Faculty of Technology Management and Technopreneurship

DETERMINANTS OF SUSTAINABLE SOFTWARE PRACTICES IN THE MALAYSIAN ELECTRONIC INDUSTRY AND THE ROLE OF KNOWLEDGE ACCESSIBILITY

UTeM
اونيۏرسيتي تيکنيکل مليسيا ملاک
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Giweze Chukwuyem

Master of Science in Technology Management

2023

DETERMINANTS OF SUSTAINABLE SOFTWARE PRACTICES IN THE MALAYSIAN ELECTRONIC INDUSTRY AND THE ROLE OF KNOWLEDGE ACCESSIBILITY

GIWEZE CHUKWUYEM

A thesis submitted
in fulfilment of the requirements for the degree of Master of Science in Technology Management

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Faculty of Technology Management and Technopreneurship

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2023

DECLARATION

I declare that this thesis entitled "Determinants of Sustainable Software Practices in the Malaysian Electronic Industry And the Role of Knowledge Accessibility" is the result of my research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in the candidature of any other degree.

Signature : .....

Name : GIWEZE CHUKWUYEM

Date : .....

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

APPROVAL

I hereby declare that I have read this thesis and, in my opinion, this thesis is sufficient in terms of scope and quality for the award of the degree of Master of Science in Technology Management.

Signature : ----------

Name : DR. NOR AZAH BINTI ABDUL AZIZ

Date : ----------

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEDICATION

To God Almighty and my beloved parents.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

ABSTRACT

The issues of software sustainability are considered a general focus for experts and an emerging area nowadays in contemporary research in the electronic industry. This current study focuses on the determinants of sustainable software practices in the Malaysian electronic industry (i.e., electronic components, consumer electronics, and industrial electronics), and attempts to investigate the possibilities of decreasing unsustainable activities. Emerging studies have not consolidated software sustainability in the electronic industry, thus suggesting a knowledge gap in the existing literature. The developers have not integrated the aspects that support environmental performance from the industrial sector. Therefore, the current study investigates the determinants of sustainable software practices in the Malaysian electronic industry. The research objective was conceptualised and a framework was developed which supports the GREENSOFT Reference Model. The research applied a quantitative approach. Data was received through questionnaire distribution among 250 employees from different software departments in the electronic industry. The study applied Structural Equation Modelling (SEM) using SmartPLSv3.0 to process the data. The findings show that software governance, software strategy, software practitioners, sustainable environmental practices and knowledge accessibility positively influence sustainable software practices. The path coefficient results reveal that knowledge accessibility has the strongest influence, followed by software strategy. In addition, the moderating result shows that knowledge accessibility moderates the relationship between software strategy and sustainable software practices. While others (i.e., software governance, software practitioners, and sustainable environmental practices) show no moderating effects. Therefore, the results from the study provide some insightful contributions for policymakers to pursue green practices and also help in the implementation and value accessibility of software sustenance for social, economic and environmental performance in the Malaysian electronic industry.

Keywords: Sustainable Software Practices, Software Governance, Software Strategy, Software Practitioners, Sustainable Environmental Practices, Knowledge Accessibility and GREENSOFT Reference Model.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

PENENTU AMALAN PERISIAN MAMPAN DALAM INDUSTRI ELEKTRONIK MALAYSIA DAN PERANAN KEBOLEHCAPAIAN PENGETAHUAN

ABSTRAK

Isu kemampanan perisian dianggap sebagai tumpuan umum untuk pakar dan bidang yang baru muncul pada masa kini dalam penyelidikan kontemporari dalam industri elektronik. Kajian semasa ini memberi tumpuan kepada penentu amalan perisian mampan dalam industri elektronik Malaysia (iaitu, komponen elektronik, elektronik pengguna, dan elektronik industri), dan cuba menyiasat kemungkinan mengurangkan aktiviti tidak mampan. Kajian baru muncul tidak menyatukan kemampanan perisian dalam industri elektronik, sekali gus mencadangkan jurang pengetahuan dalam literatur sedia ada. Pihak pemaju belum menyepadukan aspek yang menyokong prestasi alam sekitar daripada sektor perindustrian. Oleh itu, kajian semasa menyiasat penentu amalan perisian mampan dalam industri elektronik Malaysia. Objektif penyelidikan telah dikonsepkan dan rangka kerja telah dibangunkan yang menyokong Model Rujukan GREENSOFT. Penyelidikan menggunakan pendekatan kuantitatif. Data diterima melalui pengedaran soal selidik di kalangan 250 pekerja daripada jabatan perisian yang berbeza dalam industri elektronik. Kajian menggunakan Structural Equation Modelling (SEM) menggunakan SmartPLSv3.0 untuk memproses data. Dapatan menunjukkan bahawa tadbir urus perisian, strategi perisian, pengamal perisian, amalan alam sekitar mampan dan kebolehcapaian pengetahuan secara positif mempengaruhi amalan perisian mampan. Hasil pekali laluan mendedahkan bahawa kebolehcapaian pengetahuan mempunyai pengaruh paling kuat, diikuti oleh strategi perisian. Di samping itu, keputusan penyederhanaan menunjukkan bahawa kebolehcapaian pengetahuan menyederhanakan hubungan antara strategi perisian dan amalan perisian mampan. Manakala yang lain (iaitu, tadbir urus perisian, pengamal perisian, amalan alam sekitar yang mampan) tidak menunjukkan kesan penyederhanaan. Oleh itu, hasil daripada kajian tersebut memberikan beberapa sumbangan yang bernas untuk penggubal dasar untuk meneruskan amalan hijau dan juga membantu dalam pelaksanaan dan nilai kebolehcapaian rezeki perisian untuk prestasi sosial, ekonomi dan alam sekitar dalam industri elektronik Malaysia.

Kata kunci: Amalan Perisian Mampan, Tadbir Urus Perisian, Strategi Perisian, Pengamal Perisian, Amalan Persekitaran Mampan, Kebolehcapaian Pengetahuan dan Model Rujukan GREENSOFT.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

ACKNOWLEDGEMENTS

First and foremost, I would like to take this opportunity to express my sincere acknowledgement to my main supervisor Dr. Nor Azah Binti Abdul Aziz, and co-supervisor Ts. Dr. Yusri Bin Arshad from the Faculty of Technology Management Technopreneurship, Universiti Teknikal Malaysia Melaka (UTeM), for her essential supervision, support, and encouragement towards the completion of this dissertation.

I am grateful to Faculty of Technology Management and Technopreneurship for providing me the opportunity to conduct my research and for all of the resources and support provided. More so, extend a special thanks to Universiti Teknikal Malaysia Melaka (UTeM) for the good environment and hospitality.

I am also deeply thankful to my beloved wife Mrs. Enifome Sonia obiebi for her love and prayers all through my master program. Special thanks to all my colleagues, my beloved mother, father, and siblings for their moral support in completing the master program. Lastly, thank you to everyone associated with the crucial parts of the realisation of this project.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

TABLE OF CONTENTS

	PAGE
DECLARATION	
APPROVAL	
DEDICATION	
ABSTRACT	**i**
ABSTRAK	**ii**
ACKNOWLEDGEMENTS	**iii**
TABLE OF CONTENTS	**iv**
LIST OF TABLES	**vii**
LIST OF FIGURES	**ix**
LIST OF SYMBOLS AND ABBREVIATIONS	**x**
LIST OF APPENDICES	**xii**
LIST OF PUBLICATIONS	**xiii**
CHAPTER	
1. INTRODUCTION	**1**
1.1 Introduction	1
1.2 Background of the study	1
1.3 Problem statement	5
1.3.1 The Application of the Current Software System in the Electronic Sector	5
1.3.2 The Development of Sustainable Software	6
1.4 Research objectives	9
1.5 Research questions	9
1.6 Research Scope	10
1.7 Motivation of the Study	11
1.8 Significance of the Study	11
1.8.1 Theoretical Significance	12
1.8.2 Practical Significance	12
1.9 Operational Definitions	12
1.9.1 Sustainable Software Practices	12
1.9.2 Software Governance	13
1.9.3 Software Strategy	13
1.9.4 Knowledge Accessibility	13
1.9.5 Software Practitioner	13
1.9.6 Sustainable Environmental Practices	14
1.10 Organisation of the Study	14
1.11 Summary of Chapter	15
2. LITERATURE REVIEW	**16**
2.1 Introduction	16
2.2 Sustainability	16
2.2.1 Economic Dimensions of Sustainability	17
2.2.2 Social Dimensions of Sustainability	17
2.2.3 Environmental Dimensions of Sustainability	18
2.2.4 Technological Dimensions of Sustainability	19

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2.2.5 Individual Dimensions of Sustainability 19
2.3 The Theory (Model) for Sustainable Software Practices 20
2.3.1 The GREENSOFT Reference Model Overview 20
2.3.2 Sustainable Software Development Lifecycle 22
2.4 Independent Variables 25
2.4.1 Software Governance 26
2.4.2 Software Strategy 27
2.4.3 Software Practitioners 29
2.4.4 Sustainable Environmental Practices 31
2.4.5 Knowledge Accessibility 34
2.5 Dependent Variable 36
2.5.1 Sustainable Software Practices 36
2.5.2 Participation of Electronic Industries in Sustainable Software Practices 39
2.5.2.1 Information Technology-Based Industries 40
2.5.2.2 Software-Based Industries 40
2.5.2.3 Manufacturing and Engineering-Based Industries 40
2.5.2.4 Supply Chain Management-Based Industries 41
2.5.2.5 Automotive-Based Industries 41
2.5.2.6 Government-Based Industries 42
2.5.2.7 Electronic-Based Industries 42
2.6 Summary of Literature Review 44
2.7 Conceptual Framework 58
2.8 Hypothesis Development 59
2.8.1 Relationship between Software Governance and Sustainable Software Practices in Malaysian Electronic Industries 60
2.8.2 Relationship between Software Strategy and Sustainable Software Practices in Malaysian Electronic Industries 60
2.8.3 Relationship between Software Practitioner and Sustainable Software Practices in Malaysian Electronic Industries 62
2.8.4 Relationship between Sustainable Environmental Practices Sustainable Software Practices in Malaysian Electronic Industries 62
2.8.5 Relationship between Knowledge Accessibility and Sustainable Software Practices in Malaysian Electronic Industries 63
2.9 Summary of Research Gap 65
2.10 Summary of Chapter 66

3. RESEARCH METHODOLOGY 67
3.1 Introduction 67
3.2 Research Paradigm 67
3.3 Research Approach 68
3.4 Research Strategy 69
3.5 Research Design 70
3.6 Population and Unit of Analysis 72
3.7 Sample Size 73
3.8 Sampling Technique 75
3.9 Data Collection Method 76
3.10 Research Instruments Development 78
3.10.1 Instruments for Sustainable Software Practices 78
3.10.2 Instruments for Software Governance 79

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

3.10.3 Instruments for Software Strategy 79
3.10.4 Instruments for Knowledge Accessibility 80
3.10.5 Instruments for Software Practitioners 80
3.10.6 Instruments for Sustainable Environmental Practices 81
3.11 Pilot Study 81
3.12 Data Analysis 82
3.13 Partial Least Squares Structural Equation Modelling (PLS-SEM) 83
3.14 Summary of Chapter 84

4 RESULTS AND DISCUSSION 85
4.1 Introduction 85
4.2 Preliminary Data Examination 85
4.2.1 Response Rate 86
4.2.2 Dealing with Missing Responses 86
4.2.3 Data Cleaning and Screening 86
4.2.4 Outliers 87
4.2.5 Assessment of Data Normality 88
4.3 Demographic Profile of the Respondents 91
4.4 Assessment of Structural Equation Modelling (SEM) 93
4.5 Measurement Model Assessment 94
4.5.1 Construct Validity and Reliability 94
4.5.2 Measurement of Discriminant Validity 98
4.6 Assessment of the Structural Model 100
4.6.1 Coefficient of Determination (R^2) 101
4.6.2 Effect Size (f^2) 101
4.6.3 Result of Multicollinearity (Inner VIF) 102
4.6.4 Predictive Relevance (Q^2 value) 103
4.7 Direct Effect (Path Coefficient) Analysis 104
4.8 Moderation Effect Analysis 107
4.9 Summary of the Hypotheses Testing Results 108
4.10 Chapter Summary 108

5 CONCLUSION AND RECOMMENDATIONS 110
5.1 Introduction 110
5.2 Recap of the Study 110
5.3 Discussion of the Study Findings 111
5.4 Implication of the Study 125
5.4.1 Theoretical Implication 125
5.4.2 Managerial Implication 128
5.5 Limitations of the Study 130
5.6 Recommendation for Future Research 132
5.7 Conclusions 134

REFERENCES 136
APPENDICES 165

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF TABLES

TABLE	TITLE	PAGE
2.1	Summary of literature review for the gap in study	44
2.2	Systematic literature review IV and DV	57
3.1	Differences between Deductive and Inductive Research Approach (Saunders et al., 2009)	69
3.2	Differences between Qualitative and Quantitative Research Strategies (Bryman and Bell, 2015)	70
3.3	Sample Size Distribution and Requirement (Hair et al., 2010)	74
3.4	The Items for Measuring Sustainable Software Practice	78
3.5	The Items for Measuring Software Governance	79
3.6	The Items for Measuring Software Strategy	79
3.7	The Items for Measuring Knowledge Accessibility	80
3.8	The Items for Measuring Software Practitioners	80
3.9	The Items for Measuring Sustainable Environmental Practices	81
3.10	Results of Reliability Tests	82
3.11	Hypothesis Testing Summaries	83
4.1	Result of Standardized Values Univariate Outliers	88
4.2	Assessment of Univariate Data Normality	90
4.3	Respondents' Profile the Respondent's	92

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

4.4	Internal Consistency and Convergence Validity Results	96
4.5	Discriminant Validity – Fornell and Lacker Criterion	98
4.6	Outer/factor loading with Cross Loadings	99
4.7	Results of Heterotrait-Monotrait Ratio (HTMT)	100
4.8	R-square Result	101
4.9	F-square Result	102
4.10	Result of Multicollinearity – Inner VIF Values	103
4.11	Result of Predictive Relevance	103
4.12	Path Coefficient Result	105
4.13	Moderation Analysis Result	107
4.14	Summary of all Hypotheses Results	108

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF FIGURES

FIGURE	TITLE	PAGE
2.1	Sustainable Software Practices Life Cycle Process (Jnr et al., 2018)	23
2.2	The GREENSOFT Reference Model (Naumann et al., 2011)	25
2.3	Conceptual Framework of Study	59
3.1	Research Design (Collis and Hussey, 2009)	71
4.1	Presented the AVE through PLS-Algorithm	97
4.2	Structural Model with t-values (Bootstrapping Result)	106

UTeM
اونيۏرسيتي تيکنيکل مليسيا ملاک
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF SYMBOLS AND ABBREVIATIONS

ANP	-	Analytical Network Process
AVE	-	Average Variance Extracted
β	-	Path Coefficient
CA	-	Cronbach's Alpha
CFA	-	Confirmatory Factor Analysis
CMB	-	Common Method Bias
CMV	-	Common Method Variance
CO_2	-	Carbon Dioxide
CR	-	Composite Reliability
DV	-	Dependent Variable
EIA	-	Environmental Impact Assessment
EMS	-	Environmental Management System
f^2	-	Effect Size
FL	-	Factor Loading
HTMT	-	Heterotrait-Monotrait
IBM	-	International Business Machines
ICT	-	Information and Communication Technology
IEC	-	International Electrotechnical Commission
ISO	-	International Organization for Standardization
ITAP	-	Innovation and Technology Adoption Programme

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

IV	-	Independent Variable
PLS	-	Partial Least Squares
Q^2	-	Predictive Relevance
R^2	-	R Square
SEM	-	Structural Equation Modelling
SPSS	-	Statistical Package for the Social Sciences
VIF	-	Variance Inflator Factor

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
A	Research Questionnaire	166

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF PUBLICATIONS

Scopus Indexed Journal 2023

Giweze, C., Aziz, N.A.A. and Arshad, Y., 2022. Factors Influencing Sustainable Software Practices and the Moderating Role of Knowledge Accessibility: Evidence from the Malaysian Electronic Industry. *Millennial Asia*, p.09763996221117274.

Giweze, C., and Aziz, N. A. A., 2022. Determinants of Sustainable Software Practices in The Malaysian Electronic Industries. *International Journal of Academic Research in Accounting Finance and Management Sciences*, 12(2), pp. 1–15.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

CHAPTER 1

INTRODUCTION

1.1 Introduction

The chapter introduces the research, its relevance and its significance to the context of study in the Malaysian electronic industry. The problem statement identification was discussed as it relates to issues on sustainable software practices. The investigation focuses on the current emerging issues associated with sustainable software practices in the Malaysian electronic industry. It provides the readers with the general idea and approach in which the study is being investigated and highlights the main problems of the research. The chapter also presents the research questions and objectives, the scope of the study, and the significance of the study, as well as the contribution.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

1.2 Background of the Study

Sustainable software practices have been gaining tremendous attention recently, and in the local context, a processing plant for electronic industries such as consumer electronics, electrical components and industrial electronics was established in Pahang, Malaysia in 1972 showing that Malaysia has become a manufacturing hub for electronic industry (Fam et al., 2018; San Ong et al., 2019). The external trade development corporation in the Malaysian electronic industry contributed 44.4% to the electronic industry in Malaysia, and another 23.4% to the GDP thereby creating more jobs in the Malaysian electronic industry (Fam et al., 2018). The Malaysian electronic industry has the highest export to support economic growth which is important to the Malaysian economy. For instance, the electronic

component alone accounts for 34.8% of revenue and approximately RM49.48 billion in total exports (Malaysia External Trade Development Corporation, 2017). However, to sustain and stay relevant in a competitive business environment like Malaysia experts have argued that the sustainable aspect of software practices in the Malaysian electronic industry should be considered to improve equipment utilization and reduce capital expenditure (Economic Transformation Programme, Annual Report., 2015; Fam et al., 2018).

Sustainable software practices are the practice that maintains the qualities of software utilization to meet environmental performance while ensuring the development reduces environmental impact. In addition, it helps leverage the electronic industry to meet environmental standards in its operations (Pero et al., 2017). It is essential in implementing sustainable practices for companies' corporate organisational goals (Annunziata et al., 2018). Sustainable software practices consider three components of software performance: social, environmental and economic aspects of sustainable performance. These aspects-maintained sustainability and software performance in any contemporary industry. The environmental aspect helps in natural resource conservation using various ecological components (Moldan et al., 2012). The social aspect helps maintain social or societal adoption of user-friendly and sustainable practices for the environment (Shnayder et al., 2016). The economic aspect maintains software production and minimises economic growth by implementing various environmental policies (Bartelmus, 2003). In this regard, this current study maintained that all three components should be considered for the electronic industry with more focus on the environmental aspect to meet software performance and maintain environmental standards (Ogiemwonyi et al., 2022). Nevertheless, electronic industries use a set of computer devices with all the inclusive components and peripheral parts to utilise a software system that helps in the daily information and data processes. These devices make up the processing units, input and output sets, and information storage memory that enables software applications to

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

run through the units of program installations. The availability of software applications conserves energy use and gears up its usability through energy consumption. The software commands the active flow of the device's inherent parts, and the energy speeds up the hardware's capacity. Recently, the problems of environmental challenges surfaced (Ogiemwonyi, 2022). Increasing demand for sustainable service has begun to peak, and opinions supported the use of sustainable software to minimise energy usage, reduce costs, and improve client enterprise service (Moshnyaga, 2013; Sorrell, 2020). Recently, sustainable software practices and research focusing on these aspects have impacted academicians and policymakers. Research earns thrust due to the need for sustainable development and to meet the demand for safety regarding technology prospect that is useful in present-day activities (Dustdar et al., 2018; Anthony et al., 2020; Jalil et al., 2021).

Although communication technology is important in software procedure and development sustenance, although, the demand is ecological-friendly software services have not been thoroughly investigated. Communication technology avails the safety to measure software sustenance in the economic sector. However, to smoothen software practices, the production and operation services consider ecological aspects. Nevertheless, engineering by positioning ecological action to engross fewer resources to meet the standard of software sustenance provides a respite (Jnr et al., 2017; Jnr et al., 2019; Jalil et al., 2021). In addition, information technology presents the measurement to magnify knowledge to build up labour-intensive action and procedure for the electronic industry which also applies software applications in its operations. An example of such measurement is in the consumption of energy and intelligent energy grids for power exploitation using various software applications to meet environmental performance. Consequently, the influence helps raise the deployment of technology products across the electronic sector, which essentially uses the

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

heavily demanded software applications that are sustainable. For example, it estimates that modern software should replace obsolete ones to meet a performance (Jalil et al., 2021).

Currently, electronic industries such as electronic components, consumer electronics and industrial electronics have begun to utilise modern software that is sustainable to meet social, environmental and economic performance (Ben Amara and Chen, 2020); and throw out obsolete software and devices despite the ingenious of the modern devices that are not run-on modern software (Paiva et al., 2021). However, environmental sustainability in the electronics sector supports recognised software sustenance and its reflective advantage. The originality of software sustenance and trifle offered advancement to a new platform and replaced the earlier components (Albertao et al., 2010; Lago, 2019). The application of software sustainability, systems, and implementation is pervasive in the electronics sector, and the negative environmental influence worsened global problem that requires an active solution. For instance, reports show that 2% of hardware carbon dioxide generates from electronic infrastructure and other related software manufacturing activities. Therefore, using sustainable software and green technology sustenance in the electronics industries could provide a respite to consumption and production pattern to ameliorate the effectiveness and practices in software development (Lami and Buglione, 2012; Kern et al., 2019; Anthony, Majid and Romli, 2020). To achieve these benefits, developers need to checkmate these factors that influence the sustainability of software sustenance in the electronics industry of Malaysia. The targeted sector employs software applications the most. Hence, the research desires to improve this aspect of software environmental sustainability while investigating factors that determine sustainable software practices in the Malaysian electronic industry. The analysis considered several aspects of these factors and explored sustainable software practices building on existing studies.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

1.3 Problem Statement

The two leading aspects of the problem statement identifications are the main issues of software sustainability not being thoroughly investigated and the lack of empirical studies on the determinants of sustainable software practices in the electronics industry (i.e., electronic components, consumer electronics, and industrial electronics), especially in Selangor, Malaysia.

1.3.1 The Application of Current Software Systems in the Electronic Industry

The number of software products is growing significantly with more electronic industries around the world most especially in developing nations like Malaysia turning into a solution to minimize the process of software sustenance and its impact on the environment from development to usage as well as the sustainable method (Starxin, 2019). To understand the importance of sustainable software in the electronic industry and its effect on the environmental impact, it is important to investigate the determinants of sustainable software practices. However, it is even more important to also consider the e-waste generation and the electronic consumption of software from the economic and social perspective as a result of software processes from consumer electronics, industrial electronics and electronic components. Therefore, policymakers in the electronic industry need to optimize software processes since it is responsible for environmental decline (Starxin, 2019). Nevertheless, it is important to acknowledge sustainable practices in the electronics industry to develop software standard products. However, the present-day software buildout has not vigorously examined software sustainability nor the environmental practices as they relate to the electronic industry of Malaysia (Ch'ng et al., 2021). The developers in the electronics sector consider some software to meet environmental quality (Paiva et al., 2020; Barroso Paiva et al. 2021). However, the life cycle process applied to sustain software facilitates natural

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

impacts (meet environment component). They are helpful in the computerized software industries (Anthony and Pa, 2018; Anthony et al., 2020). For example, the developers predicted that obsolete devices are replaceable with modern devices that meet environmental standards using the latest software applications.

Furthermore, they threw out 44 million electronic devices due to the unsustainable standard. They replaced the obsolete software built on these devices, making way to implement sustainable software practices with the environmental standard in the Malaysian electronics sector (Knapton, 2017; Sheikh, 2020). These software products have direct and indirect impacts on the economy, society, and human activities (Dick et al., 2010). However, software applications used in the electronics industry account for approximately 2% of carbon dioxide emissions, equivalent to emissions coming from various software applications and e-waste generation from software usage (Lami and Buglione, 2012; Anthony et al., 2020). These applications' emissions generated environmental issues in the electronics sector, particularly in software applications and production.

Nevertheless, the deployment of sustainable software practices causes several of the negative effect generated by this unfriendly behaviour and practices. Thus, sustainable environmental practices are implemented as a respite to ameliorate software issues in the Malaysian electronic industry. The impact is important to regulate the governance of software products in the development stage. It makes software sustainability achievable and places software design, architecture, and developers in a position to improve software products to meet environmental, economic and social standards (Naumann et al., 2015).

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

1.3.2 The Development of Sustainable Software

There are limited studies examining the development of unceasing software that meets environmental performance in the electronics industry. In addition, despite the