Ergonomics and Noise Hazard at Wood Based Furniture Industry

Augeny satik anak Ayak, Jafri Mohd Rohani* and Affandi Mohd Zainal

Faculty of Mechanical Engineering
Universiti Teknologi Malaysia
81310 UTM Johor Bahru
Johor, Malaysia

ABSTRACT

The paper underlines the initial work that is aimed at investigating the critical process and work-related symptoms that contribute to ergonomic and noise hazard furniture production industry. The effectiveness of the current existing control measures are also identified. Furniture industry is a manufacturing industry that employs a large workforce. There are many cases of occupational health diseases reported in 2016 from the manufacturing sector in Malaysia. The highest diseases reported are noise-induced hearing loss and musculoskeletal disorders. Therefore, in this project, the focus is on the ergonomic and noise hazards in the furniture industry in Malaysia. The project will be done by using three methodologies. The methodologies are four sections questionnaire or survey, direct observation using RULA and REBA, and direct measurement to measure the noise exposure level in the working place.

Keywords: *Ergonomics, noise hazard, furniture industry, RULA, REBA*

1.0 INTRODUCTION

The wood-based furniture industry has emerged as one of fastest growing industrial sectors especially in Malaysia [1]. Many previous researchers have argued that quality and safety management aspect in this industry is poor, and great attention is required to address the issues of high cost, low productivity, poor quality, poor occupational and safety standard [2]. According to statistics in 2016 done by DOSH, a total of 7820 cases of occupational disease and poisoning have been reported to the Occupational Health Division as compared with 5960 cases reported in the year 2015. Among all the sector, manufacturing sector recorded the most number of cases of occupational disease and poisoning in 2016, a total of 3298 cases (85.4%). This means that occupational health cases keep on increasing over the years, where manufacturing industry has contributed the most. People may think that they are working in safe environment, as there are rules and regulations implemented in their company without knowing that their health is actually being threatened by all the health hazard things that give impact on their health.

The health hazard is a hazard that a worker will face in his/her workplace that can affect his/her health. Every day, workers all over the world facing a multitude of health hazards, such as dust, gases, noise, vibration, ergonomic, and noise. In wood working industry especially in the furniture industry, health hazard usually comes from the noise of the machine, chemical stuff or the dust from the wood itself.

---

* Corresponding author : jafri@mail.fkm.utm.my

For example, in Zimbabwe, the risks found by the workers of wood processing industries are noise, heavy lifting and pulling of movements that cause workers prone to have musculoskeletal syndrome disorders [3]. Among the highest diseases reported are the noise-induced hearing loss and musculoskeletal disorders. Therefore, there is a need to investigate the health hazard in the wood-based furniture industry in Malaysia to reduce the health hazard cases, and to improve the performances, productivity and effectiveness of the workers. In this project, three objectives will be set. The first one is to investigate the critical process of making furniture that contribute to ergonomic and noise hazards in the wood-based furniture industry. Second objective is to identify the work-related symptoms that contribute to these hazards and the third objective is to identify the effectiveness of the current existing engineering control in the furniture industry.

2.0 WORK-RELATED STUDY

2.1 Safety and Health in Furniture Industry
Furniture manufacturing has evolved from being a cottage based, skill dependent industry to a highly mechanized and labour intensive industry operating in high-volume production environments in countries such as Malaysia, Thailand, and Vietnam [4]. The work environment in furniture industry has always been regarded as dirty, dangerous and degenerative, i.e., "3D environment". Workers in furniture industry are also exposed to many risk factors that could affect their safety and health, for example, air-borne dust, noise emission, manual handling and chemical exposure [2]. Manual handling is an example of an ergonomic issue that brings discomfort, fatigue and back pains to the workers that will reduce workers productivity [5].

2.2 Ergonomic and Noise Hazards in Furniture Industry
Ergonomics seeks to adapt tasks, working conditions, work methods, tools, machines to maximise their suitability for people [6]. In the industry, the risk factors of ergonomics can be used to identify the existence of this ergonomic hazard in the workplace. An ergonomic risk factor is any attribute, characteristic or exposure that may cause or contribute to a musculoskeletal injury [7]. In Zimbabwe, the risks found by the workers of wood processing industries are noise, heavy lifting and pulling of movements that cause workers prone to have musculoskeletal syndrome disorders (MSDs) [3]. There is also a study that shows furniture workers being exposed to many MSDs occupational risk factors such as heavy lifting, force exertion, repetitive motions, awkward and static working postures, and many more [8]. Therefore, workers in furniture industry are mostly exposed to the MSDs that are caused by the ergonomic hazard in their working place.

While for noise hazard, there are few standards used to address the noise hazard in the industry specifically those published by Occupational Safety and Health Administration (OSHA), National Institute of Occupational Safety and Health (NIOSH), Factories and Machinery Act (FMA). Both NIOSH and FMA recommend an occupational noise exposure limit of 85 dBA eight-hour Time-Weighted Average, TWA [9]. While for OSHA, the noise level exceeds 85 dB, eight-hour TWA will require a hearing conservation program. Most of the standard agree that the exposure of noise level of 85 dB is the permissible limit in the industry. In one study done in wood industry, the machine that is widely used in the wood industry that will produce over 85 dB (typically 100 dB) is the band saws. The band saw noise is usually caused by the machine bearings, the cutting teeth, etc. [10]. This shows that noise hazard occurs in the industry. The most common effect of noise hazard is the noise induced-hearing loss among the workers [11].

3.0 METHODOLOGY

3.1   Site Visits
A number site visits was done to observe the activities carried out in the furniture industry involving furniture companies that are located at Muar and Tampoi, Johor. These visits were meant to acquire further insights and understandings on the processes involved in the wood-based furniture industry and also opportunity to identify the existence of noise hazard posed to the workers in those companies. Each site visit incurs a three hour time duration for each company. The site visits were done through the collaboration between the National Institute for Occupational Safety and Health (NIOSH) Malaysia and Universiti Teknologi Malaysia (UTM).

3.2   Interviews
Apart from the site visits, another research tool that was employed is the interview sessions. A qualitative research interview is a method that seeks to cover a more meaningful level of the outcome, though it is usually more challenging as it typically involves interpersonal and communication skills . There are two types of interview, which are an informal interview and general interview guide approach. In this research, the informal interview approach was used to interview one of the medical doctors from the *Pusat Kesihatan Universiti* (PKU), UTM who are deemed to specialise in Occupational, Safety and Health (OSH). This interview aimed to get the opinion from a medical doctor who is an expert in identifying the symptoms caused by the health hazard in a workplace. The results of this interview was then used to develop the survey questionnaire.

3.3   Survey
The survey is developed to get the information for the noise and ergonomic hazards. The development of the survey required the site visit and informal interview with an expert to get information on the survey. This survey is developed to know the workers' perception about the existence of the two-health hazard in the company and to know which hazard the workers face more often. This survey will be divided into two parts, which is noise survey and ergonomics survey. After five versions of being revised by my supervisor and expert's opinion, the survey has been drafted and it consists of four sections. The first section is used to collect the demographic data of the employees. For example, age, gender, job position, nationality, educational level and their working time. The second section is the presence of the symptoms caused by noise and ergonomics hazards. For ergonomic hazard, the symptoms are related to symptoms of musculoskeletal disorders. This part is done by referring to two questionnaires that are Cornell and Nordic Musculoskeletal Questionnaire and also based on the expert's opinion [8]. While the noise symptoms are done by referring to the questionnaire recorded by OSHA. The third section is identifying the noise and ergonomic hazard in the workplace. The two-point scale is used in this section because it is easier for the workers to understand and answer it [12]. The last section is used to know the existing control measure used by the company. This part rated based on Likert's five-point rating scale (SA=Strongly Agree, A=Agree, N=Neutral, D=Disagree, SD=Strongly Disagree). Likert scale is used to evaluate the effectiveness of the control measures that existed and being used by the workers. Among the control measure included in this part are the use of personal protective equipment (PPE), administration control and engineering control.

Data Analysis
The survey was analysed by using statistical software package SPSS. Two types of statistical methods were used in the study. The first one is descriptive statistics, where the

results will be presented as tables, frequency, percentages, means, standard deviations, range, minimum, and maximum to explain the variations. The second statistical analysis is inferential statistics. In order to investigate the factors contributing to symptoms, logistic regressions between the dependent and independent variables was analyzed.

3.4 Direct Observation

The direct observation used in this study is to assess the ergonomic hazard in the furniture industry. There are two types of direct observations, that are Rapid Upper Limb Assessment (RULA) and Rapid Entire Body Assessment (REBA).

RULA is related to postural assessment. It assesses biomechanical and postural load requirements of job task/demands on the neck, trunk and arms and wrists. After the data for each region is collected and score, tables on the form are then used to compile the risk factors variables, generating a single score. The score then will be the level produced and interpreted as shown in Table 1.

Table 1: The four levels of MSD risk for RULA

RULA Score	Interpretation
1-2	Negligible risk, no action required
3-4	Low risk, change may be needed
5-6	Medium risk, further investigation, change soon
7	Very high risk, investigate and implement change now

REBA is related to the assessment tool for the whole body postural MSDs. REBA can be conducted quickly so that multiple positions and tasks within the work cycle can usually be evaluated without a significant time/effort cost. When using REBA, only the right or left side is assessed at a time. After the data for each region was collected and scored, the tables contained in the form were then used to compile the risk factor variables, generating a single score that represents the level of MSD risk. The level of MSD risk for REBA is shown in Table 2.

Table 2: The levels of MSD risk for REBA

REBA Score	Interpretation
1	Negligible risk, no action required
2-3	Low risk, change may be needed
4-7	Medium risk, further investigation, change soon
8-10	High risk, investigate and implement change
11+	Very high risk, implement change

3.4.1 Analysis of RULA and REBA

The main ergonomic risk factors are repetitive movements, poor postures, excessive force and a lack of rest were evaluated by observing the workers during they were working [13]. In this study also, a few workers selected from each workstation will be chosen randomly. The selected participants must have at least six months of experience in the wood furniture industry and in their stations. Each observation lasted at least 30 min, namely a minimum of 10 work cycles (depending on the task to be performed). The observations were done according to a period representative of the operators' actual daily work. Photographs were taken to properly document the postures adopted. Also, the weight of the tools or material to be moved was measured. Then, the working postures will be analysed using CATIA software. The risk level for each method is used to analyse

the score calculated by the software to know the level of ergonomic hazard in each station.

3.5   Direct Measurement

For direct measurement, it focuses more on measuring the level of noise produced in the company. The measurement of noise followed the ISO 9612:2009 standard. This standard shows the guidance for the measurement and assessment of exposure to noise in a working environment. In this standard, the apparatus used to measure the noise level are dosimeter and noise meter.

Data analysis

After obtaining the data for noise level in term of decibels (dB), a five-step simple/flexible risk assessment method that derived from BS 8800:2004 was used [14]. The five step risk assessment is familiar and easy to understand for employers and occupational health and safety specialists. The criteria for risk levels of occupational hazards were obtained from regulative norms, standards, directives or scientific literature. Through this assessment, the level of risk can be known for each workstation in the industry. Table 3 shows the five-step risk assessment.

Table 3: Five-step risk assessment method [14]

Risk level numerically	Risk level	Criteris dB(A)
I	Tolerable risk	< 80
II	Justified risk	> 80- 85
III	Unjustified risk	> 85- 87
IV	Inadmissible risk	> 87- 95
V	Intolerable risk	> 95

3.6   Population Study

This is a case study involving a furniture company. The company is located either in Muar, Johor or Melaka. For the questionnaire, it was distributed to the workers in the company only and the sample size of the workers needed are around 100 participants. The observation and measurement method was conducted on each workstation that was available in the company.

4.0   CONCLUSION

The study is an initial work that has been done in anticipation that the objectives of the undertaken research can be achieved using the proposed methods. Nevertheless, for future recommendations, the study can be further continued by developing the engineering control aspect in the critical process that may contribute to hazardous environments in the furniture industry.

REFERENCES

1. Ratnasingam J., Ioras F. and Ishak M.K., 2011. Migrant Contract Workers and Occupational Accidents in The Furniture Industry, *Journal of Applied Sciences*, 11(14): 2646-2651.
2. Ratnasingam J., Ioras F. and Bennet M., 2010. Determinants of Workers Health and Safety in The Malaysian Wooden Furniture Industry, *Journal of Applied Sciences*, 10(5): 425-430.
3. Jerie S., 2012. Occupational Health and Safety Problems Among Workers in The Wood Processing Industries in Mutare, Zimbabwe, *Journal of Emerging Trends in Economics and Management Sciences (JETEMS)*, 3(3): 278-285.
4. Rampal K.G. and Nizam J.M., 2006. Developing Regulations for Occupational Exposures to Health Hazards in Malaysia, *Regul. Toxicol. Pharmacol.*, 46(2): 131-135.
5. Shikdar A.A. and Sawaqed N.M., 2003. Worker Productivity and Occupational Health and Safety Issues in Selected Industries, *Computers & Industrial Engineering*, 45(4):563-572.
6. Bridger R., 2003. *Introduction to Ergonomics*, London: Taylor & Francis.
7. Department of Occupational Safety and Health Malaysia, 2017. *Guidelines on Ergonomics Risk Assessment at workplace.* Retrieved from http://www.dosh.gov.my/index.php/en/factory-machinery/garis-panduan/ergonomik/2622-01-guidelines-on-ergonomics-risk-assessment-at-workplace-2017-1?path=garis-panduan/ergonomic
8. Nejad N.H., Choobineh A., Rahimifard H., Haidari H.R. and Tabatabaei S.H., 2013. Musculoskeletal Risk Assessment in Small Furniture Manufacturing Workshops, *International Journal of Occupational Safety and Ergonomics (JOSE)*, 19(2): 275-284.
9. Murphy W.J. and Franks J.R., 2002. Revisiting The NIOSH Criteria for A Recommended Standard: Occupational Noise Exposure. *Journal of The Acoustical Society of America - J ACOUST SOC AMER III*, 2397.
10. Owoyemi M.J., Falemara B.C. and Owoyemi A.J., 2016. Noise Pollution and Control in Wood Mechanical Processing Wood Industries, DOI: 10.20944/preprints201608.0236.v1 1-11.
11. Minja B., Moshi N. and Riwa P., 2003. Noise Induced Hearing Loss Among Industrial Workers in Dar Es Salaam, *East African Medical Journal*, 80(6):298-302.
12. Comper M.L. and Padula R., 2013. Ergonomic Risk Assessment Among Textile Iindustry Workers using Two Instruments: Quick Exposure Check and Job Factors Questionnaire. *Educação e Pesquisa*, 20:215-221.
13. Gauthier F., Gelinas D. and Marcotte P., 2012. The Vibration of Portable Orbital Sanders and Its Impact on The Development of Work-Related Musculoskeletal Disorders in The Furniture Industry, *Computers & Industrial Engineering*, 62(3):762-769.
14. Reinhold K. and Tint P., 2009. Hazard Profile in Manufacturing: Determination of Risk Levels Towards Enhancing The Workplace Safety, *Journal of Environmental Engineering and Landscape Management*, 17(2):69-80.