Perceptions of Ergonomics Importance at Workplace and Safety Culture amongst Safety & Health (SH) Practitioners in Malaysia

Md Sirat Rozlina, Mohamed Shaharoun Awaluddin, Syed Hassan Syed Abdul Hamid, Zakuan Norhayati

***Abstract*— The article reports on a study to identify key components which can be used to relate ergonomics awareness and safety culture. These components can be used to facilitate the research which aimed at determining the elements that influence the ergonomics awareness and the relationship with safety culture in an organization. A survey was done using a sample of 108 Safety and Health (SH) practitioners in manufacturing companies in Malaysia. Exploratory Factor Analysis was used to examine the SH practitioners perceptions in determining the importance of ergonomics at their workplace and their beliefs on the importance of safety culture to be inculcated at their companies. Principle Components Analysis with the Varimax rotation method was used for this analysis. 20 items for ergonomics importance at workplace were identified after EFA. The variables were i) implication and improvement (10 items), ii) suitability of workplace to the workers (7 items) and iii) ergonomics basic consideration (3 items). Safety culture questions were developed focused on the SH practitioners perceptions on safety climate importance. Three construct models based on 17 items were designed: i) commitment and leadership (7 items), ii) motivation (6 items) and iii) safety management system practice (4 items). This finding is significant in order to further study the influence of the perceptions of SH practitioners on ergonomics importance at workplace to the safety culture.**

***Index Terms*—safety culture, ergonomics awareness, Exploratory Factor Analysis, Safety and health practitioners**

I. Introduction

Ergonomics awareness has a substantial impact on the industry, organization, management, employees and overall well- being of the system ([1], [2]). Ergonomics is a scientific discipline concerning with the understanding of interactions among humans and other elements of a system [3] and it will contribute to job satisfaction [4]. According to Musonda and Smallwood (2008) [5], awareness is not only based on knowledge but also on the display of behavior. Ergonomics awareness helps in ergonomics application and contributes significantly to human well-being and safety due to a comfortable work environment and ergonomically designed tools , man- machine interface design and suitable work method to human anatomy [6]. Thus, the awareness of ergonomics is important to SH practitioners.

Safety culture has been studied by some researchers and is believed to give a positive impact to the companies [7], [8], [9], [10], [11], [12], [13], [14], [15], [16]. However, safety climate is given more emphasis in the previous study [11], [17], [18], [19], [20].

Safety culture is defined as 'a set of value, perceptions and attitudes and patterns of behavior [8], [11], [21], [22]. The purpose of inculcating a safety culture is to develop a nature whereby we repeatedly work safely while guided by a well- defined set of core values that protect and promote the health and well-being of the individual and the environment [22]. Safety culture required a development of individual safety attitudes and behaviors [17].

II. Problem Identification

The function of managing safety is usually assigned to a person in charge namely Safety and Health Officer (SHO) as mentioned under Section 29 Occupational Safety and Health 1994 [23]. In Malaysia, such people may also be designated post such as Safety and Health and Environment Officer (SHE), Health, Safety, Environment and Security Officer (SHES), engineer and the like. For the research purpose, the terminology of Safety and Health Practitioner (SH practitioner) will be used in a broader context. They are well-trained to manage the risk, and proactively intervening in unsafe situations [24], [25], [26].

The responsibility of SH practitioners is very high as the employer give the authority to SH practitioners to ensure the highest safety and health standards at the workplace and he/ she constantly interacts the employer regarding acts and regulations (refer sec 24 (b) OSHA 1994) [23]. They are also representatives of the companies to initiate any activities and steps to be taken including to advise the employer in any matter related to safety and health (refer to Reg 18(a) OSHA 1994[23]).

However, the role of OSHA regarding ergonomics has been ill-defined. In Malaysia, there is no specific act, regulations or guideline available to explain ergonomics

First author is a student of The Department of Manufacturing and Industrial Engineering, Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, 81310 UTM Skudai, Johor, Malaysia. (e-mail: rozlina@mail.fkm.utm.my).

Second author is a professor at UTM Razak School of Engineering and Advanced Technology, Universiti Teknologi Malaysia, International campus, Block H, Level 1, Jalan Semarak, 54100 Kuala Lumpur, Malaysia. (e-mail: awaludin@ic.utm.my).

Third author is working at Department of Occupational Safety and Health (DOSH), 2nd Level, Block D3, Complex D, 62530 Putrajaya, Malaysia. (e-mail: sahamid@mohr.gov.my) .

Fourth author is a lecturer at the Faculty of Management and Human Resource, Universiti Teknologi Malaysia, 81310 UTM Skudai, Johor, Malaysia. (e-mail: norhayatimz@utm.my).

ISBN: 978-988-19251-3-8
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)

implementation in general, unlike safety issues [27]. Ergonomics is important at least in theory but its actual awareness among Malaysian SH practitioners has not been investigated. Human factors or ergonomics is believed to play a fundamental role in increasing organization health and safety performance [28] and this indirectly is also associated with safety culture.

The objective of the study is to investigate the extent of ergonomics awareness and its influence in inculcating safety culture amongst SH practitioners. Ergonomics awareness is measured by their attitude in determining ergonomics importance at workplace. Basic knowledge is not studied in this paper as it is well informed that their basic knowledge on ergonomics awareness is adequate among the SH practitioners.

III. Methodology

Some psychologists [29], [30], [31] suggested that attitudes included three components: cognitive, affective and conative (behavioral). Chang and Liao (2003) [32] summarized the three components whereby the cognitive represents the beliefs or idea associated with a particular subject. The affective component is the individual's evaluation of the object and emotion associated with the object. The conative illustrates the action or intention toward action directed at the object. Shaftel and Shaftel (2005) concluded that attitude also affects behavioral intentions, which represent 'a plan of action that is arrived at through conscious, deliberately processing'[33]. Davidson et al (1985) found that 'intention was better predictors of behavior'[34]. Chang and Liao (2003) called it as behavior intention and used this methodology in their research to measure attitude of their case study object in aviation field [32]. For this paper, the authors developed the question with the basis of cognitive components, representing the beliefs of respondents. It is used to measure attitudes of SH practitioners on the importance of ergonomics on some issues.

A seven- point likert scale was employed to the both questions of ergonomics importance at workplace and safety culture to respond to those items. (1=not relevant, 2= not important at all, to 7= critical)

A. Procedure of Collecting Data

250 mails were delivered to manufacturing industries who have SH practitioners and 108 completed replied were received. This number of response is considered adequate as the trend is similar in other parts of the world, even in developed nations [35], [36], [37], [38], [39], [40].

B. Demographic Data

Respondents were asked on their position, level of education, year of work experience gained in company or other companies, year of work experience as SH practitioners and training obtained for past three years. Respondents in companies include those in electrical and electronic (27.8%), chemical or apart (15.7%), metal, machines and equipment (13%), rubber or plastic based (12%), automotive and accessories (7.4%), wooden product including furniture (4.6%), printing and publishing (2.8%), paper and paper based (0.9%), textile and leather (0.9%) and others (food manufacturing, medical products)(14.8%). Education levels were in the following categories: SPM (11.1%), Diploma (28.7%), Degree (47.1%) and Post degree (13%). Most of them were called Safety and Health Officer (SHO) (50.9%,), Safety, Health and Environment Officer (SHE) (38.9%), Health and Safety, Environment and Security Officer (SHES) (4.6%), engineer (2.8%), and others (safety and health executive, safety and environment affairs manager, and ergonomist) (2.8%). Based on their work experiences in company/ companies, most of them have 16 to 25 year experience (41.7%) and more than 25 years (21.3%). The others were 0-5 year (19.4%) and 6-15 years (17.6%).

C. Content Validity

In this study, all the measurement items were developed and constructed based on literature review and validated by relevant representative from NIOSH, academicians, DOSH and companies. This is important to determine that the items represent the domain of the construct.

D. Exploratory Factor Analysis (EFA)

EFA is used to identify how many latent variables underlie the complete set of items and reducing those items to a smaller, more manageable set of underlying factors [32]. The presence of meaningful patterns among 29 ergonomics beliefs on importance at the workplace items and simplified the importance contained in a small set of factors or dimensions. The EFA can be used when researchers have measurements on collection of variables and would like to have some idea about what construct might be used to explain the inter-correlation among these variables [41].

The questions of ergonomics importance at workplace were verified and modified from the work done by some researchers [1], [42], [43], [44] and past literature pertaining to the field of ergonomics basic and principle [45], [46], [47], [48].

EFA was done on the 29 items of ergonomics importance at workplace. The Overall- Keiser-Meyer- Olkin (KMO) measure verified the sampling adequacy for the analysis. After deleting items which has low factor loading and reliability, 20 items were identified to be appropriate for further analysis. The KMO for ergonomics importance was 0.919 (superb according to [49]) with factor loading values ranging from 0.576 to 0.821. The Bartlett Test of sphericity reached statistical significance with χ^2 (108)= 1644.205, $p< 0.0001$ indicating that the correlation between the items were sufficiently large for Principle Component Analysis (PCA). The three factors solution explained a total of 57.352% of the variance, with factor 1 contributing 54.58%, factor 2 contributing 8.06% and factor 3 contributing 6.66%. The reliability analysis, measured by cronbach alpha α values ranged from 0.804 to 0.926 and were considered as having high internal consistency for three –factor safety culture. Factor analysis, percent of variance and Cronbach alpha value can be seen in Appendix 1. The 20 items with three new factors namely as : 1) 'implication and improvement' (10 items), 2) 'suitability of workplace to workers' (7 items) and 3) 'ergonomics basic considerations' (3 items).

ISBN: 978-988-19251-3-8
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)

Safety culture variables were derived and modified from previous work done by [7], [11] [12], [19] and [20] and some literature relating to the field of safety culture and safety management [7], [8], [14], [15], [26], [48], [50], [51]. Altogether 22 items were developed for each safety culture. The KMO for safety culture was 0.915. The Bartlett Test of sphericity with χ^2 (108)= 1447.59, p< 0.0001. The three factors solution explained a total of 57.352% of the variance, with factor 1 contributing 57.352%, factor 2 contributing 8.236% and factor 3 contributing 6.114%.

The reliability analysis, measured by cronbach alpha α values ranged from 0.917 to 0.942 and were considered as having internal consistency for three –factor safety culture. Factor analysis, percent of variance and Cronbach alpha value can be seen in Appendix 2. After EFA, the items become 17 items with the three factors namely as:1) Commitment and leadership(7 items), 2) Motivation (6 items) and 3) Safety Management System Practice (4 items).

IV. Discussion

Based on the final results, three crucial factors relating to awareness of ergonomics importance at workplace were identified: 1) implication and improvement , 2) suitability of workplace to workers and 3) ergonomics basic considerations.

Ergonomics Awareness Factor 1: Implication and Improvement.

Implication and improvement is important as it needs employer to be aware on implications of not being aware of the ergonomics risk [52] and mentioned briefly in regulation 18 (Duties of Safety and Health Officers Regulation 1997) and Regulation 11 (Functions of Safety and Health Committee) under OSHA 1994.([23], [27],) to inspect any machinery, plant, equipment, or any manual work that may cause injuries and to review the effectiveness of safety and health programs.

Ergonomics Awareness Factor 2: Suitability of job to the workers

Suitability of the job to the workers or other word is to 'fit the job to the man' and is the guiding philosophy of ergonomics because it is about human engineering and workspace design relating to the design tasks to suit the characteristics of workers. It is the underlying assumptions that can be specified around which the job can be designed for any jobs [45].

Ergonomics Awareness Factor 3: Ergonomics Basic Considerations

Ergonomics basic considerations are some issues of awareness that emphasized the importance of ergonomics related to the physical or namely as anthropometric data ([45]; [46]; [53]) such as consideration of equipment design suited to the workers while purchasing equipment mentioned in 15 (2b) ([23]), layout design and workspace design under regulation 20 and 24 (Safety, Health and Welfare Regulation 1970) under FMA 1967.([54]], [27]).

Safety culture elements identified in this paper included: 1) commitment and leadership, 2) motivation and 3) safety management system practice.

Safety Culture Factor 1: Commitment and Leadership

Commitment and leadership covers employee involvement [11], [12] and commitment by top management [11], [12], [13], [14], [15], [51], leadership [24], [26], [55] subsequently would give an impact to employee empowerment [14]. It is also covered attending OHS committee chair, supporting for the development and implementation of safety activities by physical and spiritual, approving financial and technology used ([16]) in order to get the employee to be involved and empowered in safety activities [16], [56], [32]. Leadership aspect includes the way top management control the standard operating procedure, show the safe way to do task, listen and communicate actively with members of team.

Safety Culture Factor 2: Motivation

Motivation part is emphasized by job satisfaction [55] by encouragement of practicing what they obtained in training [56], [58]. Safety culture can be successful if top management appreciate the employees and give incentives for the safe behavior [11], [50], [56], [58], which in turns the workers will feel free to discuss , openly, without barrier [58] on safety activities, risk or any matter related to safety and health.

Safety Culture Factor 3: Safety Management Practice

Safety management system is one of the factor that can develop safety culture ([12], [13], [8], [7], [26], [10], [50], [11] which is measured by policy, procedures, financial budget, continuous improvement [7], [12], [55]

It is possible to confirm these construct model of Ergonomics Awareness to Safety Culture by Confirmatory Factor Analysis (CFA).

V. Conclusions

The study has identified three principal elements on ergonomics awareness that will have significant impact on safety culture measured by using three measurement variables. This finding is important to show the level of ergonomics awareness and its role in shaping safety culture. This may help in order to further study the influence of the perceptions of SH practitioners on ergonomics importance at workplace to the safety culture. Further work will be needed to confirm the theoretical model through Confirmatory Factor Analysis (CFA).

ISBN: 978-988-19251-3-8
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)

APPENDICES

TABLE 1: FACTOR ANALYSIS AND RELIABILITY ANALYSIS ON ERGONOMICS IMPORTANCE AT WORKPLACE

	Factor and items	Factor loading	% of variance	Cronbach alpha α
	Implication and Improvement			
1	..high force against time	0.805	54.58	0.926
2	.. repetitive movement	0.779		
3	.. improvements based on ergonomics analysis	0.767		
4	.. effect of work on workers	0.762		
5	.. work study considering for allowances in time measurement for a task	0.721		
6	.. continuous improvements	0.672		
7	.. suitable number of workers for each production line	0.670		
8	.. the importance of work space provision	0.662		
9	.. the importance of work space provision (in workspace/ work envelope)	0.576		
	Suitability of job to the workers			
1	.. fitting the worker to the type of tasks	0.777	8.064	0.915
2	.. improvement based on common sense.	0.775		
3	...improvement based on standards	0.716		
4	.. suitable specification for equipment	0.692		
5	.. checking the suitability of equipment for a given task	0.655		
6	.. hand tools to handle work piece such as jigs and fixtures.	0.629		
7	.. the guidelines for ergonomically designed seating and furniture	0.593		
	Basic Ergonomics Considerations			
1	.. anthropometric data in purchasing equipment	0.821	6.656	0.804
2	.. anthropometric data in workspace design	0.812		
3	.. anthropometric data in layout design	0.600		

Total variance: 65.636%, KMO=0.919, Bartlett test : χ^2=1644.205, df=210, significance (p)= 0.0001

TABLE 2 : FACTOR ANALYSIS AND RELIABILITY ANALYSIS ON SAFETY CULTURE

	Factor and Items	Factor loading	% of variance	Cronbach alpha α
	Commitment and leadership			
1	Developing a teamwork spirit	0.791	57.352	0.9130
2	Top management approved the use of new technology for generating an ergonomics environment (workplace design, equipment, workspace)	0.771		
3	New employee is instilled with the importance of ergonomics in the workplace	0.708		
4	give suitable rewards to workers who give suggestions on safety and health improvement.	0.706		
5	ensure employees are both involved and empowered.	0.657		
6	analysis and ergonomics improvements assisted by consultation	0.635		
7	give enough knowledge (training) to the safety and health practitioner in the organization.	0.631		
	Motivation			
1	meeting periodically held between managers and workers to take decisions affecting organization of work.	0.862	8.236	0.9225
2	employees view safety and health (including ergonomics) as the natural, normal and acceptable way of doing things.	0.767		
3	top management provide financial support for ergonomics issue	0.746		
4	incentive offered to workers to suggest improvement in working conditions.	0.713		
5	all organization level changed to ergonomics behaviour	0.689		
6	incentive offered to workers to put in practice and procedures of action.	0.578		
	Safety Management System Practice			
1	organization levels comment on each other on safety and health issue to identify corrective action	0.832	6.114	0.874
2	safety policy contains commitment to continuous improvement, attempting to improve objective already achieved.	0.800		
3	safety and health policy (including ergonomics) is coordinated with HR policies	0.749		
4	standards of action or work procedures elaborated on basis of risk evaluation.	0.696		

Total variance= 71.70, KMO= 0.915, Bartlett Test: χ^2= 1447.59, df= 136, significance level(p)= 0.0001

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ISBN: 978-988-19251-3-8
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)