



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

A STUDY ON ERGONOMIC ENVIRONMENT FACTOR AND INERTIA THAT CONTRIBUTE TO DISCOMFORT INSIDE TRAIN

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Manufacturing Engineering Technology (Process and Technology) with Honours

by

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DECLARATION

I hereby, declared this report entitled
**“A Study on Ergonomic Environment Factor And Inertia That Contribute To
Discomfort Inside Train”**
is the results of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering Technology (Process And Technology) with Honours. The member of the supervisory is as follow:

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ABSTRAK

Terdapat banyak faktor yang menyumbang kepada ketidakselesaian terhadap penumpang terutama dalam pengangkutan awam. Kepadatan dan struktur kereta api dapat memberi kesan terhadap alam sekitar (bunyi dan kualiti udara dalaman) dan inersia di dalam kereta api. Ketika dalam pengangkutan awam seperti bas, kereta api, pesawat terbang, kemudahan penumpang harus diutamakan. Matlamat projek ini adalah untuk mengkaji maklumat mengenai faktor risiko yang menyumbang dengan ketara kepada ketidakselesaian semasa menaiki pengangkutan kereta api, untuk menilai melalui tinjauan soal selidik mengenai maklumat mengenai faktor yang menyumbang dengan ketara kepada ketidakselesaian di dalam kereta, untuk mentafsirkan data dan maklumat yang diperolehi oleh setiap bahagian soal selidik menggunakan analisis statistik yang berkaitan dengan statistik deskriptif dan korelasi. Projek ini dijalankan dalam keretapi komuter KTMB selama beberapa bulan. Projek ini lebih tertumpu kepada kaji selidik yang telah disediakan kepada penumpang di kereta api ini. Sebanyak 130 soal selidik telah diberikan kepada penumpang wanita tetapi hanya 97 soal selidik yang sah untuk dianalisis. Dari hasilnya, semua faktor yang disebutkan mempengaruhi ketidakselesaian semasa di kereta walaupun kesannya kecil. Walau bagaimanapun, kualiti udara dalaman lebih cenderung mempengaruhi ketidakselesaian penumpang di dalam kereta api. Terdapat juga saranan kepada penumpang serta pengurusan KTMB hasil daripada projek ini.

ABSTRACT

There are a lot of factor that contribute to discomfort towards passenger especially in public transport. The crowdedness and the structure of the train can give the impact towards the environment (noise and indoor air quality) and inertia inside the train. When in public transport such as buses, trains, airplanes, the passenger's convenience should be prioritized. The goals of this project are to establish of information on risk factors that contribute significantly to discomfort while riding moving railway transport, to assess through questionnaire survey regarding the information on factors that contribute significantly to discomfort inside the train, to interpret data and information obtained by each section of the questionnaire using statistical analysis tools associated with descriptive statistics and correlation. This project is run in commuter train of KTMB for several months. This project is more focused on the survey that has been provided to passengers on this train. As many as 130 questionnaires have been given to women passengers but only 97 questionnaires are valid to be analysed. From the results, all the factors mentioned affect the discomfort while on the train even though the effect is minor. However, indoor air quality is more likely to affect the discomfort of passengers in the train. There are also suggestions to the passengers as well as the management of KTMB due to the result from this project.

DEDICATION

To my beloved parents

Mat Ariffin bin Jelani

Hasni binti Haji Ahmad

For my Final Year Project Supervisor

Dr. Wan Hasrulnizam bin Wan Mahmood

For my helpful siblings

Nurhidayah binti Mat Ariffin

Mohamad Amirul Afiq bin Mat Ariffin

Nurafiqah binti Mat Ariffin

Nursahira binti Mat Ariffin

Nuralia Aisya binti Mat Ariffin

And all my fellow friends

Fatimah binti Abdullah

Siti Fatimah binti Affandi

Nur Adlin binti Che Arbaei'

Ida Nurfarhana

Noor Amira binti Mohd Razlam

UTeM's students

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LIST OF ABBREVIATIONS

CSIRO	-	Commonwealth Science and Industrial Research Organisation
EIT	-	Environment In Train
IAQ	-	Indoor Air Quality
KTMB	-	Keretapi Tanah Melayu Berhad
MSD	-	Musculoskeletal Disorders
SARS	-	Severe Acute Respiratory Syndrome
SPSS	-	Social Package for Social Science
WW	-	Discomfort inside Train
XX	-	Environment in Train (Noise)
YY	-	Environment in Train (Indoor Air Quality)
ZZ	-	Inertia

CHAPTER 1

INTRODUCTION

1.1 Project Background

In the new global economic, transportation become a central issue for the people. Transportation become important thing for people to move from one destination to other destination. Until recently, there has been more interest in transportation especially in public transport. As this case very clearly demonstrates when the number of passenger in public transport in North America and Western European also shown an immediately increase since 1960s and 1970s (Buehler and Pucher, 2012). However, being in public transport sometimes are not comfortable and cause some sickness. Sometimes people need to stand for a long period. Prolonged standing causes muscle fatigue and mental stress.

In a recent cross-sectional study, (Halim and Omar, 2012) investigated about 80% of industrial workers in the USA experience foot or lower leg pain and discomfort associated with prolonged standing. This is due to prolonged standing actually transfer weight from upper part to lower part and finally result in lower back pain. In general agreement, the prolonged standing without dynamic movement will lead to discomfort fatigue and pain in several body regions. Declining of alertness, mental concentration and motivation can be recognized as a factor and discomfort or subjective fatigue that link to psychological fatigue (Halim *et al.*, 2012). The findings of this research provide insights for to investigate the ergonomic factors and psychophysical experience that contribute discomfort among Malaysian while riding the train.

Poor environmental conditions also sometimes cause discomfort in the body and is likely to affect the health. Sound noise can result in disturbed environments and can pose a threat to a person's health and well-being. Noise also can cause cardiovascular disturbance. Vasoconstriction will just happen with increasing of blood pressure and heart beat when acute exposure to activates nervous and hormonal responses (Savale, 2014). Moreover, in certain conditions the air quality was poor especially when public transport. This situation prevented it from pursuing good ventilation and thus cause health disorders occur to man. Legionnaires' Diseases, lung cancer from radon exposure, air bone infection such as pulmonary tuberculosis (TB) and severe acute respiratory syndrome (SARS) and carbon monoxide (CO) poisoning are the examples diseases that cause from indoor air quality (Fisk, 2017).

Effect of inertia also can give the uncomfortable situation to the passenger in train. When in a sitting position, the people tend to be at rest without any moving but sometimes when there is inertia, they need to move from their rest position. The impact of inertia and centrifugal forces on the human body amid the drive demonstrates a unmistakable significance since it perpetrates a condition of tiredness, particularly to the driver who makes an extra exertion in examination alternate travellers (Kulcsar *et al.*, 2012). This situation shows that inertia effect discomfort inside the transport.

1.2 Problem Statement

Many people currently choose to use public transport or share cars to reduce the cost of living. Furthermore, in view of recent issues of rising oil prices being reported. This is also one of the reasons why many choose to take public transport. Exposure to transportation has been shown to be related to adverse effects in discomfort inside the train. Recent development in transportation have heightened the need for people who are riding train everywhere especially in city. Train is one of the public transport that usually used by the people especially to them who are living in the city.

Over the past 10 years, rail passenger numbers have risen by about 40% and the industry is expecting demand to double over the next few decades. It is difficult to lengthen trains when peak-time timetables are at maximum capacity. Levels of overcrowding are likely to rise with a continuing increase in the activity for rail travel (Howarth & Griffin 2011). Crowding in transport is turning into a developing worry as request develops at a rate that is surpassing accessible limit. To catch the client benefits related with diminished swarming from enhanced open transport, it is important to distinguish the significant measurements of swarming that are significant measures of what swarming intends to explorers (Li & Hensher 2013). Some of the people will standing for a long time when the train is crowded.

Overcrowded will increase the inertia inside the train. The higher the mass, the higher the inertia and the more force are needed. For example, an airplane is a very large, heavy object, and it takes jet engines running at full throttle to get it going fast enough for taking off. Then, when the airplane needs to land, the pilots have to run the engines backward at full throttle, but with just as much force as during taking off. It takes the same amount of energy to stop a plane as it does to put it in the air (Ellen, 2016).

1.3 Project question

In order to develop the objectives of the research, several questions have been constructed.

The questions as follow:

- a. What are the ergonomic environment factors and inertia that need to be considering as a contributors to the discomfort while riding moving railway transport?
- b. What are the factors that contributing significantly to discomfort while riding the moving railway transport?
- c. What the most factor that can minimize discomfort according to train users understanding?

1.4 Project Objectives

This research has been developed based on several objectives:

- a. To establish information on risk factors and inertia that contribute significantly to discomfort while riding moving railway transport.
- b. To assess through questionnaire survey regarding the information on factors and inertia that contribute significantly to discomfort inside the train.
- c. To interpret data and information obtained by each section of the questionnaire using statistical analysis tools associated with descriptive statistics and correlation.

1.5 Project Scopes

This project is carried out for KTMB commuter's users in real situation while riding the train. This project is focusing in ladies' coach, so most of the respondents are women. Project will be initiated about two hours in the train from the Tampin station to the KL central train station and vice versa. There are about 18 stations will be passed. Besides, the place that are concentrating in the train is in the middle, doors and gangway of the coach. Furthermore, it is important to know that the ergonomic factors occur in the railway will cause discomfort to the passenger neither the human factors, the environmental factor nor inertia. The maintenance of balance during standing depend on descending motor command from the central nervous system. However, it cannot be achieved without sensitive and accurate input of somatosensory (muscle, joint, skin and pressure receptors), visual and vestibular system.

Preliminary studies carried out prior to the actual start of the study. It involves about 130 who are riding the commuter frequently to help the starting of the project. After that, data collection will be analysed by using SPSS software with descriptive and analysing the relationship of independent and dependent using correlation analysis. Below are the following parameters that will be studied:

Human Factor: Psychophysical (experience feeling- level of pain); biomechanical (muscle fatigue and movement).

Ergonomic Factor: Environment (humidity, noise analysis and condition in the train cabin) , inertia.

1.6 Significance of Project

The outcomes of this project are expecting on bringing a benefit towards:

a. New findings/ New Knowledge

- Have the solution to minimize the r factor of occupational diseases that cause from riding train.
- This project can offer new references and methods for future project.
- People know about health effect due to the data collection.

b. Study, research and experimentation

- Evaluate environment and inertia that we need to know according to ergonomic.

c. Application and engineering

- The uses of software for applying the analysis and relationship about dependent and independent variables

CHAPTER 2

LITERATURE REVIEW

In the modern city, the use of transportation is compulsory to each individual. The selection of vehicles is also essential to guarantee comfort and good health. Furthermore, while public transport in a remote, comfort will be the main focus because when were in the vehicle, one can relax well. If the vehicle boarded much harm, it should provide a controlled use of him. Therefore, screening ergonomic in need in dealing with this. The detail explanation related to discomfort passenger while riding trains that related to ergonomic will be focused on this chapter.

2.1 Ergonomic: An overview

Ergonomic is a system that are applying the system of philosophy, human system, discipline and profession system (Wilson, 2014). Ergonomic comes from two different word which are ‘ergo’ and ‘nomia’. Ergo means as work while nomia define as laws (Naeini and Mosaddad, 2013). Based on Pandve (2016), the profession that applies theory, principle, data and methods to designs in order to optimize human well-being and overall system performance and also the scientific discipline that concerned the understanding of interaction among human and other system also is categorized as an ergonomic. In the other word, ergonomic is a study related to the interface between workers and their work environments, including machines and work processes, to optimize employee health, safety, performance, and productivity (Barron, 2015). The Table 2.1 presents an overview of ergonomic definition.

Table 2.1 Definition of ergonomic

Research articles	Ergonomic definition
Karwowski & S. Marras (2003)	<i>Ergonomics place more emphasis on the study and application of knowledge about human physical characteristics, including work physiology and biomechanics; and on the field study approach to acquiring ergonomics knowledge and developing ergonomics technology.</i>
(Pheasant, S. and M. Haslegrave, 2006)	<i>Ergonomics is the science of work: of the people who do it and the ways it is done, of the tools and equipment they use, the places they work in, and the psychosocial aspects of the working situation.</i>
(D.Bhiase, 2012)	<i>Ergonomics is a multidisciplinary science involving fields that have information about people (e.g., psychology, anthropometry, biomechanics, anatomy, physiology, and psychophysics). It involves studying human characteristics, capabilities, and limitations and applying this information to design and evaluate the equipment and systems that people use.</i>

Ergonomic principle is applied in order to create safety, healthy, efficient and effective activities in the workplace. Besides, it is also can describe the human abilities and limitation meanwhile can also reduce risk factor. Based on Slovak (2011), risk factor that contribute to occupational ergonomic injuries and sickness such as strains and sprains and cumulative trauma disorders (CTDs) can be reduced by applying ergonomic design. There are several types of risk factor in ergonomic. Ergonomic also studies the interaction of risk factor in different three areas which are risk factor inherent in work, task and environment. However, the level of risk actually depends on how long they are on several condition (contribute risk factor) and how often they are exposed(Slovak, 2011). There is method to analysis this risk factor to get the result. In every risk factor of ergonomic, there are analysis related to each other.

2.2 Ergonomic Factor

Ergonomics risk factors are aspects of a job or task that impose biomechanical stress on the worker. Ergonomics studies are fast becoming a key instrument in determining musculoskeletal disorders (MSD) hazards. It is also the synergistic elements of musculoskeletal disorders (MSD) hazards. Risk factors also related to work activities. Factors of ergonomics also include lighting, noise, temperature, vibration, heavy lifting, repetitive motion and others. Most of the risk factors can contribute to the muscle fatigue. This is because the people become discomfort when there are the risk factors of ergonomic. However, there are three important elements that must be taken in this project. The risk factor related to human, environment and machine (tool) is also related to engineering shown in Figure 2.1

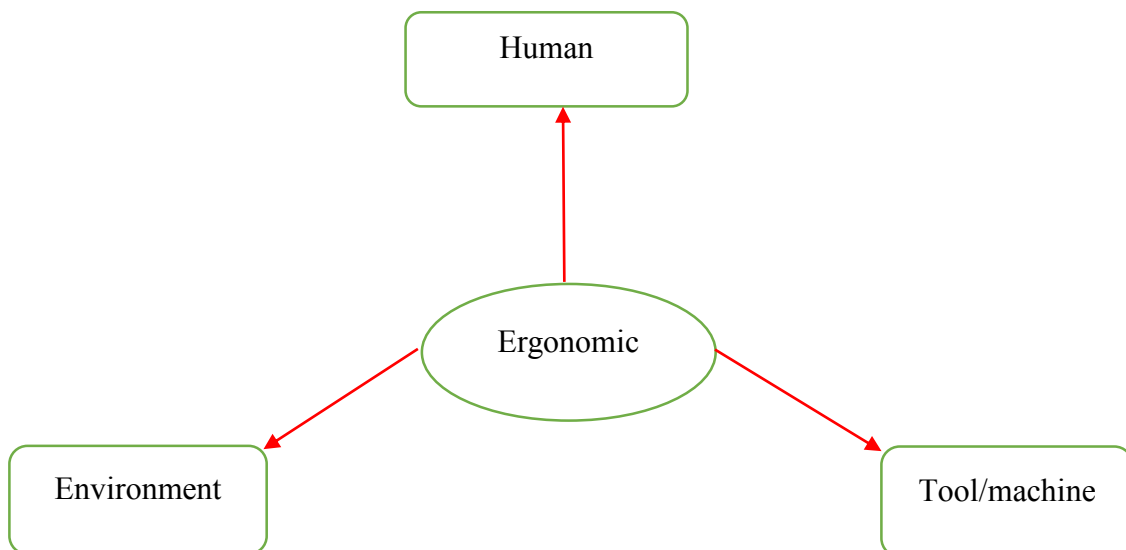


Figure 2.1 Ergonomic Risk Factor

2.2.1 Human factor

Historically, the term human factor has been used to describe the environmental, organization, job factors and human with individual characteristic which affected the behavior at work in a way which can influence health and safety. Three aspects in human factors are developed which are the jobs, the individual and the organization. All the aspects explain how they impact on people's health and safety behavior. However, human factors actually is linked closely to ergonomic which is the application of scientific information concerning humans to the design of objects, systems and environment for human use (Jane Carthey, 2009). The human factors include human capabilities and limitations, human-machine interaction and teamwork. All these put emphasis (sometimes implicit) on analysis of human performances, safety and satisfaction. Human factors is a discipline with a strong tradition in the development and application of method (Neville Stanton et al. 2005).

The research continues with regard to the first aspect of human factors which is individual. This aspect refers to the passenger in this train. The passenger is a respondent to carry out research related to comfort and discomfort when being in train. Normally, passenger that always used public transport when moving to their destination will experienced comfort compare to the people who are using the public transport seldom. However, passengers who ride this train will certainly feel discomfort because there are many passengers. Some of them had to stand. As for that seat, they may not be able to sit in comfortably. This can cause them pain, tiredness and fatigue throughout the day. Human factor will relate to muscle activity. Muscles are controlled in synergic grouping. Muscle activity is irritability that is ability to response and stimuli. It is also contractility. It is ability to shorten upon receipt to stimuli. Muscle activity is an imperative metric that give knowledge into the heap and capacity of muscle control. As the muscle contract, ATP is broken down to provide energy. Every movement in our body is generated by the muscle.