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Perception study on ergonomics practices at Malaysian quarry and mining industry

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Ergonomics, Risk factor, Quarry and mining

A B S T R A C T

Ergonomics can be viewed as an approach to decrease injury and illness rates and to improve the overall working conditions for employees by addressing risk factor exposure that may occur during manual task. The goals of this research are to analyze ergonomics risk factor 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 commonly in moderate level 3.59 in mean for the overall respondent review about the ergonomics risk among the workers at their workplace. Besides that, the most concern in ergonomics is about the awkward posture had 10.3% of them agreed and 6.9% of them totally agreed that they were in awkward posture while doing their work. As a conclusion, assessment of ergonomics in quarry and mining industries will be a platform to provide a safe and healthy working environment

Introduction

Over the past century there has been the rapid development in every country around the world, government are increasing the quality, health, and safety requirement 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 evident shows 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 such mineral 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 in the mining and quarrying sector in 2009 (Department of statistics, 2011).

The quarry and mining industry plays a very important and necessary role in the development of the country. The industry guarantees adequate and continues 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 to a longer period. The impacts are physical, affecting land, water, air, wildlife and vegetation and economic, affecting the supply and demand, revenues, employment and so on. There are also health and safety implications for both individuals and communities. Mining and Quarrying Safety and Health Act 1999 (2012) stated that quarry is a place on land where operations are carried on, 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 on, continuously or from time to time, within the boundaries of land the subject of a mining tenure, a place where operations are carried on, 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 on, 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.

Ergonomics generally are known to be related to human and their job. Te-hsin and Kleiner (2001) defines as ergonomics is a combination of the words ergo, a Greek word meaning "work" and nomics, meaning "study"-the study of work. An applied science is that coordinates the design of devices, systems and physical working condition with the capacities and requirements of the workers. According to the International Ergonomics Association (2000), ergonomics is concern with understanding interaction among people and other element of a system to optimize their wellbeing and overall system performance. In other words, ergonomics examines human behavioral, psychological and physiological capabilities and limitations.

As for the ergonomics processes Implementation Guide and Tools for the Mining Industry from the Department of Health and Human Services (2009) stated 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 an overall system performance. the guideline stated that by applying ergonomics principle to the design and evaluation of manual task which are task that involve lifting, pushing, carrying, moving, manipulating, holding, pounding or restraining a person, animal or item. In addition, the other of ergonomic principle is related to the jobs, products, environment and systems, ensuring that they meet the needs, capabilities and limitations of people. From the whole prospective ergonomics can be as a third leg of a three pronged risk management approach to reduce musculoskeletal disorder (MSD) rates.

Jaafar and Lop (2011) had stated that ergonomics is a broad science with wide variety of working condition that can affect worker's comfort and health, including factors such as lighting, noise, temperature, vibration, heavy lifting, repetitive motion, workstation design, tool design, machine design, chair design and footwear and others. NIOSH (1997) points out that the risk of musculoskeletal disorder is determined by varying physical factors but most notable are frequency, duration, and intensity of work activities. International Labor Organization (ILO) (2000) claims that there were two million workers died every year because of occupational injuries and accident. In the early 1900s reported as many as 3,000 underground coal mine workers died annually. Since then, however there has been decreasing trend in mine worker fatalities. This trend may be due to the fact that technologies advances have provided for a safer work environment and have decreased the number of worker required to perform task (2008).

Recently, researches have shown an increased interest in the technologies advance at quarry and mining and stated that while the technologies advances in the mining industry may have positively affected workers' task and the efficiency of extracting coal, they may not have reduced cumulative injuries. Many jobs still expose mine workers to musculoskeletal disorder such as awkward posture, exposure to whole body vibration, forceful exertions and repetitive motions (Zhuang and Groce, 1995). Therefore, the high prevalence of cumulative injuries in underground mining may still be present. Thus as a means of reducing cumulative injuries it would be needed to have a force towards the design of task, equipment and tools. However, the National Institute of Occupational Safety and Health's (NIOSH, 1997) interactions with mining companies have indicated that many have not chosen to entrust their resources to such an effort because a clear cost/ benefit had not yet shown.

Materials and Methods

The aim of this paper is to determine the perception among the workers in mining and quarrying industry. Total 58 samples questionnaires were taken among the quarry and mining company throughout east coast Malaysia. So far this study method has been applied by using a set of Likert –type scales multiple choice items (Rodeghier, 1996). The questionnaires were distributed to the subjects individually. Data collection for this study will be obtained from questionnaire to study the level of safety practices that has been practices in the quarry. Each company was given 50 questionnaires and were collected after 3 working days.

The questionnaire consists of four parts which all this five part will present the level of safety practices that have been implemented by the quarry and mining. Part A is the questions regarding the level of safety awareness at the quarry and mining, part B is perception of workers knowledge on safety and health at workplace, Part C is about perception of carrying out safety and health programme by workers at the workplace, and part D is about the ergonomic risk of the workers at their workplace.

The awareness, knowledge and compliance of safety among workers in mining and quarrying industry will indicate the level of safety practice. The data was analyzed by computing the mean of each answer question. The computed mean from respondent's answer were categorized into the categorizing framework as Table 1. The range of mean that form the categorizing

framework was calculated based on mid – point method (Tan and Tan, 2003).

Result and Discussion

Reliability measure: Questionnaire reliability was tested using Cronbach alpha (α) as shown in Table 2. Rodeghier (1996) found that Cronbach alpha (α) is derived from the average correlations of all the items on the scale. Meanwhile, the reliability test is shown in the Table 3, out of 5 reliability measure have been done 3 had reliability above 0.7. One item had reliability measure at least 0.506. The result indicated that the reliability measures were high for the safety perception among the quarry and mining industry.

Table 4 shows the means of safety and health practices in mining and quarry that have been studied in quarry and mining industry. Base on the Table 4 the overall of safety awareness among quarry and mines workers is 3.37 which is at the level of moderate which show that the safety awareness in this industry still not achieve the level of satisfaction. Lack of safety awareness among the quarry and mines workers can cause large disaster to occur (Guo Wei-ci and Wu Chao, 2011). This study result strengthen that safety awareness is very important in any job or occupational since lack of safety awareness may cause accident at workplace.

Based on the Table 4, safety knowledge of quarry and safety workers is 3.31 which also not achieve the satisfaction level. Knowledge of safety is very important in order to create a safe working environment and increase the awareness of safety. Lacking of knowledge will cause to accident was said by Joy (1999), many accident occurs at mines because the mineworkers were unaware of the rules, were aware but did not understand the rules, mistakenly applied the rules, ignored the rules and were poorly trained or lacked sufficient educational background. Another study from Neal et al. (2000) believed that safety knowledge is the mediating factor which contributes in creating good safety environment at workplace.

Meanwhile for safety implementation in this industry is the mean at 3.18 which shows them have implement the element compulsory in OSHA 1994. These results reflect their level of compliance towards OSHA 1994 since the questions asked in section of implementation were referred to OSHA 1994. Mekos (2010) in his study in Thessaloniki stated that insufficient in rules and regulations keep contributing accident at workplace. Besides, good safety implementation starts with complying with act and regulations (Jameset al., 2013).

Besides that, Table 4 also shows that the perception of workers at quarry and mining sector towards ergonomics is moderate with the value 3.59. As previous study claims that many jobs still expose mine workers to musculoskeletal disorder such as awkward posture, exposure to whole body vibration, forceful exertions and repetitive (Zhuang and Groce, 1995). Therefore, the high prevalence of cumulative injuries in underground mining may still be present. Thus as a means of reducing cumulative injuries it would be needed to have a force towards the design of task, equipment and tools. However, the National Institute of Occupational Safety and Health's (NIOSH's) (1997) interactions with mining companies have indicated that many have not chosen to entrust their resources to such an effort because a clear cost/ benefit had not yet shown.

Table 5 above highlight the analysis made the perception towards ergonomics risk through their workplace show that there is 41.4% agree and 29.3% of them totally agree with the range of movement in their workspace. The next question on the respondents' hands and arms free of the pressure of sharp edge on work surface shows that 41.4% of them agree and 29.3% totally agree with the statement. There were 39.7% respondents agree and 25.9% of them totally agree with the chair and stool that they use easily adjustable and suited to the task. The most important element in ergonomics is the body posture while working. 65.5 % agree and 19.0 % is totally agreed that they can change body posture while working. Half of the respondents, 50% agree that all requirement of the task can be reviewed from a comfortable position and 17.2% totally agree with it. Meanwhile the most concern in ergonomics was awkward posture. There were 10.3% respondents agreed and 6.9% respondents were totally agreed that they were in awkward posture while doing their work. As the Table 5 shows, the external factor in ergonomics such as thermal comfort, noise and vibration does not affect their body and there were 27.6% agree and 8.6% totally agree with the statement. From this study, most of the respondents were realizing there actually expose in ergonomics risk. Recent evidence stated that environment of workplace is the one of the factors affecting job satisfaction (Shikdar and Sawaqed, 2003).

Conclusion

Industrial development seems to be going towards further globalization, distributed quarry and mining industry and increased the flexibility of production and continuous speedy changes in the future. It is always related with applied ergonomics research projects, addressing specific work problems that researcher or consultant provide information with little control or influence over how to control the ergonomics risk and how to implement the risk control of the ergonomics factor among the workers. Other than that, such a useful finding for intervention program on reducing ergonomics hazard in quarry and mining industry. Hence, the companies must have a particularly important role to play in establishing a balance between ergonomics risk factors and working method and the protection of employees' health and safety.

Table.1 Range of mean for safety and health practice

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

Table.2 Characteristic of the sample

Characteristics	Category	Frequency	Percentage (%)	Mean±SD
Gender	Male	42	72.4	1.28±0.451
	Female	16	27.6	
Age	< 20	1	1.7	31.78±9.030
	20 - 29	30	51.7	
	30 - 39	14	24.1	
	40 - 49	11	18.97	
	>50	2	3.4	
Education	SPM	28	48.3	2.24±1.315
	Sijil	4	6.9	
	Diploma	10	17.2	
	Ijazah	16	27.6	
Position	Employer	16	27.6	1.72±0.451
	employee	42	72.4	

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	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 the workplace	0.892
The ergonomic risk of the workers at their workplace	0.791

Table.4 Means of all part of the questions

Questions	Means
Awareness	3.37
Knowledge	3.31
Safety implementation	3.18
Ergonomic	3.59

Table.5 The percentage respondents' distribution on ergonomics risk of the workers at their workplace

	n	TD (%)	D (%)	NS (%)	A (%)	TA(%)	Mean	SD
I can move in the range of movement in my work space.	58	0.0	0.0	20.7	41.4	29.3	4.14	0.736
My hands and arms free of the pressure of sharp edges on work surface.	58	3.4	3.4	22.4	41.4	29.3	3.9	0.986
Chair or stool that I use easily adjustable and suited to the task.	58	1.7	0.0	32.8	39.7	25.9	3.88	0.860
I can change the body posture while working	58	0.0	1.7	13.8	65.5	19.0	4.02	0.635
All requirements of the task can be viewed from a comfortable position.	58	0.0	1.7	31.0	50.0	17.2	3.83	0.729
I work in awkward postures.	58	31.0	27.6	24.1	10.3	6.9	2.34	1.222
External factors such as thermal comfort, noise and vibration does not affect my body.	58	10.3	19.0	34.5	27.6	8.6	3.05	1.115

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

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