DEVELOPMENT OF A JOB ROTATION MODEL FOR A NOISE HAZARD REDUCTION

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ABSTRACT

Job rotation is a significant approach of job design used in manufacturing, assembly or any service providing system, which requires the workers to move between different tasks, at fixed or irregular periods of time. Nowadays, an effective job rotation is increasingly employed in organizations because it helps to reduce and balance the hazard exposure among the workers. An effective job rotation requires optimum rotation parameter setting to ensure the final results will give benefits, for both occupational safety and health, and operational cost. Most of the job rotation studies by previous researchers have been performed for heavy engineering industry such as automotive assembly, forestry and construction site, but a lack of study is observed for the food and beverage manufacturing industries. In this thesis, a job rotation model of a food and beverage manufacturing company has been developed by using Mathematical Programming, and in particular, Integer Linear Programming to eliminate repetitive tasks (with high exposure of noise hazard) for each of the workers, while maintaining a constant level of production. This study was performed among 9 workers, and the proposed model was simulated under few scenarios based on machine availability and worker's competency requirement. The proposed model was then transformed into MATLAB programming framework and the optimum solutions were then analysed to verify their effectiveness. Final results are given illustrating the validity and practicality of the proposed model for different operational scenarios.

ABSTRAK

Gantian kerja ialah pendekatan pekerjaan yang penting yang sering digunakan dalam sektor pembuatan, pemasangan atau mana-mana sistem penyediaan perkhidmatan, yang memerlukan pekerja bergerak antara tugas yang berbeza, pada masa tetap atau tidak teratur. Pada masa kini, gantian kerja yang berkesan semakin banyak digunakan dalam organisasi kerana ia membantu mengurangkan dan mengimbangi pendedahan bahaya di kalangan pekerja. Gantian kerja yang berkesan memerlukan tetapan parameter yang optimum untuk memastikan sistem gantian kerja dapat memberikan faedah, terutamanya dari segi keselamatan dan kesihatan pekerjaan, dan juga kos operasi. Kajian mengenai gantian kerja yang berkesan telah dilakukan oleh penyelidik terdahulu, kebanyakannya di dalam industri kejuruteraan berat seperti pembuatan automotif, perhutanan dan sektor pembinaan, tetapi kurang kajian dilakukan bagi industri pembuatan makanan dan minuman. Dalam tesis ini, model gantian kerja telah dicadangkan untuk sebuah syarikat pembuatan makanan dan minuman, dengan menggunakan Pengaturcaraan Matematik secara amnya, dan Pengaturcaraan Linear Integer secara khususnya, untuk mengurangkan tugas-tugas berulang yang terdedah kepada bahaya kebisingan yang tinggi untuk setiap pekerja, sambil mengekalkan tahap pengeluaran. Kajian ini dilakukan di kalangan 9 pekerja, dan model yang dicadangkan disimulasikan di bawah beberapa senario berdasarkan keadaan mesin dan kompetensi pekerja. Model yang dicadangkan kemudiannya diubah kepada pengaturcaraan MATLAB dan penyelesaian optimumnya dianalisis untuk mengesahkan keberkesanannya. Hasil kajian ini menunjukkan praktikaliti model tersebut di dalam mengawal pendedahan bahaya kepada pekerja berdasarkan keperluan syarikat.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Industrial workers are frequently exposed to occupational hazards in their workplaces. Such hazards can affect workers' physical and mental health, safety, and productivity. Excessive hazard exposure (above the permissible level) can lead to occupational injuries and illnesses which will, consequently, result in unnecessary compensation payments, indemnity, and medical services.

Frequent safety and health problems in industrial facilities are musculoskeletal disorders (MSDs), cumulative trauma disorders (CTDs), hearing loss, heat stress, chemical or radiation burns, etc. These problems are the results of excessive exposure to occupational hazards such as industrial noise, heat, physical workload, and toxic chemicals and substances.

Occupational Safety and Health Administration (OSHA) has recommended a hierarchical approach to workplace hazard control: engineering approach, administrative approach, and the use of personal protection equipment. Among them, the administrative approach provides a good compromise between implementation cost and effectiveness. Job rotation is one of the most frequently recommended administrative methods due to its ability to balance occupational hazard risks swiftly at low or even no costs.

In brief, workers are required to change their jobs during the day. In this way, the physiological effect from hazardous jobs can be shared by many workers, instead of being accumulated by one worker. It is a helpful approach in reducing daily occupational hazard exposure of individual workers.

1.2 Background of the problem

Malaysia has become part of the world's manufacturer among Asian country. However, this recognition has created occupational safety and health (OSH) issues among the workers while they are at work.

Occupational safety and health (OSH) was first implemented in Malaysia some 130 years ago towards the end of the 19th century (DOSH 2007). The Department of Occupational Safety and Health is the only government agency responsible for administrating, managing and enforcing legislation pertaining to OSH in the country, with the vision of making all occupations safe and healthy whilst enhancing the quality of working life (OSHA, 1994).

The occupational diseases and poisoning statistic data from DOSH report show increasing trend as shown in Figure 1.1. The data describes the number of case from the year 2005 to Aug 2015. Most probably this increment is due to increase of the number of industrial companies in Malaysia. The number of cases investigated by type of disease in year 2015 is tabulated in Table 1.1. However, this data was not reported based on industrial sector.

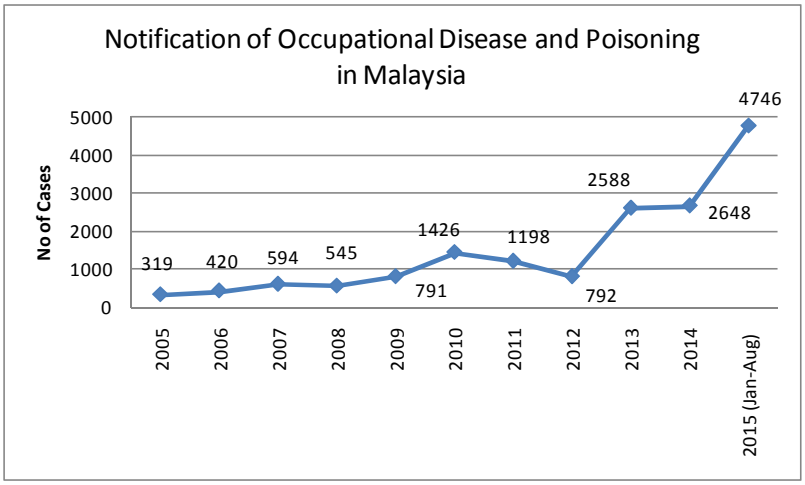

Figure 1.1: Notification of occupational disease and poisoning in Malaysia (DOSH 2015 annual report)

Table 1.1: Number of cases of occupational disease in Malaysia, 2015 (January-August)

Diseases	Cases
Occupational Lung Diseases (OLD)	86
Occupational Skin Diseases (OSD)	38
Occupational Noise Induced Hearing Loss (NIHL)	4287
Occupational Muscular - Skeletal Disorders (OMD)	208
Occupational Poisoning	27
Disease cause by Physical Agent	5
Disease cause by Biological Agent	67
Occupational Cancer	2
Psychosocial Problem	2
Other Types of Occupational Diseases	16
Non Occupational Diseases	8
Jumlah	**4746**

Majority of industrial companies in Malaysia are an SME (micro, small and medium-sized enterprises). Hazard reduction through engineering control solution sometime may not be feasible to implement as it needs higher initial cost. Thus, administrative controls such as job rotation are often the most cost-effective method for solving the problem.

However, job rotation has many limitations because the hazard itself is not actually removed or reduced, but only limits the dose of hazard exposure. To verify the effectiveness of job rotation implementation, several studies have been conducted to analyse the effectiveness of job rotation in order to reduce the occupational health hazard. Yet there is currently a gap in existing studies. It reveals that most job rotation studies have been done for heavy engineering industrial such as automotive, forestry, and construction. Lack of study is observed for the food manufacturing industry.

Therefore, this study is carried out at the food manufacturing industry to analyse the reduction of occupational health hazard through optimal job rotation schedule implementation.

1.3 Statement of the problem

Several studies were conducted and concluded that job rotation is considered as an effective tool for successful implementation of administrative strategy to reduce hazard at work place. To fill the gap of previous research, this study is performed for food and beverage manufacturing industry.

The common causes of illness in food and beverage industries are:

- Musculoskeletal disorder (MSDs) mainly comprising work-related upper limb disorders (WRULDs) and back injuries
- Work-related stress, which can be caused by poor work organization
- Occupational asthma caused by inhalation of bakery and grain dust
- Occupational dermatitis from hand-washing, contact with foodstuffs, etc.
- Rhinitis caused by irritant dusts such as bakery and grain dust, spices and seasonings
- Noise-induced hearing loss where noise levels exceed 85dB(A)

This thesis will identify the occupational hazard and assess the hazard level at case study plant, Company PQR, one of food and beverage manufacturing companies in Johor Bahru. Job rotation schedule will be analyzed using mathematical programming approach as solution to reduce the identified hazard exposure.

1.4 Scope

(i) A case study is done in food and beverage manufacturing industry
(ii) Hazard identification will cover work environment (noise, heat, radiation, dust, lighting) and Biomechanical hazards (lifting, standing, repetitive motion)
(iii) Job rotation schedule will be analysed based on the most significant risk job
(iv) Employ mathematical programming as an optimization method

1.5 Objectives

(i) To identify the most significant risk hazard at the case study plant
(ii) To obtain the optimal job rotation schedule to reduce the hazard exposure level

1.6 Significant of the research

The significance of this study is to create a Mathematical Programming model based on the occupational hazard problem scenario at the case study plant. This model will be used to obtain the optimum and effective job rotation schedule in order to help the company to reduce the hazard exposure through administrative control. A safe work environment will improve workers health, job satisfaction and organization's productivity.

1.7 Conclusion

As the conclusion, this study is done in order to help to reduce the occupational hazard exposure by developing effective job rotation schedule. In the next chapter, the literature review of hazard assessment technique and previous study on job rotation application will be discussed for a better understanding of this research.

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