19.8	30.8	28.6	9.9	3.07	1.153

TD: Totally disagree; D: Disagree; NS: Not sure; A: Agree; TA: Totally agree

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