

ERGONOMICS AWARENESS IN CONSTRUCTION INDUSTRY

HAZWANI HALIPAH

A project report submitted in partial fulfillment of the
requirements for the award of degree of
Master of Science (Construction Management)

Faculty of Civil Engineering
Universiti Teknologi Malaysia

AUGUST 2014

DEDICATION

Mom and Dad,

Your Support Have Been More Precious

Naznara,

You'll Always Will Be Close To My Heart.

My Supervisor,

You Have Inspired Me In Many Ways That You Could.

ACKNOWLEDGEMENT

In the Name of Allah, Most Gracious The Merciful,

This dissertation would not have been possible without the guidance and the help of several individuals who in one way or another contributed and extended their valuable assistance in the preparation and completion of this study. All thanks to the Almighty for His grace, I have completed this project successfully.

First and foremost, my utmost gratitude to Assoc. Professor Aziruddin Ressang as my research supervisor who helped guided and provided impetus for the duration of the study. I am indebted to you, for your guidance, patience and support, which I have to admit to have inspired me in many ways, where the thesis is the final product of it. I wish to also acknowledge my lecturers and friends, who were indirectly involved in helping me to source for respondents.

Last but not the least, my family and the one above all of us, the omnipresent God, for answering my prayers for giving me the strength to plod on despite my wanting to give up and throw in the towel.

I will not forget all your kindness and thank you very much.

ABSTRACT

Musculoskeletal Disorders is serious issue on construction site due to low awareness of the project participants. This study is to find ways to enhance the ergonomics awareness in Construction Industry. Literature Review was carried out and questionnaire was formulated and distributed on construction site around Johor Bahru. The data collected was analysed by using Relative Importance Index (RII). The result showed ergonomics awareness among construction players is in high level which still can be enhance by proper training and education provide by the top management of their organisation

ABSTRAK

Gangguan *Musculoskeletal* adalah isu yang serius di tapak pembinaan kerana kesedaran yang rendah daripada pekerja projek. Kajian ini adalah untuk mencari cara-cara untuk meningkatkan kesedaran ergonomik dalam Industri Pembinaan. Kajian Literatur telah dijalankan dan soal selidik telah disediakan dan diedarkan di tapak pembinaan di sekitar Johor Bahru. Data yang diperolehi dianalisis dengan menggunakan Indeks Kepentingan Relatif. (RII). Dapatan kajian menunjukkan kesedaran ergonomik dalam kalangan pekerja pembinaan berada pada tahap tinggi dan masih boleh ditingkatkan dengan latihan dan pendidikan yang disediakan oleh pihak pengurusan atasan organisasi mereka.

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	DECLARATION	ii
	DEDICATION	iii
	ACKNOWLEDGEMENT	iv
	ABSTRACT	v
	ABSTRAK	vi
	TABLE OF CONTENTS	vii
	LIST OF TABLES	xi
	LIST OF FIGURES	xiii
	LIST OF ABBREVIATIONS/SYMBOLS	xiv
	LIST OF APPENDIX	xvi
1	INTRODUCTION	1
	1.1 Background	1
	1.2 Statement of the Problem	4
	1.3 Research Aim and Objectives	6
	1.4 Limitation of Study	6
	1.5 Significant of Study	7
	1.6 Summary of Research Methodology	8

2	LITERATURE REVIEW	9
2.1	Introduction	9
2.2	Ergonomics in General	10
2.3	Origin of Ergonomics	14
2.4	Definition of Ergonomics	15
2.5	Ergonomics Program (OSHA 1994)	19
2.5.1	Initial Action	13
2.5.2	MSD Incidents and the Action Trigger	14
2.5.3	Required Elements of the Ergonomics Program	21
2.5.4	The Quick Fix	31
2.5.5	Recordkeeping	32
3	RESEARCH METHODOLOGY	34
3.1	Introduction	34
3.2	Data Collection	35
3.3	Research Methodology Flowchart	36
3.4	Method of Data Collection	38
3.4.1	Design of Questionnaire	38
3.5	Data Collection Analysis	40
3.5.1	Cronbach's Alpha	41
3.5.2	Relative Importance Index (RII)	43
3.6	Conclusion	44
4	DATA ANALYSIS AND FINDINGS	46
4.1	Introduction	46
4.2	Reliability Analysis	47

4.3	Section A: Organisation Detail	48
4.3.1	Type of Organisation	49
4.3.2	Position	50
4.3.3	Organisation	52
4.3.4	Experience in Construction Industry	53
4.3.5	Most Familiar Project Type	55
4.4	Section B: Ergonomics Program	57
4.4.1	Ergonomics Program Attend	57
4.4.2	Importance of Ergonomics Program (Key Elements)	59
4.4.3	Implementation of Ergonomics Program (Key Elements)	60
4.4.4	Level of Ergonomic Programs (Key Elements)	62
4.4.5	Importance of Ergonomics Programs in Organisation	64
4.4.6	Implementation of Ergonomics Program in Organisation	66
4.4.7	Level of Ergonomics Management Program in Organisation	67
4.5	Section C: Ergonomics Awareness Among the Construction Players	68
4.6	Summary	74
5	RECOMMENDATION AND CONCLUSION	75
5.1	Introduction	75
5.2	Conclusion Based on Objectives	76
5.2.1	Objective 1: To Study Ergonomics Programs on Construction Site	76

5.2.2	Objective 2: To Study The Level of Ergonomics Awareness among the Construction Players	77
5.2.3	Objective 3: To Propose Enhancement Ergonomics Awareness Among the Construction Players	78
5.3	Recommendation to Enhance Ergonomics Awareness among Construction Players	78
5.4	Recommendation for Further Research	78
5.5	Research Limitation	79
5.5.1	Time Limitation	80
5.5.2	Cost limitation	80
5.5.3	Respondents' Reluctance	81
5.6	Conclusion	81
	REFERENCES	82
	APPENDIX	87

LIST OF TABLES

TABLE NO	TITLE	PAGE
1.1	Occupational Disease Statistics by Social Security Organization (SOCSCO) 2010	3
2.1	Definition of Ergonomics	17
2.2	Employees and Training Objectives	28
2.3	Ergonomic Training for Various Categories of Employees	29
3.1	Ranking Criteria (Likert-Type Method)	40
3.2	Example of Matrix Checklist	40
3.3	Reliability Scales for Cronbach's Alpha α	42
3.4	Relative Importance Index (RII) Scale	44
4.1	Result Reliability Test of Section from Questionnaire	48
4.2	Types of Organisation	49
4.3	Respondents' Position in Organisation	50
4.4	Respondents' Organisation	52
4.5	Respondents' Experience	54
4.6	Project Type	55
4.7	Ergonomics Course/Briefing/Seminar Attend by Construction Players	57
4.8	Importance of Key Elements of Ergonomics Program	59
4.9	Implementation of Key Elements of Ergonomics Program	61

4.10	Summary of Relative Importance Index (RII) for Level of Ergonomics Program for Key Elements	62
4.11	Ergonomics Program in Organisation	65
4.12	Implementation of Ergonomics Program in Organisation	66
4.13	Summary of Relative Importance Index (RII) for Level of Ergonomics Program for Ergonomics Management in Organisation	67
4.14	Comfort Aspect	69
4.15	Health Aspect	70
4.16	Safety Aspect	70
4.17	Cost Aspect	71
4.18	Complaint Aspect	71
4.19	Training Aspect	72
4.20	Summary of Ergonomics Awareness Among the Construction Players	72

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE
1.1	Accident rate (including ergonomics) in 2010. (The Bureau of Labor Statistics, 2011)	5
1.2	Research Framework Flow Chart	8
2.1	Summary of Ergonomic in General	13
2.2	Elements of an Ergonomic Program	31
3.1	Research methodology flowcharts	37
4.1	Percentage of respondents from different types of organisation	49
4.2	Percentage of respondents' position in organisation	51
4.3	Percentage of respondents' organisation	53
4.4	Percentage of respondents' experience in construction industry	54
4.5	Percentage of project type	56
4.6	Ergonomics program attend by construction players	58
4.7	Summary of RII scale of ergonomics awareness among the construction players	73

LIST OF ABBREVIATIONS / SYMBOLS

DOSH	Department of Safety and Health
MSDs	Musculoskeletal Disorders
NIOSH	National Institute of Occupational Safety and Health
OSHA	Occupational Safety and Health Act
CTDs	Cumulative trauma disorders
IEA	International Ergonomic Association
SOCISO	Social Security Organization
ILO	International Labour Organization
WRP	work restriction protection
PPE	Personal protective equipment
HCP	health care professional
RII	Relative Importance Index
SPSS	Statistical Package for the Social Science
SHC	Safety and Health Committee
WMSD's	work related musculoskeletal disorders
ERA	ergonomics risk assessment
DOE	Department Of Environment
ERF	Ergonomics Risk Factor

LIST OF APPENDIX

APPENDIX	TITLE	PAGE
A	Questionnaire form	88

CHAPTER 1

INTRODUCTION

1.1 Background

Ergonomics in Malaysia has been introduced over a decade ago with the establishment of the ergonomics division in the National Institute of Occupational Safety and Health (NIOSH) on 1st December 1992, while its provision has been stated under Occupational Safety and Health Act (OSHA) 1994 (Ab Muin Z. and Sapri M., 2013). Although ergonomics has been carrying out by the government almost centuries ago, but it is not widely implemented and practiced in Malaysia. Besides, occupational disease consists of human organs tends to happens mainly due to lack of ergonomics awareness among the people at the workplace. Without ergonomics awareness, effort to endorse ergonomics practice can be tough and lead to injuries and illness; and directly affects the workers' productivity, performance and cost.

Moreover, Ab Muin Z. and Sapri M. (2013) asserted ergonomics has large impact to health and safety at the workplace such as at construction site. Occupational disease with consists of cumulative trauma disorders (CTDs) is one of the issues confronting by the organization all around the world. It became seriously when the rate of occupational disease that comprises musculoskeletal injuries at the

workplace was greatly increased from year to year; and directly affects the cost and productivity.

According to International Ergonomic Association (IEA) (2003), ergonomics or human factors is the scientific discipline concerned with the understanding of interaction among humans and other elements of a system in order to optimize human well-being and overall system. It is about conforming or fitting the work, equipment and workplace with the worker that intended to maximize worker's comfort, health and safety, productivity and efficiency (Mustafa *et. al.*, 2009).

This is one of the government efforts to identify ergonomics hazard at the workplace. Ergonomics hazard means the physical factors that may endanger musculoskeletal systems due to the weakness of body position, poor workplace design, fatigue or stress (OSHA, 2008). According to Norashikin *et. al.* (2011), musculoskeletal is one of human organs covers the human muscle system involving neck, shoulder, spine, wrist, elbow, thigh/hips, knees, lower legs, and others.

In order to ensure the implementation of ergonomics done effectively, government has taken steps to clarify the enforcement of ergonomics in Occupational Safety and Health Act (OSHA) 1994. Refer to Shikdar and Sawadeq (2003), failure in applying the principle of ergonomic at the workplace will contribute to physical and mental stress. According to them, it will directly affect health quality of the workers and automatically their productivity will decrease. This problem should be taken seriously where it requires a comprehensive participation of ergonomics in ensuring health and safety of the construction players are always at an optimum level.

Quality work environment, healthy and sustainable help an organization's core business processes run smoothly. Besides, a good working environment (workplace) will provide comfort and satisfaction to the user (construction players)

that lead to maximum performance in achieving organizational goals and objectives (Raymond and Cunliffe, 1997). Therefore, implementation of ergonomics at the workplace has also forced organization to become more creative in the way they structure their human resources to ensure that they are the most productive with the health and safety workplace at construction site and office is constantly provided.

According to Deputy Minister of Human Resources, Senator Datuk Maznah Mazlan (2011) states that, there are a total of 1221 cases of occupational disease at the workplace have been reported in 2010 compared to 949 cases in 2009. Disease involved organ systems contribute second highest number of cases due to occupational disease statistics by Social Security Organization (SOCSO) 2010 which include construction industry as mention in Table 1.1 below.

Table 1.1: Occupational Disease Statistics by Social Security Organization (SOCSO) 2010

Source: Seminar Paper of Safety, Health, Jobs and the Environment (2011)

Type of Disease	2009	2010
Disease caused by agent	481	551
Disease involved organ systems	252	377
Occupational cancer	19	14
Other diseases	197	279
Total Cases	949	1221

The value of compensation by SOCSO increased as registered because of the increasing number of occupational disease which includes construction industry. This is according to Minister of Human Resource, YB Datuk Dr. S. Subramaniam (2011) states that, RM 1.549 billion has paid as compensation to the workers due to

accidents at the workplace in 2012 compared with RM 1.354 billion in 2009. It shows that disease involved organ systems happened at the workplace subsidize to the cost matters and automatically smudge the economy of the country. In fact, if there is no action taken to prevent this disease from happened, it will contribute to the permanent injury or death (NIOSH, 2008). For that reason, the involvement of ergonomics is said to have a positive impact on the symptoms of musculoskeletal disorders, reduce injuries and workers' compensation claims and lost workdays or absenteeism due to illness (Dwayne *et. al.*, 2010).

1.2 Statement of Problem

Building and construction is one of the oldest activities of mankind and all the works is divided into many jobs and trades. However, the works division often results in repetitive jobs, known as monotonous (Koningsveld, 1997). With regards to the all works divisions, one should expect much effort to improve health and safety in the building and construction industry, or at least within the company. According to Koningsveld (1997), it is notable that the attention of ergonomics and health and safety specialist has been rather poor compared to other industries and office work.

Physical works demand in construction industry especially at higher level of exposure can be considered as the main risk factor for work-related musculoskeletal disorders (MSDs) (Molen, H. F. V. D., et al, 2005). Merlino, L. A. et al, (2003) asserted that some work-related activities such as heavy lifting, bending and twisting, and forceful movements have been previously identified as risk factors for musculoskeletal pain. Moreover, Punnet, L. and Wegman, D. H. (2004) added the MSDs include a wide range of inflammatory and degenerative conditions affecting the muscles, tendons, ligaments, joints, peripheral nerves, and supporting blood vessels which these include clinical syndromes such as tendon inflammations and

related conditions (tenosynovitis, epicondylitis, bursitis), nerve compression disorders (carpal tunnel syndrome), and osteoarthritis, as well as less well standardized conditions such as low back pain.

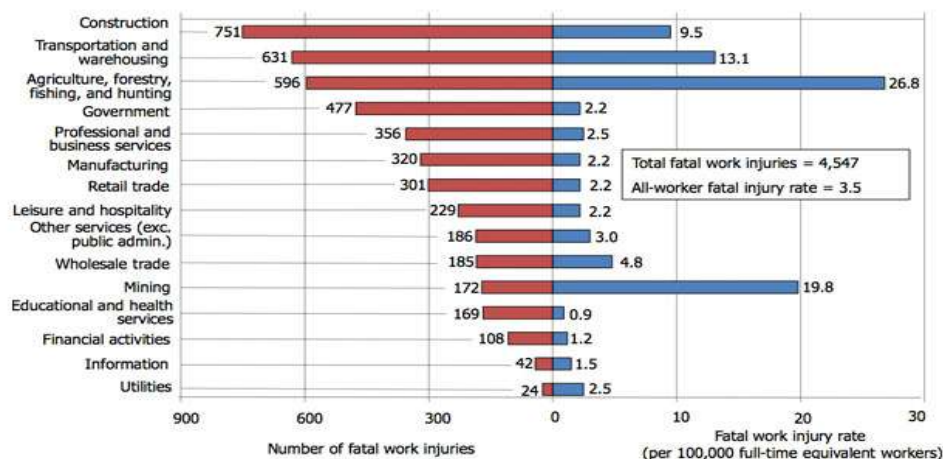


Figure 1.1 : Accident rate (including ergonomics) in 2010. (The Bureau of Labor Statistics, 2011)

Most of the construction workers lack of knowledge in ergonomics and safety and health program which can reduce number of workers whom is dealing with health problems due to extreme physical work demand. Other than that, proper understanding upon ergonomics programs and the awareness of ergonomics among construction players are crucial to be done by responsible party such as by association National Industrial of Occupational Safety and Health (NIOSH) and Department of Safety and Health (DOSH) to increase the access of safety and health purposes on site.

1.3 Research Aim and Objectives

This study aims to enhance the ergonomics awareness in Construction Industry among the construction players. Objectives of this study are:

1. To study ergonomics programs on construction site.
2. To study the level of ergonomics awareness among the construction players.
3. To propose enhancement ergonomics awareness among the construction players.

1.4 Limitation of Study

Throughout the entire process of this research, there are several limitations imposed. Firstly, this study only takes consideration of construction players associated in construction industry in Johor Bharu area only. Moreover, Johor Bharu has the most growing area for construction compared to any other places in Malaysia as there are many developments take place in this area thus offers many types of constructions available to be selected as the case study for this research. Furthermore, the study area is selected as it is near to the researcher and there is available access to reach to the study area.

The construction players are limited to the person involve in the project such as design team, management team and constructors, where they will have different perspectives towards ergonomics awareness in construction industry. Perspectives from each the construction players are very important since they are the decision-makers that will manage construction project flows from the early stage of

construction to the end. Their decisions and perspectives are said to be very important because they will determine the level of ergonomics awareness among the construction players and ways to enhance the ergonomics awareness.

1.5 Significant of Study

This study is potentially to make a better understanding from what an organization practice at construction industry and what ergonomists expected from ergonomics practices in the construction industry by the players. This study is useful in order to improve life time working performance and safe working environment among construction players in construction industry. Ergonomists can gain a better understanding of level awareness upon ergonomics program to the construction players at construction site and increase the quality of ergonomics program.

1.6 Summary of Research Methodology

The research methodology to be carried out to fulfil the objectives of the study includes the method of data collection such as literature review, document study, questionnaire design and data collection. The overall research design is as shown in Figure 1.2:

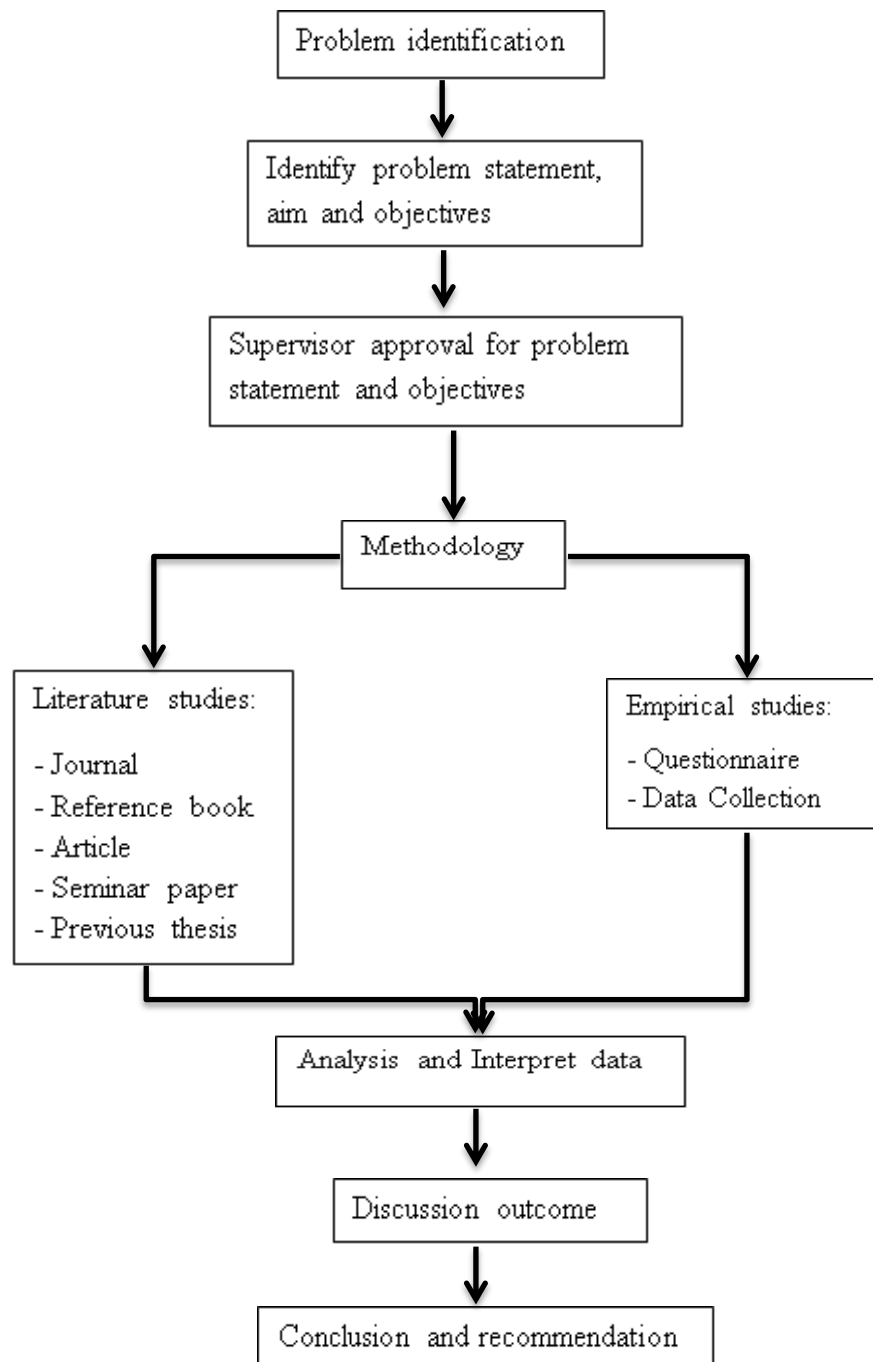


Figure 1. 2: Research Framework Flow Chart

REFERENCES

- Ab Muin Z. and Sapri M. (2013), *Level of Organization Awareness on the Importance of Ergonomics to Health and Safety at the Workplace*. 4th International Conference on Business and Economic Research (4th Icer 2013) Proceeding.
- Allen, E. S. (2010).*Oxford Medical Dictionary*. Oxford University Press. Print Publication Date: 2010. Print ISBN-13: 9780199557141. Published online: 2010.
- Andi & Minato (2003). *Collection of statistical information on Green Public Procurement in the EU*. PricewaterhouseCoopers; Significant and Ecofys.
- Bresnen M & Marshall N. (1990), *Partnering in construction: a critical review of issues, problems and dilemmas*, Retrieved from http://bmb.cu.edu.tr/evlac/_private/Documents/Literature%20review%20links/704563_758064766_713763574.pdf, Retrieved on 2nd April 2014.
- Creswell, John.W (1994), *Research design: Qualitative & quantitative approaches*, Retrieved from <http://www.getcited.com/cits/PP/1/PUB/103171111>. Retrieved on 3rd April 2014
- Dul. J. (2009). “*Business Ergonomics Beyond Health and Safety: Work Environments for Employee Productivity, Creativity and Innovation*”. Contemporary Ergonomics 2009: Taylor and Francis Group/CRC Press.

- Dul, J. and Weerdmeester, B. (2010). *“Ergonomics for Beginners”*: 3rd edition. Boca Raton: Taylor and Francis Group/CRC Press.
- Dwayne, V. E., Donald, C., Irvin, E., Mahood, Q., Keown, K., Theberge, N., Village, J., Vincent, M.S., and Cullen, K., (2010). *Process and Implementation of Participatory Ergonomics Interventions: A Systematic Review*. Journal of Ergonomics. Vol. 53, No.10, October 2010, 1153-1166.
- International Ergonomics Association (2003). *IEA Triennial Report 2000-2003*. Santa Monica, CA: IEA Press.
- International Labour Organization (ILO), (2010). *Ergonomic checkpoints : Practical and Easy-to-implement Solutions for Improving Safety, Health and Working Conditions*. Second Edition. International Labour Office, Geneva, 2010.
- Institute of Ergonomics and Human Factors (2004). *Ergonomics Definition*. Reached on 12th April 2014 at www.ergonomics.org.uk.
- Jeff. W. J., and James. M. L. (2004). *“History and Use of Relative Importance Indices in Organization Research”*. Organizational Research Methods 2004 7: 238.
- Joseph. A. Gliem., & Rosemary. R. Gliem. (2003). *“Calculating, Interpreting and Reporting Cronbach’s Alpha Reliability Coefficient for Likert Type Scale”*. Paper presented at the Midwest Research to Practice to Conference in Adult, Continuing and Community Education, The Ohio University, Columbus, OH, October, 2003.
- Koningsveld, E. A. P. (1997), *“History and Future of Ergonomics in Building And Construction”*. Ergonomics, 1997, Vol. 40, No. 10, pg 1025-1034.
- Mahmud, N., Kenny T.D., Raemy, M.Z., and Hassan, S.N., (2011). *The Effects of Office Ergonomic Training in Musculoskeletal Complaints, Sickness Absence, and Psychological Well Being: A Cluster Randomized Control*

Trial. Asia Pacific Journal of Public Health. pp. 1-17. DOI: 10.1177/1010539511419199.

Michelle, Z.B. (2007). “*Managing Ergonomics Risk Factors on Construction Site*”. Faculty of Civil Engineering, Universiti of Technology Malaysia, Johor, Malaysia

Miles, A. K (2000). *The Ergonomics and Organisational Stress Relationship*. Florida State University School of Business.

Molen H. F. V. D., Sluiter J. K., Hulshof C. T. J., Vink P, *et al.* (2005). “*Implementation of Participatory Ergonomics Intervention in Construction Companies*”. Scand J Work Environ Health 2005, Vol. 31, Issue 3, pg 191–204

Mustafa, S.A., Kamaruddin, S., Othman, Z. and Mohzani, M. (2009). *Ergonomic Awareness and Identifying Frequently Used Ergonomics Programs in Manufacturing Industries Using Quality Function Deployment*. American Journal of Scientific Research. ISSN 1450-223X Issue 3(2009),pp.51-66.

National Institute of Occupational Safety and Health (NIOSH) (2008). *Guidelines for Identification Hazard, Risk Assessment and Risk Control*. Ministry of Human Resources Malaysia.

Punnet, L. and Wegman, D. H. (2004), “*Work-related Musculoskeletal Disorders: The Epidemiologic Evidence and the Debate*”. Journal of Electromyography and Kinesiology, 2004, Vol. 14, pg 13–23

Raymond S dan Cunliffe (1997). *Tomorrow’s Office Creating Effective and Humane Interiors*. E&FN Spon.

Rowan, P.M. and Philip C.W., (1994). *Ergonomics Is Good for Business. Work Study*. MCB University Press. Vol. 43, No. 8, 1994, pp. 7-12.

- Shengli Niu. (2009). "*Ergonomics and occupational safety and Health : An ILO perspective*". Applied Ergonomics, Vol 41, Issue 6, pg. 744-753.
- Shikdar, A. A., dan Sawadeq, N. M. (2003). *Worker Productivity and Occupational Health and Safety Issues in Selected Industries*. Computers and Industrial Engineering. 45(4), 563-572.
- Thomson, R., (2011). "*Flexible Workspace Design and Ergonomics Training: Impacts on The Psychosocial Work Environment, Musculoskeletal Health, and Work Effectiveness Among Knowledge Workers*". Applied Ergonomics, Vol 38, pg. 482-494.
- Ugwu. O. O., & Haupt. T. C. (2007). "*Key Performance Indicators and Assessment Methods for Infrastructure Sustainability – a South African Construction Industry Perspective*". Building and Environment, Vol 42, pg. 665-680.
- Vischer, J. C., (2007). *The Effects of the Physical Environment on Job Performance: Towards A Theoretical Model of Workspace Stress*. Stress and Health 23: 175–184.
- Williams. C. A. (2010). "*Academic Training and Practicing Ergonomists – Meeting The Needs*". Contemporary Ergonomics and Human Factors 2010: Taylor and Francis/CRC Press.
- Williams. C. A. (2011). "*Academic Training and Practicing Ergonomists-Meeting The Needs*". Contemporary Ergonomics and Human Factors: Taylor and Francis Group/CRC Press.
- Wilson. J. R. (2000). "*Fundamental of Ergonomics in Theory and Practice*". Applied Ergonomics, Vol 31, Issue 6, pg. 557-567.
- Shorrock, S.T., and Chung, A.Z.Q., (2010). "*Mind Gap: Research and Practice in Ergonomics and Human Factors*". Contemporary Ergonomics and Human Factors: Taylor and Francis Group/CRC Press.

OSHA 3125. (2000-revised). *“Ergonomics: The Study of Work”*. US Department of Labor, Occupational Safety and Health Administration.

Whysall, Z.J, Haslam R.A., Haslam, C., (2004). *Processes, Barriers, And Outcomes Described By Ergonomics Consultants In Preventing Work-Related Musculoskeletal Disorders*. *Appl Ergon* 2004; 35(4):pp343–51.