ERGONOMICS ANALYSIS OF FALLING AMONG WORKERS AT WORKPLACE

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Specially dedicated,

To my beloved husband,

Ng Zheng Yi

To my brothers and sister, lecturers, and fellow friends

For their support and encouragement

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ABSTRACT

Slips and trips are the most common cause of major injuries at work. Fall accidents continue to be a significant cause of fatal injuries and economic losses. Identifying the risk factors causing slip-induced falls is key to developing better preventive measures to reduce fall accidents. Although many studies suggest human physical condition may be one of the risk factors for slip-induced falls, there has been no documented study examining the relationship between human intrinsic factors (physical and psychophysics), extrinsic factors (external environments), and fall accidents. As such, the overall objective of the current study was to identify factor contribute to slips and fall incidents among workers at workplace in Malaysia. This project will analysis slip distance based on the interaction of the external environments factors, human physical factors, and human psychophysics factors that causes the incident of slips and falls. Based on the result suggestion and guideline can be produce to overcome the slips and falls incident.

ABSTRAK

Kemalangan kejatuhan adalah punca pertama kecederaan di tempat kerja. Kemalangan kejatuhan terus menjadi punca besar untuk pekerja kecederaan , maut dan kerugian dalam ekonomi. Untuk mengamalkan langkah-langkah pencegahan yang lebih baik untuk mengurangkan kemalangan jatuh faktor-faktor risiko yang menyebabkan kemalagan kejatuhan berlaku kena dipastikan. Walaupun banyak kajian telah menunjukkan keadaan fizikal manusia adalah salah satu faktor risiko yang menyebabkan kemalangan kejatuhan, tetapi masih tiada kajian telah mengaji hubungan antara faktor manusia intrinsik (fizikal dan psychophysics), faktor-faktor ekstrinsik (persekitaran luar), dan kemalangan kejatuhan. Oleh sebab itu, projek ini diilhamkan untuk mengenal pasti punca-punca utama berlakunnya masalah tergelincir dan terjatuh dikalangan para pekerja khasnya ditempatkerja. Seterusnya projek ini akan mengira jarak tergelincir dari hasil interaksi antara faktor-faktor persekitaran luaran, faktor-faktor fizikal manusia, dan manusia psychophysics faktor. Hasil daripada projek ini, ia boleh membantu untuk menghasilkan beberapa cadangan dan penambaikan kepada garis panduan yang sedia ada untuk meminimakan kejadian tergelincir dan terjatuh. Projek kehendak jarak slip analisis yang menyebabkan kejadian tergelincir dan terjatuh. Berdasarkan cadangan keputusan dan garis panduan boleh menghasilkan untuk mengatasi tergelincir dan jatuh kejadian.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Slips and trips are the most common cause of major injuries at work. Analysis and prevent falling accidents among workers at workplace is one of the most essential issues that cannot be taken lightly. The costs to industry are substantial and there is incalculable human cost and suffering to those injured, even it only minor falls, it may cause serious injured or dead of falling workers.

Legal actions following an injury can be extremely damaging to business, especially where the public is involved. Insurance only covers a small part of the cost.

Professionals put forth a great deal of effort in code development and other accident-prevention techniques designed to either eliminate recognized hazards or, at the very least, reduce the chance that a recognized hazard will lead to an accident. Even with this effort and under the most rigorously controlled safety code and

standard enforcement, fall accidents occur. The one variable hardest to predict or control is that of human limitation.

People have accidents when they think they are safe. When a hazard is recognized, the normal human reaction is to be cautious to avoid it, however with the presence of environmental cues, such as inadequate lighting or warnings, once fails to recognize a hazard, behaves accordingly, and an accident occurs.

Effective solutions are often simple, inexpensive and can lead to other benefits. The most effective approach is to have human factor analysis techniques to identify hazards, understand human limitation and create action plan to identified hazard and create action plans to reduce accidents.

The aim of this project investigate the impact of human factors on the likelihood and severity of slip and trip accidents and to develop practical strategies to control and reduce the incidence of these events.

1.2 Background of the Study

Fall injuries constitute a considerable financial burden: workers' compensation and medical costs associated with occupational fall incidents have been estimated at approximately $70 billion annually in the United Sates. Many countries like Malaysia are facing the same challenges as the United States on fall injury in the workplace. The costs to industry are substantial and there is incalculable human cost and suffering to those injured, even it only minor falls, it may cause serious injured or dead of falling workers.

In Malaysia Slips and trips are the most common of workplace hazards and make up over a third of all major injuries. Over 10,000 workers suffered serious injury because of a slip or trip last two years. From the Table 1.1, year 2011 fall accidents over contribute to 14217 reported cases, although the number of fall accidents decreased to 55187 in year 2011 but the percentage of contribute by the fall accidents in overall industrial accidents are actually increased from 12% as shown in Figure 1.1 to 13% of overall industrial accidents as shown in Figure 1.2.

Thus, Ergonomics analysis refers to external environmental, human physical and individual characteristics analysis which played a significant role in identified a series of common contributory factors preceding the fall accidents and these critical identified factors leading to effectively controlled and prevent fall accident.

Table 1.1: Numbers of Industrial Accidents by Causes in 2011 and 2012 (Source: SOCSO Annual Report, 2011 and 2012)

No	Causes	Reported Cases in Year 2011	Reported Cases in Year 2012
1	Fall	14217	13851
2	Struck from falling object	5495	5690
3	Stepping, hit or crushed by object	21295	20246
4	Caught in or between object	5336	5643
5	Overexertion or strenuous movement	3518	2715
6	Contact or expose to extreme temperature	655	646
7	Contact or expose to electrical current	53	50
8	Contact or expose to dangerous substances	7070	6346
	Total	57639	55187

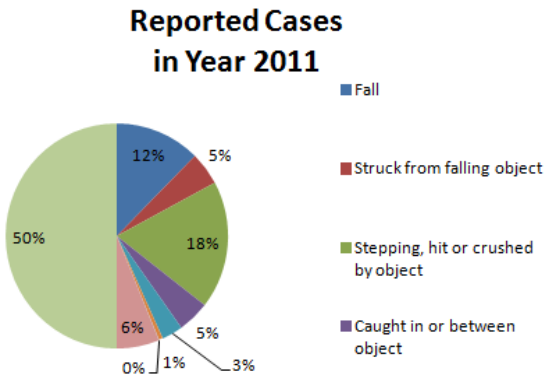

Figure 1.1: Types of accidents (percentage) Industrial Accidents in year 2011

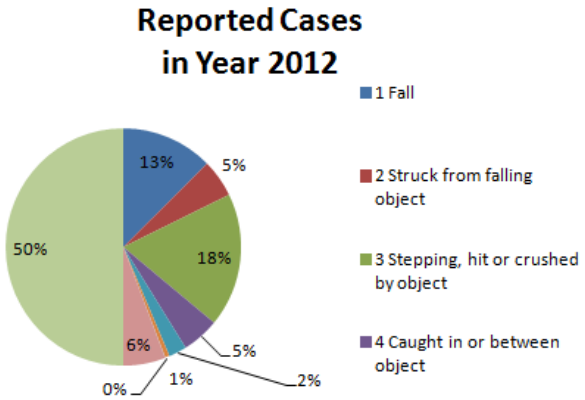

Figure 1.2: Types of accidents (percentage) Industrial Accidents in year 2012.

1.3 Problem Statement

From July 1 2013, all 600,000 private companies throughout the Malaysia will have to implement the new ruling - The retirement age for the private sector was increased from the current 55 to 60 under the Minimum Retirement Age Act, which was passed in June and gazetted in August last year.

Many studies have shown that with advancing age there is an increasing incidence of slip and fall injuries (Campbell et al., 1981; Rubenstein et al., 1988; Rice et al., 1989) which mean fall accident increase due to increasing worker from 55 to 60, therefore we need identified factors preceding the fall accidents, relationship between fall accidents factors and fall accidents so that more guideline for fall accidents prevention can be produced and the fall accidents will not be increased as the number of advancing age workers.

1.4 The Significance of the Study

This study provides a clear view to identify falls accidents among workers in Malaysia workplace. According to W.H. Heinrich (1931), who developed the so-called domino theory which each accidents factor would actuate the next step in the manner of toppling dominoes lined up in a row in the same way that the removal of a single domino in the row would interrupt the sequence of toppling, Heinrich suggested that removal of one of the factors would prevent the accident and resultant injury. Therefore, fall accidents in Malaysia can be preventing once the fall accidents factors are identified and remove as per domino theory.

1.5 Objective of Project

Objectives of the study:

1. To identify factors preceding the fall accidents happen in Malaysia workplace.
2. To establish the relationship between external environment and human body and fall accidents.
3. To identify usable, practical strategies for the control and reduction fall accidents.

The main objective of this study is to identify and determine the main factors proceeding of fall accident happen. Through this objective, a survey will be done to identify and determine causes fall accidents happen in selected workplace.

The second objective is to investigate the relationship between human factor and fall accidents. When a fall hazard is recognized, the normal human reaction is to be cautious to avoid it. This objective investigate how human factor (Human physical factors like muscle fatigue) as a basic factor lead to fall accident. For example human physical fatigue causes from continual repetition, worker need to walk around like operation operator result in physical fatigue so when added environment factors will lead to fall accident.

Once the fall accidents factors, relationship between factors and fall accidents identified usable, practical strategies for the control and reduction fall accidents.

1.6 Scope of Study

Slips and falls incidents occur on the same level only.

1.7 Organization of Thesis

Chapter 1 explained the introduction and background of the slips and falls incidents especially at work place.

Chapter 2, the literature review will discuss on ergonomics analysis method, slips and falls information on its theories, types of fall.

Chapter 3 consists of methodology about how to apply ergonomics analysis fall accident causes. This chapter provides the development of questionnaire to workplace.

Chapter 4 present a full breakdown of the underlying issues and human factors associated with the slip or trip incidents investigated and provide recommendations how to reduce fall accidents.

1.8 Conclusion

This chapter provides an introduction to slips and falls. It is also clarify the problems arise related to this research. The objective and scope of the research are stated and the problem statements are provided. The next chapter discusses the literature review of the study.

REFERENCE

Davis, P. R. (1983) *Human factors contributing to slips, trips and falls*. Ergonomics. 26: 51-59.

Li, K.W., Chen, C.J., (2004). *The effect of footwear soling tread groove width on the coefficient of friction with different sole materials, floors, and contaminants.* Applied Ergonomics 35, 499–507.

Aznee.S, (2010). *Analysis of Slips and Falls Among Workers at Workplace*. Rainbow sdn bhd

Bailer, Stout, Reed and Gilbert, (2001). *Fall in Older People: Risk Factor and Strategies for Prevention.* Cambridge University Press

Carlsoo, (1962). A Method For Studying Walking on Different Surfaces. Ergonomics.Vol. 5, pp. 271-274.

Chang, (2001). *The effect of surface roughness and contaminant on the dynamic friction of porcelain tile*. Applied ergonomic, 32, 173-184

Lockhart TE, Spaulding JM, Park SH.(2006) *Age-related slip avoidance strategy while walking over a known slippery floor surface*, Epub 24(1):23-34

Williams, and Lissner. (1962). *Biomechanics of Human Motion*, Philadelphia: Saunders Company, 122.

Perkins. (1978). *Measurements on Slip Between the Shoe and the Ground During Walking*, In: C. Andersson and J. Senne (ed.), Walkway Surface: Measurement of Slip Resistance. ASTM STP 649, pp. 71-87.

Chiou,(2000). *Evaluation of workers' perceived sense of slip and effect of prior knowledge of slipperiness during task performance on slippery surfaces*. American Industrial Hygiene Association Journal. ;61:492–500

Perkins and Wilson, (1983). *Slip Resistance Testing of Shoes - New Development,* Ergonomics. No. 19, pp. 193-196.

Scheil, and Windhovel. (1994). *Unsteady speed measurement with the measuring method of Manning*. Engineering of Industrial Science. 20:177–181.

Son, (1990). *The effect of postural changes on slip and fall accidents*.
Davis, (1983). *Human Factors Contributing to Slips, Trips and Falls*. Ergonomics, vol. 26, No l, pp. 51-59.

Dekker, (2002*). Occupational Injury Prevention*. Journal of Safety Research
Temple, J.A, *Three Interactive Processes of Social Influence: Facilitating Changes In Energy Conservation Attitudes and Actions as a Exposure to Five Types of Communications Strategies*. Unpublished doctoral Dissertation. Santa Cruz, CA: University California, 1985

Gronqvist, Hirvonen and Tuusa (1993). *Slipperiness of the floor-shoe interface: comparison of objective and subjective assessment.* Applied Ergonomic, 24, 258-262

Steven. (2003). *Slip and Fall Prevention.* ESIS Inc. Taylor and Francis.
Sttandberg and Lanshammar, (1983). *On the Biomechanics of Slipping Accidents*. In:H.

Strandberg, (1985). *The effect of condition underfoot on falling and overexertion accident*. Ergonomic, 28, 131-147

APPENDIX A