

**DESIGN AND DEVELOPMENT OF ERGONOMICS MOUSE
TRAY FOR OFFICE WORKERS**

**TIONG JING YIN
B051410161**

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA
2018**



DESIGN AND DEVELOPMENT OF ERGONOMICS MOUSE TRAY FOR OFFICE WORKERS

This report is submitted in accordance with requirement of the University Teknikal
Malaysia Melaka (UTeM) for Bachelor Degree of Manufacturing Engineering

by

TIONG JING YIN

B051410161

941101-08-5512

FACULTY OF MANUFACTURING ENGINEERING

2018

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: **DESIGN AND DEVELOPMENT OF ERGONOMICS MOUSE TRAY FOR OFFICE WORKERS**

Sesi Pengajian: **2017/2018 Semester 2**

Saya **TIONG JING YIN (941101-08-5512)**

mengaku membenarkan Laporan Projek Sarjana Muda (PSM) ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. *Sila tandakan (√)

SULIT (Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysiasebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972)

TERHAD (Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/ badan di mana penyelidikan dijalankan)

TIDAK TERHAD

Disahkan oleh:

Alamat Tetap:

Cop Rasmi:

Tarikh:

Tarikh:

*Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini perlu dikelaskan sebagai SULIT atau TERHAD.

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: **DESIGN AND DEVELOPMENT OF ERGONOMICS MOUSE TRAY FOR OFFICE WORKERS**

Sesi Pengajian: **2017/2018 Semester 2**

Saya **TIONG JING YIN (941101-08-5512)**

mengaku membenarkan Laporan Projek Sarjana Muda (PSM) ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. *Sila tandakan (✓)

- SULIT** (Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysiasebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972)
- TERHAD** (Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/ badan di mana penyelidikan dijalankan)
- TIDAK TERHAD**

Disahkan oleh:



TIONG JING YIN

Alamat Tetap:

57, Taman Dahlia,

33000 Sitiawan,

Perat.

Tarikh: 06-07-2018.

Cop Rasmi: **DR. RADIN ZAID BIN RADIN UMAR**

Senior Lecturer

Faculty of Manufacturing Engineering

Universiti Teknikal Malaysia Melaka

Hang Tuah Jaya

78100 Durian Tunggal, Melaka

Tarikh: 6/7/18

*Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini perlu dikelaskan sebagai SULIT atau TERHAD.

**FAKULTI KEJURUTERAAN PEMBUATAN**

Tel: +606 – 331 6429 / Faks: +606 – 331 6431

Rujukan Kami (Our Ref) : UTeM
Rujukan Tuan (Your Ref) :Ketua Pustakawan
Perpustakaan UTeM Kampus Induk
University Teknikal Malaysia Melaka
Hang Tuah Jaya, 76100 Durian Tunggal
Melaka.

11 June 2018

Tuan/Puan,

PENKELASAN LAPORAN PSM SEBAGAI TERHAD LAPORAN PROJEK SARJANA MUDA KEJURUTERAAN PEMBUATAN ; TIONG JING YINSukacita dimaklumkan bahawa Laporan PSM yang tersebut di atas bertajuk "*Design and Development of Ergonomics Mouse Tray for Office Workers*" mohon dikelaskan sebagai TERHAD.

2. Hal ini adalah kerana ianya merupakan projek yang ditaja sepenuhnya oleh syarikat luar (ErgoWorks Sdn. Bhd.) dan hasil kajiannya adalah sulit.

Sekian dimaklumkan. Terima kasih.

Yang benar,

DR. RADIN ZAID BIN RADIN UMAR
Senior Lecturer
Faculty of Manufacturing Engineering
Universiti Teknikal Malaysia Melaka
Hang Tuah Jaya
76100 Durian Tunggal, Melaka

Tandatangan dan Cop Penyelia

NOTA: BORANG INI HANYA DIISI JIKA DIKLASIFIKASIKAN SEBAGAI SULIT DAN TERHAD. JIKA LAPORAN DIKELASKAN SEBAGAI TIDAK TERHAD, MAKA BORANG INI TIDAK PERLU DISERTAKAN DALAM LAPORAN PSM.



ErgoWorks Sdn Bhd

INDUSTRIAL & OCCUPATIONAL ERGONOMIC SOLUTIONS PROVIDER

Company Registration No: 715438-P

113-2, 2nd Floor, Jalan TKS 1, Taman Kajang Sentral, 43000 Kajang, Selangor DE.

Tel : 03-8734 9141 | Fax : 03-8734 6141

E-mail : ewsb@my-ergoworks.com | Url : www.my-ergoworks.com

Date: 31th Mei 2018

Ref.No: EWSB_SMT/2018/UTEM/053

Dr. Radin Zaid Bin Radin Umar
Fakulti Kejuruteraan Pembuatan,
Universiti Teknikal Malaysia Melaka,
Hang Tuah Jaya,
76100 Durian Tunggal, Melaka.

Melalui: YBhg. Prof. Madya Dr. Zamberi Bin Jamaludin
Dekan, Fakulti Kejuruteraan Pembuatan,
Universiti Teknikal Malaysia Melaka,
Hang Tuah Jaya,
76100 Durian Tunggal, Melaka.

PER: STATUS MAKLUMAT TERHAD UNTUK MAKLUMAT DALAM PROJEK SARJANA MUDA OLEH TIONG JING YIN.

Adalah dimaklumkan bahawa Tiong Jing Yin (941101-08-5512) telah menganalisa laporan-laporan kami dalam menjayakan projek sarjana muda beliau. Sebahagian besar maklumat yang beliau gunakan adalah bersifat peribadi dan sulit, kerana melibatkan maklumat peribadi klien-klien kami. Oleh itu, diminta supaya laporan projek sarjana muda beliau diberi status "terhad".

Sekian, terima kasih.



Hisarniza Binti Harun

Pengurus Kewangan & Pentadbiran

ErgoWorks Sdn Bhd

DECLARATION

I hereby, declared this report entitled “Design and Development of Ergonomics Mouse Tray for Office Workers” is the result of my own research except as cited in references.

Signature :

Author's Name : TIONG JING YIN

Date : 11 June 2017

DECLARATION

I hereby, declared this report entitled "Design and Development of Ergonomics Mouse Tray for Office Workers" is the result of my own research except as cited in references.

Signature : 

Author's Name : TIONG JING YIN

Date : 11 June 2017

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of Universiti Teknikal Malaysia Melaka as a partial fulfilment of the requirement for Degree of Manufacturing Engineering (Hons). The member of the supervisory committee is as follow:

.....
(Dr. Radin Zaid Bin Radin Umar)

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of Universiti Teknikal Malaysia Melaka as a partial fulfilment of the requirement for Degree of Manufacturing Engineering (Hons). The member of the supervisory committee is as follow:



DR. RADIN ZAID BIN RADIN UMAR
Senior Lecturer
Faculty of Manufacturing Engineering
Universiti Teknikal Malaysia Melaka
76100 Durian Tunggal, Melaka
MALAYSIA

.....
(Dr. Radin Zaid Bin Radin Umar)

ABSTRAK

Beberapa penerbitan melaporkan kepada isu-isu muskuloskeletal dalam kalangan pekerja pejabat. Hanya sedikit usaha campur tangan memberi tumpuan kepada menyelesaikan masalah ini dari sudut kawalan kejuruteraan pandangan. Siasatan lanjut telah dijalankan antara pekerja pejabat dan didapati isu-isu yang berulang seperti miskin postur, pergerakan berulang-ulang, dan tempoh penggunaan tetikus boleh meningkatkan faktor risiko atas pekerja pejabat. Upper Limb Musculoskeletal Disorders (ULMDs) telah menjadi sangat biasa dalam kalangan pekerja pejabat. Projek ini bertujuan untuk merekabentuk dan membangunkan satu dulang tetikus prototaip yang kos efektif dan boleh memperbaiki postur pekerja pejabat bila menggunakan tetikus komputer. Metodologi ini dibahagikan kepada tiga fasa - fasa 1, Fasa 2 dan Fasa 3. Fasa 1 merangkumi kajian kesusasteraan, meneliti laporan-laporan penilaian profesional ergonomik yang dikumpul dari syarikat ergonomik. Fasa 2 adalah penilaian keperluan pekerja pejabat, spesifikasi Reka bentuk, produk conceptualization, mengumpul dimensi papan kekunci dan mengecil turun rekabentuk konsep dengan menggunakan ciri dan kaedah pemeriksaan dan mendapatkan maklum balas daripada profesional ergonomik. Di samping itu, Solidworks digunakan untuk melakukan simulasi dan analisis ke atas faktor tekanan dan keselamatan cadangan dulang tetikus. Analisis kos dibangunkan dengan menggunakan analisis Breakeven untuk mengira kuantiti dan kos breakeven prototaip polylactic acid (PLA) dan prototaip Aluminium. Selain itu, lima orang pakar-pakar profesional ergonomik akan dipilih untuk menguji dan menilai cadangan dulang tetikus. Kesimpulannya, ia adalah diperhatikan bahawa postur profesional ergonomik telah bertambah baik dan jarak antara menaip dan komputer tetikus telah dikurangkan. Hasil purata masa yang diambil oleh subjek untuk menyelesaikan tugas yang diberi dengan menggunakan dulang tetikus yang dicadangkan adalah lebih pendek daripada masa yang diambil dengan menggunakan cara tradisional.

ABSTRACT

Several publications reported high prevalence of musculoskeletal issues among office workers. Only a few interventions efforts have focused on solving the problem from an engineering control point of view. Further investigations of office workers identified recurring issues such as poor posture, repetitive motion and duration of using mouse may increase the risk factors of Upper Limb Musculoskeletal Disorders(ULMDs). ULMDs are become very common in office working area. The aim of this project is to design and develop a prototype mouse tray that is cost effective and can improve the upper limb posture when using computer mouse. The methodology was segregated into three phases- Phase 1, Phase 2 and Phase 3. Phase 1 includes literature review, review reports of professional ergonomics assessments that collected from consulting ergonomic company. Phase 2 is need assessments of office workers, design specifications, product conceptualization, collecting dimensions of keyboard and narrowing down the conceptual design by using Pugh's screening method and getting feedback from professional ergonomics consultants. In addition, Solidworks software was used to do simulation and analysis on stress and safety factor of proposed mouse tray. Cost analysis was developed by using Breakeven Analysis to calculate the breakeven quantity and breakeven cost for PLA prototype and Aluminium prototype. Besides, five professional ergonomics consultants were selected to test and evaluate the proposed mouse tray. In conclusion, it was observed that the upper limb posture of the professional ergonomics consultants was improved and the distance between alphabet typing and computer mouse was reduced. The results of average time taken for subjects to complete the given task by using proposed mouse tray is shorter than the time taken by using traditional approach.

DEDICATION

Only

my beloved father, Tiong Bun Liang

my appreciated mother, Lim Tia See

my adored sisters, Lee Ling, Lee Kien and Shu Yin

for giving me moral support, money, cooperation, encouragement and also understandings

Thank You So Much & Love You All Forever

ACKNOWLEDGEMENT

Firstly, I would like to express my sincere gratitude to my supervisor, Dr. Radin Zaid Bin Radin Umar for his support, guidance, monitoring and encouragement throughout the whole study period. His encouragement helped me to concentrate on my research and complete my research successfully.

I would like to express my appreciation to my panels, Dr Shajahan Bin Maidin, Dr Rahimah Binti Abdul Hamid and Dr Saifudin Hafiz Bin Yahaya for giving suggestions, comments in this study.

Last but not least, I am grateful with the cooperation given by the technicians, Encik Ghazalan and Encik Hairudin for helping with the fabrication of prototype. I would also like to thank professional ergonomics consultants from ergonomic consulting company for providing input and feedback for this study.

Finally, I would like to express my deepest gratitude for a constant support, emotional understanding and love that I received from my family. Besides, I am grateful to my friends and their encouragement and help when I face with problems.

TABLE OF CONTENTS

Abstrak	i
Abstract	ii
Dedication	iii
Acknowledgement	iv
Table of Contents	v
List of Tables	viii
List of Figures	ix
List of Abbreviations	xii

CHAPTER 1: INTRODUCTION

1.1 Background	1
1.2 Problem Statement	3
1.3 Objectives	4
1.4 Scopes	4
1.5 Significant of Study	5
1.6 Organization Report	5

CHAPTER 2: LITERATURE REVIEW

2.1 Upper Limb Musculoskeletal Disorders among Office Workers	7
2.2 Poor Posture, Repetitive Motion and Duration of using mouse	10
2.3 Type of Mouse Trays	14
2.3.1 Patent search	14
2.3.2 Mouse trays on market	18
2.3.2.1 Swivel mouse tray	18
2.3.2.2 Mobo MECS-BLK-001 Chair mount ergo mouse tray system	18
2.3.2.3 Fully articulating mouse platform	19
2.4 Office Workstation Set-up	20

CHAPTER 3: METHODOLOGY

3.1	Introduction	24
3.2	Phase 1	25
3.2.1	Literature review	25
3.2.2	Review reports of professional ergonomics assessments	26
3.3	Phase 2	27
3.3.1	Needs assessment	27
3.3.2	Design requirements of prototype	28
3.3.3	Conceptual designs on proposed mouse tray	28
3.3.4	Detailed design of proposed mouse tray	29
3.3.5	Collect keyboard dimension	29
3.3.6	Prototype	30
3.3.7	Simulation and analysis	31
3.3.8	Cost Analysis	31
3.4	Phase 3	32
3.4.1	Getting feedback from five professional ergonomics consultants	32

CHAPTER 4: RESULTS AND DISCUSSION

4.1	Introduction	33
4.2	Phase 1	33
4.2.1	Analysis of reports from ergonomic consultant company	33
4.2.2	Collect data from UTeM staffs	49
4.2.2.1	Location of mouse and keyboard placement	49
4.2.2.2	Distance between mouse and keyboard	51
4.2.2.3	Measurement of time with a given task	52
4.3	Phase 2	55
4.3.1	Conceptual design on proposed mouse tray	55
4.3.2	CAD drawings	56
4.3.3	Cardboard mock up prototype	59
4.3.4	Wood mock up prototype	65
4.3.5	Concept screening	67
4.3.5.1	Pugh's screening method	67
4.3.5.2	Feedback from ergonomic consultant company	67
4.3.6	Stress and safety factor analysis	68
4.3.6.1	PLA prototype	68

4.3.6.2	Aluminium plate prototype	69
4.3.7	3D printer prototype	70
4.3.8	Final design of PLA prototype	72
4.3.9	Final design of Aluminium plate prototype	74
4.3.10	Cost analysis	75
4.4	Phase 3	77
4.4.1	Results of evaluation form from professional ergonomics consultants	77
4.4.1.1	Usability	77
4.4.1.2	Usefulness	78
4.4.1.3	Desirability	79
4.4.2	Feedback from professional ergonomics consultants	79

CHAPTER 5: CONCLUSION AND RECOMMENDATION

5.1	Conclusion	81
5.2	Recommendation	83
5.3	Sustainable Design and Development	84
5.4	Complexity	84
5.5	Long Life Learning (LLL) and Basic Entrepreneurship (BE)	85

REFERENCES

APPENDICES

A	Gantt Chart for FYP 1	93
B	Gantt Chart for FYP 2	94
C	Feedback Form	95

LIST OF TABLES

2.1: Comparison of prevalence of MSDs discomfort in Malaysia and Australia	7
2.2: Summarized of prevalence of MSDs among office workers in different countries	8
2.3: Mouse tray review summary	17
4.1: Number of subjects from different companies	35
4.2: Frequency and percentage of mouse and keyboard placement in different conditions	40
4.3: Number of subjects and percentage of mouse and keyboard placement in different conditions	50
4.4: Measurement of distance between mouse and keyboard among 30 UTeM staffs	52
4.5: Time taken for subjects to complete the given task using traditional approach	53
4.6: Time taken for subjects to complete the given task using proposed mouse tray	54
4.7: Screening matrix used to evaluate the 3 concepts	67
4.8: Fixed cost	75
4.9: Variable cost	75
4.10: Comparison between cycle time of PLA and Aluminium plate prototype	77
4.11: Distributions of the professional ergonomics consultants' responses on the usability of the proposed mouse tray	78
4.12: Distributions of the professional ergonomics consultants' responses on the usefulness of the proposed mouse tray	78
4.13: Distributions of the professional ergonomics consultants' responses on the desirability of the proposed mouse tray	79

LIST OF FIGURES

1.1: Type of device that American used in work in year 2014	2
2.1: Prevalence (total case) rate of WRULDs per 100,000 people employed in the last 12 months in Great Britain	8
2.2: 12 month's prevalence and point prevalence of neck, upper limb and low back pain of the office worker adapted from	9
2.3: Experimental positions showing mouse placement with respect to keyboard	11
2.4: Median RMS for muscle tension for each mouse position	11
2.5: RULA scores for upper arm on each mouse position	12
2.6: Several problems caused by repetitions activities when overuse the mouse	13
2.7: Mouse positioned at the right of keyboard resulting awkward angle	13
2.8: Patent of mouse tray	15
2.9: Patent of extended mouse tray	15
2.10: Multi-functional mouse tray	16
2.11: Mouse tray with padded forearm	16
2.12: Adjustable mouse tray	17
2.13 Swivel mouse tray	18
2.14 Chair mount ergo mouse tray system	18
2.15 Fully articulating mouse platform	19
2.16: Typical office workstation layout	20
2.17: The percentage of pain when the mouse is placed beside the keyboard	21
2.18: The percentage of pain when the mouse is placed on separate table	21
2.19: Six support conditions are recorded by ATI	22
2.20: comparison of force applied to support in different conditions	22
2.21: Discomfort score in different conditions	23
3.1: Process flow of methodology	25
3.2: Process flow of collect reports written by ergonomic professionals	27
3.3: Keyboard measurement	30
3.4: Keyboard measurement	30

3.5: Keyboard measurement	30
4.1: Statistics of body parts discomfort in office setting among 728 office workers	34
4.2: Statistics of upper limb discomfort in office setting among 473 office workers	34
4.3: Subjects demographic distribution by gender among 200 office workers	36
4.4: Subjects demographic distribution by age among 200 office workers	36
4.5: Duration of computer used per day among 200 office workers	37
4.6: Statistics of awkward posture of office workers due to mouse position through observation from the reports	38
4.7: Awkward posture of office worker when using computer mouse	38
4.8: Complaints on upper limb symptoms among office workers due to mouse location	39
4.9: Frequency of upper limb part affected among office workers	39
4.10: Statistics of mouse and keyboard placement among 200 subjects	40
4.11 (a): Example of placement keyboard and mouse on desk	41
4.11 (b): Example of placement keyboard and mouse on desk	41
4.11 (c): Example of placement keyboard and mouse on desk	42
4.11 (d): Example of placement keyboard and mouse on desk	42
4.11 (e): Example of placement keyboard and mouse on desk	43
4.11 (f): Example of placement keyboard and mouse on desk	43
4.11 (g): Example of desk with keyboard tray but the placement of keyboard on desk	44
4.12 (a): Example of placement of keyboard on tray and mouse on desk	44
4.12 (b): Example of placement of keyboard on tray and mouse on desk	45
4.12 (c): Example of placement of keyboard on tray and mouse on desk	45
4.12 (d): Example of placement of keyboard on tray and mouse on desk	46
4.12 (e): Example of placement of keyboard on tray and mouse on desk	46
4.12 (f): Example of placement of keyboard on tray and mouse on desk	47
4.13 (a): Example of placement of mouse and keyboard on tray	47
4.13 (b): Awkward forearm posture when using mouse	48
4.14: Examples of placement keyboard and mouse on desk among UTeM staffs	51
4.15: Examples of placement mouse on desk and keyboard on tray	51
4.16: Example of concepts generated during the concept generation stage	56
4.17: Conceptual design 1 of proposed mouse tray	57
4.18: Conceptual design 2 of proposed mouse tray	57
4.19: Conceptual design 2 of proposed mouse tray	58

4.20: Conceptual design 3 of proposed mouse tray	58
4.21: Conceptual design 4 of proposed mouse tray	59
4.22: First concepts	60
4.23: Second concepts	60
4.24: Bottom part of second concepts	61
4.25: Design of cover part	61
4.26: Second evolution of conceptual design 2	62
4.27: Side view of second evolution of conceptual design 2	62
4.28: Cardboard mock up prototype of third concepts	63
4.29: Second evolution of conceptual design 3	63
4.30: Cardboard mock up prototype of fourth concepts	64
4.31: Second evolution of conceptual design 4	64
4.32: Wood mock up prototype of conceptual design 1	65
4.33: Wood mock up prototype of conceptual design 2	66
4.34: Wood mock up prototype of conceptual design 3	66
4.35: Stress and safety factor analysis for PLA prototype	68
4.36: Stress and safety factor analysis for Aluminium plate prototype	69
4.37 (a): 3D printer prototype	70
4.37 (b): 3D printer prototype	71
4.37 (c): 3D printer prototype	71
4.38 (a): Final design of PLA prototype	72
4.38 (b): Final design of PLA prototype	72
4.38 (c): Final design of PLA prototype	73
4.38 (d): Final design of PLA prototype	73
4.39 (a): Aluminium plate prototype	74
4.39 (b): Aluminium plate prototype	74
4.40: Breakeven analysis for PLA prototype	76
4.41: Breakeven analysis for Aluminium plate prototype	76
4.42: The upper limb posture of subject in neutral posture	80
4.43: The upper limb posture of subject in neutral posture	80

LIST OF ABBREVIATIONS

CCOHS	-	Canadian Centre for Occupational Health and Safety
EHRs	-	Environmental Health and Radiation Safety
EMG	-	Electromyography
MSD	-	Musculoskeletal System Disorder
NIOSH	-	National Institute of Occupational Safety and Health
PLA	-	Polyactic Acid
RMS	-	Root Mean Square
RULA	-	Rapid Upper Limb Assessment
ULDs	-	Upper Limb Disorders
USB	-	Universal Serial Bus
WRULDs	-	Work-related Upper Limb Disorder

CHAPTER 1

INTRODUCTION

1.1 Background

In the 21st century, computer has become an essential electronic device in daily life. Computer is defined as a gadget that takes instruction and perform the commanded instructions and operations accordingly. Computer able to store and process the data quickly, therefore increase the productivity of worker. Computer has been widely used in different places such as hospitals, banking sectors, business, marketing and etc. Chris (2014) found that computer is the device that commonly used in the workplace. According to Harvey & Peper (2010), the usage of mouse in a working day can equal or more than the time spent using a computer keyboard for working. As personal computer become more popular in working area, a dramatically increased in the number of office workers suffer from upper extremity musculoskeletal pain (Harvey & Peper,2010).

Reality Mine (2014) which is a technology data business that measure and collect consumers behavioural data. The statistics from Reality Mine shown that 64% of American used computer in the workplace during the week in year 2014 as shown in Figure 1.1. According to the statistics from the Organisation for Economic Co-operation and Development (2012), the average American spend approximately 1790 hours every year in work. Department of Statistics Malaysia (2010) stated that employees who use computer in workplace increased 91,660 persons in 2007, which has increased 10.2% as compared to 83,159 persons in 2006. Usage of computer in the workplace has risen dramatically, there

are 6 in 10 workers using a computer for their work in 2000 as compared to 3 in 10 workers in a decade earlier (Marshall, 2001).

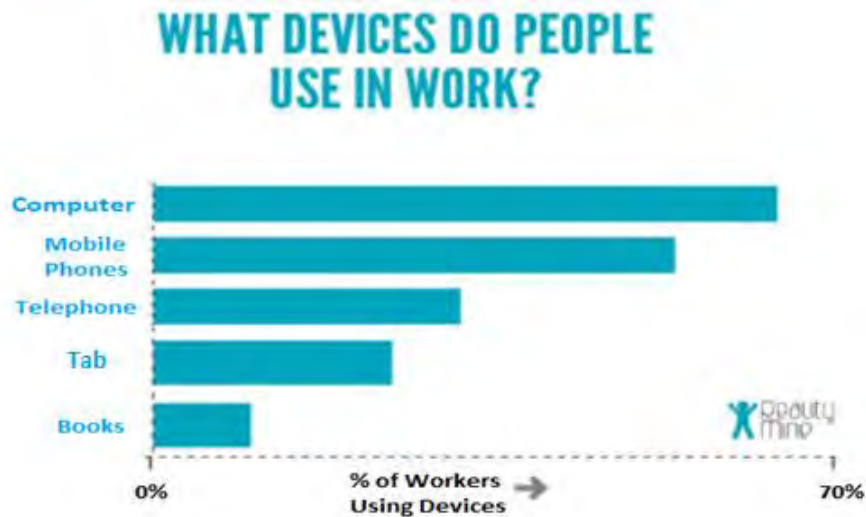


Figure 1.1: Type of device that American used in work in year 2014 (Reality Mine,2014)

Office workers are mostly key-in data, data processing, emailing and much more which mainly using computer mouse and keyboard typing. They conducting daily routines in front of computer for long hours. Majority office workers spend 5 to 8 hours on computer per day (British Psychological Society, 2012). Poor upper limb posture when using computer and mouse for a long period may increase the risk to injury. The more extreme posture or non-optimal posture when using mouse can cause discomfort in upper limbs (Harvey & Peper,2010). Upper limb disorders (ULDs) is become very common in office working area. ULDs are defined as the pain that involving from fingers to shoulder. From the European statistical data, it was found that 41.3% of office clerks is suffer from upper limb pain (Andriana et al., 2016). Therefore, an ergonomic design set-up in the workstation is important to ensure the comfort and safety for the workers. Ergonomic defined as a workstation designed that fits to human. According to Handbook of Industrial Engineering published by Salvendy (2001), ergonomic defined as the “the science of fitting workplace condition and job demands to the capabilities and inabilities of the worker”, is an important element in a proper designed workstation.