DEVELOPING INTEGRATED SOLID WASTE MANAGEMENT FRAMEWORK AND STRATEGIES FOR MALAYSIAN HIGHER EDUCATION INSTITUTIONS

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FACULTY OF BUILT ENVIRONMENT
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ABSTRACT

Changing consumption patterns and increasing demand for material resources in business has made solid waste management (SWM) more challenging than ever, particularly in developing countries. Most research into SWM and recycling initiatives mostly discussed in developed countries and municipalities instead of institutional level of operations. One institutional business in particular, the higher educational sector, poses distinct roles and stewardship principles in the natural world. Evidence suggests that strategic planning could considerably improve the effectiveness of SWM. However, existing SWM practices among Malaysian institutions remain in their infancy, and the country still suffers from heavily reliance on landfills. There is a lack of current research exploring the current state of institutional SWM initiatives and strategic impacts which may hamper sustainability business practise and stewardship. For that reason, this research aimed to identify the key success factors, and empirically assesses the relationship between strategic implications; i.e. legislation, environment, economic and social aspect between the institutions. A mixed-method research design via sequential approach was adopted for data collection and analysis. This research commenced with a robust literature review presenting a theoretical framework that embraces strategic performance measurement on institutional SWM. The theoretical framework focuses on seventeen (17) SWM factors with five (5) strategic implication variables has effect to sustainable FM practices. Expert interviews with 10 interviewees responsible in managing their institutional operations were piloted to validate the variables under study. Through expert interviews, fourteen (14) SWM factors were shortlisted and five (5) strategic implication variables were validated. A macro level questionnaire survey was then employed with 129 questionnaires returned. The survey instrument analyses the cause-effect relationship between SWM factors and strategic implication variables. Correlation analysis revealed a relationship between the principal SWM factors implemented between institutions with the strategic impacts. Hierarchical multiple linear regression analysis was performed to further examine the differences between the principal SWM factors which had an effect on the strategic implication variables. As the result, five regression models for each strategic implication variable were established. These findings confirmed that SWM factors for Malaysian higher education institutions were significantly correlated to strategic implications. A strategic institutional SWM performance framework was developed based on the regression models produced, which can be employed as a decision-making tool. Findings this research highlights innovative solutions for facilities managers and managers at board-level in terms of practical SWM advice, as well as describing how such initiatives may encourage sustainable business practices.

ABSTRAK

Perubahan corak penggunaan dan peningkatan permintaan terhadap sumber bahan dalam perniagaan mengakibatkan pengurusan sisa pepejal menjadi satu tugas yang mencabar, terutamanya di negara-negara membangun. Terdapat banyak penyelidikan terhadap pengurusan sisa pepejal dan inisiatif kitar semula tetapi kebanyakannya dibincangkan dalam negara-negara maju dan sektor perbandaran dan bukannya di peringkat operasi keinstitusian. Satu perniagaan institusi, sektor pengajian tinggi, khususnya, menggayakan peranan yang berbeza dan prinsip-prinsip pengawasan alam semula jadi. Terdapat bukti-bukti yang menunjukkan bahawa perancangan strategik dapat meningkatkan keberkesanan pengurusan sisa pepejal. Walau bagaimanapun, pengurusan sisa pepejal yang sedia ada di kalangan institusi-institusi di Malaysia masih di peringkat awal, dan kebanyakan bergantung kepada pelupusan. Kekurangan penyelidikan kini mengemukakan keadaan inisiatif-inisiatif pengurusan sisa pepejal sekarang dan kesan-kesan strategiknya mungkin menghalang kemampanan amalan perniagaan dan pengawasan. Dengan sebab itu, penyelidikan ini bertujuan untuk mengenalpasti faktor-faktor kejayaan utama, dan secara empirikal menilai hubungan antara implikasi strategik; iaitu aspek perundangan, persekitran, ekonomi dan sosial antara institusi-institusi. Satu reka bentuk kaedah campuran melalui pendekatan turutan telah digunakan bagi pengumpulan dan penganalisisan data. Penyelidikan ini dimulakan dengan kajian literatur yang teguh di mana satu kerangka teori yang merangkumi pengukuran prestasi strategik di pengurusan sisa pepejal keinstitusian disampaikan. Kerangka teori ini fokus pada tujuh belas (17) faktor-faktor pengurusan sisa pepejal dan lima (5) pembolehubah implikasi strategik mempunyai kesan kepada kemampanan amalan-amalan pengurusan fasiliti. Temuduga pakar dengan 10 orang ditemuduga bertanggungjawab dalam pengurusan operasi keinstitusian mereka telah dilaksanakan

secara perintis bagi mengesahkan pembolehubah-pembolehubah. Melalui temuduga pakar, empat belas (14) faktor-faktor pengurusan sisa pepejal disenaraipendekkan dan mengesahkan lima (5) pembolehubah-pembolehubah implikasi strategik. Dengan itu, kajian soal selidik peringkat makro telah digunakan dengan 129 soal selidik dikembalikan. Instrumen kajian ini menganalisis hubungan sebab-akibat antara faktor-faktor pengurusan sisa pepejal dan pembolehubah-pembolehubah implikasi strategik. Analisis korelasi menunjukkan bahawa terdapat hubungan antara faktor-faktor pengurusan sisa pepejal utama yang dilaksanakan oleh institusi-institusi dengan impak strategik. Analisis regresi linier berganda hierarki telah dilakukan untuk mengkaji secara lanjut perbezaan antara faktor-faktor pengurusan sisa pepejal utama yang mempunyai kesan ke atas pembolehubah-pembolehubah implikasi strategik. Hasilnya, lima model regresi bagi setiap pembolehubah implikasi strategik telah ditubuhkan. Penemuan ini mengesahkan bahawa faktor-faktor pengurusan sisa pepejal bagi Malaysia institusi-institusi pengajian tinggi mempunyai hubungan yang ketara dengan implikasi strategik. Rangka kerja prestasi strategik keinstitusian pengurusan sisa pepejal dibinakan berdasarkan model-model regresi yang dihasilkan, di mana rangka kerja ini boleh digunakan sebagai instrumen membuat keputusan. Hasil daripada penyelidikan ini mengetengahkan penyelesaian inovatif kepada pengurus fasiliti dan pengurus di peringkat lembaga di atas pengetahuan pengurusan sisa pepejal, dan bagaimana inisiatif seperti itu boleh membawa kesan terhadap amalan perniagaan yang mampan.

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LIST OF ABBREVIATIONS

ANOVA	:	analysis of variance
BMU	:	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety of Germany
C&D	:	construction and demolition
CapEx	:	capital expenditure
CRC	:	centralised refuse-chute
CSF	:	Critical Success Factor
CSR	:	corporate social responsibility
DEFRA	:	Department for Environment, Food and Rural Affairs
DETR	:	Department of the Environment, Transport and the Region
DOE	:	Department of Environment
DSD	:	Dual System Deutschland
DSM	:	Department of Standards Malaysia
DTi	:	Department of Trade and Industry
EC	:	European Commission
EEE	:	Electrical and Electronic Equipment
EMS	:	Environmental Management System
ENV	:	Ministry of Environment
EPHA	:	Environment Public Health Act
EPR	:	extended producer responsibility
EQA	:	Environmental Quality Act
EU	:	European Union
FM	:	facilities management
HDB	:	Housing Development Board

IFMA	:	International Facility Management Association
KPI	:	key performance indicator
KSNP-SPP	:	National Policy and Strategy for the Development of Waste Management Systems
LEV	:	Local Voluntary Delivery
LUA NRW	:	North Rhine-Westphalia State Environment Agency
MANOVA	:	multivariate analysis of variance
MHEI	:	Malaysian higher education institution
MHLG	:	Ministry of Housing and Local Government
MOH	:	Ministry of Health
MONRE	:	Ministry of Natural Resources and Environment
MOSTE	:	Ministry of Science Technology and Environment
MRF	:	materials recovery/recycling facilities
MS	:	Malaysia Standard
MWM	:	Master Plan on National Waste Minimisation
NGO	:	non-government organisation
NSP	:	National Strategic Plan
NSWMD	:	National Solid Waste Management Department
OECD	:	Organisation for Economic Cooperation and Development
OpEx	:	operational expenditure
OSHA	:	Occupational Safety and Health Act
PEV	:	Small Volume Delivery Station
PPSPPA	:	Solid Waste and Public Cleansing Management Corporation
RDF	:	refuse-derived fuel
Rio+20	:	the United Nations Conference on Sustainable Development
RoHS	:	Restriction of Use of Certain Hazardous Substances

SFP	:	strategic facility planning
SLA	:	Service Level Agreement
SME	:	small medium enterprise
SOP	:	standard operation procedure
SPSS	:	Statistical Package of Social Science
SWCA	:	Taiwan’s Solid Waste Clearing Act
SWCorp	:	Solid Waste and Public Cleansing Management Cooperation
SWM	:	solid waste management
SWPCM	:	solid waste and public cleansing management
TEPA	:	Taiwan’s Environment Protection Agency
UN	:	United Nations
UNEP	:	United Nations Environment Programme
UNESCO	:	United Nations Educational, Scientific and Cultural Organisation
WEEE	:	Waste Electrical and Electronic Equipment
WRF	:	Waste Recycling Fund
WTE	:	waste-to-energy

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APPENDIX M	homogeneous Subset
APPENDIX N	excluded variables[b] (using *enter* method) for predicted variable – waste stream reduction / waste minimisation
APPENDIX O	excluded variables[a] (using *enter* method) for predicted variable – cost reduction
APPENDIX P	excluded variables[a] (using *enter* method) for predicted variable – revenue generated
APPENDIX Q	excluded variables[a] (using *enter* method) for predicted variable – change of recycling behaviour/culture

APPENDIX R excluded variables[a] (using *enter* method) for predicted variable – compliance of Acts

CHAPTER 1: INTRODUCTION

1.1 Introduction

This chapter provides the background of this research and highlights the main issues in managing solid wastes in Malaysia, the rationale for performing this research, the problem statement which has become the impetus for carrying out this research, and its aim and objectives. The chapter also briefly describes the research design and methodologies, scope, and significance of the research. The thesis structure is outlined at the end of this chapter.

1.2 Background of Study

This research presents a study of the strategies of institution solid waste management (SWM) by investigating the trend and scenario of contemporary SWM in Malaysia, a developing country which has experienced extraordinary economic advancement in consistent after its independence. This rapid development has boosted urbanisation and industrialisation and sharply increased population. The National Solid Waste Management Department (2013), Moh and Abd Manaf, (2014) and Akil et al. (2015) have reported that the higher the extent of urbanisation and economic development, the more the volume of solid waste generated. Consequently, there have been large expansion in the capacity of solid waste produced in the nation (NSWMD, 2013). The landfill method is widely used due to a lack of strict policy towards SWM, causing the environment quality rapidly worsening in the country. Osman et al. (2009) and Moh and Abd Manaf (2017) claimed that managing solid waste is the biggest environment challenges in Malaysia. Part of ‘Vision 2020’ is enhancing environmental protection and integrating its SWM system. Thus, one of the greatest challenges Malaysia facing is that in spite of the vast volume and complexity of waste generated, the criterions of waste management are still inadequate (Desa et al., 2012), affecting the image of the country worldwide.

Additionally, UNEP (2004) has reported that collecting, recycling, treating and disposing of increasing quantities of solid waste remains a major challenge not only for developed countries but also developing countries. Recently, the declaration of Rio+20 (2012) highlighted and encouraged the sharing of knowledge and advanced technologies from the best practise learned from developed countries to developing countries. Recycling is commonly defined as reuse and recovery of materials from waste to the production of new merchandises. Recycling is essential because it not only minimises quantity of solid waste, but also alleviates consumption of natural resources as a result of economic development (Bor et al., 2004). A few scholars (Barr et al., 2003; Pitt, 2005; Armijo de Vega et al., 2008) have also recognised recycling is the most popular environmental initiatives and best-established practice worldwide due to economically driven, socially and environmentally sounds initiatives. In fact, recycling is among the most evident, enforceable, and measurable of the environmentally sound exercises that an institution campus can accept (Armijo de Vega et al., 2003). However, this scenario is only valid within developed countries, while developing countries still lack infrastructure and formal recovery and recycling practises.

As mentioned above, most scholars see the relevance of recycling as an objective. However, such initiatives are less implemented in terms of best practises between the developing countries, whether in municipal, commercial, industrial, or other sectors in which wastes are disposed of in less sustainable ways. Lack of the strict enforcement of policies and directives in developing countries result in non-effective solid wastes management in each sector. Therefore, proactive SWM is imperative to improve the practise of SWM in the country.

Since higher education institutions are similar to huge commercial concerns in terms of students and staff waste production and utilisation of energy and materials (Viebahn, 2002), they have the distinct responsibility to educate the youth whom may the politicians, teachers, and decision-makers of tomorrow about environment protection especially in SWM aspect. Specifically, this study is focused on Malaysian higher education institutions (MHEIs) and intends to observe a perspective of strategic implication on SWM that is ecologically friendly. However, the provision for infrastructure and supply-chains upholds its regional waste policies with a focus on recovery and recycling. In addition to policies and infrastructure, financial, environment and management aspects are required for planning and managing solid waste sustainability.

Higher education institutions have an ethical responsibility towards the environment. They are anticipated to be chiefs in the effort for environmental protection. Particularly it is anticipated that higher education institutions can steer the endeavour towards responsible waste management. Proper waste management will lead to advantages for the higher education institution, such as a decrease of financial resources directed to waste management (Armijo de Vega et al., 2008). The methods and initiatives of managing solid waste are therefore vital as they affect benefits and strategic impacts towards the environment, in social and economic terns.

As this thesis focuses on MHEIs by investigating its SWM in strategically and outlining the possible directions of future development, it is crucial to outline the set of principal factors and develop a strategic performance framework for MHEI solid waste. The findings of this study will allow for facilities managers and waste administrators in other organisations to plan their solid waste recycling in a strategic way.

1.3 Problem Statement

Sustainability is a global issue. However, most efforts are done in developed countries, and few are seen in developing countries (Armijo de Vega et al., 2003). The increasing urban population in developing countries and the disappointing answer from the authorities to the raising claims for appropriate waste management services have been twin dilemmas confronting cities in these countries (Owusu et al., 2012; Ahmed & Ali, 2006; Gellynck et al., 2011). Dawda (2010) also concurred that the quality of environment is speedily worsening specifically when related to the issues of solid waste, that has becoming a challenging mission for numerous huge metropolitan heterogeneous regions in majority developing countries. Hoornweg (2012) stressed that waste production rates will double over the next twenty years in lower income countries as well.

As portion of the Rio Declaration endorsed in 1992, Malaysia has consented to notably enhance the national's SWM services (Moh & Abd Manaf, 2014). However, to date, solid waste is still a key environmental issue in the country. The landfill is a major method applied for managing the continuous increase of solid waste generation annually and is the method that Malaysia is most highly dependent on (Moh & Abd Manaf, 2017); however a majority of the landfill areas are open dumping sites with excess capacity, which cause severe environmental and social risks (Manaf et al., 2009; Yunus & Kadir, 2003). 7.34 million tons of solid wastes were produced in Malaysia in 2006, sufficient to fill up 42 buildings (Siraj, 2006). The function of SWM in Malaysia is generally undertaken simultaneously with other related functions, for instance street-light and drainage maintenance, public area cleansing and landscaping (Moh & Abd Manaf, 2014). Moh and Abd Manaf (2014) further asserted no specific measures have been taken to address the problems of waste minimisation and recycling. This situation is troubled if the wastes are generated continuously and rapidly without proper planning to handle it in a sustainable way.

The effectiveness of the organisation in managing its sustainability responsibilities is rated low owing to the sustainability is not yet embedded in business objectives (Elmualim et al., 2010). Ellison and Sayce (2006) emphasised that in spite of the amalgamation of sustainability principles into business agenda, it is both demanding and challenging to employ these principles to the commercial property arena. In contrast, Mason et al. (2003) highlighted the increasing acceptance that the sustainable development concept may now be observed in the management and activities of a growing number of universities.

Implementation of the 3Rs (reduce, reuse and recycle) has been a succeeded strategy in many developed countries, yet its implementation among developing countries is yet to be fully realised (Agamuthu et al., 2011). According to the current international declaration such as Agenda 21 and Rio+20, the implementation of 3Rs has now evolved into 4Rs (reduce, reuse, recycle and recover) in many developed countries. However, Malaysia is still practising the 3Rs (Zen et al., 2014; Moh & Abd Manaf, 2014).

Despite the rise recognition for recycling as being a form of appropriate waste management in developing countries and an extensive quantity of both qualitative and quantitative single nation case studies on recycling to our knowledge (Ferrara, 2008; Fehr et al., 2000; Kathirvale et al., 2003; Zen et al., 2014), no single research has ever been conducted on SWM initiatives in the aspect of strategic facilities management.

Additionally, in Malaysia, most past research has focused on municipal SWM (Isa et al., 2005; Murad & Siwar, 2007; Saeed et al., 2009; Afroz et al., 2013; Agamuthu et al., 2011; Zen et al., 2014; Moh & Manaf, 2014; Akil et al., 2015). Despite little previous research (Elfithri et al., 2012; Desa et al., 2012; Zain et al., 2012) concerning waste management and recycling in universities, no research has been conducted to evaluate the SWM factors in the aspect of strategic implication from MHEI setting. Zen et al. (2014) highlighted the deficiency of research that evaluates the implication of recycling initiatives on the society broadly by considering a variety of means of recycling in Malaysia. It is indeed critical to have a comprehensive list of SWM factors which can guide the MHEI in planning their strategic facility plan by integrating sustainability into the business core objectives and mission so as to yield the profits for SWM and deliver a sustainable environment as well.

Nevertheless, the major concern includes determining the significant factors that contribute to the strategic implementation of higher education institution SWM. Which factors influence strategic SWM in the local context? How are these significant factors to be assessed as critical factors for strategic SWM? Hence, this study attempts to investigate the critical variables that could have strategic impacts in MHEIs SWM.

1.4 Rationale for Prioritising Recycling Initiatives in SWM

Sustainable development is a major issue worldwide. Several declarations for example Rio declaration of Rio Earth Summit (1992), Kyoto Declaration (1990), Agenda 21 (1992), Thessaloniki Declaration (1997), and Rio+20 stressed on the growing significant of environmental concerns in all sectors. In light of the environmental agenda, all sectors including the government, companies and even individuals play key roles in protecting environment.

Rapid industrialisation and economic development have led enormous expansion of solid waste produced (Moh & Abd Manaf, 2014). Misra and Pandey (2005) and Medina (1997) determined an effective positive relationship between the development phase of a nation and its volume of waste produced. For instance, in Kuala Lumpur, Malaysia, the rate of waste produced is unceasingly increasing annually due to unmanageable depletion caused by the ever-growing population, attitudes towards shopping and the pursuit of high living standards (Saeed et al., 2009). This concurs with Noor et al.'s (2013) study, which reported that the growing population and speedy urbanisation in the Malaysia Straits affect municipal solid waste generation, which has escalated from 5.6 million tonnes in 1997 to higher than 8 million tonnes in 2010, with a forecast of more than 9 million tonnes by 2020. This is undeniable that rapid development and increasing of population has a strong relationship with the sharp increasing of the waste generation.

Nowadays, the landfill is a general method employed for the municipal solid waste disposal in Malaysia. Most landfills are open dumping areas (Latifah et al., 2003; Yunus & Kadir, 2003; The Ingenieur, 2009). Agamuthu et al. (2011) reported that to date, about 95% of waste in Malaysia is thrown directly into landfills. He further stated that this not only leads to environmental issues but is also unsustainable from an economy viewpoint. Additionally, waste disposal through landfilling becomes additionally problematic due to land paucity and high demands and the rise of land prices (Manaf et al., 2009). Therefore, adopting recycling initiatives is imperative (Agamuthu et al., 2011) and should act as a priority for SWM in Malaysia.

In the aspect of statistically investigation, the statistics have shown that nowadays the recycling rate in Malaysia is barely 11%. The rate is relatively low compared to those in developed countries for example Germany (74%), Belgium (71%), Austria (67%) and the Netherlands (66%). In other words, European Union (EU) countries including Austria, Belgium and the Netherlands attain even higher levels of recycling greater than 50% (Eurostat, 2009). Hence, although the Ministry of Housing and Local Government has set a target of 22% recycling to be achieved by the year 2020, much efforts and initiatives must be made to attain such a recycling target.

Likewise, the plea for sustainable recycling in developing countries has extensively been recognised in several scholars (van Beukering & Bouman, 2001; Suttibak & Nitivattananon, 2008; Wilson et al., 2006; Troschinetz & Mihelcic, 2009). Empirical evidence suggests that solid waste recycling minimises environmental risk and is an import-substituting economic action which also can save energy, conserve resources and save waste collection and disposal expenses (Kaseva & Gupta, 1996). Other past studies (Muttamara et al., 1994; Folz, 1991; Kaseva & Mbuligwe, 2000; Suttibak and Nitivattananon, 2008) have also pinpointed that recycling is broadly recognised as a sustainable municipal SWM approach because of its capability to minimise disposal expenses and waste transport expenses, while extending the life spans of sanitary landfill areas. Mamat and Chong (2007) indicated that while recycling activity in

Malaysia is increasing, the recycling industry must to be improved. They further explained that the Malaysian behaviour towards recycling is higher, but only a few practise it. It is alarming that due to the scarcity of appropriate recycling activity, Malaysia imports recycled waste from other countries to generate its own recycled goods (The Star, 2003).

Through the extensive literature review set out above, it can be understood that the achievement of SWM is scant in Malaysia. Thus, the first and second objectives of this research is to identify the principal factors for SWM strategy in local context and to develop relationship between the principal factors and strategic implications of SWM strategy. Finally, the rational for conducting this study is the establishment of a strategic performance framework for SWM in Malaysia.

1.5 Research Aim and Objectives

The aim of this research is to develop strategic performance framework for higher education institution SWM in Malaysia. To accomplish the aim, three objectives have been determined as follows:

- To determine the principal factors for higher education institutions SWM in the local context.
- To develop the relationship between the principal factors and strategic implications of MHEI SWM strategy.
- To establish the extent to which these principal factors have an impact on strategic solid waste operation at the institutional level in MHEIs.

1.6 Research Methodology

This study uses the mixed method approach. Mixed method research is defined as the combination of qualitative and quantitative data collection and analysis within a particular study (Teddlie & Tashakkori, 2003; Johnson & Onwuegbuzie, 2004; Plano Clark, 2005; Molina-Azorin, 2012). The rationale of using mixed method includes:

I. Generate more extensive knowledge necessary to inform theory and practice (O' Cathain et al., 2007; Johnson & Onwuegbuzie, 2004); theory can be generated and verify simultaneously in the same study as well (Molina-Azorin, 2012).

II. Collecting various data applying different strategies and methods resulting mixture is likely to result in complementary strengths and non-overlapping drawbacks (Brewer & Hunter, 1989; Johnson & Turner, 2003).

III. Enrich the researcher's capability to draw conclusion about the puzzle under study (Mertens, 2005).

IV. More comprehensive findings can be obtained for increased conclusion validity (Johnson & Christensen, 2004)

V. Present stronger proof for a conclusion through convergence and corroboration of findings (Johnson & Onwuegbuzie, 2004).

In this study, the sequential strategy involves the exploratory phase as first phase of qualitative method, followed by the confirmatory phase as second phase of quantitative method (Creswell, 2009). The qualitative method included personal interviews, followed by the quantitative method conducted using a questionnaire survey for a larger sample.

Sequential implementation of data collection is the most ordinary implementation employed (Molina-Azorin, 2012). Sequential mixed method involves starting with a qualitative method via semi-structured interview for exploratory purposes. This is followed by a quantitative, survey approach with a big sample so that the researcher can test hypothesis and generalise results to a population (Creswell, 2009). Hence, the sequential mixed method was employed in this study.

Basically, the study was conducted step by step where the flow is shown in Figure 1.1. The major process was divided into seven major categories which include:

I. Preliminary Study

The current issues and problems were identified through the initial reading on articles and journals. The research area was selected, and the aim and objectives were established in this stage.

II. Literature Review/ Develop Theoretical Framework

A literature review was carried out to collect the latest issues and information related to the research. It was obtained from the related articles, journal, books and even online resources that have been published by the qualified researchers. Through the global literature review, a total of seventeen (17) SWM factors that could affect the strategic SWM and recycling initiatives, and an additional five (5) strategic implication variables were identified. In addition, the strategic elements of facilities management were reviewed as well to assess the trend of SWM and recycling practices in MHEIs. Furthermore, a theoretical framework was constructed to elucidate the relationships among principle SWM factors and strategic implication variables which could affect the strategic SWM strategy.

III. First Stage of Primary Data Collection (Semi-structured Interview)

According to Sekaran and Bougie (2009), primary data refers to information gained first-hand by the researcher on the variables of interest for the explicit purpose of the study. In the current study, the first stage of primary data was obtained via semi-structured interview for exploratory investigation purpose. Interviews were conducted with ten (10) selected MHEIs for the purpose of validating the SWM factors and strategic implication variables identified via extensive review and confirm the SWM factors which reflect the existing phenomenon in MHEIs.

IV. Qualitative Data Analysis (Validation of SWM Factors and Strategic Implication Variables)

The findings obtained was analysed and evaluated after the data collection was completed. The qualitative data collected from the interview was analysed via content analysis. Content analysis is a transparent method because the coding scheme can be expressly set out so that replications and follow-up studies are feasible. A coding process with themes from common discussion points found in interviews was developed. The principal SWM factors and strategic implication variables appropriate and applicable to the local context were determined.

V. Second Stage of Primary Data Collection (Questionnaire Survey)

The questionnaire survey is developed for confirmatory investigation. The purpose of this survey is to accomplish the third objective, which is to determine the extent to which the principal SWM factors have an impact on the strategic solid waste operation at institutional level in MHEIs. Additionally, the present trend of MHEI SWM practices was evaluated in this stage. A total of 129 valid questionnaire surveys from MHEIs were obtained.

VI. Quantitative Data Analysis (Developing Strategic Performance Framework)

A strategic performance framework was developed after the data was analysed. Statistical Package of Social Science (SPSS) software was used as the instrument. The validated and significant contributed SWM factors and strategic implication variables were adapted into the framework.

VII. Conclusion

The findings and results are summarised and recommendations are provided to ensure the research may be reviewed in the future. The conclusions that result will be integrated with initial objectives of the study.

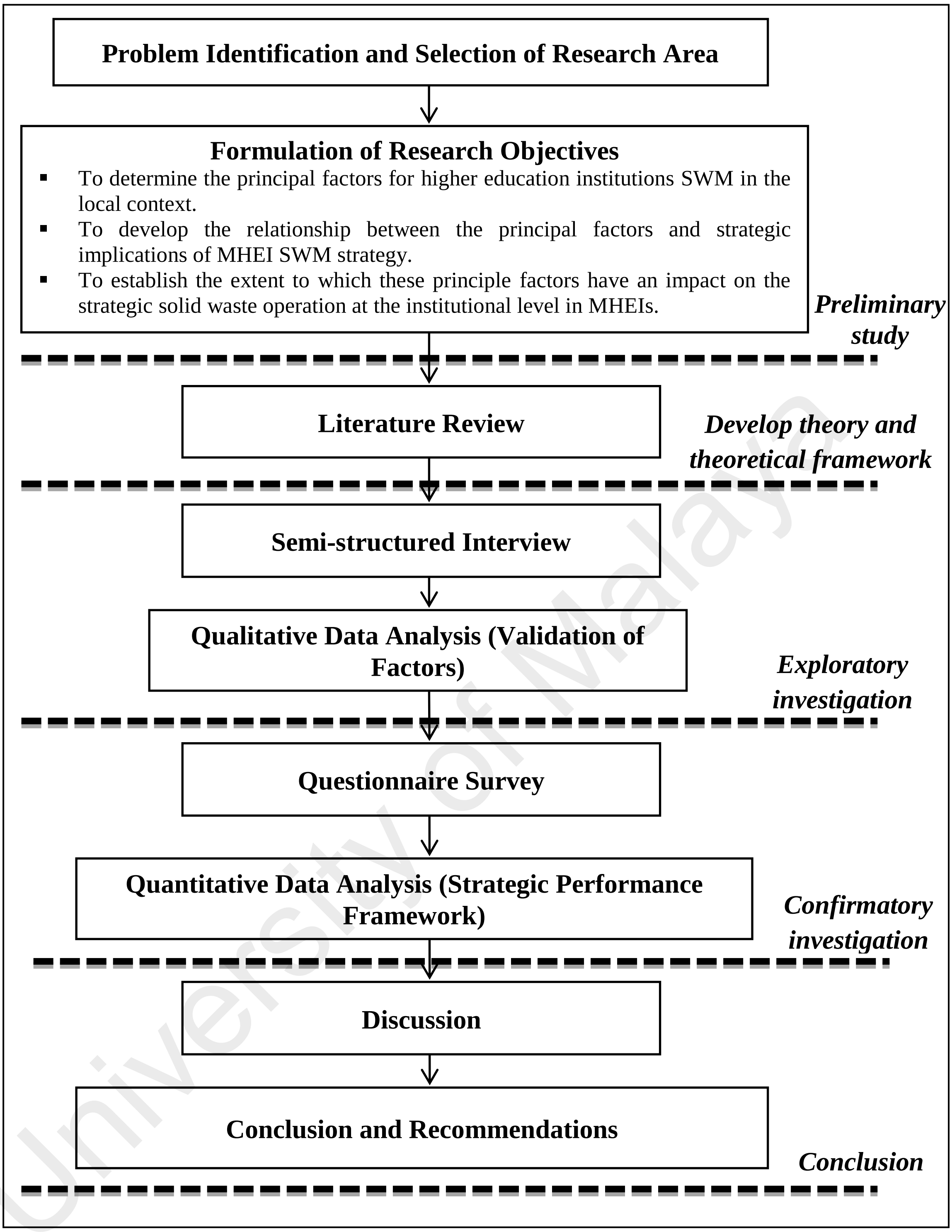


Figure 1.1: Research process

1.7 Scope of Study

The scope of the study is principally focused on strategic SWM in MHEIs. Long term strategic SWM is normally planned and executed by the solid waste co-ordinator in facilities department or institution’s sustainable unit. Thus, this study will approach facilities managers, directors or managers of the institution’s sustainable unit, and other experts involved in institution planning and execution of SWM and recycling initiatives. The respondents for interview and questionnaire survey are limited to experts in design and execution of solid waste recycling initiatives in MHEIs. As the data is obtained from the personnel responsible in operation of SWM in MHEI, the data are reliable.

Generally, MHEIs registered with Department of Higher Education (formerly known as Ministry of Higher Education) will be selected in this study. Higher education institutions are recognised as leaders for environment protection and also have a distinctive responsibility, especially relating to knowledge transfer about sustainability. Moreover, higher education institutions also have the characteristics of institutional business. Integrating sustainability into institutional business core objectives is principal to both yield profits from SWM and deliver a sustainable environment.

1.8 Significance of the Study

The research is important to assist in planning the strategic SWM by considering the principal SWM factors and its strategic implication. Earlier studies on waste disposal and recycling mainly focused on municipal and manufacturing sectors in Malaysia. It gives the impression that this research has potential to bridge the current gap in existing research. The outcome of the study will facilitate the critical decisions undertaken by the solid waste administrator in higher education institutions environment. Additionally, this study will be useful for other organisations in planning their SWM. The study is also expected to boost the principles of business sustainability and cost reduction into practise. The other contributions of the study include:

I. Significant factors to be considered when planning strategic SWM in an organisation.

II. Aspects of SWM in Malaysia, including awareness of the importance of a strategic recycling programme.

III. Establishing a rationalisation for further research into the sustainable development of SWM in Malaysia.

IV. A proposed performance framework which is anticipated to boost the SWM of an organisation by focusing on the principal factors and its contribution towards strategic implication variables.

V. Contribution of the research findings into the body of knowledge in academic and not only corporate institutions, but also many other related facilities and industries, such that a strategic recycling programme will bring cost reduction and sustainability when implemented.

1.9 Structure of Thesis

This thesis comprises eight chapters. The summary of all the chapters are presented below.

Chapter 1 provides an outline of the thesis structure and the details that the study is focused on.

Chapter 2 begins with an overview of sustainable development in business and education, role of business, and FM operational support services for business. After that, sustainable development and waste-related policies are reviewed by discussing the policies framework for commercial solid waste in both developed and developing countries. The characteristics of higher education institutions as institutional businesses and championing environment sustainability and the institutions business and services position towards sustainable development is reviewed as well. This chapter closes with an overview of strategic and operational FM in business sector.

Chapter 3 reviews the literature on sustainable waste management followed by the implementation of existing waste-related policy in commercial and institution. Literature related to higher education institutions waste trends was reviewed as well. The factors that have impact on strategic SWM are then described, followed by a review of recycling performance measurement and strategic implication variables towards SWM initiatives. The study is moderated by MHEI groupings to avoid respondents' bias. This chapter closes with the overview of theoretical framework for higher education institution for the development of research strategies.

Chapter 4 performs the research design and the methodology adopted in the current study. The methodologies for this research are aimed to attain the objectives created and lead to the valid conclusions. The methodology approach employed in the research is mixed method approach. This chapter discusses the research design, approach taken by this research, and relevant phases implemented for this research. Qualitative and quantitative methodologies were described followed by a discussion on the selected methodology. The chapter concludes with a concise consideration of the reliability and validity of the adopted methodology.

Chapter 5 describes the carrying out of a series of interviews held in the MHEIs to validate findings from the literature review in Chapter 3. The MHEIs SWM factors and strategic implication variables are analysed and validated in this chapter. The second phase of this research looks into detailed information on how MHEIs are managing their solid waste and conducting recycling programme, and identification of the principal SWM factors and strategic implication variables in local context. This was carried out through semi-structured interviews. The outcomes from the interviews are presented and discussed in this chapter. This chapter closes with a summary of validated SWM factors and strategic implication variables; and validated theoretical framework.

Chapter 6 describes a large scale questionnaire survey which was conducted with a population of higher education institutions throughout Malaysia. Several hypothesises of the study are developed to explore the extent of solid waste recycling practices and the relationship of key SWM factors associated with strategic solid waste operations. Statistical procedures and analysis are presented along with research objectives and hypothesises findings obtained.

Chapter 7 discusses the results from relevant research methods employed in accordance with the theoretical framework of SWM for MHEIs. Relevant findings from both exploratory and confirmatory phases are presented and discussed based on the aim and objectives for this research. Finally, a strategic SWM framework for MHEIs is proposed.

Chapter 8 provides a general summary of the research objectives and discusses the general results of the study. This chapter also describes a range of limitations of the study and targeted contributions and recommendations for the study.

1.10 Summary

This chapter has underlined the issue of the study and provided the overview of the study. There are three objectives formulated throughout this study. This chapter also briefly explains the research methodology for the study. The structure of thesis and significance of the study are presented as well. The extensive literature reviews for this study are discussed in the following chapters.

CHAPTER 2: SUSTAINABLE DEVELOPMENT ON SOLID WASTE MANAGEMENT

2.1 Introduction

For the purpose of gaining a profound understanding of the research context, a review on the sustainable development and waste-related policies is necessary and important. This chapter starts with the review of sustainable development and policies framework on commercial solid waste. The special characteristics of higher education institutions towards the environment sustainability are also highlighted. Lastly, the chapter highlights the strategic facilities management (FM) intervention in higher education institution solid waste management (SWM) and towards sustainable development.

2.2 Sustainable Development in Business and Education

Today, sustainable development is the impulse amalgamated into the commitments of majority of business organisations worldwide (Suggett & Goodsir, 2002). Sustainable development is not simple and requires considerable time and effort. The dominant view of governments and business globally is that sustainable development is continued economic development made more environmentally sensitive to increase living standards worldwide and break the connection between poverty and environmental degradation (UN, 2010).

Nowadays, many international organisations such as the UN, UNEP, EU and Organisation for Economic Cooperation and Development (OECD) have highlighted the strategic policies for responsible business practices. They have formulated strategic policies such as corporate social responsibility (CSR) and producer responsibility for their member states to adapt in their own policies for business sustainability. Owing to increasing societal expectations about the business role in society (Golob & Bartlett, 2007), CSR is the notion of businesses profiting the environment, economy and society and accepting broader responsibilities beyond business (Henderson, 2007).

In terms of sustainable development in education, Dahle and Neumayer (2001) asserted that the potential contributions of educational institutions in sustainability has already recognised by different sectors, for example the United Nations (UN), European Union (EU), and other government policies and various international agreements. Several universities have willingly signed several declarations to determine their obligations to sustainability (Wright, 2002). The Stockholm Declaration of 1972 was the first to pivot to sustainability in higher education and recognise the interdependency between humanity and environment (UNESCO, 1972). In other words, higher education institutions have striven to become more sustainable and have get involved into international environmental sustainability contracts (Kaplowitz et al., 2009). Alshuwaikhat and Abubakar (2008) have pointed out that the definite characters of universities in fostering sustainable development have been emphasised in various important declarations, which include the Kyoto Declaration (1990), Agenda 21 (1992), and Thessaloniki Declaration (1997). In 1990, more than 300 university governors in over 40 nations endorsed the Talloires Declaration with a 10-point action plan for integrating sustainability and environmental literacy in education, research, operations and outreach at universities and colleges (UNESCO, 1990). As a consequence of signed commitments and voluntary decisions, some higher education institutions have commenced on projects to integrate sustainability into their system (Alshuwaikhat &

Abubakar, 2008). For instance, universities have attempted to boost campus recycling as part of a waste management scheme connected to campus sustainability endeavours (Barlett & Chase, 2004; Pike et al., 2003).

2.2.1 Role of Business

According to Lantos (2001), commerce is a main economic establishment for delivering want-satisfying products and services; offering occupations and reasonable wage for workforces; and creating the investment capital required for economic growth. Hooi et al. (2012) on the other hand stated that business used to look environmental sustainability as an expense of carrying out business but presently it has been considered as a possible source of competitive benefit and market chance. Since the commercial sector is one of the main sectors that drive the economics of a country, it also must show commitment to act responsibility towards the environment. It is especially anticipated that commercial sector would drive endeavours towards appropriate waste management.

Lavy (2008) stressed that business success is characterised not only by yearly gain margins, but also diverse aspects of the building portfolio and environment. These factors include administering regular maintenance, operations, and energy utilisation; executing condition evaluations and benchmarking studies; modifying and supporting with policies; and supporting the enforcement of the organisation's strategic and tactical planning. The financing, technical, and management proficiency of the business sector are critical to meet sustainable development objectives (UN, 2010). Hence, businesses are now searching for the means to achieve competitive benefits via greening programmes by practising pollution prevention, energy efficiency, decrease of waste stream, resource conservation and eco-friendly goods.

Furthermore, when a sustainable policy is in place is a much greater opportunity of more sustainable initiatives being embedded into the business (Price et al., 2011). Business has become more proactive by advocating the corporate social responsibility (CSR) movement and using its investment in sustainable ways (UN, 2010). The G8 Summit Declaration Heiligendamm 2007 emphasised the importance and contribution of corporate social responsibility (CSR) in the commercial sector (OECD, 2009). OECD work demonstrated that voluntary plans in CSR have facilitated the accumulation of the management proficiency needed to interpret law, regulation and less formal societal expectation into the routine operations of companies (OECD, 2009).

Conventionally, businesses evaluate their own performance towards the economic perspective (such as revenue). However, with the rise of awareness in corporate social responsibility (CSR), businesses have begun assessing and taking into consideration to what degree their commerce operations have influenced the environment and their communities. As awareness of generating and sustaining development has progressively become more essential, issues have been raised as to how the business sector should address them (Hooi et al., 2012).

In the aspect of waste management, commercial waste is the waste generated by small business, public institutions, service firms, retail shops or industrial companies (Zhang et al., 2010). By the year 2020, Malaysia’s recycling targets in commercial and industrial will reach 22% (Agamuthu et al., 2011). As CSR evolves, the role of business from an economic perspective will extend to the environmental and social perspectives.

Thus, it is believed that the commercial sector shall contribute to achieving Malaysia's recycling target in Vision 2020.

2.2.2 FM Operational Support Services for Business

According to Chotipanich and Nutt (2008), facilities management (FM) is generally deemed a "non-core" centre management function, functioning primarily at operational level, administering facility resources and services to assist the routine operations of an organisation, its consumers and staffs. McLennan (2000) asserted that FM has "the facts of physical facilities performance with the knowledge of business objectives, operations and support services". Overall, FM embraces a broad range of services, comprising health and safety, human resources management, real estate management, building services maintenance, contract management, financial management, change management, domestic services and utilities supplies (Kamaruzzaman & Zawawi, 2010). It is anticipated that strategic FM involvements will be desired occasionally at the active upper management level, as a part of the longer term corporate business strategy in general (Chotipanich & Nutt, 2008). The progressive importance of FM to add value in a business leads to strategic FM becoming the focal point.

Goyal (2007) stated that the business case for developing facilities management hinges on an understanding in the potential of facilities for producing quality work conditions to assist key activities. Price et al. (2011) added that the most recent catalyst for development within the FM industry could be seen to be sustainability and environmental agenda. Sustainable FM must take into consideration the aspects of economic, social and environmental sustainability to provide a rounded service, which is required in modern times (Elmualim et al., 2010). Noor and Pitt (2009) also advocated that it is crucial to interpret FM at a strategic level so as to enhance the organisational effectiveness of a business.

FM ranges to the corporate level, in which it leads to the release of strategic and operational objectives on daily basis (Noor & Pitt, 2009). To date, a good deal of research into FM has altered the centre of FM practice from operational services towards strategic management (Yiu, 2008). Since FM is developing into an essential corporate discipline, there are growing number of organisations are now integrating their daily commerce performance to their method of administering their facilities and workplace assets (Edum-Fotwe et al., 2003).

2.3 Sustainable Development and Waste Policy

Since the Brundtland's report and the Rio Summit, governments and organisations worldwide have started sustainable development as a desired aim and established metrics for sustainable development (UN, 2010). At the United Nations Conference on Sustainable Development (Rio+20), world leaders and high level representatives commend present and call for sustained, fresh and innovative public-private partnership among governments, non-governmental stakeholders, industry and academia intending to develop capacity and technology for waste management, including for waste prevention (UN, 2012). Through Rio+20, the action of restructuring taxation and phasing out any harmful subsidy should be considered to reflect a country's environmental intentions. Those policies should fully take into consideration the specified demands and situations of developing countries, with the objective of reducing the probable harmful effects on their development and in a manner that defends the affected communities (UN, 2012). The current economic improvement in developing countries triggered a move of interest from SWM in developed countries to developing countries (Shekdar, 2009).

Since the Rio Declaration of 1992, there has been a better interpretation of the position and role of SWM in the economic, ecological and social framework within nations (MHLG, 2005a) while environmental issue for example recycling have been section of the school curriculum (Bolaane, 2006). The Rio+20 called on all nations to prioritise sustainable development in the distribution of resources in the light of domestic priorities and demands, and they recognised the key significance of increasing economic support from all sources for sustainable development for all nations, particularly developing nations (UN, 2012). In tandem with environmental programme, people from all walks of life, whether from the government, private or commercial sector play vital roles in managing solid waste in sustainable way.

Malaysia is a signatory country to international protocols such as Agenda 21 which require the use of best available methods to safeguard the environment. This would require SWM to be co-ordinated on a nationwide scale with huge centralised facilities supplying the major centres of population (MHLG, 2005b). Performance statistics are the best way to evaluate policy implementation. Malaysia has targeted 22% recycling rate from the commercial and industrial sectors by 2020 (Agamuthu et al., 2011). It is proven that the target is achievable in other countries, as, for example, England was able to recycle and reuse 52.8% of its commercial wastes in 2009 (DEFRA, 2011a; 2011b). Of this, more than 20% of the wastes from each business sector was recycled and reused in England (DEFRA, 2011a; 2011b). In 2012, the recycling rate in Germany was 74% (Eurostat, 2009), whilst in Singapore in this year it was 60%. It is believed that these high recycling rates were the result of the fully implementation of the policies throughout these countries. Apparently, there is a gap of between the policy frameworks of developed and developing countries.

A few authors (Armijo de Vega et al., 2008; Barr et al., 2003; Pitt, 2005) have argued that recycling is the most popular environmental initiatives and best-established practice worldwide due to economic driven, socially and environmentally sounds initiatives. Yet in Malaysia, there is a lack comprehensive and strategic commercial solid waste policy as stipulated under the Solid Waste and Public Cleansing Management Corporation (PPSPPA) (2007), most of the commercial wastes are sent to landfill, and recycling is not the mandatory. This is the consequences of the strained of regulatory framework imposed on business and the lack of resource recovery facilities available at this juncture.

2.3.1 Policies Framework for Commercial Solid Waste

Needless to say, no SWM and recycling practices are effectual without a well-established policy framework. One of the eight goals of the UN Millennium Declaration 2000 is to ensure environmental sustainably by incorporating sustainable development into national policies and programmes. After a decade, the waste related policy issue has been highlighted. Rio+20 identifies that solid wastes, for instance electronic and plastics waste, pose specific challenges that should be tackled. World leaders and high level representatives have called for the establishment and execution of thorough domestic and local waste management policies, strategies and regulations during the Rio+20 conference (UN, 2012).

In principle, a global policy framework has been adopted from the UN perspective and cascaded down to the individual countries and the down to the regional municipalities and corporations involved (as shown in Figure 2.1). This policy framework (Figure 2.1) helps to position the responsibilities and roles of each individual state to execute the policy. Municipal authorities portray important characters in official recycling via the commencement and implementation of recycling schemes (Bolaane, 2006). For example, developed countries like the United Kingdom and Germany, as EU member states, apply the EU Waste Framework Directive for regulating their SWM policies and regulations. Looking at a developed island country such as Singapore, it can be seen that its SWM is more advanced than that of Malaysia. Later section also reviews the policies framework of a developed island country - Singapore in addition to the UK and Germany. The Rio Agenda 20+ has stipulated the need to encourage capacity building and sharing of knowledge from the best practices used in the developed countries to developing countries. Hence, policies and legislations for developing countries such as Indonesia, Thailand and Malaysia would also be reviewed to distinguish the current issues. The reviews of developed countries' policy frameworks are expected to provide a policy paradigm for Malaysia's commercial SWM.

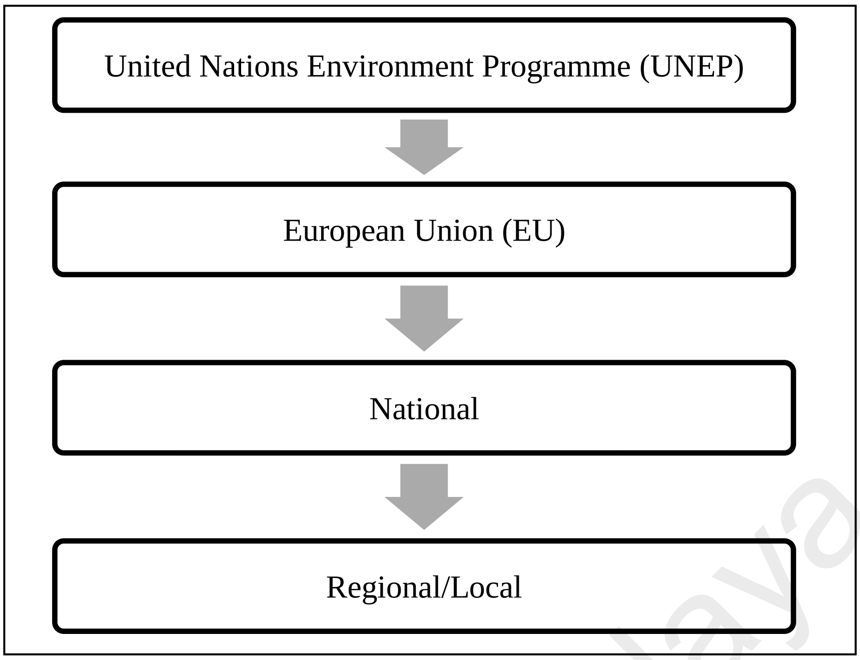


Figure 2.1: Policy framework from Union Nations (UN) perspective

2.3.1.1 European Union (EU) Directives

In the European context, the European Union (EU) has ability to influence policies within the most of its member states (EC, 2008: 1999). EU directives are a form of EU legislation which encompass deadlines for the fulfilment of the rights and responsibilities in the directives to be implemented into the member states (EC, 2013). EU directives formulate definite end outcomes that must be attained by each member state. National authorities must revise their laws to fulfil these targets, but they are allowed to determine how to do so (EC, 2013). EU directives call for member states to establish legislation on waste collection, recycling, reuse and disposal of the certain waste streams for instance packaging waste, batteries, electrical and electronic waste (EC, 2013). The implementation of directives into the law of the member states accomplishes the purpose of ensuring the full availability of those rights and responsibilities to citizens and enterprises.

The waste management hierarchy (Figure 2.2) should be applied according to its priority order in waste-related policy of the EU member states (EC, 2012a). Avoidance, re-use, recycling, recovery, composting, incineration and landfill applied together form the foremost elements of a sustainable SWM policy following a waste hierarchy (Figure 2.2). Waste prevention, which is the best alternative for the environment, is the highest priority, followed by preparing for re-use, recycling, other recovery and disposal (DEFRA, 2015). Pitt (2005) commented that the waste minimisation scheme has been progressively implemented in the commercial sector. He further reasoned problems cannot be diverted from inadequate contract management competence and negligence on the function of the FM discipline to efficiently manage outsourced waste management solutions in the commercial sector. The next section discusses the directives that EU member states shall apply into their commercial SWM according to its prioritisation.

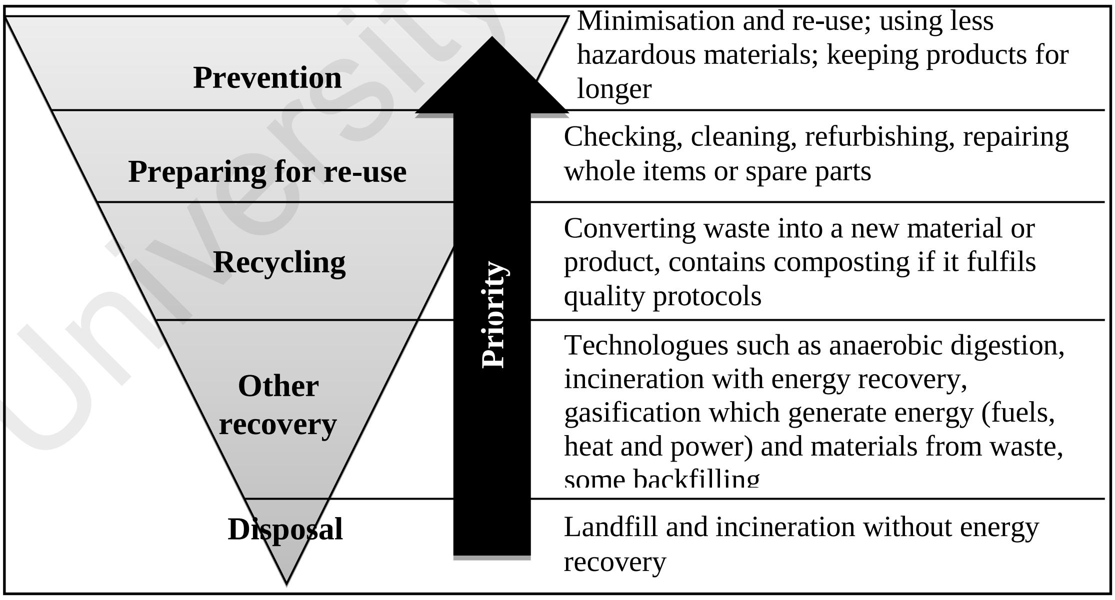


Figure 2.2: Waste hierarchy (DEFRA, 2011c, 2011d; EC, 2012a; 2014)

(a) Waste Framework Directive (2008/98/EC)

Appropriate implementation and execution of EU waste legislation is among the key precedence of EU environmental policy. The Waste Framework Directive (2008/98/EC) is the fundamental law of European waste policy. The Directive formulates some key waste management principles, and requires that waste must be handled without risking human health or destroying the environment (EC, 2012a).

The Directive consists of the "polluter pays principle" and "extended producer responsibility (EPR)". It also introduces new provisions to facilitate waste prevention and recycling as section of the waste hierarchy, and comprises two new recycling and goals to be attained by 2020: 50% preparing for reuse and recycling of some waste materials from households and other origin related to households, and 70% preparing for reuse, recycling and other recovery of construction and demolition (C&D) waste (EC, 2012a). To date, due to the pressure imposed by the government to fulfil EU targets on the Waste Framework Directive (2008/98/EC), reducing waste generated has become a key issue in businesses.

(b) Landfill Directive (1999/31/EC; 2003/33/EC)

The Landfill Directive is one of the directives that EU strictly enforces on its member states and which has vital implication for waste handling and waste disposal. The main objective of the Directive is to impede or minimise as much as possible adverse impacts to the environment from the waste landfilling, by issuing strict technical requirements for waste and landfills (EC, 2012a). There is an ancillary legislation related to landfill waste, which is Council Decision (2003/33/EC). According to this directive, the quantity of biodegradable municipal waste must be minimised to 50% in 2009 and to 35% in 2016. All member states must incorporate the Landfill Directive (1999/31/EC) into national legislation (EC, 2012b). Member states must ensure that the operations of landfill sites comply with the provision of the Directive and report to the Commission every three years on the enforcement of the Directive. All the wastes must be treated before being sent to a landfill (EC, 2012a).

(c) Packaging and Packaging Waste Directive (94/62/EC; 2004/12/EC; 2005/20/EC; 2013/2/EU)

This Directive offers for measures that focusing on controlling the manufacture of packaging waste and stimulating recycling, reuse and other methods of waste recovery (Europa, 2011). The member states must initiate schemes for the return and/or collection of used packaging to achieve the goals set by the European Commission (EC). Those targets include the following (Europa, 2011):

- Recovery target: minimum 60% by mass of packaging waste to be recovered or incinerated at incinerator with energy recovery;
- Recycling target: between 55% and 80% by mass of packaging waste to be recycled;
- Recycling target: 60% by mass for board and paper, 50% for metals, 22.5% by mass for plastics and 15% for wood.

Likewise, member states shall introduce information schemes (databases) on packaging and packaging waste so that the achievement of the goals of this Directive can be administered by the Commission (Europa, 2011). The waste incineration at infrastructures with energy recovery are considered as contributing to the achievement of those targets.

(d) Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC; 2012/19/EC)

EU attempts to preserve the environment from the harmful effects of WEEE are based on two crucial directives that are WEEE directive (2002/96/EC; 2012/19/EU) and Restriction of Use of Certain Hazardous Substances (RoHS) in Electrical and Electronic Equipment (EEE) Regulations directives (2002/95/EC) (Afroz et al., 2013). Under this Directive, 85% of WEEE produced confirms that approximate 10 million tons, which is almost 20kg per capita, will be separately collected from 2019 onwards. Member states are to advocate the design and production of electrical and electronic equipment which take into consideration and accelerate demolishing and recovery, especially the recycling and reuse of WEEE. Additionally, member states must make sure all WEEE collected are delivered to accredited treatment facilities. Producers of EEE must apply the best available treatment, recovery, and recycling techniques (Europa, 2011).

To meet and achieve the targets set in the EU directives, all the member states such as Germany, the United Kingdom, Netherlands and others are formulating and implementing their national waste legislation respectively. The treatment infrastructure and plants are rapidly developed throughout the member states as the strategies to fulfil the recycling and recovery rates. To date, the recycling and recovery rates reported by the member states has steadily increased. The following section looks into the policy framework in Germany and United Kingdom (UK) for commercial solid waste which followed by a non-EU member, Singapore policy framework.

2.3.1.2 Developed Countries

Developed countries for instances the UK and Germany are the member states of European Union (EU), hence their waste management legislations are based on the European waste policy, but this is not the case in Singapore. Germany is considered one of the most successful countries in respect of waste recovery whereas the UK's waste recovery is still in its infancy. However, in recent years, the UK has begun to rationalise the need to enhance its recycling infrastructure, such as materials recovery/recycling facilities (MRFs) as well as introducing incinerators with recovery features. Consecutive section discusses the solid waste policies in EU developed countries for instance Germany and UK, and one of Asia's developed countries - Singapore.

(a) Germany

Prevention, recovery and disposal, which are the origins of waste management, have become the main principles of waste hierarchy in Germany (BMU, 2013). The provisions regarding landfill in Germany are stricter than the requirements in the EU Landfill Directive. The Landfill Ordinance was enforced on 1 August 2002 to ensure no harmful effects and the environment will appear from landfill waste in the long term. The Landfill Recovery Ordinance which was enforced on 1 September 2005 was palnned to end bogus recycling schemes in landfills (BMU, 2012). Germany usually takes a pioneering role in forming EU waste law. For example, the German Packaging Ordinance gave rise to the implementation of national measures in neighbouring states such as Austria, the Netherlands, France and Belgium, which in turn inspired the adoption of the EU Directive 94/62/EC on Packaging and Packaging Waste of 20 December 1994 that is now lawfully binding for all EU member states (BMU, 2016). German waste management is an essential industrial sector and supplys advanced technology for the effective use of waste as a resource and the environmentally sound disposal of the remaining residual waste (BMU, 2013). Hence, German waste management has the greatest waste recovery quotas globally and is already making a significant contribution to sustainable management (BMU, 2012: 2013).

The government of Germany is aiming to attain nearly complete high-quality recovery by 2020. Germany provides know-how and cutting-edge technology to reach the goals set at European and international levels. Product responsibility is the focal point of the country's waste management policy (LUA NRW, 2006; BMU, 2013), which was first laid down in 1991 in the Packaging Ordinance (BMU, 2012). Through this policy, the provision for effectual and environmentally sound waste prevention and recovery measures are created in the production stage (LUA NRW, 2006) and this is under the responsibility of producers and distributors (BMU, 2013). This contains the obligation to take back packaging after use (BMU, 2012). The 1996 Closed Substance Cycle and Waste Management Act and Ensuring Environmentally Compatible Waste Disposal and the Federal Emission Control Act are the legal bases for this policy (BMU, 2013). Additionally, the Acts are formulated by applying precautionary principle, the polluter-pays principle and the principle of co-operation as a base (LUA NRW, 2006). With these policies, Germany has smoothly developed a modern waste and closed cycle management system with an important positive impact on the protection of soil, water and above all general health (BMU, 2012).

According to the Closed Cycle Management Act of 1996, producer responsibility may be executed through legislation (laws, ordinances, administrative regulations) and also through voluntary commitments on the part of the producers and distributors (BMU, 2012). Subsequent on 1 January 2003, the Commercial Wastes Ordinance was entered into force, which increased the requirements placed on the recovery of municipal solid wastes and certain types of construction and demolition waste by prescribing better separation and more effectual pre-treatment. The Ordinance on the Management of Waste Wood was enforced on 1 March 2003, the Ordinance on the Management of Waste Wood was entered into force, which laid down requirements for the recycling, energy recovery and disposal of waste wood (BMU, 2012). In addition, the Act for Simplification of Supervision under Laws relating to Waste Management came into force on 1 February 2007 to relieve the sector of unnecessary bureaucracy and increase the efficiency of supervision (BMU, 2012).

Germany governs the Sale, Return and Environmentally Sound Disposal of Electrical and Electronic Equipment (Electrical and Electronic Equipment Act – ElektroG) as implementation of Directive 2012/19/EU on WEEE sets forth concrete obligations for all relevant stakeholders (manufacturers, trade, municipalities, owners, disposers) to have extensive recycling of WEEE to make a substantial contribution to the conservation of natural resources and the reduction of pollutant emissions (BMU, 2015).

(b) United Kingdom (UK)

The introduction of progressively stringent UK waste management policies, for instances the Environmental Protection Act 1990, act as the driver towards better sustainability in various sectors, including healthcare waste management in the UK (Tudor et al., 2005a) and also the commercial waste management. Applying to all sectors of waste management, the EU Waste Framework Directive and related directives on specified waste streams have become the foundation for UK waste management policy and legislation (Costa et al., 2010). The main legislative documents contain:

- Environmental Protection Act (1990): presents the description of waste and the duty of care on manufacturers or operators for the waste collection, treatment and disposal;
- Environmental Act (1995): summarises the necessity for a domestic waste strategy, the requirement for improved legislative and institutional setting for waste management, and sets the producers' obligation concerning reuse, recover and recycle of waste.

Owing to the pressure from the EU Waste Framework Directive (2008/98/EC), a waste hierarchy has been set out to help in waste control. The present well-established hierarchy alternatives consist of waste minimisation, reuse, recovery, other recovery for instance energy recovering from incineration and at last disposal to landfill (Pitt, 2005), which is alike with the hierarchy adopted in EU directives (shown in Figure 2.2). The UK has laws that request some companies to ensure that a portion of what they sell is recovered and recycled. These producer responsibility regulations are followed EC legal requirements which includes producers such as vehicles, packaging, batteries, electrical and electronic equipment (DEFRA, 2015). Starting 1 January 2015, the waste such as plastic, glass, paper and metal must be collected separately by waste collection authorities according to the Waste (England and Wales) (Amendment) Regulations 2012 (DEFRA, 2014). The amendment is intended to assure the waste experiences recovery operations in keeping with the directive and to facilitate recovery (DEFRA, 2014).

Besides, through Environmental Permitting (England and Wales) Regulations 2010, the waste disposal and recovery requests a permit under EU legislation with the primary objective of deterring harm to human health and the environment. This legislation also empowers the UK to give for exemptions from the requirement for a permit, providing general rules are laid down for every type of exempt activity, and the operation is registered with the corresponding registration authority (DEFRA, 2014).

In addition, over-reliance on landfills as the main waste disposal method has brought the country under pressure to apply a more sustainable waste management method as entailed under European Union (EU) landfill directives (1999/31/EC) (Pitt, 2005). Strong economic and regulatory instruments in the UK such as the imposition of landfill tax and prohibitions can contribute to making the reuse or recycling economically viable (Costa et al., 2010). The landfill directive provides the conditions for the waste disposal in landfills to prevent or minimise adverse effects on the environment. It also introduces prohibitions for some categories of waste such as tyres and sets targets to slowly minimise the quantity of biodegradable waste transported to landfills (Costa et al., 2010 cited from EC- European Commission, 1999; Barr et al., 2003; Pitt, 2005). Landfill Tax is enforced throughout the UK and its profits are partially used to reinforce programmes to enhance resource proficiency.

Apart from the above directives, the Packaging Directive (94/62/EC) is formally adopted by the EU with the purpose of approximating the EU member-state laws administering the packaging waste management. The EU directive on packaging waste as a first priority is to prohibit the manufacture of packaging waste and the supplementary basic principles are to reuse packaging, recycle and other methods of recovering packaging waste and thus, reduce the ultimate disposal of such waste. The recovery and recycling targets of packaging waste have been set as mandatory for the EU member states and both have been achieved in 2001 with the recovery of 50-65% and recycling of 15-45% of packaging waste generated in every member state via a revised packaging directive (2004/12/EC). New packaging targets for 2013 to 2017 were announced in the EU Directive, with the recycling of packaging waste of 71.8% and 72.7% were targeted in 2016 and 2017 respectively (DEFRA, 2015). Moreover, the producer responsibility regime executes the Packaging and Packaging Waste (2004/12/EC, revised by Directive 94/62/EC). The Producer Responsibility Obligations (Packaging Waste) Regulations 2007 is imposed to include recycling and recovery, while the Packaging (Essential Requirements) Regulations 2003 include single market and optimisation aspects (DEFRA, 2015). The legislation places a "Producer Responsibility" on commercial premises based on the "Polluter Pays Principle", requiring the commercial sector to take back the waste it produces through its supply of goods to the final consumer (Bolaane, 2006). Additionally, the polluter pays principle is imposed in Switzerland, where enterprises are liable for the management of their urban and special waste (Costa et al., 2010).

Furthermore, the European Union (EU) has attempted to defend the environment from harmful effect of WEEE according to two crucial directives, which consist of WEEE directive (2002/96/EC) and the Restriction of Use of Certain Hazardous Substances (RoHS) in EEE Regulations directives (Afroz et al., 2013), with the aim to minimise the quantity of waste from electrical and electronic and rise its re-use, recovery and recycling (DEFRA, 2014). In UK, legislation has delegated the obligation to the operators (private sector) to report, invest in, and manage the treatment of WEEE under producer compliance systems. The producers, pre-processors, and exporters must make sure the WEEE that picked out from different sources, must be treated by applying the best available treatment, recovery, and recycling methods (Turner & Callaghan, 2007).

The Single Use Carrier Bags Charges (England) Order 2015 was introduced in 2015, which initiated a 5p charge on single-use plastic carrier in England from 5 October 2015. The legislation is enforced because a survey reported that in 2013, supermarkets sent out more than 8 billion single-use carrier bags throughout the UK. That is almost 130 bags per person. This equal to about 57,000 tonnes of single-use carrier bags in total per year. However, small and medium-sized (SME) businesses are exempted from the plastic bag charge in England. This minimises the administrative responsbility on both start-up and developing businesses at a time to support new growth in UK's economy. However, in Wales, there has been a minimum charge of 5p on single-use carrier bags since 2011. The charge contains paper bags and applies to all organisations (including SMEs) (DEFRA, 2015).

End-of-life vehicles (ELVs) Regulation 2003 is introduced with the aim to deter waste from end-of-life vehicles and encourage the collection, re-use and recycling of their components to preserve the environment, while batteries directive aims to enhance the environmental performance of batteries and reduce the impact waste batteries towards the environment (DEFRA, 2014). Another effort to reduce waste is the hospitality and food service voluntary agreement, which aims to reduce food and related packaging waste by 5% and risee the overall rate of food and packaging waste recycled, develiered to anaerobic digestion or composted to 70% by 2015 (DEFRA, 2015).

(c) Singapore

Looking at an example from Asian developed countries, SWM in Singapore has conventionally been undertaken by the Ministry of the Environment and Water Resources (MEWR), which previously known as the Ministry of the Environment (ENV). The statute coping with SWM in Singapore is the Environmental Public Health

Act (EPHA) and the regulations that passed under the EPHA include Environmental Public Health (Public Cleansing) Regulations and Environmental Public Health (General Waste Collection) Regulations. Under these two regulations, all solid wastes generated have to be collected (Bai & Sutanto, 2002). Waste collection for industrial and commercial premises is carried out by licensed waste collectors. As a regulator, the ENV sets guidelines on good practices under its "Code of Practice for Licensed General Waste Collectors", which is a set of guidelines for licensed waste collectors to adhere.

The Environmental Public Health Act (EPHA) has been amended on 1 April 2014 to address the compulsory reporting of waste data and submission of a waste reduction plan by the owner, occupier, or lessee of a work place (NEA, 2016).

Landfilling in Singapore has been identified as the least desired disposal approach due to the extremely restricted landfill size for waste disposal and the requirement to conserve this restricted capacity for the future (Bai & Sutanto, 2002; Zhang et al., 2010). Singapore has prioritised waste minimisation to minimise the quantity of waste generated, while the scope for doing so is quite limited in comparison with EU countries. However, incineration began in Singapore prior to EU countries, since there is limited land on the island. The SWM hierarchy applied in Singapore is waste minimisation, which comprises the 3Rs, followed by incineration and landfill (Bai & Sutanto, 2002). The first Singapore Packaging Agreement (SPA), which is a joint initiative by government, industry, and NGOs to cut packaging waste that comprise about one-third by weight of Singapore's domestic waste, was launched in 2007 (NEA, 2016). The second SPA effects from 1 July 2012 has made good progress. In 2016, stakeholders cumulatively minimised about 32,000 tonnes of packaging waste and saved more than S$75 million (NEA, 2016).

SS 587, a certifiable management system standard, has a framework lined up with other acknowledged international management system standards (e.g., ISO 14001, Environmental Management). This is a new voluntary Singapore Standard for the end-of-life ICT (infocomm technology) equipment management. Environmentally responsible methods of managing end-of-life (EoL) ICT equipment contain processes for instance reuse, repair, material recovery, and responsible disposal (NEA, 2016).

2.3.1.3 Developing Asian Countries

A policy associated with SWM is also necessity and vital especially for developing countries. Waste management in Asian developing countries is based on the various international declarations, particularly the Rio+ declaration. These policies have cascaded down to individual countries at the regional level to enable them to implement their waste management (as shown in Figure 2.1). The subsequent sections discuss on the policies on commercial SWM in the developing countries of Indonesia, Thailand, Taiwan, China, as well as Malaysia.

(a) Indonesia

Inadequate integrated resource management policies have led to ineffectual SWM in Indonesia. The government of Indonesia has approved several international waste legal frameworks, for instances the Basel Convention in 1993 and Kyoto Protocol in June 2004 implying that the government concerns about the possibly negative waste impact on environment (IPCC, 2006; MoE, 2005). Meidiana and Gamse (2010) commented that lots of definite endeavours are required in both domestic and regional level because of lacking in waste regulations. Until 2008, the country has had no national waste policy defining the concepts, aims and methods for national waste management. In 2008, the government of Indonesia issued policies via the instrument of the Public Works Regulation No. 21/PRT/M/2006 concerning the National Policy and Strategy for the Development of Waste Management Systems (KSNP-SPP) (IndII, 2012). The new domestic regulation for waste management - Waste Management Law No.18/2008, was released in the same year as a legal instrument obliging all associated parties to support the national waste management policy (Meidiana & Gamse, 2010; IndII, 2012). The new Waste Law, however, does not contain subject of integrated waste management (Meidiana & Gamse, 2010) because the waste management practices in Indonesia still focus on landfilling. Special efforts are needed to encourage responsible businesses to operate with an EPR strategy (IndII, 2012). Rolling out the 3R policy throughout Indonesia is one of the strategic objectives stipulated in the National Mid-term Development for the years 2010-2014 (IndII, 2012).

(b) Thailand

Open dumping is the most popular SWM method in Thailand. Solid waste practices in Thailand are primarily governed by the unauthorised sector (Suttibak & Nitivattananon, 2008). Prior to 1994, most legislation dealt with the common tidiness of refuse in the city areas; there was no legislation associated to the recycling procedure (Muttamara et al., 1994). Positive signs of recycling publicity in Thailand began in 1997 by the Ministry of Science Technology and Environment (MOSTE) (MONRE, 1997). The government of Thailand implements an environmentally-friendly waste disposal scheme in the National Resources and Environmental Policy, and it will not allow Thailand to become an end receiver of waste - which means a country that has to bear the expenses of industrial waste and pollution (UNEP, 2009). The policy has been established for integrated SWM by aiming to minimise waste generation and promote the 3Rs hierarchy. However, the present laws lack regulations to embrace the whole

SWM. Although the national policy emphasises integrated waste management, well-defined measures to support waste reduction and public participation in such initiatives have not been mentioned (UNEP, 2009). Suttibak and Nitivattananon (2008) identified the indicators used for assessing the local government authorities' performance in SWM to enhance the recycling initiatives in Thailand.

(c) Taiwan

The evolution of recycling scheme in Taiwan has been from a free market mechanism (prior to 1988) to government-controlled infrastructure (after 1988 to now). Before 1988, Taiwan's government concentrated on SWM but not for resource recovery; the objective of Waste Disposal Act is mostly to restrict and concentrate on the waste-end clearance and handling. The traditional recycling scheme is principally depended on personals, unofficial waste-collectors and processing workshop and also small businesses. Hence, the recycling programmes at this stage tend to have economic profit rather than to safeguard environment (Chen et al., 2009).

Nowadays, basic conceptions of Taiwan's Solid Waste Clearing Act (SWCA) comprise the four generally recognised principles of natural-resource conservation-reduction, reuse, recovery and recycling - the "4-R" principles. Legislations and take-back programmes for recovery resources have enforced in 1988 (Chen et al., 2009). Later in 1997, a recycling management structure, the Waste Recycling Fund (WRF), was organised by Taiwan's Environment Protection Agency (TEPA). Some policy tools implemented are continuously agreeable with the EPR concept, which divert either economic or physical responsibility upstream to the producers and is extensively employed as a means of incorporating sustainable development principle into environment management (Widmer et al., 2005; Nnorom & Osibanjo, 2008). As a result, the government of Taiwan makes the mandatory for producers take economic obligation for the recycling and treatment of second-hand products (Chen et al., 2009). Further in 2001, manufacturers, importers and retailers gained the responsibility to handle solid waste from goods produced, imported, or retailed (Bor et al., 2004).

(d) Republic of China

SWM has been a continuing issue in the Republic of China (APO, 2007). With metropolitan residents accounting for more than half of the total population, China is undergoing a speedy expansion in solid waste generation and growing stress for SWM in cities. The quantity of municipal solid waste collected and transported is projected to reach 585 million tons by 2030 (World Bank, 2013). The World Bank (2005) reported solid waste legislative arrangement in China are complicated and often overlap, or have areas where no agency is responsible. Improved regulation is required due to increasing wastes volumes, and increasing sophistication needed for equipment and infrastructure. In 2000, eight pilot cities which should officially disseminate household waste sorting were affirmed by the Department of Construction as one of the efforts towards integrated SWM in China. Shanghai was one of the pilot cities (Huang et al., 2014). APO (2007) reported the Republic of China has made strong efforts to boost industrial-waste management and formulated many new policies, includes giving impetus to the construction of incineration plants. APO (2007) also reported the sustainable utilisation of natural resources has become a crucial problem in China; hence, the country's waste management policies have shifted to reusing and recycling resources.

(e) Malaysia

The earliest Act formulated in Malaysia was the **Environmental Quality Act (EQA) 1974** to avoid, mitigate, and control pollution, which subsequently boosts environment quality (Afroz et al., 2013). The **Refuse Collection, Removal and Disposal By-law** under Local Government Act 1976 was implemented by many local authorities to regulate the solid waste collection and its disposal, however the By-law deals only with the manner of waste disposal by households and commercial/ industrial establishments and its collection (MHLG, 2005c). There was no specific national plan that caters for solid waste management since the implementation of the Action Plan for a Beautiful and Clean Malaysia (ABC Plan) back in 1987, which was intended to minimise the generation of solid waste among waste generators. Unfortunately, there was no legal and fiscal instrument to regulate the plan (Moh & Abd Manaf, 2017). According to Kathirvale et al. (2004), the waste management approach applied in Malaysia is landfilling. Owing to speedy expansion and scarcity of area for new landfill, city councils have developed a new outlook by embarking the programmes for instance waste recycling and recovery followed by incinerating the waste to energy recover with only the final inert material being considered for landfilling.

Indeed, recycling is still at its infancy in Malaysia (Manaf et al., 2009). Nevertheless, with the increase of environmental awareness, the government starts to advocate recycling by drawing up policies and offering cooperation to private waste management companies (Desa et al., 2012 cited from Sapan Agarwa, 2007; Manaf et al., 2009). This coincides with the **Eighth Malaysia Plan (RM-8)** 2001-2005 which also promulgated the implementation of a thorough SWM policy to address and highlight on waste minimisation, re-use and recovery (MHLG, 2005c; Moh & Abd Manaf, 2014). However presently, privatisation is no longer the focus of the issue in Act 672, as attention to solid waste issues such as severe cases of illegal disposal, handling of non-domestic waste and construction waste, and solid waste reduction and recycling has significantly increased, requiring proper enforcement legally (Moh & Abd Manaf, 2017).

The **National Solid Waste Management Policy**, the first comprehensive policy on waste management, was formulated in 2006 to implement a waste management hierarchy (Figure 2.3) by highlighting waste minimisation via 3R activities, intermediate treatment, and final disposal (Agamuthu et al., 2011; Moh & Abd Manaf, 2014). It is known as the **National Strategic Plan (NSP)** for SWM in Malaysia (NSP, 2005). The Policy aims to develop an economical and sustainable SWM which will be accepted by the public (NSWMD, 2013). To achieve the aim, the Policy proposes an integrated municipal SWM that practices a waste management hierarchy prioritising waste minimisation via the 3R (reduce, reuse, recycle) in both the pre- and post-consumer phases through the use of proper technologies, facilities, equipment and service standards. The NSP scope covers commercial and industrial premises as well. NSP for SWM also emphasises on the advancement of unsanitary landfills as well as the construction of new sanitary landfills and transfer stations with material recovery facilities (MRF) (Desa et al., 2012). NSP presents the foundation for SWM policies and approaches in Peninsular Malaysia until 2020 (Afroz et al., 2013; Agamuthu et al., 2011). The government of Malaysia privatised the SWM in 1996 via NSP, which brought about the establishment of three solid waste concessionaries with diverse operational zones: Idaman Bersih Sdn Bhd for northern areas, Alam Flora Sdn Bhd for central areas and Southern Waste Management for southern areas (Manaf et al., 2009). Moh and Abd Manaf (2017) highlighted that the introduction of the NSP and Waste Minimisation Master Plan (WM-MP) provides a pathway towards an improved and transformed solid waste management system in Malaysia, focusing on solid waste minimisation and recycling.

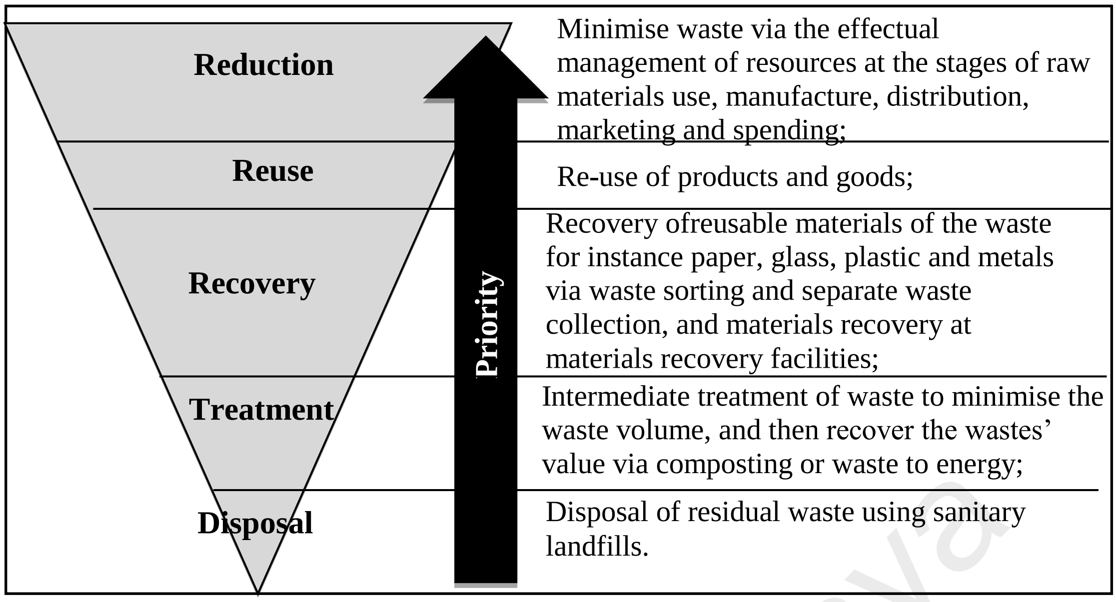


Figure 2.3: Waste hierarchy adopted in Malaysia (MHLG, 2005a)

The **Master Plan on National Waste Minimisation (MWM)** commenced in **2006** to realise a material cycle society where waste minimisation programmes are systemised and adequately enrooted in the behaviour of government, private sector, and the public in Malaysia (Agamuthu et al., 2011; Moh & Abd Manaf, 2014). The MWM delineates waste minimisation schemes; action plans for Federal Government and local authorities; and pilot projects that comprise the groundwork of guidelines on waste minimisation (Agamuthu et al., 2011).

The **Solid Waste and Public Cleansing Management (SWPCM) Act 2007** (Act 672) was gazetted in 2007 and implemented on 1st September 2011, with the principal of underpinning the institutionalisation of polices, plan and approaches of actions for SWM (NSWMD, 2013). The Act consists of eight types of controlled solid waste from commercial centres, public areas construction areas households, industrial region, institutions, imported, and others which can be prescribed from time to time (Manaf et al., 2009). Furthermore, National Solid Waste Management Department has been created as the regulatory organisation to integrate SWM system at the national level

(NSWMD, 2013; Moh & Abd Manaf, 2014), whereas the PPSPPA executes the operations by taking charge of the position of administering solid waste from local authorities and monitor the concessionaires (Manaf et al., 2009). The SWPCM Act 2007 identified and signed a contract with three main private concessionaires for Peninsular Malaysia. There us Southern Waste for the southern states [Negeri Sembilan. Melaka, and Johor], Environment Idaman for the northern states [Kedah and Perlis] and Alam Flora Sdn Bhd for regions of Pahang, Kuala Lumpur and Putrajaya. It comprises seven states, 52 local authorities, 113 solid waste collection schemes and also 113 public cleansing zones throughout Peninsular Malaysia (Moh & Abd Manaf, 2014). Agamuthu et al. (2011) argued that while the endorsement of the SWM Act 2007 has presented the legislative framework for SWM, it is still ineffective because it has not been implemented and cannot be put into effect due to deficient of supplementary regulations. Moh & Abd Manaf (2017) agreed that although there is a rigorous implementation of mandatory source separation among Malaysian starting from 1 September 2015, there are challenges to the success of source separation and recycling practice towards achieving the national recycling target of 22% by the year 2020. Nevertheless, Moh and Abd Manaf (2017) also stressed that the most significant transformation in the SWM system in Malaysia nowadays has been the implementation of mandatory source separation under Act 672.

Solid Waste Management and Public Cleansing Corporation Act 2007 (Act 673) is introduced to ensure the enforcement of Act 672. Act 673 is introduced to administer and enforce solid waste and public cleansing management laws and other related matters. Under Act 673, NSWMD coordinates the cooperation between the Federal Government agencies, State Government, local authorities, related private organisations, and the public in ensuring smooth implementation of solid waste and public cleansing management (Moh & Abd Manaf, 2017).

The waste of electrical and electronic equipment (WEEE) is also a main issue in the country, because these wastes increase year by year. A majority of developed countries are effectively dealing with the WEEE by stipulating effectual legislations, establishing recycling facilities, and stringently adhering to the principle of EPR to decree electronic producers and importers to take-back second-hand electronic merchandises (Afroz et al., 2013). Change in behaviour of the governments, applicable legislation associated with WEEE, restraint of WEEE dumping, enforcement of EPR, and transfer of technology on effectual WEEE recycling have become the vital problems in the integrated WEEE management in developing countries (Afroz et al., 2013). Malaysia is encountering problems with fast development of domestic WEEE amount which is produced from business entities and institutions (Afroz et al., 2013). Owing to the slow legislation related progress, the collection system, and the construction of formal recycling facilities, Malaysia established its first WEEE law- **Environment Quality (Scheduled Wastes) Regulations 2005** (Afroz et al., 2013).

As part of the strategic thrust of the Third Outline Perspective of Malaysia Solid Waste Plan, the government is not only concerned about the setting up of incinerators for safe and effective waste management but also stipulates stratagems for waste minimisation, reuse and recycling as portion of comprehensive waste management policy (Yahaya, 2008). An order of preference for action to minimise and manage waste in Malaysia is shown in Figure 2.3. The waste hierarchy as adopted in Malaysia is slightly different than that introduced in European Union (as shown in Figure 2.2 and Figure 2.3 respectively). As Pitt (2005) highlighted, the waste hierarchy options for other countries vary because of dissimilar geography, culture, environment, urban structure, planning scheme and others.

It is recognised that waste reuse and recycling are considered sustainable forms of waste management (MHLG, 2005c), and nowadays SWM in Malaysia is now at a critical juncture. Although the waste hierarchy (Figure 2.3) options comprises a broad ranking of preferred solutions, the present recycling rate in Malaysia is only 11%, well below the rates in developed countries. Continued efforts need to be made in regard recycling initiatives in Malaysia, especially in the commercial sector. It is essential for businesses to grasp the entire network of the materials they consume and the methods that should be dealt with from infancy to ensure that sustainability is reflected in their businesses.

2.4 Positioning Institutions Business and Services towards Sustainable Development

Within businesses, social responsibility is a balancing act in which business must balance economic, social and ethical performance (Lantos, 2001). Corporate social responsibility (CSR) is increasingly important in the achievement of sustainability (Henderson, 2007; Williamson et al., 2006). In today's more environmentally aware global culture, managers and administrators of the institutions' organisations should adopt recycling initiatives as part of their strategic management initiative for CSR reporting needs. CSR has been determined as a concept in which firms incorporate social and environmental interests in their business operations and in their collaboration with stakeholders on a voluntary basis (EC, 2001).

It has been argued that CSR reporting is a mechanism through which firms can give information on issues of social and environment (Golob & Bartlett, 2007). Hence CSR is a channel via which organisations can represent a change from the conventional viewpoint of companies merely supplying services and goods, to contribute to the welfare of the society (Steiner & Steiner, 1997) and consequently “achieve” sustainable development (DTi, 2004). Lantos (2001) asserted that CSR implies the responsibility originating from the implicit “social contract” between business and society for organisations to be approachable to society’s long-run demands, improving the positive outcomes, and decreasing the adverse impacts of its action on society.

Walker et al. (2007) asserted that CSR may compel organisations to be more open with financing decisions and then decisions can no longer be explained on cost alone. McWilliams et al. (2006) pointed out that understanding the responsibility of leadership could be expanded to understanding the decision-making procedure and how decisions about CSR activity are influenced by requirements from numerous stakeholders. According to Tudor et al. (2008) quoted from Chapple et al. (2005), the principles of CSR can be expressed in many forms which includes the utilisation of voluntary EMS for instance ISO 14001, signing international contracts for instance the UN Global Compact, or joining local initiatives.

McWilliams et al. (2006) stressed that apart from understanding the motivation for the provision of social advantages, the ways which the provision of these products influences society via strategic CSR should be understood as well. He further explained that one example of strategic CSR is when a company connects the provision of a public good to the trade of their products (e.g. eco-labelling). Tudor et al. (2008) also highlighted strategic initiatives for implementing the concepts of CSR into the waste management can be summarised under four major headings:

I. Implementing a holistic approach.
II. Building up networks with key stakeholders. For instance, setting up effective community partnership and also on a strategy that integrated sustainable waste and energy management.
III. Utilising social enterprise. For instance, providing jobs or employment opportunities in disadvantaged communities.
IV. Active staff involvement. For instance, empowering workers to implement a variety of environmental management programmes integrating waste, water and energy; this includes awareness raising campaigns on solid waste recycling.

In sum, implementing CSR concept into university's strategic plan for waste management not only contributes to sustainable environment, but also provides the economy a boost. This concurs with Zen et al. (2014), who suggested that the participation of business enterprises in providing the economic incentives could advocate recycling participation. According to Lantos (2001), some feel that organisations enthusiastically engaged in CSR programme can address numerous social ills, such as by offering employment opportunities, ameliorating the environment, and advocating international justice even if it charges the shareholders money. In addition, Lantos (2001) also claimed that consumers have a commitment to support socially responsible organisations rather than socially negligent or socially unresponsive businesses. For example, it is likely for consumers refuse to support polluting businesses or be willing to pay more for pollution control. Similar with higher education institutional community, students and staff are considered consumers that should support socially responsible business in institutions.

2.4.1 Characteristics of Universities and Colleges: Institutional Business, Championing Environment Sustainability and Premise Use

As higher education institutions are for teaching, research and policy development, with their influence and resources, the tertiary sector such as universities and colleges is acknowledged as suitable to shoulder the leadership for environment protection (Dahle & Neumayer, 2001). Well et al. (2009) displayed similar views, stating that higher education institutions portray a multi-faceted role within regional economies and are of key significance in knowledge creation and transfer worldwide through teaching, research and other activities.

Universities are regarded as small towns in terms of area size, population, and the numerous composite activities going on in campuses (Kaplowitz et al., 2009; Alshuwaikhat & Abubakar, 2008). Hence, universities can be considered as communities with considerable direct and indirect influences on the environment (Alshuwaikhat & Abubakar, 2008).

In terms of their students and staff, waste production, and utilisation of energy and materials, universities are thus similar to huge commercial concerns (Viebahn, 2002). Additionally, universities are slowly towards waste stream reduction, cost reduction and even profit generated by carrying out the environmental initiatives. Similar with the commercial sector, Hooi et al. (2012) stated that presently business views environmental sustainability as a latent source of competitive benefit and market chances. Therefore, institutional businesses should now search for methods to accomplish competitive benefit via greening activities from practising waste stream minimisation, resource preservation, as well as the profit generated.

In terms of population, university communities possess many defining characteristics in comparison to the overall population. A large student category, mainly in the young adult and adolescent age range, exists together with a typically much smaller staff group with ages covering the adult range (Kelly et al., 2006). The community is highly educated. Previous studies (Grazhdani, 2015; Sidique et al., 2010; Chen et al., 2009) confirmed that folks with higher education are anticipated to be more aware of environmental problems which would advocate them to recycle. Additionally, universities have the potential to teach environmental literacy to politicians, teachers, and the decision-makers of tomorrow (Eagan & Keniry, 1998).

Hence, universities have a distinct responsibility, particularly regarding to youth training and public awareness about sustainability (Viebahn, 2002). The youth might be the leader of a department or company or even the leader of the country in future. If they are equipped with the knowledge, they can apply it in the industry. Higher education institutions can educate and determine the principles of awareness and stewardship of the natural world, increase the opportunities of clean and pleasurable local and universal environments for the future (Creighton, 1999). Besides, an institution can provide students the knowledge of the interrelationship between business decisions and the natural environment, and thereby model behaviours that foster environmental concern (Creighton, 1999). These authors attempt to position institutional roles in environment sustainability and clearly imply that there is a strong impetus to focus the research on universities environment sustainability via SWM and recycling initiatives.

Fundamentally, MHEIs are categorised as public universities, private universities, and colleges. According to the Ministry of Education Malaysia (2014), the total population of the registered MHEIs consists of 20 public universities, 71 private universities, and 326 colleges. A majority of public universities own their campus, whereas most of the private universities only hold a lease on a premise. This is similar with colleges, as a majority of colleges are small institutions and do not possess property for their campus. The premises types of the MHEIs are not taken into account for this study since not all the institutions have owned property for their campus.

2.4.2 Defining FM and Environmental Policy

FM is considered a young industry in developing countries like Malaysia. However, over the years, the discipline of FM has witnessed an increasing requirement to assess obtainable facilities, improve employee efficiency, and prolong a building's service life (Piper, 2004). A facilities manager has an important role in designing for service provision according to business demand known as strategic level of FM (Noor & Pitt, 2009).

As environmental objectives are increasingly written into corporate objectives, the FM provider is envisaged as a part of delivering on environmental commitments (Price et al., 2011). Noor and Pitt (2009) also stressed that contemporary FM does not simply look after the building, since emphasis on the built environment is clear. The financing, technical, and management capability of the business sector are critical to meeting sustainable development targets (UN, 2010).

Furthermore, Price et al. (2011) highlighted legislation that delivers a main impulse for organisations to carry out their activities in a sustainable direction. It can be argued that enforcement of environmental legislation acts as motivating force for the change of organisations. Grazhdani (2015) also emphasised that different recycling and waste management policies on recycling rate are required in the modern complex waste management and process. Walker et al. (2007) indicated that this is reflected in company reports, with the environmental and corporate social responsibility (CSR) aspects of business activity usually featuring in annual reports.

Price et al. (2011) claimed that there are discrepancies in the effort on sustainability between small organisations and large organisations. He further stated that small companies usually do not distinguish environmental problems so easily compared to large companies. Baylis et al. (1998) found that 70% of large corporations with a sustainability policy were inspired by said policy compared to 54% of small to medium-sized companies. Apparently, there is a gap between a sustainability policy and enforcement within a business practice and also a difference on account of company size (Baylis et al., 1998). That study is compatible with the findings of Price et al. (2011) study, which indicates that large companies are more likely to execute sustainable business practice across the board compared to small companies. Thus, FM is in a position to establish sustainability policy to cover the wider environmental agenda in both large and small companies.

2.4.3 Strategic FM versus Operational FM

The strategic facilities management is paramount to improve the efficiency and effectiveness of SWM and recycling initiatives in accordance with the vision of achieving environmentally sustainable development. According to David (1989), strategic management is the art and science of planning, executing and evaluating cross-functional decisions that allows an organisation to attain its objectives. Yiu (2008) added that management plays a vital strategic role in adapting the organisation to its environment.

Strategic planning is crucial to improve the proficiency and effectiveness of SWM in accordance with the vision of achieving environmentally sustainable development to strengthen perennial growth. Improving standards of waste collection, phasing out open dumping of solid waste and introducing environmentally sound treatment and disposal facilities via implementation of new technologies will cost money. However, strategic planning and the adoption of cost-effective waste management strategies is a means to maximise return on such investments (MHLG, 2005b).

A strategic facility plan is necessary for strategic FM. The International Facility Management Association (IFMA) in its "Project Management Benchmarks Survey 2002" defines the strategic facility plan:

> "A strategic facility plan is defined as a two- to five-year facilities plan encompassing an entire portfolio of owned and/ or leased space that sets strategic facility goals based on the organisation's strategic (business) objectives. The strategic facilities goals, in turn, determine short-term tactical plans, including prioritisation of, and funding for, annual facility related projects." (IFMA, 2009, p.5)

Strategic facility planning (SFP) accelerates an organisation's strategy by optimising facilities to satisfy the strategic correlations between the organisation, products/services and facilities (IFMA, 2009). Strategic facility planning recognises that all decisions made in business planning have a direct impact on an organisation's real estate assets and demands (IFMA, 2009). Alexander (1996) stated that facilities managers act on strategic demand, developing plans in line with the corporate strategy. This coincides with Kaya et al.'s (2004) proposal that facilities should be strategically planned, aligned to business wants and demonstrated contribution to attain business goals.

In the institutional sector, the value of any higher education institution regarding sustainability must be articulated and implemented in its perennial strategic plans. Such plans initiate with the vision statement for the institution, lending legitimacy to the sustainability agenda in the greater context of the institution mission (Carmichael & Chameau, 1999).

In the operational strategy of FM, Chotipanich and Nutt (2008) indicated that operational concerns are dominant during stable periods of organisational development, typically with low rates of incremental and predictable change; therefore, FM practices tend to be routine, reactive and short term. Then (1999) contended for a strategic view instead of an operational view of FM. From the strategic level, the factors are economic viability, assets optimisation, and sustainable business opportunities. However, many organisations have been accustomed to the current operation and refuse to change. A few scholars (Jahiel & Harper, 2004; Velazquez et al., 2005; Dahle & Neumayer, 2001) have stressed that refusal to accept change is a general circumstance in organisations and a primary barrier in many sustainability endeavours.

2.5 Summary

This chapter has reviewed the literature relating the current scenario of the SWM and recycling initiatives globally as well as in Malaysia. The main issue in this chapter highlights the importance of policy enforcement in SWM. It has been shown that policy enforcement in developed countries makes recycling mandatory for each sector, and contributes high achievement in recycling activities. In contrast, a lack of policy enforcement in developing countries causes recycling initiatives to remain ineffective. The necessity of integrated SWM and recycling programmes is due to environmental pollution and a rapid increase of solid waste amount. In line with the importance of sustainable development and the effective SWM, facilities managers play a vital role in strategically plans embraces aspect of cost, human capital and operation into the institutional sustainability objectives with their stakeholders. With the coordination of facilities managers, cooperation among those charged with attaining strategic objectives can be improved, the expenses for SWM activities can be reduced to a minimum and then increase the recycling performance of an organisation.

This chapter has summarised the importance of regional policy directions and the role of FM in integrated SWM for an organisation. As mentioned earlier, after reviewing the policy frameworks of both developed and developing countries, it is evident that it is mandatory for developed countries to conduct recycling initiatives and achieve the target set by the government. In contrast, a lack of stringent regulations on SWM in developing countries lead to the difficulties of an organisation in planning strategic SWM. Hence, policy and regulation are the most important component in determining the overall SWM strategies. The following chapter discusses the critical elements required for the integrated SWM and how those elements contribute to strategic implications.

CHAPTER 3: REVIEW ON HIGHER EDUCATION INSTITUTIONS SOLID WASTE MANAGEMENT FACTORS AND STRATEGIC IMPLICATIONS

3.1 Introduction

Given that two objectives of this research are to identify principal higher education institutions solid waste management (SWM) factors affecting the strategy of SWM strategy and strategic implication variables, this chapter will begin with an introduction of the sustainable SWM and the higher education institutions waste trends. This is followed by an extensive and detailed literature review of the higher education institutions SWM factors. This leads to a review of recycling performance measurement and its strategic implications, and concludes with the development of theoretical framework.

3.2 Sustainable SWM

Waste is defined as a non-product output with an undesirable or zero market value (UNEP, 2004). Waste generally includes any material for which the holder has no further use and has the intention to discard (MHLG, 2005c). Waste also relates to the superfluous consumption of natural resources, superfluous costs and environmental damage (MHLG, 2005b). According to Solid Waste and Public Cleansing Management Act 2007, solid waste includes:

a) any scrap substance or discarded residues or rejected products resulting from the function of any process;

b) any material needed to be discarded of as being spoiled, worn out, ruined or otherwise broken; or

c) any other substance that according to this Act or any other written law is requested by the authority to be disposed of,

but does not refer to scheduled wastes as stipulated under the Environmental Quality Act 1974, sewage as defined in the Water Services Industry Act 2006 or radioactive waste as delineated in the Atomic Energy Licensing Act 1984.

Solid waste management (SWM) is a discipline associated with the control of generation, storage, collection, transfer and transport, processing and disposal of solid wastes (Tchobanoglous et al., 1993). Sustainable SWM should balance the demand to safeguard resources and the correspondingly essential accountability to avoid environment contamination (MHLG, 2005a). Within the acknowledged waste hierarchy (as shown in Figure 2.3), it is necessitous to strike this balance, consuming the existing resources prudently and addressing the instantaneous concerns (MHLG, 2005b).

The waste hierarchy is a recognised component in establishing integrated waste management procedures, specifying the order in which alternatives for waste management should be taken into consideration based on environmental effect (DEFRA, 2002). Zhang et al. (2010) explained that being wholly dependent on incineration and landfilling to resolve the solid waste issue is not suggested because of cost increase and environmental concerns. According to DETR (2000) and DEFRA (2005), effectual waste management via reduction, recycling and reuse is one approach through which sustainability can be accomplished. Additionally, Isa et al. (2005) stated that the execution of an appropriate SWM programme with a suitable recycling approach as an intrinsic element is significant to the mitigation of the issues regarding solid waste generation, treatment, and disposal as well as environmental conservation.

A few authors have stressed that even though recycling is an explicit move towards waste minimisation, treating materials for re-use still needs the practice of energy and resources (Finnveden & Ekvall, 1998; Luyben & Cummings, 1981) and recycling alone will not build an environmentally sustainable waste management programme (Armijo de Vega et al., 2003). Amutenya et al. (2009) emphasised recycling that is an approach extensively promoted to proliferate effectiveness and to reach waste reduction goals. Recycling gives a sustainable means to the country's SWM with the raising of waste generation, finite space for waste disposal, and other related issues from social issues to the economy matters (Moh & Abd Manaf, 2014). Additionally, recycling business conjointly provides significant quantities of job prospects, specifically for those who are not well-educated (Chen et al., 2009). Chen et al. (2009) further revealed in his study that there is an increase of job opportunities provided by the both collection and processing sector for the individuals at the high school and/or below high school education level.

Campus sustainability has been emphasised for many years (Bardati, 2006; Moore et al., 2005); however, there is still an issue of global interest for university policy makers as consequence of the realisation of the effects of the activities and operations of universities have on the environment (Alshuwaikhat & Abubakar, 2008). Alshuwaikhat and Abubakar (2008) has the opinion that a sustainable institution campus should be a healthful campus environment, together with a flourishing economy through the conservation of energy and resource, waste minimisation and an effectual environmental management, and stimulates equity and social justice in its affairs and export these values at the community, national, and international levels.

Dahle and Neumayer (2001) claimed that the most considerable institution environmental effects are those causing by campus waste, sustainable activities within these areas can effectually preclude environmental degradation. SWM comprises a variety of programmes that should be employed to minimise solid waste amount on campus, for instance reusing and recycling wastes, composting and source reduction (Dahle & Neumayer, 2001). Hence, UNESCO (2005) proclaimed 2005-2014 as the period of Education for Sustainable Development, definitely acknowledging the imperative demand to integrate sustainable development issues and elements into education and learning (Zhang et al., 2011).

According to National Solid Waste Management Department (2013), a holistic concept of integrated SWM has become a prerequisite in planning for the future to stem from the present issues of disposing solid waste in Malaysia. Integrated SWM should include waste source reduction before going into the waste stream, recovery of produced waste, recycling, composting, environmentally sound disposal via incinerators and sanitary landfills that comply with best management practices (NSWMD, 2013).

3.2.1 Existing Material Recycling System in Malaysia

SWM services encompass the segregation, storage, collection, transport, processing, recycling, treatment, and disposal of controlled solid waste (Manaf et al., 2009). Recycling is the separation of domestic waste, paper, plastics, glass and other wastes with the purpose of reverting them to the industry for advantage (de Oliveira & Borenctein, 2007). Recycling process comprises either closed-loop recycling or open-loop recycling (Boguski et al., 1994). Closed-loop recycling represents a recycling practice in which waste is recycled into an identical product.

While the government of Malaysia has progressively adopting the Agenda 21+ into local level when implementing recycling initiatives, it has only restricted household recycling programmes. It should be adopted widely in commercial and institution waste recycling initiatives as well, since the commercial and institutional sector has the obligation to act responsibility towards the environment. The existing recycling system in Malaysia is applicable to all sectors, as depicted in Figure 3.1.

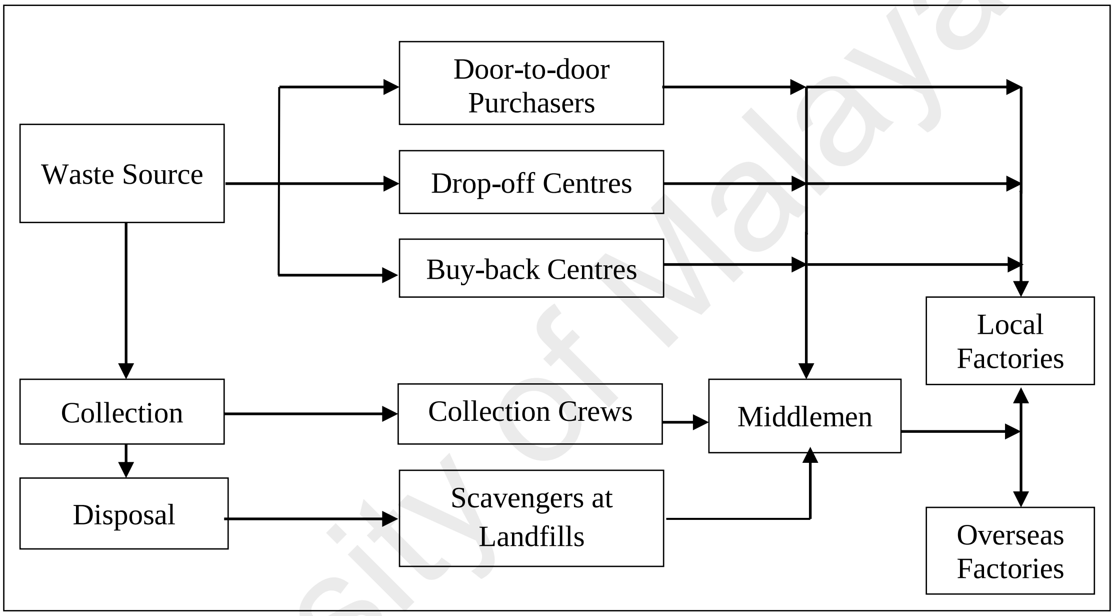


Figure 3.1: Existing recycling system in Malaysia (MHLG, 2005c)

According to MHLG (2005c), waste for re-use and recycling is separated from the waste stream by private contractors, waste collection crews, and scavengers at landfill sites and transfer stations. From the existing waste recycling system (as depicted in Figure 3.1), key players can be grouped at four levels: waste generators, tailgate recyclers & the middlemen, scavengers, and recycling facilities/factories. In the current four-level recycling system, it is noted that there are no regulations that control collection and sale of recyclables. Basically, recyclable materials are collected from the source by three general methods, which are (NSWMD, 2013):

- Collection by a private organisation's vans or lorries

- Collection by third parties who sell recycling items to a buy back centre
- Direct personal transport to recycling drop-off centres.

A survey on recycling players in Malaysia showed that there are 86% of the recyclable were transferred directly by people to drop-off centre whereas the remaining 14% of wastes was collected by vans or lorries to drop-off centre. Several charity organisations have carried out recycling campaigns to collect recyclables from the public as well (NSWMD, 2013). The survey also revealed that recycling activities by traders, recyclers, middlemen and buy back centres are more market driven compared to drop off centres (NSWMD, 2013). More and more surveys on recycling performance in each sector should be conducted constantly to improve the recycling collection system.

Malaysia Standard (MS 2505:2012) serves as a benchmark for the household solid waste flow (as illustrated in Figure 3.2). The flow acts as a guideline for contractors to manage solid waste.

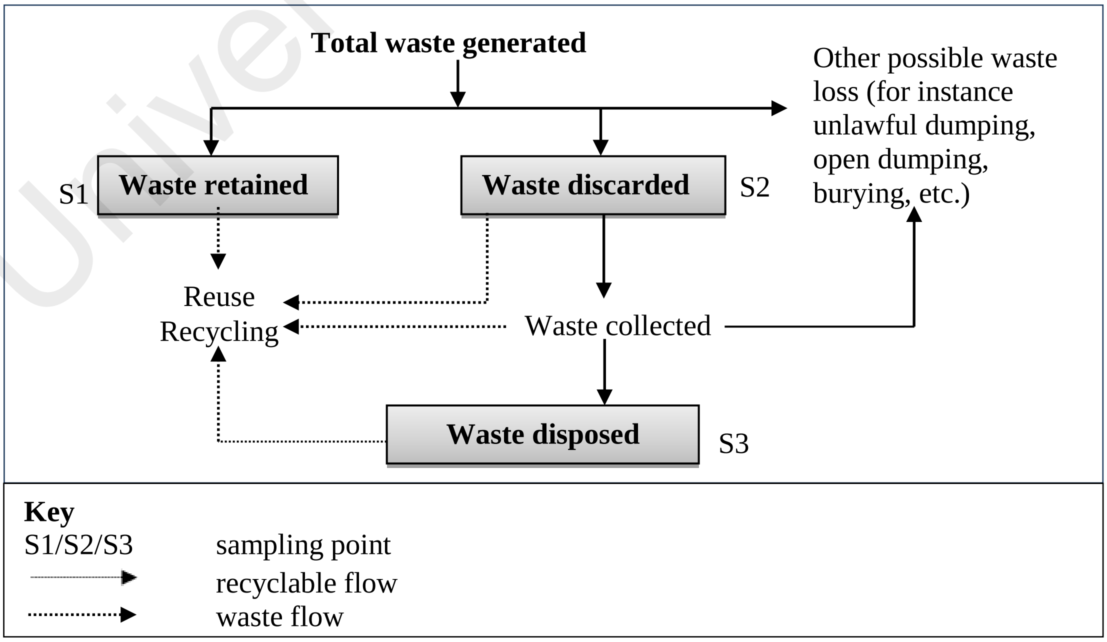


Figure 3.2: Household solid waste flow (Department of Standards Malaysia (DSM), 2012)

Sampling refers to solid wastes generated at any time throughout the year for which precautions are taken to avoid major fluctuations, special events, or seasonal event such as school holidays, festivals, fruit seasons, and so on. Selection of sampling points depend on sampling use, normally targeting three separate phases in the whole waste flow, such as waste retained (S1), waste discarded (S2), and waste disposed (S3). Waste retained refers to any waste not discarded at the collection point and temporarily kept within a premise for certain purposes such as recycling and/or reuse (DSM, 2012). Waste discarded refers to solid waste placed at the collection point to be collected by authorised waste collectors or contractors while waste refers to the solid waste from collection points which is then transported to SWM facilities (DSM, 2012; NSWMD, 2013). A license for a waste contractor/collector is issued by PPSPPA.

Based on the household solid waste flow (as demonstrated in Figure 3.2), waste discarded and waste retained contribute to the total amount of waste generated from homes on the whole. It include wastes either stored at home for recycling or reuse purpose, or undesired waste places at the collection point to be collected by the waste collection servicer (DSM, 2012). Wastes disposed will be emptied from the lorry for sorting into particular waste components at a designated sorting area which normally on the dumping site. The differences between total waste generation and waste disposal reveal the quantity of waste reduction, most likely due to the reuse and/or recycling activities. This includes several other possible waste losses spanning the process of waste generation to disposal (DSM, 2012).

Waste sorting is carried out by separating the solid waste components into combustible and non-combustible components. Combustible materials consist of paper, food wastes, plastics, textiles, rubber and leather, wood, and garden wastes.

Incombustible components include glass, ferrous metals, aluminium and non-ferrous metals, other inorganics, and oversized bulky wastes (DSM, 2012).

In terms of the figures of existing recycling system and household solid waste flow, both are solely designed for residential or household. However, recyclable materials are not fully recovered and recycled, as recycling is not commonly practiced among Malaysian households (Fauziah & Agamuthu, 2012; Omran et al., 2009). Apparently, the government of Malaysia focuses more on residential SWM instead of commercial or higher education institution. This phenomenon results in a lack of policies and guidelines as well as poor consistency of SWM in higher education institutions and commercial areas. The next section discusses the implementation of existing waste related policies in terms of commercial and higher education institution solid waste.

3.2.2 Implementation of Existing Waste-Related Policy in Commercial and Institution Sector

Malaysia aims for 22% of all solid wastes to be recycled by 2020, but the existing recycling rate is only 11%. Comparing to other developed countries, where recycling rate was about 30% to 47%, Malaysia is lagging behind (Mahmud & Osman, 2010). A survey had been done by National Solid Waste Management Department indicated that on average, the recycling rate for commercial and institution is only 7.4% (NSWMD, 2013). It is definitely still lagging to achieve targeted recycling rate by the year 2020. Statistics also show that recyclable items are gauged at 0.12 kg/employee/day, while waste produced is gauged at 1.94 kg/employee/day (as illustrated in Table 3.1). Recyclable items from commercial businesses and institutions come from public administration, hotel, business offices, restaurant, education, transportation, health, wet markets, wholesale and retail.

Table 3.1: Recyclable materials and recycling rate of commercial and institutional waste (National Solid Waste Management Department, 2013)

	Sum of the weight excludes wholesale and retail trades, includes hypermarket (kg/day)	**Sum of the weight excludes wholesale and retail trades (kg/day)**	**Kg/employee /day#**
Recyclable materials kept by the chosen Commercial and Institutional	678,482	571,482	0.12
Waste discarded	8,545,993	8,438,993	1.82
Waste generated (waste discarded + recyclables)	9,224,476	9,010,476	1.94
Recycling rate	-	**7.4%**	
Total number of employees in the chosen commercial and institutions	-	4,640,523	
Source: Number of Employees from Economic Census 2011, Department of Statistics *Note: # the approximation of kg/employee/day excludes wholesale and retail trades.*			

The result of the survey also indicated the overall of recycling rate in Malaysia is only achieved 10.5% (NSWMD, 2013). The recycling rate is relatively low compared to the EU countries, which attain a much higher rate of recycling, reaching over 50% in 2009 (Eurostat, 2009). The recycling rate is other Asian countries is also higher than Malaysia, including Taiwan (60%), Thailand (60%), Singapore (61%) (SWCorp, 2014), as well as the Philippines (25%) (Andin, 2006). Despite that, Malaysia still relies on the import of waste and scrap. Although the imported quantity of recyclable items is below the exported quantity, in terms of value, imported recyclables are higher than those of exported recyclables. As a result, there is a deficiency in the balance of business for all recyclable categories, not including plastic waste (as presented in Table 3.2).

Table 3.2: External trade of recycling items for year 2011 for Malaysia (National Solid Waste Management Department, 2013 quoted from International Trade Centre (UN Commodity Trade Database), 2011)

Category of waste and scrap	Import			Export			Trade Balance (USD)
	Quantity in MT	USD/ MT	Total (USD)	Quantity in MT	USD/ MT	Total (USD)	
Paper	218,929	326	71,370,854	214	1,159	248,026	(71,122,828)
Plastic	142,860	456	65,144,160	153,865	695	106,936,175	41,792,015
Ferrous	2,050,146	527	1,080,426,942	70,107	306	21,452,742	(1,058,974,200)
Non-ferrous	104,829	2,566	268,987,672	57,058	2,786	158,978,345	(110,009,327)
Total	2,522,800	-	1,507,912,740	301,015	-	292,538,267	(1,215,374,473)

The lack of strict enforcement and implementation of the policies throughout Malaysia leads to a relatively low recycling rate and deficits in the balance of trade for recyclable materials. On the contrary, due to EU directives containing deadlines for the implementation of obligations in the directives into the law of the member states (EC, 2013), EU directives have the great impacts towards the solid waste policies of its member states to attain the EU directives' goals. In sum, without well-established policies and implementations, wastes cannot be managed sustainability.

3.2.2.1 Waste Policy: Dealing with Higher Education Institutions Waste

Various solid waste-related policies and legislations have been introduced and implemented since 1988, and the 3Rs principle has been established based on these policies and legislations, and was also strongly publicised by the Malaysian government, but achievement is yet to be seen. In contrast, higher education institutions in developed countries are mandatory and include compliance with various legislation standards on SWM practices. For instance, The University of Southampton, UK has a Duty of Care to make sure all wastes are managed to avoid release into the environment. The University has employed licensed waste contractors to discard diverse waste streams (Zhang et al., 2011). Systematic enforcement and regulatory action ensures effective waste separation at source, establishment of recycling collection points, efficient transportation, and the manufacture of collected recyclable materials, increasing recyclable materials collection frequency and the potential for recovery and recycling (Moh & Abd Manaf, 2017).

Additionally, since electrical and electronic equipment is widely used, disposal and management of waste electrical and electronic equipment (WEEE) is given attention worldwide. WEEE regulations have been established to enhance the environmental performance of all operators engaged in the life cycle of electrical and electronic equipment. The university's accountabilities are to make sure that all WEEE collected are for treatment or recycling, and that the WEEE is transported into the appropriate logistical chain to make sure it is recycled or disposed properly (Zhang et al., 2011). In addition, the Batteries Directive also places on universities for the collection, treatment and recycling of waste accumulators and batteries (Zhang et al., 2011).

3.2.3 Higher Education Institution Waste Trends

Waste and material consumption may be significantly minimised by strategic planning and execution of recycling initiatives. Most waste generated by higher education institution is recyclable. An effectual SWM initiates with the ample and dependable information of what is in the waste stream coming from institutional entities (NSWMD, 2013). Burnley (2007) reported that for a practical recycling initiative, the national waste composition must be distinguished. Armijo de Vega et al. (2008) agreed and laid emphasis on the waste characterisation as the first move in developing integrated waste management. Armijo de Vega et al. (2008) argued that waste stream in seasonal countries will change when the climate changes. For instance, there is larger use of beverages and bottled water during the warm season, this entails a greater waste generation from containers in which they are sold (Armijo de Vega et al., 2008). Since Malaysia is not a season country and usually hot throughout the year, the waste stream will not much change in the year. Indeed, information on waste components assists in getting into possible alternatives for sustainable waste disposal, recycling and reuse (Moh & Abd Manaf, 2014). Smyth et al. (2010) identified typical university campus waste streams in Canada (as illustrated in Table 3.3), while waste compositions for institutions in Malaysia were identified via a survey by the National Solid Waste Management Department (2013) (in Table 3.4). The main institutional sector in the survey consists of universities, polytechnics, colleges, schools, government offices, clinics, hospitals as well as public transportation facilities (NSWMD, 2013).

Table 3.3: Description of the solid waste composition and its' categories at university campus in Canada (Smyth et al., 2010)

Classification	Description of material
Paper and its products	
Reusable printer	Printer paper printed on one side
Used printer	Private printer paper
Unused printer	Blank printer paper
Mixed paper	Magazines, catalogues, coloured paper, envelopes, etc
Corrugated cardboard	Used corrugated cardboard
Newspaper	Used newspaper and flyers
Boxboard	Cereal and tissue boxes
Paper towel	White paper towel
Refundable	Tetra drink packs
Single-use hot beverage cups	Disposable tea and coffee cups
Plastics	
Refundable	Plastics beverage receptacles
Recyclable	Plastics #1-7 (see note)
Soft plastics	Plastic bags and packaging
Durable plastics	Pens, cafeteria tray, plastic utensils
Milk bottles	Cartons, jugs, plastic receptacle
Dairy-non-milk	Yoghurt, ice cream, cheese
Glass	
Recyclable	Jars not including glass beverage containers Glass beverage bottles
Refundable	Incandescent bulbs, other types of glass not included
Other	above
Expand polystyrene	Styrofoam™ disposable food packaging
Ferrous metals	
Recyclable	Tin cans from food and drink preparation Cutlery from cafeteria
Other ferrous	
Non-ferrous metals	
Refundable	Aluminium soda and juice cans
Other	Aluminium foil
Organic matter	
Compostable	Raw fruit, vegetables, coffee grounds and tea bags All other food waste besides meat, bones and bread
Other compostable	
Textiles	Clothing, cleaning rags
Hazardous	Batteries, paint cans, autoclaved biology
"E" waste	Electronics and electronics packaging
Rubber and leather	
Other	Non-recyclable
***Note*: Plastics are numbered 1-7 to identify the generic family of plastic resin the container is made from. This standard coding system was established by the Society of the Plastics Industry to assist in separating for recycling.**	

Table 3.4: Waste composition for institutional in Malaysia (National Solid Waste Management Department, 2013)

Category	Waste
Organics	Food waste
	Garden waste
	Wood
Paper	Mixed paper
	Newsprint / Old newspaper
	Cardboard
Plastics	Polystyrene
	High-density Polyethylene (HDPE) and low-density Polyethylene (LDPE)
	Polyvinyl Chloride (PVC)
	Polypropylene
	Polyethylene Terephthalate (PET)
	Other plastics
Glass	Glass bottle
	Sheet glass
Metals	Aluminium
	Ferrous metal
	Other non-ferrous metals
Household hazardous waste	Batteries
	Fluorescent tube
	E-waste
	Aerosol Cans
	Paint container
Others	Tetrapak
	Diapers
	Rubber
	Textiles
	Leather
	Porcelain / Ceramic
	Other minor components

Smyth et al. (2010) stated that paperboard and paper consist of different types of paper such as printed paper, newspaper, mixed paper, corrugated cardboard, boxboard and paper towel, and makes up the largest portion of higher education institutions campus waste stream. Paper outputs comprises a large part of the solid waste produced by higher education institutions due to their educational and academic activities (Amutenya et al., 2009). This concurs with Kathirvale et al. (2004), who revealed the quantity of paper waste from the institutional sector was greater than that from the residential and commercial sectors. Smyth et al. (2010) in his study also concluded that paper and its products, throwaway drink receptacles, and compostable organic material were three of the most important material types for aimed waste reduction and recycling attempts at higher education institution campus. However in Malaysia, a survey done by National Solid Waste Management Department (2013) showed that food waste was the highest proportion of the institutional waste stream rather than paper waste (as illustrated in Figure 3.3). However, paper waste produced in institutions is much greater than that from residences, which is only 8.5% (NSWMD, 2013).

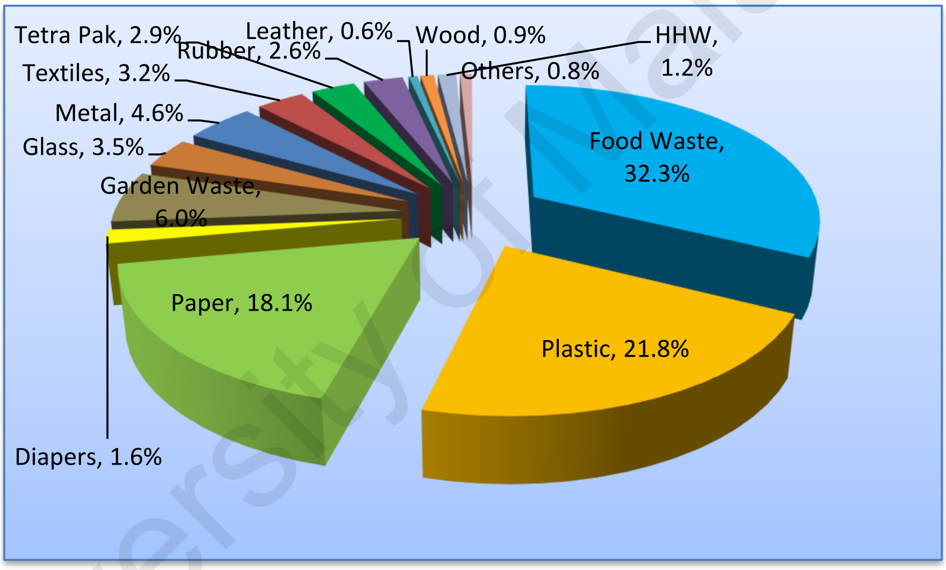


Figure 3.3: Composition of institutional waste for Malaysia (NSWMD, 2013)

Paper recycling is not a new concept because in 1994 the European Community, under the Directive on Packaging and Packaging Waste 94/62/EC (EC, 1994), commenced to set goals to increase paper and cardboard recycling from packaging (Villanueva & Wenzel, 2007). However, the issue is how paper recycling could bring benefits to organisations and institutions from the social, economic and environmental perspectives.

Since recycling is among the most tangible, assessable, and enforceable of the environmentally sound practices that a campus can commence (Armijo de Vega et al., 2003), many higher education institutions in developed countries have implemented recycling as a waste management activity, and as a beginning stage for sustainability schemes (Mason et al., 2003; Pike et al., 2003). This may save money for higher education institutions and are usually highly visible and normally non-controversial (Barlett & Chase, 2004). However, understanding who the typical recycler is and what type of initiative will lead to the highest recoveries at the least economic costs, which is a composite task to which there is no single answer (Perrin & Barton, 2001).

Since none of the study identifies the solid waste composition solely for MHEIs, higher education institution's waste composition as identified by Smyth et al. (2010) and National Solid Waste Management Department (NSWMD, 2012) will be incorporated and then adopted in this study. Clinical wastes are not included in this study since not all Malaysian higher education institutions (MHEIs) provide medical related courses.

3.3 Higher Education Institution SWM Factors

Universities can be considered small towns based on population, large size, and many complex activities being conducted on campuses (Alshuwaikhat & Abubakar, 2008; Kaplowitz et al., 2009). Thus, large volumes of various types of waste are generated as a result of these activities on campuses. According to Roy et al. (2008), reducing waste on campuses is one of the main imperative problems in environmental programmes for higher education. It is suggested that the sole pro-environmental behaviour that could be classed as normative is that of recycling (Barr, 2007). Kelly et al. (2006) advocated that effective recycling initiatives should rely not only on technology, but also on active participation, so the development and maintenance of environmentally responsible behaviour is of significant importance. Many scholars have studied waste management and recycling in various disciplines (as illustrated in Table 3.5), but there has been no study regarding SWM and recycling initiatives in the aspect of strategic FM planning. Hence, in this study the SWM factor has been defined as initiatives for managing solid wastes in higher education institutions in order to attain strategic implications via its implementation. Seventeen (17) SWM factors have been identified that influence higher education institutions SWM based on the precedent studies.

Table 3.5: Precedent studies on factors influencing strategic SWM

Title of study	Source Year	Methodology	SWM Factor(s)
Can corporate social responsibility and environmental citizenship be employed in the effective management of waste?: Case studies from the National Health Services (NHS) in England and Wales	Tudor et al. (2008)	Interview and case study (4)	▪ ISO 14001 accreditation (EMS) ▪ Partnership ▪ Awareness ▪ Strong support from top management level
Solid waste characterisation and recycling potential for a university campus	Armijo de Vega et al. (2008)	Observation	▪ Providing feedback ▪ Waste disposal and collection contract
Constraints to promoting people centred approaches in recycling	Bolaane (2006)	Questionnaire (284) and interviews (3)	▪ Source separation at source ▪ Awareness ▪ Monetary incentives

Table 3.5, continued

Title of study	Source Year	Methodology	SWM Factor(s)
Assessment of factors influencing the performance of solid waste recycling programs	Suttibak and Nitivattananon (2008)	Questionnaire (120) and interview	▪ Material Recovery Facility (MRF) ▪ Monetary incentive ▪ Partnership ▪ Proximity of recycling facilities ▪ Awareness ▪ Mandatory recycling ▪ Training
Issues associated with transforming household attitudes and opinions into materials recovery: A review of two kerbside recycling schemes	Perrin and Barton (2001)	Questionnaire (763)	▪ Proximity of recycling facilities ▪ Collection frequency
University community responses to on-campus resource recycling	Kelly et al. (2006)	Questionnaire (678)	▪ Awareness ▪ Source separation at source ▪ Proximity of recycling facilities ▪ Money incentives or rewards
Reducing solid waste in higher education: The first step towards 'greening' a university campus	Smyth et al. (2010)	Interview	▪ Proximity of recycling facilities
Greening academia: Developing sustainable waste management at Higher Education Institutions	Zhang et al. (2011)	Case study	▪ Awareness or campaign ▪ Waste disposal and collection contract ▪ Partnership ▪ Proximity of recycling facilities
Public understanding and its effect on recycling performance in Hampshire and Milton Keynes	Thomas (2001)	Case study	▪ Awareness ▪ Proximity of recycling facilities
Garnering input for recycling communication strategies at a Big Ten University	Kaplowitz et al. (2009)	Interview, focus group and questionnaire (3896)	▪ Awareness ▪ Proximity of recycling facilities
Recycling performance of firms before and after adoption of the ISO 14001 standard	Babakri et al. (2004)	Questionnaire (177)	▪ EMS

Table 3.5, continued

Title of study	Source Year	Methodology	SWM Factor(s)
Paper recycling patterns and potential interventions in the education sector: A case study of paper streams at Rhodes University, South Africa	Amutenya et al. (2009)	Conservation and interview	▪ Proximity of recycling facilities ▪ Goal setting policy ▪ Strong support from top management level ▪ Monetary incentives
Service quality and benchmarking the performance of municipal services	Folz (2004)	Questionnaire survey (2096)	▪ Collection frequency ▪ Source separation at source ▪ Goal setting policy ▪ Mandatory of recycling programme
Developing an environmental management system for a multiple-university consortium	Barnes and Jerman (2002)	Case studies	▪ EMS
Attitude towards recycling household waste in Exeter, Devon: quantitative and qualitative approaches	Barr et al. (2003)	Questionnaire (673) and qualitative data	▪ Awareness or campaign ▪ Education ▪ Proximity of recycling facilities
A comparison of municipal SWM in Berlin and Singapore	Zhang et al. (2010)	Literature review	▪ Source separation at source ▪ Waste disposal and collection contract ▪ Collection frequency ▪ Recycling C&D waste ▪ Partnership ▪ Education
The market-incentive recycling system for waste packaging containers in Taiwan	Bor et al. (2004)		▪ Making recycling mandatory ▪ Market incentive ▪ Methods of waste recovery
Overcoming barriers to campus greening: A survey among higher educational institutions in London, UK	Dahle and Neumayer (2001)	Interview (16)	▪ Awareness or campaign ▪ Marketing recyclables materials ▪ Education ▪ Proximity of recycling facilities

Table 3.5, continued

Title of study	Source Year	Methodology	SWM Factor(s)
Trends in shopping centre waste management	Pitt (2005)	Questionnaires and interviews	▪ Marketing recyclables materials ▪ Partnership ▪ Methods of waste recovery ▪ Waste disposal and recycling contract
The recycling business for sustainability in Taiwan	Chen et al. (2009)	-	▪ Marketing used products ▪ Mandate recycling
Student engagement with sustainability: understanding the value-action gap	Chaplin and Wyton (2014)	Questionnaire (396) and focus group interviews	▪ Incentives ▪ Education ▪ Proximity of recycling facilities
The characteristics of organic sludge/sawdust derived fuel	Chen et al. (2011)	-	▪ Alternative recovery method-refuse-derived fuel
Economies of size and density in municipal solid waste recycling in Portugal	Carvalho and Marques (2014)	Observation (37)	▪ Composting ▪ Waste separation ▪ Awareness
Recycling in Brazil: Challenges and prospects	Campos (2014)	-	▪ Method of waste recovery ▪ Collection frequency ▪ Material Recovery Facilities (MRF) ▪ Proximity of recycling facilities ▪ Education and training ▪ Monitoring recycling performance
Quantitative assessments of municipal waste management systems: Using different indicators to compare and rank programs in New York State	Greene and Tonjes (2014)	Archival documents (10 cases)	▪ Method of waste recovery ▪ Incentives ▪ Reporting on recycling performance
Assessing the variables affecting on the rate of solid waste generation and recycling: An empirical analysis in Prespa Park	Grazhdani (2015)	Field questionnaire survey	▪ Reporting feedback on recycling performance ▪ Training ▪ Incentive ▪ Education ▪ Mandate recycling

Table 3.5, continued

Title of study	Source Year	Methodology	SWM Factor(s)
How the Brazilian government can use public policies to induce recycling and still save money?	Murakami et al. (2015)	Case study (11)	▪ Recyclable materials market ▪ Top management involvement ▪ Methods of waste recovery ▪ Partnership ▪ Mandate recycling initiatives
Solid waste collection and recycling in Nibong Tebal, Penang, Malaysia: A case study	Isa et al. (2005)	Questionnaire (60) and on-site observations	▪ Resource recycling facility ▪ Source separation at source ▪ Awareness or campaign
Waste management and recycling practices of the urban poor: A case study in Kuala Lumpur city, Malaysia	Murad and Siwar (2007)	Questionnaire (300)	▪ Making recycling programme ▪ Waste separation at source
Assessment of municipal solid waste generation and recyclable materials potential in Kuala Lumpur, Malaysia	Saeed et al. (2009)	Literature review	▪ Waste separation at source
Integrated paper recycling management system in UKM campus	Elfithri et al. (2012)	Case study	▪ Partnership ▪ Policy ▪ Awareness or campaign
Focusing on recycling practice to promote sustainable behaviour	Zain et al. (2012)	Questionnaire (100)	▪ Awareness or campaign ▪ Proximity of recycling facilities ▪ Collection frequency
Survey and analysis of public knowledge, awareness and willingness to pay in Kuala Lumpur, Malaysia- a case study on household WEEE management	Afroz et al. (2013)	Interview and questionnaire (330)	▪ Awareness or campaign ▪ Partnership

Table 3.5, continued

Title of study	Source Year	Methodology	SWM Factor(s)
Composting- closing the loop at home: A household home composting programme in Majlis Bandaraya Petaling Jaya (MBPJ)	Ministry of Housing and Local Government (MHLG). (2010)	-	▪ Partnership ▪ Methods of waste recovery ▪ Awareness or campaign
3R related policies for sustainable waste management in Malaysia	Agamuthu et al. (2011)	Interview, questionnaire (54) and focus group discussion (25)	▪ Awareness ▪ Proximity of recycling facilities ▪ Source separation at source ▪ Making recycling mandatory ▪ Education ▪ Training ▪ Monetary incentives
The profiles of household solid waste recyclers and non-recyclers in Kuala Lumpur, Malaysia	Zen et al. (2014)	Questionnaire (460)	▪ Awareness ▪ Proximity of recycling facilities ▪ Monetary incentives ▪ Education
Overview of household solid waste recycling policy status and challenges in Malaysia	Moh and Abd Manaf (2014)	Literature review	▪ Reporting on recycling performance ▪ Waste separation at source ▪ Awareness ▪ Method of waste recovery- incineration ▪ Partnership ▪ Collection method and frequency ▪ Incentives ▪ Education ▪ Mandatory for recycling ▪ Proximity of recycling facilities
The effects of socio-economic influences on households recycling behaviour in Iskandar Malaysia	Akil et al. (2015)	Questionnaire (600)	▪ Awareness ▪ Recycling infrastructure ▪ Mandate recycling initiative ▪ Waste separation at source

It must be noted that to date, no work has examined whether the relationship between those factors to the strategic impact on higher education institutions SWM, and no attempt has been made to define strategic in response to higher education institutions SWM. Overall, based on the results of the past research seventeen (17) SWM factors that have significant influence on the strategic implication on higher education institution SWM and recycling initiatives have been identified. The following sections will discuss these significant factors in detail on the part of FM discipline in higher education institution SWM. The seventeen factors are as follows:

1. Goal/target setting policy
2. Reporting feedback on recycling performance
3. Waste separation at source
4. Mandate the recycling initiatives
5. Collection frequency
6. Awareness or campaign
7. Incentives or rewards
8. Partnership
9. Marketing recyclable materials
10. Strong support from top management level
11. Education and training programme
12. Environmental Management System (EMS) certification
13. Proximity of recycling facilities
14. Methods of waste recovery
15. Materials Recycling/Recovery Facilities (MRF)
16. Waste disposal and collection contract provision
17. Recycling construction and demolition (C&D) waste from refurbishment work

3.3.1 Goal/Target Setting Policy

A goal-setting policy is deemed as the utmost essential for the accomplishment of SWM and recycling initiatives. The target of materials to be recycled or recovered are set in a goal setting policy. For instance, for the purpose of encouraging integrated waste management and recycling, the UK government launched landfill tax and a stringent restriction on waste going to landfill in 1996 (Pitt, 2005). Additionally, Huang et al. (2014) examined past researches concluded that global experience reveals that government policies can be very effective to minimise wastes.

According to Amutenya et al. (2009), formulating and implementing a policy at the upper management level will set the tone for all staffs to take part. For instance, university management should impose a green rule for staff to follow in order to boosting the recycling rate (Elfithri et al., 2012). Wan et al. (2014) suggested that policymakers should understand the associations between policy measures and current behavioural intentions to further improve the existing policy strategies while addressing public demand.

Ward et al. (2014) suggested that an appropriate recycling programme should be introduced within an established standard operation to change current attitudes and behaviours towards the habit of waste separation at source, sustaining the momentum and continuous participation. Amutenya et al. (2009) in their research on university paper recycling suggested that universities could develop a policy for all the handouts or booklet to be printed on both sides, as a means of minimising paper use. A study by McCaul and Kopp (1982) also noticed that target setting boosted beverage bottle recycling among college students. They also reported that goal-setting (for instance, requesting participants to collect a set of recycling materials quantity over a period of time) boosted recycling among students. Definitely, goal setting policy by setting target for the recycling plays a vital role to increase recycling rate. However, it may require a long-term period of implementation to show results.

3.3.2 Reporting Feedback on Recycling Performance

No SWM or recycling exercise can be successful and environmentally friendly in the long-term without an appropriate monitoring system (Murad & Siwar, 2007). Waste management is a complicated process that requires a great deal of information from diverse sources, such as reliable data pertaining waste generation, influencing factors on waste generation and predictions of waste amounts (Zurbrugg et al., 2011; Lebersorger & Beigl, 2011). Since CSR reporting is a primary communication instrument with stakeholders about an organisation's CSR activities, reporting is an essential communication instrument or channel to confirm better corporate transparency and support better engagement with multiple stakeholders (Golob & Bartlett, 2007). Campos (2014) recommended that improvements in the national information system for solid waste are needed to follow up recycling rates attained by the municipalities and other relevant data.

Many higher education institutions-associated activities and operations require monitoring for major environment effects. This includes workshops and laboratory use, buildings and grounds maintenance as well as materials and the usage of energy (Alshuwaikhat & Abubakar, 2008). Armijo de Vega et al. (2008) mentioned that through the Solid Waste Management Act in USA, waste reduction and recycling programs is necessary for schools, colleges and universities by making a yearly report of all those recycling activities. Additionally, waste reduction in the manufacturing sector can be enhanced if regulatory authorities require registered companies to report on their "Environmental Performance" (MHLG, 2005c).

Moh and Abd Manaf (2014) also emphasised that one of the fundamentals for an effective recycling programme is the accurate data on waste composition and generation. They further stated that the existing circumstance in Malaysia did not have organised documentation of the waste generated and its composition. As recycling only appears as private businesses between waste generators and private companies, there is no thorough data on quantity, composition and characteristics, and waste sources (Moh & Abd Manaf, 2014). Greene and Tonjes (2014) concurred that it is apparent that there are abundant challenges to enhancing waste data in such ways, mainly because many private enterprises publicise data begrudgingly, and enterprises and/or municipalities operationally mix sectors, making data separation awkward. Addressing the lack of accurate solid waste and recycling information in Malaysia, Solid Waste and Public Cleansing Management Cooperation (SWCorp) aims to be the main reference and focal information sharing point when it comes to the solid waste management industry (Moh & Abd Manaf, 2017).

Furthermore, availability of the commercial and institutional SWM performance statistics or data is a critical challenge confronted by developing countries. Recycling initiatives cannot be evaluated and revised for better improvement without statistics as well as s measurement- and performance-driven waste strategy. A study by Dahlen et al. (2009) indicated that on top of inconstant waste stream definitions, there are errors in official waste statistics due to inaccurate measurement at scale and gaps because of the wastes are not collected in proper waste management systems (for instance illegal dumping and home composting). Data used in calculating performance indicators are always inconstant (Simmons et al., 2006; Wen et al., 2009), leading to common confusion regarding the waste assessments (Greene & Tonjes, 2014). A study done by National Solid Waste Management Department (2013) found that the issue arose from the waste collectors or companies in Malaysia; for instance, traders or middlemen do not have appropriate record-keeping system and hence the data given by them were solely based on estimates rather than real figures. Scheinberg and Anschutz (2006) also indicated that waste reports may also overlook data when unlicensed scavengers collect wastes or contract carters divert recyclables themselves to increase returns. Indeed, in Malaysia, only household SWM statistics are recorded and managed, excluding the commercial and industrial sectors. However, the amount of obtainable data on SWM and recycling in Malaysia is considerably restricted, with no organised analysis and regular records countrywide from local authorities, leading to imprecise and out-of-date databases (Hassan et al., 2000; Moh & Abd Manaf, 2014).

Furthermore, the government of Malaysia is reliant on pertinent concessionaires and local authorities for the SWM database particularly when it comes to policy making and executions. However, data and reports from private concessionaires are mostly restricted and outdated, while the waste minimisation and recycling data given by local authorities are much more extensively differed and may be incoherent in terms of precision and consistency as surveys are carried out on an unplanned basis and not standardised. This happened due to the deficiency of policies in advocating waste minimisation despite continuous efforts to boost awareness (Moh & Abd Manaf, 2014).

It is widely known that deficient data quality is a main difficulty for facilities managers proposing an indicator to apply (Tsoulfas & Pappis, 2008) because an indicator can only produce a dependable representation of environmental performance if it is based on trustworthy, quality data (Perotto et al., 2008). However, performance indicators do deliver essential information for facilities managers, waste managers, and policy makers and can assist in assessing internal programmatic progress and performance (Greene & Tonjes, 2014). The measurement of recycling performance is discussed in detail in Section 3.4.

3.3.3 Waste Separation at Source

Various municipalities in developed countries have adopted source separation schemes that require households to separate waste prior to collection (Simmonite, 1990; Dennison et al., 1992). Many of these source separation programmes are anticipated to fulfil the recycling goals set by either national or state legislation (Parkes & Proctor, 1992). In Berlin, Germany, many efforts have been made towards recyclable waste separation and recycling; consequently, commercial waste decreased tenfold from the period 1992-2007 (Zhang et al., 2010).

Waste segregation may provide enhanced opportunities for recycling and reuse with resultant savings in raw materials costs (UNEP, 2004). Hence, several national governments, municipalities, and non-government organisations (NGOs) in developing countries advocate sources separation as a practicable strategy for sustainable waste management (Bolaane, 2006). Zhang et al. (2010) reported high recovery rate were attained through separating the collection of waste for instance paper, glass, light weight packaging and organic waste. A study by Carvalho and Marques (2014) also stated that in Portugal public should be motivated to separate more amounts of municipal solid waste for recycling, expressly paper and glass. Indeed, Agamuthu et al. (2011) has indicated the sole barrier in material recovery practice comes from the fact that Malaysian municipal solid waste is exceedingly commingled. Consequently, waste contains high moisture content, which decreases the value of recyclables materials.

In addition, waste separation can give more scope for recycling and reuse while also minimising treatment costs (UNEP, 2004). However, Zhang et al. (2011) argued that comingled recycling initiatives (where all dry recyclables are put into only one receptacle or bag by students) are deemed to be more convenient than source separation initiatives in terms of time and effort students require for recycling. They are also simpler and safer to operate, generate greater recyclables recovery rates, and are as cost-effective as alternate methods.

In spite of that, separation at the source (integrated recycling and additional recycling) is one of the major reasons behind the high rates of recycling achieved in countries such as Japan and Germany. Enforcement of source separation typically comes after extensive public education programme (MHLG, 2005c). A study by Agamuthu et al. (2011) found that 3Rs stakeholders from various agencies consider that the Malaysian public is prepared for waste separation at source. Public response on source separation should be periodically reviewed and the appropriate time for its implementation then determined, bringing the discussion to the introduction of mandatory source separation under the Act 672 (Moh & Abd Manaf, 2017).

In Malaysia, solid waste separation can be achieved by:

- Pre-process recycling: collect co-mingled waste and separate at centralised facilities.

- Integrated recycling: collect separated recyclables at source at the same time as other wastes.
- Additional recycling: collect separately from drop-off centres, buyback centres or kerbside.

Under SWPCM Act 2007, the distribution of waste bins started from October 2011 to 2014 for the purpose of advocating waste separation at source. Each household is anticipated to handle waste separation at source which would be collected by designated private concessionaires (Moh & Abd Manaf, 2014). Besides, booklets or handouts on waste separation, recovery and recycling were disseminated to households with the purpose of introducing them on handling their solid waste appropriately based on this implementation of source separation (Moh & Abd Manaf, 2014). Starting from June 1st 2016, mandatory source separation was legally implemented in the Federal Territory of Kuala Lumpur, Putrajaya, and states of Peninsular Malaysia except Selangor, Perak, and Pulau Pinang states. Mandatory source separation is expected to enable higher recovery of recyclable materials and extend the operating capacity of landfill sites (Moh & Abd Manaf, 2017).

Bolaane (2006), on the other hand, argued that lack of manpower, transport and financial resources would make it troublesome for municipalities to coordinate source separation schemes. He further stated that problems arise is source-separated recyclables are not collected promptly and the bins are full and began overflowing, the participants stopped source separating their recyclable items. One of the issues in Malaysia is that source separation for plastics is limited because of the relatively lower price compared to paper and metal waste. In spite of the reality that most plastics are recyclable and easy to process, recycling awareness among plastics producers themselves is lacking (Moh & Abd Manaf, 2014). Besides, despite the introduction and implementation of transformative solid waste policy and plan strategies, solid waste management and public cleansing services are not standardised, as not all states in Malaysia utilise a similar implementation of policy and plan strategies, particularly Act 672 and Act 673 (Moh & Abd Manaf, 2017).

A study on university campus by Kelly et al. (2006) discovered that 76% of respondents pointed out that requiring separation of recyclables would not affect their participation in recycling. However, Masson et al.'s (2004) cross-contamination analysis of waste at Massey University (New Zealand) demonstrated that enhanced waste separation performance could escalate the recycling rate. It is imperative to investigate whether source separation could increase the recycling rate and bring about strategic implication in MHEIs SWM.

3.3.4 Mandate the Recycling Initiatives

Mandatory recycling initiatives have not been enforced in Malaysia, but are often strictly enforced in other developed countries. According to MHLG (2005c), waste reduction should employ a combination of mandatory and voluntary instruments. Bor et al. (2004) argued that laws or directorial instructions may be applied as a compulsory instrument to control manufacturer and end-user behaviour to recycle. Punishments or fines enforced on the producer's end-users can improve the recycling endeavours of such producers (Murakami et al., 2015). This is in line with Suttibak and Nitivattananon's (2008) research, which revealed that school directors in Thailand perceive mandatory recycling as a key influential factor in recycling programmes.

Noor et al. (2013) found that Section 102 of the SWPCM Act 2007 forces producers to get back their outcomes or goods after consumed by consumers at their own expenditure, which considered one way to mandate recycling activities. Agamuthu et al. (2011) found that 100% of the stakeholders' focus group discussion in their study agreed on prescribing laws to make recycling compulsory in Malaysia. However, the existing solid waste Acts in Malaysia are not mandatory for the commercial and institutional sector in terms of recycling and reporting feedback on recycling performance.

Under National Strategic Plan (NSP), both solid waste reduction and recovery will be achieved through a combination of mandatory and voluntary instruments (Moh & Abd Manaf, 2017). However, Murad and Siwar (2007) affirmed that recycling programmed not being made mandatory is one of the reasons for households not recycling waste materials. Grazhdani (2015) also suggested that mandate recycling activities by charging households by the amount of their waste generation helps to enhance recycling and reduce the disposal to landfill. In the aspect of law and regulation, it is imperative to make sure that formulating regulations be revised to request that developers supply areas and facilities for recycling purpose, instead of just requiring them to lay aside an area for collecting waste (NSWMD, 2013). While such prerequisite would increase some cost to the whole (high-rise) development, it would boost recycling exercises for those developers (NSWMD, 2013).

In contrast, Folz (2004) claimed that mandatory participation in recycling had no significant outcome on the quality of recycling programme. A survey done throughout the households in Malaysia found that only 20% of the households concurred that there should be punishments in place to implement recycling, while others suggest a willingness to change their attitudes rather than having authorities compel them to do so (NSWMD, 2013). In line with Akil et al.'s survey (2015), a majority of the respondents (70%) will willingly participate without legal sanctions. Prior to 1997, the government of Taiwan set up a recycling policy that mandated recycling rates for declared receptacles for instance iron, paper, plastic and glass (Bor et al., 2004). Bor et al. (2004) further explained that manufacturers, importers, and merchants were responsible to recycle what they manufactured, imported, or traded. They were required to achieve the imposed recycling rate; otherwise, they could be fined or even instructed to close their businesses. Since this policy simply disregarded the market mechanism of recycling behaviour, solid waste recycling rates were far below envisaged (Bor et al., 2004). However, a study by Chen et al. (2009) disclosed that mandated recycling legislation has contributed significantly to waste collection and environmental improvements.

Moh and Abd Manaf (2014) strongly recommended that regulatory compliance is necessity for solid waste recycling. Schemes for instance enforcing charges or fees and compulsory for recycling should be offered critical consideration for execution. Moh and Abd Manaf (2014) further advocated that an additional fee should be levied on the quantity of wastes disposal to landfills to make landfill more expensive besides aiding to pay for recycling endeavour or enforcing fines for those do not recycle. In Malaysia, lack of mandatory recycling means that the recycling rates is far behind those achieved in developed countries; although the implementation of mandatory source separation at household level under Act 672 highlights separation of three recyclable waste categories, which are plastic, paper and "others" (Moh & Abd Manaf, 2017). Therefore, it is important to investigate whether mandatory of recycling would have strategic implication towards MHEIs recycling programmes.

3.3.5 Collection Frequency

Reliable recycling services should be given to furnish convenience because it is an indispensable prerequisite to recycling (Moh & Abd Manaf, 2014). According to Folz (2004), recycling convenience was measured by collection frequency, day schedule of collection, and collection point. Folz (2004) further stated that the most convenient recycling service are those that provide weekly, kerbside recyclables collection on the same day with the solid wastes collection and allow citizens to mix materials instead of separating those items (for instance glass, newspapers, aluminium, and plastics) into different bins. In addition, additional recycling drop-off centres at convenient and public locations and areas should be offered with effectual and proficient recycling collection services (Moh & Abd Manaf, 2014).

A study by Perrin and Barton (2001) revealed that households in England prefer the collection be done frequently such as fortnightly to weekly collection. A survey's result showed that the amount of recyclables able to be collected was the second most essential factor that may have an effect on recycling activities in Malaysia (NSWMD, 2013). Zain et al. (2012) in their study also commented that many suggested additional operation hours for Recycling Centre should be provided for them to send the recyclable materials.

In Germany, producers may enclose the "Green Dot" label to their product which shows to the consumer that the producer of the merchandise is a participant of Dual System Deutschland (DSD) programme, and that instead of taking back the packaging to the producer or supplier the packaging should be collected, separated, and recycled via DSD system (Zhang et al., 2010). Furthermore in Brazil, Campos (2014) stressed that the high recycling rates are attained by the strong exploitation of the labour of hundreds of thousands of collectors of recycling materials.

The waste collection approaches in Singapore are divided into direct collection and indirect collection approach (Zhang et al., 2010; Bai & Sutanto, 2002). The direct collection approach contains collecting waste straight from particular households and shop lots. Yet, this method is very labour intensive, exhausting and time consuming. On the other hand, two indirect collection approaches have been employed with the first is the one adopted in used high-rise flat blocks where wastes are gathered in large quantities in bulk receptacles on the flats' basement. The second indirect collection system is a centralised refuse-chute (CRC) system that has been commenced and executed in flats since 1989. This system permits housing refuse to be discharged straight from particular flats through a general discharge chute to the central refuse receptacle, and also permits a small vehicle to go directly up to the central refuse chute of every apartment block and convey the central refuse receptacle mechanically from the central refuse chute to the waste collection lorry (Bai & Sutanto, 2002). Additionally, the Housing Development Board (HDB) provides centralised recycling repository services to complement the door-to-door collection of recyclables (Zhang et al., 2010).

As in Brazil, the selective collection for municipal solid waste is functioned based on a door-to-door schedule or implementing Small Volume Delivery Stations (PEVs) that accept not only dry solid waste recycling but also small amounts of construction waste, bulky waste and waste ensuing from pruning of trees, while Local Voluntary Delivery (LEVs) are always set up in public buildings, schools, supermarkets, parks, and shopping centres to get dry recyclable solid wastes (Campos, 2014). Door-to-door selective collection schemes in Brazil normally occur in central commercial areas and are almost randomly performed by autonomous waste pickers (Campos, 2014). The waste pickers recover waste, turning the waste into raw materials for industry, and provide waste management public services that should be given by local government (Campos, 2014 quoted from Abreu, 2009).

A conventional SWM technique in developing countries exposes a range of issues which includes small collection coverage and improper collection services, coarse open dumping and burning without the control of air and water pollution, the breeding of flies and vermin as well as the managing and restriction of unofficial waste collecting or scavenging activities (Ogawa, 2000; Schoot Uiterkamp et al., 2011). In Malaysia, a due diligence exercise conducted by Alam Flora in 1996 demonstrated that many local authorities failed to follow the collection frequency proposed, mainly because of the inefficient collection route organisation and frequent breakdown of vehicles (MHLG, 2005c). Basically, recycling players in Malaysia consist of two types, which the first involved the street picker and scavenger while the second took part in drop-off centre, buy back centre, middle man and recyclers (as demonstrated detailed in Table 3.6).

Table 3.6: Categories of recycling players (National Solid Waste Management Department, 2013)

Recycling Player 1	Recycling Player 2
Door-to-door collector Street picking Waste collection labours Scavengers	Drop off centre Middle man Junk shop who deals recyclables Buy back centres Recycler (purchasers of recyclable materials or end user)

Tarmudi et al. (2012) and EPSM (1979) stressed on the issues involved in the waste collection system, where the three main inefficiencies in SWM were recognised which are inappropriate disposal method, inadequate coverage of the collection systems and ineffective collection manners as well. More efforts and investigation need to be done in this area to find out the strategies and methods to solve these issues.

3.3.6 Awareness or Campaign

There is recognition that in order to achieve waste reduction and recycling, it is vital to develop public awareness on SWM (Carvalho & Marques, 2014). Each year about 60% of the allocation (around RM70 million or US$18 million) is used in raising awareness among Malaysians (Agamuthu et al., 2011). In a study done by National Solid Waste Management Department revealed that in general, both urban and rural respondents from residential rated increasing awareness method on recycling as the utmost successful ways to further advocate waste reduction and recycling (NSWMD, 2013).

Public awareness efforts are needed to be broadened to cover their understanding on the costs incurred in SWM and the facilities required for provision of the services (MHLG, 2005b). It is also essential to know that what the consequences are if we refuse to recycle. Lots of print and electronic media attempt to build awareness in the expectation that recycling initiatives would get widespread support. However, these endeavours, to some extent, have be defeated to educate and build awareness and some despise those efforts, thinking that the recycling issues were unimportant (Zain et al., 2012). Failure to interpret awareness into exercising recycling could restrict the accomplishment of public awareness initiatives planned to facilitate recycling (Bolaane, 2006). In other words, no programme will be effective unless the public is actively engaged, at the very least in recycling programmes, and this remains a key priority for change (MHLG, 2005b). Therefore, the effectiveness and environmental friendliness of the recycling programme should be tested regularly, such as promoting the consumer campaigns to motivate citizens to work together in separating waste and purchasing recycled products.

The importance of personal attitude and behaviour for the success of recycling is highlighted by few scholars. Zain et al. (2012) claimed that attitude and behaviour indeed is the major cause of individual not practicing recycling. Price et al. (2011) stressed that to deliver environmental goals and to survive in a sustainable environment not only technological innovation but also a change in behaviour of the consumers is imperative. Some authors recommended that one of the methods of fostering long-term reuse and recycling behaviour is through information spreading methods (Bolaane, 2006; Shackelford, 2006) for instance awareness increasing campaigns (Grodzinska-Jurczak et al., 2006). Generally, awareness of recycling initiatives and the feeling about such initiatives could affect a person to participate or not to participate (Bolaane, 2006).

In the aspect of commercial sector, while there have been campaigns to motivate the public to recycle their waste, there is no durable structured plan to reuse, recycle or recover the resources from products which the consumers have intention to discard (MHLG, 2005b). However, Agamuthu et al. (2011) through the stakeholders' focus group discussion found that the entire stakeholders agreed that awareness is important for recycling.

In the aspect of WEEE, recycling operations in more economically developed countries are conducted officially and launched with a high level of awareness of environmental protection. Afroz et al. (2013) suggested that the current initiatives can be conducted by the government in Malaysia by organising seminars, campaigns, and workshops to raise the awareness level of the households and to motivate them to recycle their WEEE.

Barr et al. (2003) stressed that communities are more willing to recycle if they were concerned about the waste issue. In order for any new scheme or system to be known and undertaken in the context of an organisation, the challenge is to build a mechanism of awareness (Hooi et al., 2012). Various recycling programmes such as spreading information on recycling facilities and programmes (Zen et al., 2014), workshops, seminars, talks, exhibition and campaigns are considered ways for spreading the awareness on recycling initiatives. For instance, the "Awareness and Recycling Management" workshop had been organised around UKM campus (Elfithri et al., 2012). The participants in a household home composting programme suggested that authorities should think of awareness programme and more publicity to get the people involved (NSWMD, 2012). For instance, a composting programme could be promoted during relevant events such as Organic Day or World Environment Day. However, according to MHLG (2005b), public response has been disappointing on the recycling programme - the National Recycling Programme commenced by the MHLG. Akil et al. (2015) concurred that there has been a failure to motivate the community to respond positively, although various successive campaigns have been carried out to instil awareness among Malaysians. This reflects that other initiatives are required to be conducted simultaneously to obtain public participation.

Thomas (2001) further stated that understanding what and how well people know how to involve in strategies and what they select to do about involves precious data for local authorities in distinguishing where and how to aim for public information campaigns and effectually increasing quality of participation. This increases the amount of wastes diverted in a cost-effective manner. Experience from Milton Keynes, UK study (Thomas, 2001) demonstrated that expanding the scope of recyclables collected by strategies without attaining a good level of comprehension among participants of what they being requested to do will not bring about better diversion. Besides, a household recycling study by Barr et al. (2003) showed that in some cases the residents patently placed the initiative and obligation onto the local authority for 'disseminating' information 'to' them. Fundamentally, there was no concept of responsibility on behalf of the residents to 'find' the information and thus not necessarily a willingness to recycle if such information was obtained.

Public awareness of recycling is comparative high throughout New Zealand (Kelly et al., 2006); however, there is in contrary phenomenon in Malaysia. Public awareness for recycling in Malaysia is in its infancy (MHLG, 2005b) and environmental awareness is still low compared to other developed countries (MHLG, 2005a; Desa et al., 2012; Afroz et al., 2013). This lack of awareness was as a result of a lack of publicity for the recycling initiatives (Zain et al., 2012). No broader publicity of the schemes that could have aroused wider public interest have led to lower participation rates (Bolaane, 2006). Continual development of awareness and information programmes directed to consumers is critical to the success of waste reduction (MHLG, 2005c). Kaplowitz et al. (2009) and Zhang et al. (2011) asserted the operation of recycling strategies must be complemented by appropriate advertising and promotion. Updating potential participants about what they should do and the advantages of recycling has been commonly agreed to be crucial to maintaining recycling programme participation (Thomas, 2001; Folz, 1999; Dahle & Neumayer, 2001).

In order to improve participants' comprehension of the recycling system requirements, by promotion and education and encouraging them to enhance how well they segregate their recyclable materials and their understanding of which materials are accepted by the system (Thomas, 2001). Numerous methods (media or modes) have been employed in communicating recycling programme information to individuals. These communication modes embrace radio commercials/ public service announcements, bulletins, television advertisements, stickers on bins and individual contacts. Some of these modes can be applied in the university setting (Kaplowitz et al., 2009; Dahle & Neumayer, 2001). Evident recycling advertisement would encourage some to recycle frequently (Barr et al., 2003). Dahle and Neumayer (2001) reported that one of the most imperative methods to be undertaken is increasing environmental awareness within campus communities. They highlighted the University of Bath and John Moores University in UK, which created guidance booklet and website as a media for conveying information about environmental advances and areas that require enhancement to the higher education institution as well as disposal routes for waste and its classifications. Efficient spreading of recycling information on what, where, and how to recycle in layman's terms established a platform to encourage and educate the public to be concerned about basic recycling practices (Moh & Abd Manaf, 2014).

Thomas (2001) indicated that recyclers were mostly found to be more concerned about advertising and more well-informed about recycling, with non-recyclers more aware of returns to recycle and accessibility. In New Zealand, a study on the concourse area recycling scheme at Massey University (Kelly et al., 2006) revealed that the students have the higher awareness of recycling compare to the staff might be attribute to the situation that they frequented the concourse area more frequent than did staff.

The National Strategic Plan Report 2005 demonstrates that public awareness on SWM need to be boosted to obtain public support for waste minimisation and recycling efforts; and to understand the need for SWM facilities that are environmentally sound (MHLG, 2005b). November 11th was designated as National Recycling Day in Malaysia in 2001 in an effort to increase public awareness and since then it has become a yearly affair (Moh & Abd Manaf, 2014). A statistical study on investigation of factors that influence recycling programmes in a Malaysia middle class municipality in Subang Jaya, Selangor, found that awareness concept should be given much consideration (Chenayah et al., 2007). Moh and Abd Manaf (2014) found that irrespective of the category of recyclable materials, awareness towards waste recycling is inferior and that most people are not capable to translate their interests to act upon the matter. Various surveys have indicated the most Malaysians are concerned about the importance of 3Rs (reduce, reuse and recycle), however, environmental drives alone were ineffective (Agamuthu et al., 2011) and very few practise recycling for various reasons (Mutang & Haron, 2012). Moh & Abd Manaf (2017) agreed that despite ongoing efforts, there are still lack of public participation and commitment, lack of a sense of civic responsibility in managing solid waste.

3.3.7 Incentives or Rewards

Incentives may be a channel of promoting recycling behavioural change, this can count for two forms when considering advocating pro-environmental behaviours, either rewarding participation or penalising non-participation (Chaplin & Wyton, 2014). Chaplin and Wyton (2007) highlighted there can be financial rewards or others, for instance gaining social approval; it is disputed that it is better to reward positive behaviour than punish negative behaviour, punishing the negative behaviour does not necessarily advocate an alternative positive behaviour. Grazhdani (2015) advocated that pricing system via pay-as-you-throw policy could offer a reward for community to increase recycling so as to minimise the waste amount for disposal. Bolaane (2006) in his study found that the high participation rate could be an effect of the monetary return. He further explained that the common attitude of households was that they would be more tended to conduct recycling if they could gain monetarily from waste sorting and giving back the materials. Hence, it can be said that reward positive behaviour by giving incentives indeed can accelerate the recycling performance.

The provision of monetary incentives comprising interest, loans, and compensatory merchandise for recycling members, low investment costs and transportation costs extensively improves recycling implementation (Suttibak & Nitivattananon, 2008). Agamuthu et al. (2007) also recommended that monetary incentives method to stimulate recycling programmes at household level. Ho (2002) stated that a reward programme such as the deposit reimbursement with the return of drink bottles and cans can be adopted together with the introduction of extended producer responsibility (EPR). For an instance in the USA, all municipalities in the state subsumed under the New York Bottle Bill release a deposit when applicable bottles are recycled. As a result, 73% of targeted cans and bottles that are traded per annum are recovered via this deposit law (Greene & Tonjes, 2014).

Offering incentives may stabilise and then boost recycling programmes in Malaysia as it reinforces the local market, recyclers and producers (MHLG, 2006). In line with the government's effort to transform the public mind towards a sense of responsibility for clean environment, the concept of 'Trash to Treasure' has been introduced, where proper waste separation benefits the recyclers in the forms of monetary incentives or resources, Solid Waste and Public Cleansing Management Cooperation (SWCorp) aims to change existing public perception towards waste (SWCorp, 2014). Monetary incentives such as deposit refund and buy-back schemes will be the most attractive approaches of collecting recyclables. Financial incentives such as cash back schemes for the consumers could create the waste reduction (MHLG, 2005c). Nonetheless, stakeholders have mentioned that 3Rs programme economic incentives, for instance tax discounts should be applied to industries executing a 3R and take back system (Agamuthu et al., 2011). Incentives and rewards should be offered to frequently complying recycling companies and developers (NSWMD, 2013). Amutenya et al. (2009) further suggested that within the corporate or enterprise environment, monetary incentives are a potentially essential motivation. Moh and Abd Manaf (2014) also recommended monetary rewards such as incentives and rebates to commence new recyclers among public and community and until they are capable to continue the recycling habit, the function of financial rewards should be less relied on.

In a study on paper recycling, Amutenya et al. (2009) recommended that universities could make a yearly function to reward the department that spend the least quantity of paper per capita along with the greatest recycling. They also advocated that recycling could be advocated for via incentives such rewarding the department which minimising the paper use and recycle the most. Another study by Bolaane (2006) stated that awareness of the necessity for recycling can be increased by direct rewards such as money targeted to the participants.

As aforementioned, a few scholars have suggested giving some forms of incentive to recycle, such as awards or prizes (Kelly et al., 2006) to increase the participation rate. However, Iyer and Kashyap (2007) warned that while incentives such as rewards have predictably brought about better participation in recycling programs, the behaviours are not continued once the incentive is removed. Moh and Abd Manaf (2014) also agreed the voluntary attempt of people to execute recycling is vital to attain greater recycling rates without depending on financial incentives as not all recyclable items have sufficient economic value according to the present market mechanism. This view concurred with Berglund (2006), who mentioned that moral intention and non-economic value are more vital motivations to recycle than financial drives. It is considered that in the long term, there should be a move towards a voluntary approach without an emphasis on economic benefits (MHLGe, 2005c). Apparently, some scholars have advocated monetary incentives or rewards, but some not. Hence, before incentives schemes are considered, it is crucial to make sure that the waste collection scheme is operating well and effective.

3.3.8 Partnership

Needless to say, a programme will succeeded if any organisation comes to join, support and actively participate in it. Stakeholder involvement is a success that appeared from the Rio Summit and has obtained momentum over the past 20-plus years (UN, 2010). Yahaya and Larsen (2008) also argued that legislation has been prepared, institutions have been established, and goals have been formulated but the most complex part is the implementation of the Act with continuous commitment from the stakeholders to ensure effective and efficient solid waste management. Stakeholders can provide organisations with a range of resources they need to execute their business such as capital, materials, staffs as well as customers (Deegan, 2002).

Generally, partnership among various stakeholders which include the government, private sectors, non-government agencies, local communities and others is necessary while implementing Local Agenda 21 programmes (MHLG, 2010). Troschinetz and Mihelcic (2009) also asserted that recycling programmes embarked by the government will be unsuccessful without the participation of all stakeholders. Besides, skills and knowledge required among stakeholders responsible for planning, design, construction, and management of solid waste and its facilities and services which were still lacking at this junction (Moh & Abd Manaf, 2017). These stakeholders are the official private sector, communities, schools, NGOs and international organisations (Suttibak & Nitivattananon, 2008). Moh and Abd Manaf (2014) agreed that deficiency of collaboration and diverse operating basis minimise the chances to improve recyclables collection effectiveness and potential for recycling would not be functioning at its maximum probability. Local authorities should encourage collaboration among stakeholders in the development of sustainable recycling programmes (Troschinetz & Mihelcic, 2009). The issue in Malaysia is that waste generators, waste pickers, traders, NGOs, collection service providers, recycling centre operations and end-users mention that they have restricted information and linkage with each other (Moh & Abd Manaf, 2014). In this regards, appropriate coordination and linkage is requisite to ensure the effectiveness of each responsibility on SWM.

As a commercial service, FM is related to the establishment of efficient partnerships to transfer quality services (Alexander, 2003). Pitt (2005) pointed out that shopping centre managers can contribute directly by enhancing centralised chances for the re-use and recycling of waste generated by the leaseholders. Schoot Uiterkamp et al. (2011) indicated that a joint endeavour of public and private sectors in developing countries in facilitating integrated recycling can be a silver bullet in the protection of the environment. Read (1999a) also believed sustainable development can be transferred via collaboration among local authorities, enterprises, community parties, and the public. In this regards, Moh and Abd Manaf (2014) encouraged effective linkage among government, local municipalities, recycling centre operators, collection service providers, merchant, non-governmental organisations and other associated stakeholders. This would lead to less restraint on the integrated planning and development of SWM and recycling services.

3.3.8.1 Internal Partnership

Internal partnership among departments/units/faculties is encouraged and important in a higher education institution. Zhang et al. (2011) advocated that collaboration among various departments was essential to the scheme. The Campus Services Manager and the Environment Manager should take accountability for cooperating with the campus community to integrating waste minimisation, reuse, recycling and sustainable practices into all aspects of institution business.

Envirowise (2002a) studied shopping centre recycling and revealed that sustainable waste management needs communication and collaboration with retail units and suppliers. Success relies on the involvement of the shopping centre's leaseholders and their distributors and suppliers. He further explained that shopping centre managers can donate directly by enhancing centralised chances for reuse and recycling of waste generated by the leaseholders. They are in an essential position to encourage retailers to adopted best practice. Similar to higher education institutions, the facilities managers have to centralise the chances for the reuse and recycling of waste generated by the leaseholders, residential colleges, faculties as well as the administrative departments.

3.3.8.2 External Partnership

Private public partnership has appeared as an alternative to encourage and boost the SWM and recycling service delivery. Indeed, private public partnership is one of the approaches for the efforts to waste minimisation and removal at source via goods and process innovations as well as the development of green technologies for industry in Singapore (Lang, 2007). Murakami et al. (2015) pointed out that partnership provides employment and income for many disadvantaged communities. A company provides the support and equipment necessary to perform the selective collection through a public-private partnership. In addition to municipal entities, these partnerships have also been established with waste picker cooperatives in certain localities (Murakami et al., 2015).

A previous study in Thailand (Suttibak & Nitivattananon, 2008) indicated the involvement of different recycling development partners for instance government authorities, NGOs, private sectors, community leaders, school directors, and international organisations may contribute to higher recycling performance. For instance, the collaboration with NGOs in terms of technical support (such as MRF) and advocating public to sort their compostable waste impose the great influence on recycling performance (Suttibak & Nitivattananon, 2008). Dahle and Neumayer (2001) also suggested that higher education institutions could ask for collaboration with their local communities for waste storing and transport. Another example of recycling partnership shown in a study by of Elfithri et al. (2012) is the partnership between Alam Flora Sdn Bhd and Universiti Kebangsaan Malaysia (UKM) in paper recycling programmes.

Besides, extended producer responsibilities (EPR) prompt the partnership between the producers and industries. The voluntary initiatives of EPR in Malaysia are restricted to some multinational businesses who have begun EPR-associated activities for instance take back programmes, which are normally part of their worldwide corporate environmental policies. Such companies comprise: Motorola, Nokia, Dell, Apple, and HP who have executed voluntary recycling and take-back program which shows practical instances of EPR initiatives to the local Malaysian manufacturers and industries (Afroz et al., 2013). For instance, Dell’s branch in Malaysia introduces an online recycling facility and collect all branches of computer and computer peripherals for free recycling. However, in order to execute the government-driven (mandated) and non-government driven (voluntary) EPR programmes, there is imperative to call for intense collaboration between government and non-government stakeholders (Afroz et al., 2013), which is also needed in higher education institutions recycling programmes.

3.3.9 Marketing Recyclable Materials

The future of the recycling industry is very much dependent on market forces (MHLG, 2005c). Market pressures encompass customer demand for sustainable products (Walker & Preuss, 2008; Walker et al., 2015; Zhu & Sarkis, 2006). Absence of a recycling market is one of the limitations that industry and government confront which obstructs the effort to sustainable development; therefore, expansion of the local market should be a precedence (Pitt, 2005). According to Widmer et al. (2005), optimising the value added of the used products must be advocated to support securing economic efficiency and sustainability.

A study by Bor et al. (2004) described a market-incentive scheme to recycle waste-packing receptacles in Taiwan, which was effective and presented a solving method for SWM in Taiwan. Market incentives offer an instrument that can lead public and private agents towards a more resource-saving and successful scheme for SWM, and also offers rational solution to minimise waste in a nation with restricted resources (Bor et al., 2004).

Regulations and policies are essential tools in creating recycling market in a country. A study by Chen et al. (2009) revealed that in a response to going up interests over building a zero-waste society, developed policies and regulations are introduced by the Taiwanese government to industrialise whole recycling industry and establish a market opportunity for secondary items or components.

While much effort, cost and time are required to attain the maximum recycling rate, it would also be influenced by market demand. The extent to which a specific item to be recycled relies on the presence of local and domestic markets; the prerequisite for secondary raw materials, original materials prices and the global business in secondary raw materials (Wilson et al., 2006). As stressed by Chen et al. (2009), the overwhelming need for recycled materials plays a crucial role in a prospering recycling market. The market also depends on the quality of materials, the quantity recoverable, the cost of raw materials and the industries' capacity (MHLG, 2005c). Based on the National Solid Waste Management Department (2013), recycling programmes conducted by recyclers, traders, middlemen and buy back centres are more market driven compared with the drop off centres. Hence, unsteady market demand and recyclables price has led the group to be suspicious to expand or continue their recycling programme or business.

Bor et al. (2004) argued that local government parties play a crucial role in continuing fairness in recycling markets.

Fluctuating market prices have a significant effect on the demand and supply of recyclables and hence has a direct impact on the recycling programme (MHLG, 2005c). In Malaysia, the most significant factor affecting the traders, middleman and buy back centres in recycling activities is an unsteady market demand and therefore, price uncertainty (NSWMD, 2013). According to MHLG (2005c), demand for paper and cardboard for recycling is high throughout Malaysia because of escalating prices for raw wood pulp. Additionally, aluminium cans receive the highest price and are in demand in Malaysia. This is because the cost required to produce cans from recycled aluminium is less than 5% of the cost of manufacturing from raw materials. Pitt (2005) argued that while cardboard is wisely a high value material, it is ignored by collection systems due to its heavy size; a large quantity is need to make collection cost-effectively viable. In contrast, Chen et al. (2009) claimed that if the new products are more recyclable, the government could offer the processing factories lower operating costs and greater value added in quality and price, leading to higher financial returns.

However, Dahle and Neumayer (2001) argued that a market for sustainable commodities can be created and encouraged by demanding environmentally friendly products and technologies. Bor et al. (2004) anticipated that by establishing new recycling markets, thousands of jobs will be generated while practising sustainable use of natural resources. Based on the above discussion, the recyclables materials market is vitally important for the success of the recycling initiatives. Yet more investigation needed to be conducted to generalise this factor in relation to the strategic implication on higher education institution waste management and recycling initiatives.

3.3.10 Strong Support from Top Management Level

The strategic level always comes from superior management in an organisation, and become the fundamental notion of the entire execution of recycling activities. Keramitsoglou et al. (2013) claimed that recycling activity has been conventionally enforced top-down by the municipal authorities without public involvement in decision-making on implementation. However, the notion and understanding of the strategies not only require to be understood and employed by the superior management, but have to be disseminated to the whole organisation's part (Hooi et al., 2012). Meanwhile, the implementation of notions established at the strategic level will reach the operational level which all needed items for the accomplishment of recycling initiatives will be fixed in this level (Hooi et al., 2012).

Murakami et al. (2015) identified the managerial and organisational-related barriers which comprise the absence of a strong top management support (Moors et al., 2005), refuse to change (Stone, 2000; Calia et al., 2009; Neto & Jabbour, 2010), and deficiency of organisational capabilities such as incompetent superior management governance, lack of staff participation, weak communication system and operational inertia (Murillo-Luna et al., 2011). Pitt (2005) emphasised that lack of leadership, dedication from senior management, awareness and waste management skills are some of the causes behind the commercial sector being slow to initiate waste minimisation schemes.

Senior management leadership or top management commitment for strategic CSR is important. One of the utmost essential factors is the influence of leaders within the organisation. It is because their behaviour which acts as a model and message-sender to all (Lantos, 2001).

3.3.11 Education and Training Programme

Educating the public on recycling has been found to improve the recycling rate (Grazhdani, 2015). In spite of directly influencing awareness, recycling education attempts are probable to boost the growth of social and moral norms towards desirability of recycling (Grazhdani, 2015). In spite of that, Suttibak and Nitivattananon (2008) studied the recycling performance among the municipalities in Thailand and found that training is mandatory for professional and directorial staff in a range of areas such as the utilisation of specialised equipment, operation and maintenance, and monitoring and assessment. Politicians always commit low precedence to solid waste compared to other municipal events (Moghadam et al., 2009) with the end result of restricted trained and skilful workforces in the municipalities (Sharholy et al., 2008).

Stakeholders either from government or private sectors perceive that staff involved in recycling activities require technical training (Agamthu et al., 2011). Campos (2014) stressed on the staff training and management on Material Recycling Facilities (MRF) operation, which must rely on qualified professionals. Moh and Abd Manaf (2014) pointed out that shortage of proficiency in aspects of understanding and technical complicates the endeavours in dealing with the issue within the local municipality and its area of dominion and any strategies in tackling the problem would be less effectual and not successful. NSWMD (2013) also recommended providing training to authorised recyclers on accessible technologies. International experiences in the field of recycling and environmental is necessary. Hernandez et al. (1999) conversely stated that those from informal recycling networks should be trained and incorporated into the formal system.

Likewise, stakeholders strongly believe that education portrays a vital role in making recycling a success (Agamuthu et al., 2011). Dahle and Neumayer (2001) also claimed that the barrier was ascertained to be the deficiency of environmental education within the campus community. Hence, institutions should provide specialised training and continuing education to professionals in the field of SWM (MHLG, 2005b).

Zhang et al. (2010) asserted that understanding about the details of recycling is more tightly related to recycling behaviour than common environmental knowledge. More effective endeavours towards educating the community about adequate solid waste recycling etiquette is indispensable to look the progress in the recycling rate (Ho, 2002) as this be shortage of information is a main obstacle to recycling programme (McDonald & Oates, 2003). Past research has shown that there was recycling knowledge gap among the parts of the university communities on where to recycle, what to recycle and how to recycle (Kelly et al., 2006; McDonald & Oates, 2003; Kaplowitz et al., 2009;). Likewise, empirical evidence suggests that personal participation in recycling programmes is associated with understanding of what, where and how to recycle as well as knowledge of how recycling profits the environment (Tuckeer, 1999; Folz, 1999; Barr et al., 2003; Zen et al., 2014). It is suggested that educational programmes increase not only understanding of the subject area but also the potential impact an individual can have by adjusting their own behaviours (Chaplin & Wyton, 2014).

3.3.11.1 Introduce Recycling in Curriculum

Teaching environmental topics as segment of courses can assure the students pay attention and learn, as environmental issues are “tied up” to subjects they have taken to study (Dahle & Neumayer, 2001). Hopkinson et al. (2008) identified a "campus curriculum", where campus environmental management is looked as an educational tool, hence an integrated approach to learning combining formal and informal emerges.

Alshuwaikhat and Abubakar (2008) suggested making sustainability a teaching tool by instilling sustainability into both undergraduate and graduate courses and curriculum for areas of the built environment, science and technology, humanities and management, and so on. For instance, Pike et al. (2003) highlighted Francis Marion University in US, introduced a recycling course in an effort to fulfil the students' targets of raising campus awareness about sustainability and recycling. Additionally, while there are prevalent and generally accepted practices of using extra wrapping and significant quantities of plastic bags in Malaysia, progressive education should enable a change in retail practice and consumer expectations of less wasteful practices (MHLG, 2005c).

The literature reveals that knowledge and education efforts have an important position in disseminating knowledge about recycling, recycling behaviour and attitudes (Iyer & Kashyap, 2007; Barr et al., 2003). Campos (2014) supported the education encouraging reduction in waste generation and separation at source. Zain et al. (2012) indicated that various recognised advantages of an education programme for the higher education institutional community would assist people to recognise what waste can be recycled and how they can segregate recyclable items from disposable waste. Indeed, the formal education system provides an opportunity to instil in the younger generation understanding of the issues and an appreciation that it is the responsibility of everyone to contribute to waste minimisation via reduce, reuse, and recovery. It is recognised that once students understand the issues and what can be done to address them, they can serve as "drivers for change" (MHLG, 2005b).

3.3.12 Environmental Management System (EMS) Certification

As with any organisation, an environmental management system (EMS) is an instrument to attain the environmental targets of the organisation. An EMS standard is based upon the circular "Plan-do-check-act" model for constant enhancement (MacDonald, 2005) and is expressed as "part of the whole management system that contains organisational structure, planning activities, duties, practices, procedures, processes and resources for formulating, executing and maintaining environment policy" (Dalhammar, 2000; Alshuwaikhat & Abubakar, 2008). Price et al. (2011) claimed that the FM department should be well placed to attain ISO 14001 for their own activities as FM department portrayed a key role in enforcing environmental management policies.

In the light of Barnes and Jerman (2002), EMS can be an effective instrument for educational institutions to successfully administer different environmental matters and enhance campus sustainability. Applying EMS stipulates an effectual guidance for organisations such as universities and colleges to concurrently establish, develop and review their operations and exercises in more environmentally and socially responsible ways (Piper, 2002). EMS performance and certification do assist universities and colleges to incorporate their environmental, safety and health management structures and in several cases their quality management systems. Its implementation influences everyone directly or indirectly by virtue of its common targets, for instance perennial environmental enhancement, improved recycling, and waste minimisation (Morrow & Rondinelli, 2002).

ISO 14001 certification is voluntary. Watson and Emery (2004) stated that ISO 14001 can be employed as a means to manage and execute environmental and legal requirements. However, companies normally use apply ISO 14001-based EMS as a platform to develop their management structures and to decrease their adverse effect on the environment (Sambasivan & Fei, 2008). Alshuwaikhat and Abubakar (2008) mentioned that ISO 14001 is widely employed by lots of universities in Europe and USA to achieve sustainability. However, Alshuwaikhat and Abubakar (2008) in their study found out the ISO 14001 does not address strategic planning for campus sustainability. Babakri et al. (2004) also argued that even though ISO 14001 certification has been required by customers and stakeholders, companies still have no well-defined knowledge of the advantages of implementing ISO 14001. There are five core elements of ISO 14001: Environmental Policy, Planning, Implementation and Operation, Checking and Corrective Action, and Management Review (Babakri et al., 2004; Halila & Tell, 2012).

Previously, manufacturers in Malaysia played an unimportant role in integrated waste management exercises, as there are no evidently defined policies or incentives for waste minimisation, recycling of goods, and recovery and reuse of items. However, with the stress for companies to meet requirements of ISO 14000, specifically those engaged in export of manufactured goods, additional attention has been paid to such matters in recent years (MHLG, 2005b). In addition, small suppliers are assisted and guided by their clients to implement waste reduction measures. This has been proven to have been successful in connection with implementation of ISO 14001, especially when results indicate not only savings in time, human resource and materials, but also new products for sale (MHLG, 2005c).

However, Parry (2000) stated that enhancement in recycling is one of the more measurable business advantages of ISO 14001 and several companies have attained cost savings correlated with minimising waste. Several case studies discussed the positive influence of ISO 14001 certification on recycling performance. For instance, Rondinelli and Vestage (2000) in their study of an internal manufacturing firm revealed that ISO 14001 certification directed personnel towards materials recycling and fostered their dedication to recycling. In addition, during the period following the establishment of ISO 14001, the waste quantity that had to be delivered to landfills was decreased approximately 2600 tons within 3 years and the waste cost of generation per ton of aluminium dropped around $1.83 within 3 years as well. A survey conducted by Mohammed (2000) in Japan revealed that about 69% out of 106 ISO 14001 certified firms cut down on paper purchases because of the implementation of ISO 14001 and beyond 60% of the firms have been given special consideration to the reuse and recycling of their packing and final goods. Findings of Babakri et al.'s (2004) study indicated that recycling performance improvement due to ISO 14001 certification was considerably lower for bigger firms than it was for smaller ones. A study on small medium enterprises (SMEs) by Halila and Tell (2012) found that five firms did not pursue the ISO 14001 certification because of the prohibitive cost of certification, dissatisfaction quality of the consultants' advice, and insufficient motivation from customers or other essential stakeholders. While scholars have advocated the EMS in their studies, the implementation of the EMS in MHEIs' organisation is still questionable.

3.3.13 Proximity of Recycling Facilities

Accessibility may be classified into a number of elements including location suitability, material acceptability, and perceived distance (Barr et al., 2003). Raising the quantity of recycling logistics will boost convenience by eradicating the distance difficulty, thus possibly increase recycling activities (Clarke & Maantay, 2006; Chenayah et al., 2007). Effective recycling initiatives require a prudently deliberated, accessible and convenient-to-use infrastructure reinforced by a consistently utilised, tailored communication campaign (Zhang et al., 2011).

According to a study carried out by the MHLG, the actual practice in 3Rs programme is only 80%, although there is 100% awareness among the public. Chaplin and Wyton (2014) in their study found that the lack of recycling facilities is a major barrier that students perceive to be preventing them from following sustainable living practices. The main cause for this phenomenon is deficiency of facilities, which includes collection timetable or unsuitability of facilities location. Nowadays in Malaysia, existing facilities comprise recycling bins, recycling centres, moveable collection unit (van), silver boxes and recycling lorry (Agamuthu et al., 2011). However, many collection vehicles and recycling lorries are old and frequent breakdowns hamper the collection efficiency (MHLG, 2005c). Similar findings were noted by Perrin and Barton (2001) that the most general causes showed for not recycling were inconvenience and far distance to recycling storage and centres. Barr et al. (2003) also concurred that the impact of a convenient (easy access to recycling) and well-understood of recycling programme can have considerable behavioural impact. This entails that those who found it more convenient to recycle materials would recycle more often. It is well established that convenient to recycling containers causes a considerable increase in recycling behaviour (Tucker, 2001; Ludwig et al., 1998).

Zain et al. (2012) studied higher education institution staff and student behaviour in a recycling programme at UKM and revealed that more than 50% of the respondents were not concerned about the Mobile Recycling Centre in campus because of the shortage of publicity and the location of the centre was inappropriate. They further explained that facilities supplied for recycling were lacking cause the recycling simple for the UKM community, primarily because of the outlying of the recycling centre, incommoding those who do not have own transportation to send the recyclable items. Additionally, Bolaane (2006) and Gunton and Williams (2007) underlined that adding the quantity of recycling bins in every department or unit should also be supported by awareness-raising, as people be apt to react more when they are made interested.

Few studies (Miller Associates, 1999; Ball & Tavitian, 1992) recognised that a lack of collection receptacle can have a considerable effect on decreasing participation levels. Zhang et al. (2011) and NSWMD (2013) affirmed that a limited amount of recycling services and facilities were accessible, often hidden away and inconveniently located caused weak participation rate in recycling practices. A study by Hansen et al. (2008) in Michigan State University (MSU), US found that MSU stakeholders protested about the comparatively small amount of recycling bins undoubtedly dispersed across campus in quite unfamiliar locations and puzzlement about what items were accepted to recycle. Besides, Mason et al. (2003) also revealed that universities students aware for a scarcity of on-campus recycling facilities caused the implementation of a zero-waste programme at Massey University, New Zealand.

Williams (1991) reported that insufficient storage placement was cited as the major excuse for not recycling in a university campus. Kelly et al. (2006) also reported that 83% of students and 67% of staffs would likely to recycle more if recycling bins are provided around campus. Failure to receive a collection container in the beginning has been revealed to be a main cause for households stopping to take part (Miller Associates, 1999). Thomas (2001) further asserted that negative influences (such as insufficient of storage place, inconvenience and distance to recycling facilities) were more regularly found as restraints and obstacles to non-recyclers. A majority of stakeholders perceive that adequate recycling facilities are essential in the accomplishment of recycling programmes (Agamuthu et al., 2011). Dahle and Neumayer (2001) also suggested that higher education institutions should cut down the number of parking areas available to the students and staffs, and therefore supply more places for recycling containers.

Smyth et al. (2010) suggested the replacement of the badly labelled, unequally distributed paper receptacles is a potential strategy to attain higher recycling rate, thus need to be further promoted (Foo, 1997). Researches have indicated that supplying a campus community with convenient opportunities to recycle (such as buying new and accessible recycling bins) and effectually communicating how to utilise a recycling scheme, will bring about greater paper recycling rates (Brothers et al., 1994; Wang & Katzev, 1990; Williams, 1991; Pike et al., 2003; Hansen et al., 2008; Kelly et al., 2006; Amutenya et al., 2009; Kaplowitz et al., 2009). Foo (1997) in his study also recommended that all recycling bins should be accessibly placed, ideally at every floor of occupants' blocks. More research by Thomas (2001) on household kerbside recycling disclosed that repeated reminders, supplied by either printed bags or stickers to place on boxes or covers of wheelie bins, to encourage households about the recyclable materials to recycle, did indicate a relationship with greater levels of understanding.

Many scholars have highlighted the importance of appropriate location of recycling facilities would increase the recycling rate and bring the success of recycling. Moh and Abd Manaf (2014) also agreed that providing recycling bins at strategic location and areas is a good start for increasing recycling rates. However, Bai and Sutanto (2002) commented that the accessibility of waste disposal, to some degree, is also responsible for the increase of solid waste generated. People incline to throw out usable products merely because they are worn and outdated. Thus, further study in this area is important to generalise this factor.

3.3.14 Methods of Waste Recovery

In developed countries, waste recovery programmes for recycling started in universities 20 years previously (Armijo de Vega et al., 2008). Campos (2014) pointed out that higher income cities normally employ capital intensive technology for waste management activities and tasks, while lower income cities tend to rely on labour-based technology option. Indeed, many developing countries still have a simple, non-modernised waste system (Henry et al., 2006; Asase et al., 2009), and this causes a rising attention over the deficiency of SWM in these nations (Taboada-Gonzalez et al., 2011; Al-khatib et al., 2007). Murakami et al. (2015) suggested that granting resources to universities and technological institutions could lead to the development of a new solution that overcome the technical limitations, as well as help to spread the solution to other manufacturers (largely the small- and medium-sized companies). While in developing countries for instance Malaysia, the preferred option to dispose the wastes is landfilling because of the lack of infrastructure and facilities to support the recovery programmes.

In Malaysia, only six out of ten operational sanitary landfills are still in function in Peninsular Malaysia with five of them is for energy recovery, which is methane (Noor et al., 2013). The methane embodied in the collected landfill gas would be applied for generating electricity or straight as a fuel to displace fossil fuels such as oil and coal, which is an environmental advantage (Noor et al., 2013). Bai and Sutanto (2002) claimed that the landfill concept is no longer sustainable and recognised that in waste minimisation, the operation of incineration is regarded as the major challenge of the future. Meanwhile Kaseva et al. (2005) recommended that composting activities are a suitable method for achieving sustainability in waste management.

3.3.14.1 Incineration

Particularly in terms of energy efficiency, there are potential for considerable profits on an institution's investments (Dahle & Neumayer, 2001). Incineration is believed to be a waste disposal method in Malaysia because the country could not solely rely on landfill method (Moh & Abd Manaf, 2014). Schmidt et al. (2007) in a study on the comparison of present situation with scenarios of waste recycling, incineration or landfilling summarised that paper incineration was a better disposal choice than landfill, because incinerators produce heat and electricity, and also conserve wood resources. This coincides with Bor et al. (2004), who found that incinerators can produce electricity for selling to power businesses and then gain considerable additional earnings. Hence, there are more advantages to incineration compared to landfill.

While incineration is an alternative solid waste disposal method worldwide after landfill, but it is also regarded as one of the most costly SWM alternatives because of the requirement of highly skilful workforces and thorough maintenance, money-intensive and high maintenance cost (World Bank, 1999). Moh and Abd Manaf (2017) also agreed and highlighted that the development, operation, and maintenance of incineration require huge investment and skilled personnel. Bor et al. (2004) in his study on packaging container recycling found that incineration management has the highest external expense (environmental destruction cost of air pollution) compared with other waste-management activities. However, with the concerns of emission of dioxin and other carcinogenic pollutants and a lack of a proper approach and expertise to tackle these concerns, the question of relying on incineration remains (Moh & Abd Manaf, 2017).

Nonetheless, solid waste incineration in Singapore has been afforded a topmost precedence over other waste disposal methods since the land is tremendously scarce. All waste incineration factories are fitted out with a pollution control system, electricity generation (cogeneration facilities) and scrap metal recovery facilities (Bai & Sutanto, 2002).

Incineration is not a new technology in Malaysia; it was created to dispose hazardous wastes (Manaf et al., 2009). However presently, about 95% of wastes were sent for landfilling with only insignificant quantity of the waste subject to intermediate treatment; the surplus wastes are either transported for treatment at small incineration factories, shifted to re-processors, or is disposed unlawfully (MHLG, 2005b). There are five current incinerations with a small capacity of less than 100 tons in Malaysia and three large-scale incinerators to be constructed in Peninsular Malaysia (New Straits Times, 2013). These incinerators have advanced technology for waste management particularly those that have least influence on the environment and cost-effective would be built up in Malaysia via international open tender (Moh & Abd Manaf, 2014). However, with the release of dioxin and other health-threatening gases from incinerators together with other carcinogenic contaminants, the issues of depending on this technology remain (Moh & Abd Manaf, 2014). Definitely, the existing incinerators are not providing positive results and some do not operate upon its completion due to financial constraints and the nature of the collected waste (mixed waste that contains high moisture content), which is not suitable for the operation of incinerators (Moh & Abd Manaf, 2017).

3.3.14.2 Composting Using Anaerobic Digestion

Organic waste (food and yard waste) is difficult to recycle. However, it can be recovered for use. Food waste is a vital resource that the soil needs to remain fertile and suitable for plants to grow. The common treatment method is composting. Animal bedding and food from the cafeteria would be composted and processed by worms, removing a considerable waste stream from landfill, providing nutrients to the campus landscaping operations (Barnes & Jerman, 2002), and also improving soil structure and reducing the requisite for fertilisers (Dahle & Neumayer, 2001). However, Carvalho and Marques (2014) commented that composting, although a good practice, entails extra utility costs.

Food waste reached the highest rate in Malaysia's waste stream in 2005 (NSWMD, 2013). If food waste is not managed well by dumping at landfills this may contribute to the pollution of water and produce greenhouse gases, and then lead to global warming (MHLG, 2010). Via composting, a significant waste reduction at source can be achieved and the compost produced can be used as soil additive (MHLG, 2005c) and utilised in garden and green areas (MHLG, 2010). However, composting is not favoured because of the unattractive economic criteria, difficult operating mechanisms and environmental problems of odour, noise and aesthetics (MHLG, 2005c).

Diaz et al. (1993) also claimed that organic wastes are usually the weightiest element of the waste stream, thus costing the most money to dispose of, and have the highest possibility to release greenhouse gases once interred in a landfill. This concurs with Smyth et al. (2010), who indicated that shifting organics from the waste stream has confirmed to be tough. In some of USA universities brought their food waste to local growers who used it as chow for goats and pigs (UF Sustainability Task Force, 2002) as well as the developing countries, for instance the higher education institutions in Tanzania reutilised the food waste by carrying it to livestock cultivators who used the wastes as animal fodder (Mbuligwe, 2002). Carvalho and Marques (2014) in their study also encouraged Portugal inhabitants to conduct composting of their own waste. This practice considerably decreases expenditures for waste management.

3.3.14.3 Refused Derived Fuel (RDF)

Refuse-derived fuel (RDF) technology has for many years been the refuse processing technology applied in developed countries such as Europe, America and also Japan (Kupka et al., 2008; Fu et al., 2005). The growth of derived fuel will not only assist to attain the intention of waste disposal, but also permit its use as an option fuel, rising the percentage of home-grown energy sources, and thus accomplishing the objective of energy conservation (Chen et al., 2011).

RDF-5 is the most general category of refuse-derived fuel comes from sewage sludge, in which wastes are diminished to one-tenth of the original volume after processing, it can be readily conveyed or kept (Chen et al., 2011). Besides, it is also easy in use as it can be kept under normal temperatures for 6 to 12 months without decomposing. The fuel can also be applied straight in the fired boiler as the major combustible or when mixed with other fuels (Raili & Marttl, 1996; Alter, 1996; Weber et al., 2009). The mixture of organic sludge and sawdust to generate sludge refuse-derived as an option fuel is cost effective and has environmental advantages for instance minimising the utilisation of coal, which also overcome the problems occurred in conventional process such as the generation of heavy tarry composite which causes corrosion problems (Chen et al., 2011).

3.3.15 Materials Recycling/Recovery Facilities (MRF)

A material recovery facility (MRF) is specialised equipment that designed to separate commingled wastes into recyclables and non-recyclables. MRFs are industrial facilities and hence must be exceedingly planned and designed (Campos, 2014). The decision to deploy an MRF must be supported by the appropriate planning and design so that its abundant technical and financial operation can be assured. The choice of MRF model must consider the needs of the given case, local conditions, and the specific type of wastes that will be treated, aiming at the best possible performance (Campos, 2014).

The function of MRFs is to perform sustainable SWM and to operate in the provision of municipal solid waste to be fuel for combustion factories (Suttibak & Nitivattananon, 2008). An MRF must have its operations supervised by a qualified professional and have the appropriate maintenance programmes (Campos, 2014). The MRFs may have static tables with masonry or conveyor belts for material sorting, and various components that contribute to the waste separation, depending on the size, weight and attractiveness of the waste, among others (Campos, 2014).

In an MRF, recovered materials may be processed on site or taken off-site for further treatment (MHLG, 2005c). For small municipalities collecting up to 20 tons of solid waste per day, the most suitable solution should be one small size MRF that handles up to 7 tonnes per day or a few facilities of smaller capacity (Campos, 2014).

Campos (2014) on the other hand claimed that structural deficiencies in SWM systems are illustrated by the many treatment and final disposal facilities that were abandoned or destroyed after being installed. He further described there is a general deficiency of capacity to manage, maintain and technically operate facilities, not only but largely in the smaller cities.

A study by Suttibak and Nitivattananon (2008) in Thailand found that MRFs have some gaps because the cutting-edge technology for mixed wastes can breakdown with poor quality waste sorting by the unofficial parties before proceeding to MRFs and also from insufficiently skilful personnel for large scale MRFs. In almost all Brazilian municipalities, irrespective the population size, the MRFs for sorting, pressing, baling and trading of materials recovered from dry waste are informally operated by waste pickers, in an irregular and dangerous way (Campos, 2014). Further investigation is needed to examine the effects of MRFs on the strategic implication on higher education institutions recycling initiatives.

3.3.16 Waste Disposal and Collection Contract Provision

Service provider contract provision for recycling operation is vitally important (Pitt, 2005). A contractor's eligibility should be comprehensively evaluated according to objective, evidence-based specifications such as: reliability, technical proficiency, experience and track record, equipment and facilities possessed by contractor; operational strategies and practices, public health and environmental safeguard practices

(Zhang et al., 2011). In Singapore, the Ministry of Environment (ENV) as the regulator sets standards on good practices under its "Code of Practice for Licensed General Waste Collectors", a guideline that authorised waste collectors must follow (Bai & Sutanto, 2002).

With a distinct definition of core business and strategies, tied with strong management facets and qualities, a Service Level Agreement (SLA) can perform as a valuable and effectual business tool (Andersen, 2006). Outsourcing of solid waste disposal and management is highlighted in few previous studies. Armijo de Vega et al. (2008) mentioned that it is the obligation of every higher education institution in Mexico to contract out (outsource) the waste segregation service to a private company. A previous study of Bolaane (2006) also indicated that Gaborone municipality was contracting out source separation schemes to the private sector. While in Berlin, the collection of commercial waste is either done by producers or contracted out by a specialist company (Zhang et al., 2010).

The University of Southampton, UK developed a new electronic ordering system to centralise all procurements. The environment advantages of this practice were threefold: it noticeably minimised the quantity of resources spent by the University's operations; the quantity of suppliers decreased from 30,000 to 7000 according to favoured supplier contracts, extensively minimising administrative expenses; considerable cost savings were negotiated via consolidation of spending power (Zhang et al., 2011).

3.3.17 Recycling Construction and Demolition (C&D) Waste from Refurbishment Works

Construction waste originates from refurbishment, repair work, and construction, and can generate at any phase of a project from commencement to completion (Kulatunga et al., 2006). Materials stemming directly from construction and demolition (C&D) site waste are both of greater value and more difficult to recover and process for reuse (Zhang et al., 2010).

Alshuwaikhat and Abubakar (2008) asserted that recycling encourages contractors to recycle in constructing buildings and also foster staff and student recycling helps to preserve resources. Kulatunga et al. (2006) advocated that the development of better communication channels within organisation, providing appropriate training to the construction personnel concerning waste management practices, and also introducing rewards for proper waste management practices would help to establish and execute waste management applications in the construction industry and then enhance its performance.

In the international context, such as in UK, the EU Waste Framework Directive, a key binding action within the thematic strategy on the prevention and recycling of general waste (European Commission, 2005), requires C&D waste to have a minimum of 70% reuse, recycling or other materials recovery by 2020 in EU member states (Hiete et al., 2011). In Japan, the recycling of certain materials is mandatory in demolition (Tam, 2009).

For the purpose of reinforcing recycling of C&D waste, Singapore's National Environmental Agency establish some recycling facilities transforming C&D waste into (the low value-added) secondary aggregates for further processing into non-structural concrete goods for use in new buildings or as materials for temporary road access in construction sites. Furthermore, partnerships among recycling companies, construction companies and research institutions are encouraged to discover the innovative utilisation of recycled materials as alternatives for conservative construction materials, and also to assess the performance of these recycled building materials and products (Zhang et al., 2010).

However, Kulatunga et al. (2006) found that in Sri Lanka, labourers from construction sites showed the least attention to waste management practises. The excuses include time restriction of the construction industry and lack of advantages obtained by such practices. Kulatunga et al. (2006) further mentioned that from the perception of labourers, less individual profits are obtained by implementing waste management practices. Looking at Malaysia, there is a lack of empirical evidence on recycling C&D waste. Further investigation is required before this factor can be generalised.

In conclusion, based on the extensive literature review, a set of SWM factors that have impact to strategic SWM is identified. However, this study looks into the factors that appropriate for MHEIs.

3.4 Measurement of Recycling Performance

Environmental performance indicators are a necessary management instrument for making performance-based decisions about programme stratagems, and when applied appropriately, they can drive innovative policy development and technological designs (Greene & Tonjes, 2014). Indicators are regularly applied in the area of waste management by waste managers, policy makers, and academics (Greene & Tonjes, 2014) as well as facilities managers. Some recycling policies may influence recycling diversion and participation (Folz, 2004). This is challenging for facilities managers to identify the most appropriate measure that suitable for the organisation to evaluate the performance whether attain the strategic outcomes of the recycling programme. In other words, facilities managers should identify the significant initiatives needed to attain the desired service level and the best practices that perform to have the possibility for closing a performance gap.

In addition, Suttibak and Nitivattananon (2008) stated that management measures must take into consideration of the involvement of development partners, building SWM capacity pertinent to waste recycling approaches, enhancing recycling performance, and focusing on key important factors. Hence, these management measures are expected to enhance the performance of an organisation SWM and recycling initiatives towards the strategic level.

Many performance measures or indicators have been examined in previous studies (Rhyner, 1998; Wenger et al., 1997; Guimaraes et al., 2010; Mendes et al., 2012; Wilson et al., 2012; Armijo et al., 2011; Chavez et al., 2011). However, most waste indicators are not yet objective because there is still no standard metric definition or inclusion criteria for formulas globally (Lave & Hendrickson, 1999; Themetis & Kaufman, 2010). Waste indicators, particularly, are essential for programmatic comparisons, communication concerning systems, guiding progress towards enhanced waste scheme policy and design (Wen et al., 2009) and can be utilised for goal-establishing and progress review (Greene & Tonjes, 2014). In common sense terms, waste indicators identify necessitated measurements to determine whether system objectives are being met (Vergara & Tchobanoglous, 2012). As Perrin and Barton (2001) claimed, the current indicators measure performance not only in visible weights, quantities and numbers but also based on the satisfaction level of households with their recycling and waste facilities.

To be successful, recycling initiatives require the active and sustained participation of the community (Ittiravivongs, 2012). Participation levels in recycling programmes is one of the measurement of the success of recycling programmes (Suttibak & Nitivattananon, 2008). The participation level in a programme is apparently critical to success; however, it is not just how many people involve but how well they perform so, how well they participate, that is an essential parameter (Thomas, 2001). For instance, in assessing performance in source-separation recycling programmes focus has most regularly been on participation: on why people do or don't take part, and on their motivation and behaviours towards recycling and other environmental concerns. Chaplin and Wyton (2014) reflect Barr's model stated that participation is largely reliant on practical issues for instance access to facilities. Thomas (2001) also stated that participation rate had to be appraised, as directly measured data was not presented, and was based on self-reported data, opt-in requests for participation and earlier measured participation.

The increase in research published on waste sector performance manifests the rising awareness with environmental problems over the last ten years and with the related value for money (Carvalho & Marques, 2014). Suttibak and Nitivattananon (2008) highlighted in their study the achievement of recycling will not only rely on Participation levels in recycling programmes (participation rate) or the efficiency of the programmes (diversion rate), but also on the effectiveness of such a programme (e.g. benefit to cost ratio or net cost per ton). Benefit to cost ratio or net cost per ton is one of the measures for recycling performance. The cost of managing solid waste is categorised as two (Tellus Institute, 1991):

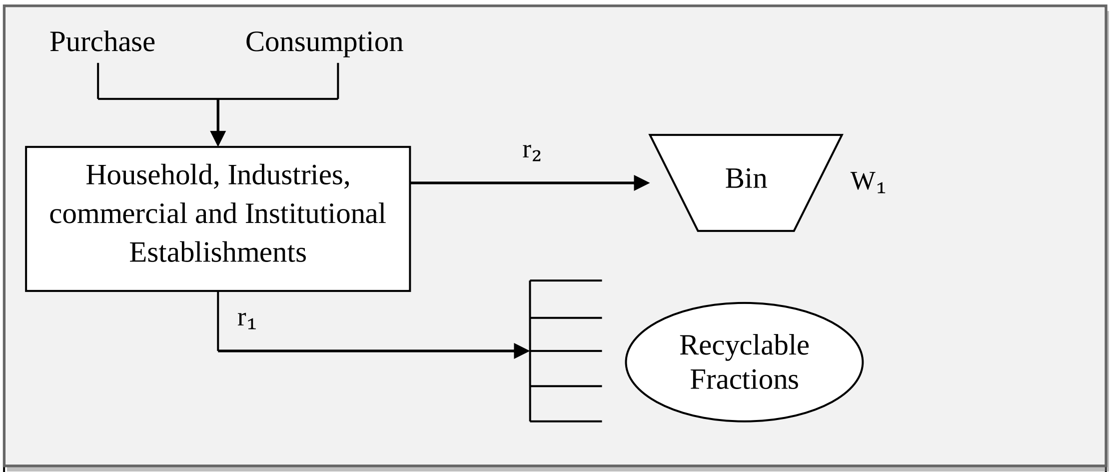
(i) Conservative and budgetary costs of waste management: costs of waste disposal, collection and recycling;

(ii) Environmental destruction costs resulted by waste management actions: landfill leach, gas discharges and recycling lorry exhaust.

While the major expenses of collection and separating enterprises are fixed costs and variable costs. Fixed costs are the expenses of land use, vehicles, workshops and equipment; while variable costs comprise largely of labour, operation and maintenance costs (Bor et al., 2004). Suttibak and Nitivatananon (2008) commented that labour is normally one of the costliest aspects of a recycling programme. Since many operators (re-processors) are involved in recycling and reprocessing of waste materials because of the financial incomes for such investments, the implementation of recycling is believed to bring the reduction of cost. How to achieve this is also interesting and challenging for the facilities managers.

Kaufman et al. (2010) highlighted that most general indicator for assessing environmental effectiveness of waste system is recycling rate. This is because waste regulations generally introduce quantitative recycling goals of certain waste materials (Snell & Hurst, 2009) because recycling is graded mostly on the waste hierarchy after reduction (Greene & Tonjes. 2014). Diversion rate is suggested by Thomas (2001) in his study and he asserted that diversion rate will be the equal to the recycling rate. This is in contrast with Greene and Tonjes (2014) who commented there was difference between recycling and diversion rate, the major difference is that diversion rate comprises composting activities and suggesting that composting may influence GHG emissions. They also found that there was not a strong correlation between diversion rate and recycling rate, which are always applied interchangeably. This suggested that while a municipality may rank first regarding recycling rates, they may not also have the highest diversion rate (Greene & Tonjes. 2014).

Zhang et al. (2011) claimed that it is hard to compare recycling rates between countries as diverse measurements are applied. Folz (2004) in a study of kerbside and drop-off recycling found that cities that had a higher population density, aimed more materials, and second-hand co-collection lorries for solid waste and recyclables had higher levels of recycling diversion. In Malaysia, recycling rates are applied by the government to evaluate the recycling performance for all entities. A model for estimating the recycling rate is created for all the entities as illustrated in Figure 3.4 (NSWMD, 2013).



Where,

r_1= waste-separated recyclables items (e.g. newspapers, aluminium cans, etc)
r_2= mixed recyclable items in the waste bin
W_1= waste generated as in the waste bin.

Figure 3.4: Model to assess the recycling rate from households, industries, commercial and institutional organisations (NSWMD, 2013)

Referring to the above figure, recycling rate for each establishment was estimated. For instance, Commercial and Institutional recycling rate is the volume (weight) of recyclable materials as a proportion of total solid waste produced at source (i.e. waste separated by the organisations) (NSWMD, 2013). The rate is calculated below:

$$\text{Commercial and institutional recycling rate (\%) by commercial sub-sectors} = \frac{\sum \text{(THC) Total commercial and institutional recyclables}}{\sum \text{(THC) Total waste produced by commercial and institutional}}$$

Where:

THC= total volume of recyclable separated for recycling (kg) for each sector
TWG= total volume of waste produced/computed based on unit amount generation for each sector

Figure 3.5: Commercial and institutional recycling rate (NSWMD, 2013)

While there is the recycling rate introduced by the government of Malaysia, the question is whether the institutions, organisations or establishments will apply to evaluate their recycling performance. As Kaufman et al. (2010) indicated, while many materials are preferably recycled, the recycling rate is not an appropriate method of waste system sustainability and environmental advantage. Lehman (2012) also agreed and suggested that while recycling is a crucial part of sustainable policies, recycling alone is not sufficient to attain sustainable systems because the recycling rate does not manifest the differences in environmental impacts when managing non-recyclable wastes applying numerous technologies, for instance anaerobic digestion composting or waste-to-energy (WTE) incineration. This view coincides with Greene and Tonjes (2014), who mentioned that generally, municipalities with the highest recycling rate are cited as the most environmental sound and greenest, yet in reality, they still may be landfilling considerable amounts of waste. Additionally, based on the solid waste-related Acts in Malaysia such as SWPCM Act 2007, it is not yet mandatory for MHEI to evaluate recycling performance. However, the metrics or indicators of measurement have an impact on strategic implication variables.

3.5 Strategic Implications on Institution Solid Waste Operation

Strategic planning is crucial to improve the delivery of recycling performance to attain sustainable development and reinforce long-term growth (MHLG, 2005b). Strategic facilities planning for an institutional SWM will bring an institution business to the minimisation of waste stream, decrease of the cost operation and even income created.

Indeed, recycling conserves natural resources, consumes less manufacturing energy, minimises total disposed waste amount, decreases demand for virgin materials, minimises environmental and economic costs, and health as well as environmental risks (Bolaane, 2006; Martin et al., 2006; Kinnaman, 2006; Van den Bergh, 2008). A study carried out by Agamuthu et al. (2011) showed that the local authority stakeholder perception on the major advantage of 3R activities was the highest for pollution prevention, followed by resource preservation, businesses generation and the last is economic benefit. In other words, the notion of turning wastes into valuable financial capitals, environmental and social revenues (US EPA, 2012) has obtained amassed interest as a method of defending the environment because it provides one of the most workable solutions both cost-effectively and ecologically for administering waste (Omran et al., 2009). In sum, it is imperative to give focus on environmental, economic, social and also legislation aspects of higher education institution SWM by scrutinising the strategic implication to operationalise service delivery for recycling programmes.

3.5.1 Waste Stream Reduction / Waste Minimisation

Majority of the recycling programmes initiated are aimed for the environmental sustainability as a priority. Thus, in the area of SWM, waste stream reduction is considered as the first aim to be attained. Envirowise (2002a) has identified a variety of advantages that come from waste minimisation in enterprise. These advantages comprise increased earnings, competitiveness, enhanced management control and corporate image. Pitt (2005) also highlighted eliminating recycled items from the waste stream is one noteworthy move towards decreasing cost.

Waste reduction is quite hard to measure (Greene & Tonjes, 2014) therefore the recycling rate has become the prevailing measure to assess waste stream reduction. Few scholars (Fullterton & Kinnaman, 1995; Sepulveda et al., 2010; Oliveira & Rosa, 2003) identified that via recycling programmes, natural resources can be protected, discharges reduced and the encumbrance of solid waste can be minimised as well. Meanwhile, recycling generates occupation and invites investments (Kassim & Ali, 2006; van Beukering & Curlee, 1998).

Nonetheless, waste reduction is a main objective of the composting programme. By composting, a significant waste reduction at source can be achieved (MHLG, 2005c). For instance, in a household home composting programme carried out by Petaling Jaya City Council found that most of the households recorded between 40%-60% of reduction (volume) in solid waste for disposal. Meanwhile, the amount of money spent on waste management could be considerably reduced (NSWMD, 2012). More investigations are needed to generalise this variable in local context.

3.5.2 Cost Reduction

One of the foremost challenges with developing sustainable waste management system is the cost of implementation (Lakhan, 2015). Cost reduction and profit generated is the first matter to look into when measuring the strategic impact in economic perspective.

Pitt (2005) indicated that true cost of waste is a strong corporation case for taking action to avoid and minimise waste. Through cost accounting, Bohm et al. (2010) stressed that supporting policies are required in recycling initiatives to make up for the cost gap since both the marginal cost and average cost of waste reuse are higher than disposal cost. Furthermore, Callan and Thomas (2001) examined the costs of municipal solid waste services and also researched economies of scope and then concluded that there were cost savings from providing cooperative disposal and recycling services. Hernandez et al. (1999) stated that recycling can minimise costs to the municipality for the solid waste collection and disposal by minimising the waste volume that the municipality deliver to its landfill. Carvalho and Marques (2014) in their study on municipal solid waste recycling in Portugal found that incineration incline to reduce costs by about 15%.

One of the recycling activities was proved to have cost reduction is recycling of animal waste (Murakami et al., 2015). Murakami et al. (2015) further mentioned that recycling of animal wastes benefits the fertilizer producers, as it reduces the cost of raw materials used in the manufacture of fertilizers (compared to mineral inputs) and improves the performance of the fertilizer in soil fertilization.

Atkinson et al. (2004) emphasised that the success criteria for strategic FM functions are to minimise the turnover of FM cost. Thus, it is critical important to identify whether the current recycling practices in higher education institution could reduce the cost for the organisation.

3.5.3 Revenue Generated

It is vital to understand that strengthening recycling programmes not only prolong the lifetime of landfill, it also supports the economy because recycling gives broad lucrative business ventures opportunities (Moh & Abd Manaf, 2014). Chen et al. (2009) agreed that recycling business creates notable economic significance. Campos (2014) emphasised the role of economy in boosting the recycling of certain materials. Campos (2014) pointed out that the waste recycled by industry exclusively meets the demands of economic production chains of the sector and is not of importance to environmental management. However, Hernandez et al. (1999) stated that increasing awareness of the economic advantages of recycling, as well as the health and environmental benefits, has guided the municipalities to integrate recycling into the development of SWM.

Bor et al. (2004) pointed out that in the methods of waste recovery, incinerators can produce electricity to sell to power enterprises and then earn extensive additional incomes. Likewise, composting as one of the waste recovery methods could able to generate profit for a university or college business by selling the composting products. Murakami et al. (2015) pointed out that the revenue earned by the producer by selling zinc waste and reducing costs of waste disposal are the key promoter of zinc recycling. Murakami et al. (2015) also found that the job of waste picking for recycling constitutes a source of income for many poor people in Brazil.

In addition, Steven (1978) studied on the total cost of waste collection services in 340 US towns in the duration of 1974-1975 and she identified there were continual profits to scale for cities with a population larger than 50,000 residents. This is concurred with the Carroll's (1995) study that investigated the recycling cost in Wisconsin municipalities with an average population size of around 26,000 residents and found constant returns as well. Later in the study of Abrate et al. (2012) who examined the costs of waste disposal and recycling services in Italian municipalities in the duration of 2004-2006 found there were also continual profits to scale in the waste collection for a population around 42,500 residents. These authors also concluded the rise of the quantity of waste delivered for recycling would not entail a significant rise in total costs. Further investigation is needed to examine whether there are still constant returns in recycling programmes.

3.5.4 Change of Recycling Behaviour/ Culture

According to Berita Harian (2012), a sum of 22,000 tons of solid waste are being disposed day-to-day throughout Malaysia, which is roughly a growth of 10,000 tons from the total solid waste disposed in year 2011 and would present continual rise to 30,000 tons per day by the year 2020 if same recycling behaviour persists among public. The characteristics of consumerism in determining attitude and behaviour are significant, as elucidated by an absence of understanding of the effect of waste from the production and packaging of food (Bekin et al., 2006). In general, the increasing rate of solid wastes in Malaysia has manifested from the change of consumption customs among Malaysians, as their per-capita income has risen throughout the years, where they can afford for more consumers than before (Abdul Jalil, 2010) along with the speedy population development and also urbanisation (Tarmudi et al., 2012). Moh and Abd Manaf (2017) also stressed that with significant advancement of living standards, it is inevitable that solid waste generation increases over the years without any transformation in the attitudes and habits of Malaysians in managing their waste.

Sustainability awareness is part of community behavioural change. An investigation had been conducted on the behavioural components of waste management as indices for understanding how to positively change such behaviours. The result showed that there was a relationship of recycling behaviour between the involvements of non-profit organisations, newspaper reading, politics and religious activities (Martin et al., 2006). Conditions of the physical surroundings have been shown to be a critical factor in recycling behaviour (Omran et al., 2009).

McCarty and Shrum (1994), Tongler et al. (2004), Foo (1997) and Ho (2002) reported inconvenience as a key influence on one's recycling behaviour, who continue stated that such concerns appeared to outweigh attitudes about the enduring importance of recycling behaviour. Saphores and Nixon (2014) agreed that recycling behaviour itself is the result of a diverse set of factors including convenience, social norms, moral considerations, environmental awareness, knowledge, as well as environmental concerns regardless of education level, gender, and income. However, Zen et al. (2014) in a study on household recyclers profile found that the greatly interested household recyclers still conduct recycling activities regardless of the inconvenience and shortage of recycling facilities at household level.

It can be argued that to become sustainable, remarkable change to behaviour is necessary, to a limited extent some changes in action appear to be happening (DEFRA, 2009). Malaysian households tend to rely on local authorities and municipal waste collectors to manage waste issues including source separation and recycling with the basis that they pay their taxes to the local municipalities (Moh & Abd Manaf, 2017). In attempt to actually change people's behaviour, obstacles that inhibit them from recycling particularly from their very own perceptions have to be addressed (Moh & Abd Manaf, 2014). The social environment for recycling with a strong community connection or society group will boost recycling behaviour (Zen et al., 2014).

3.5.5 Compliance of Acts

In the case of regulation, the cost raise may because of an essential rise in service quality commanded by the regulator (Simoes & Marques, 2012). Definitely, regulation is required to assure quality and effectiveness profits (Bel et al., 2010). Few authors argued that enhanced environmental protection via the optimisation of waste management practices is the typical emphasis of waste management policies and technologies in countries where powerful legislation has been well formulated and immediate health concerns have been controlled (Wilson, 2007; Vergara & Tchobanoglous, 2012). In countries with unsophisticated waste management infrastructures, public health inclines to be the motivating factors for their national policies (Wilson, 2007; Vergara & Tchobanoglous, 2012).

In many countries, EPR is established in recent years as a tool of social and economic development to facilitate the solid waste collection and return to the corporate sector. Regardless the support from government at any level, importers, distributors and manufacturers, including their waste and packaging, electric and electronic components and products are needed to assume responsibility for the whole life cycle of their products (Campos, 2014).

As discussed earlier in Section 2.3.1.1 in Chapter 2, the EU directives enforced by EU towards its member states is effective as the recycling rate achieved by those developed countries is high. The member states adopt the EU directives into their national policies to mandate and set the target for the recycling programmes in their country. For instance, in the developed countries such as UK, retailers are subject to a number of regulations and other mandatory fees such as the packaging waste regulations, duty of care and the landfill tax (Pitt, 2005). Apart from the retailers, all the sectors including higher education institutions also have to compliance with the statute set by the government.

Campos (2014) in his study highlighted the legal framework of SWM in Brazil, he mentioned that in most cases, both formal and informal collection are conducted by waste picker who very frequent use human- or animal-drawn vehicles without following the minimum conditions required by national legislation that the law states "*the use of equipment that is compatible with the technical standards, environmental and public health*".

Focusing in Malaysia, the function of SWM is commonly carried out simultaneously with other associated functions for instance public area cleansing, street-light and drainage maintenance and landscaping. There is no particular measure in the aspect of waste minimisation and recycling (Moh & Abd Manaf, 2014) and many issues happened because of non-existence of appropriate policy on a proper system to manage and dispose solid wastes as well as lack of compliance in the Housing and Local Government Ministry's 1990 Technical Guidelines on Sanitary Landfills, Design and Operations, which proposed that all new landfills are at Levels III and IV with anti-pollution features (Moh & Abd Manaf, 2017). Municipal solid waste is under the management of MHLG while Department of Environment (DOE) handles schedule or hazardous waste, and clinical waste which are under the Ministry of Health (MOH) (Moh & Abd Manaf, 2014). SWPCM Act 2007 (Act 672) is the sole regulation which formulated for SWM purpose in all sectors. Under the Act, any solid waste disposal could be by any method of destruction, incineration and deposit of decomposing (Nagapan et al., 2012). Clause 71, 72 and 73 of SWPCM Act 2007 highlight the disposal of solid waste. All the solid waste includes institutional solid waste should be stored, treated or disposed solely at licensed SWM facilities. Besides, any occupier of any premise has the responsible to avoid any unauthorised disposal of solid waste on his premises. Clause 73 states the solid waste should be disposed at the proper place while

Clause 74 states that any person may be specially given direction to ensure to comply this Act on solid waste separation, handling and storage as well. Any unlawful solid waste deposit and disposal is not allowed under Clause 76.

There are minimum two clauses in this Act that directly commence the 3Rs strategy which are Clause 101 Reduction, Reuse and Recycling of Controlled Solid Waste and Clause 102 Take Back System and Deposit Refund System (Moh & Abd Manaf, 2014). Manufacturers, importers, and dealers have the obligation to recycle their products under Clause 102(1). Since this Act is generally for household SWM, waste bins with a volume of 1201 equipped with wheels were distributed from October 2011 to 2014 under this Act. It is expected each household has to conduct waste sorting which would be collected by designated private concessionaires (Moh & Abd Manaf, 2014).

Furthermore, Clause 112(2) Existing Solid Waste Management Facilities states if any permitted SWM facility does not comply with existing requirements related to environmental effect, quality and level of SWM services or public health, the owners or occupiers of such facility are required to apply for fresh approval under this Act. However, Moh and Abd Manaf (2014) argued that although the endorsement of SWPCM Act 2007 has given legislative empowerment to the government and framework for the SWM, it cannot be imposed and implemented entirely owing to deficiency of other supportive regulations. Even though there are regulations 2011 under SWPCM Act 2007, Federal Government Gazette, those regulations are mostly for the licensing of the collection services, public cleaning management services, and transportation services. Meanwhile, although there is also a regulation states that owner or occupier of premises could separate the waste can be recycled or take to recycling centre. However no mandatory or compulsory for the person to do so as no fine imposed to them.

In addition, the current provisions of the Environmental Quality Act (EQA) 1974, the Local Government Act 1976 and the Street, Drainage and Building Act 1974 are not precisely formulated to manage SWM problems comprising waste recovery and recycling. Similar to Occupational Safety and Health Act (OSHA) 1994 (Act 514) which was gazetted in 1994 provides the legislative framework to insure the safety and health for all Malaysian workforces. Section 16 stated the duty of the employers and self-employed people to establish safety and health policy to ensure employees is safe and health to work, however no mandatory requirement for employers or self-employed people to proper manage solid waste in the working places including 3Rs (reduce, reuse, recycling). The regulations under EQA 1974 such as Environmental Quality (Scheduled Wastes) Regulations 2005 are specifically for hazardous wastes, which are not covered in this research. In fact, there is no Federal or State legislation that widely manages all aspects of SWM particularly recycling in this matter (Moh & Abd Manaf, 2014).

Moh and Abd Manaf (2014) further elucidated that policy implementation can only be carried out unofficially and in informal practice by stakeholders. Although mandatory recycling started in September 2015, it is not definite that this will resolve the issue and does not include commercial and institutional sectors. This is in line with Agamuthu (2010), who emphasised the present enforcement solely highlighted and requested solid waste producers to minimise the solid waste generation, to use environmentally friendly goods, restrict waste generation, import, consumption, dispose of specified goods, practise recycling coding and labelling, and utilise any means to minimise adverse impact of solid waste towards the environment and to minimise, recycle and reuse solid waste. In view of the above issues discussed, enforcing the legislation is a difficult but mandatory task for the strategic SWM.

3.6 Development of Theoretical Framework

A theoretical framework is a representation, either graphically or in narrative mode, of the key conceptions or variables, and their presumed relationship with each other (Punch, 2005). In the present research, a theoretical framework has been developed based around a global collection of review derived from significant SWM factors, together with its strategic implication variables. This structured framework corresponds to the objectives of the research highlighted in Chapter 1. Hence, the theoretical framework for higher education institutions SWM and recycling initiatives is demonstrated in Figure 3.6.

The established SWM factors and how the factors influence the performance of strategic solid waste operation in MHEIs are built-in under this framework. Implications of the performance framework of higher education institutions' SWM is, therefore, an emphasis on the relationship of the significant SWM factors and strategic implications. Another contribution is that the strategic implication variables comprise indirect business relationship, which is often seen in business practices. Overall seventeen (17) SWM factors were considered as significant factors believed to influence strategic solid waste operation at the institutional level. These variables were reflected in the past research and studies while others have specially related to this research. This chapter has discussed these variables in detail.

The framework conceptualises the link between the seventeen (17) SWM factors (independent variables) and the five (5) strategic implication variables on SWM (outcome variables). The framework is moderated by classifying the research sample using three MHEI groupings (to act as moderating variable) after considering the institutional financial aspect. According to Ministry of Education Malaysia (2015), the total expenditure of government on higher education has been increased at a rate of 14% per annum, driven mainly by subsidies to public higher education institutions. Besides, 90% of the expenditures of public higher education institutions are Government funded (Ministry of Education Malaysia, 2015). Yahaya and Larsen (2008) also stated that due to limited financial and funding resources in handling solid waste disposal and treatment technologies, the quality of service among local authorities is significantly unequal. Thus, it is believed that management among the public universities, private universities and colleges may differ in the financial capability aspect. For this particular research, the two key variables which are independent variables and dependent variables could help researcher to identify both the level of implementation and level of effectiveness when conducting statistical inferences. Besides, the theoretical framework could help researcher to develop hypothesis which will be tested through the statistical inferences. Additionally, this constructed framework is not just concerned towards universities and colleges organisations, but also concerned with other organisations which have similar characteristics with institution organisations.

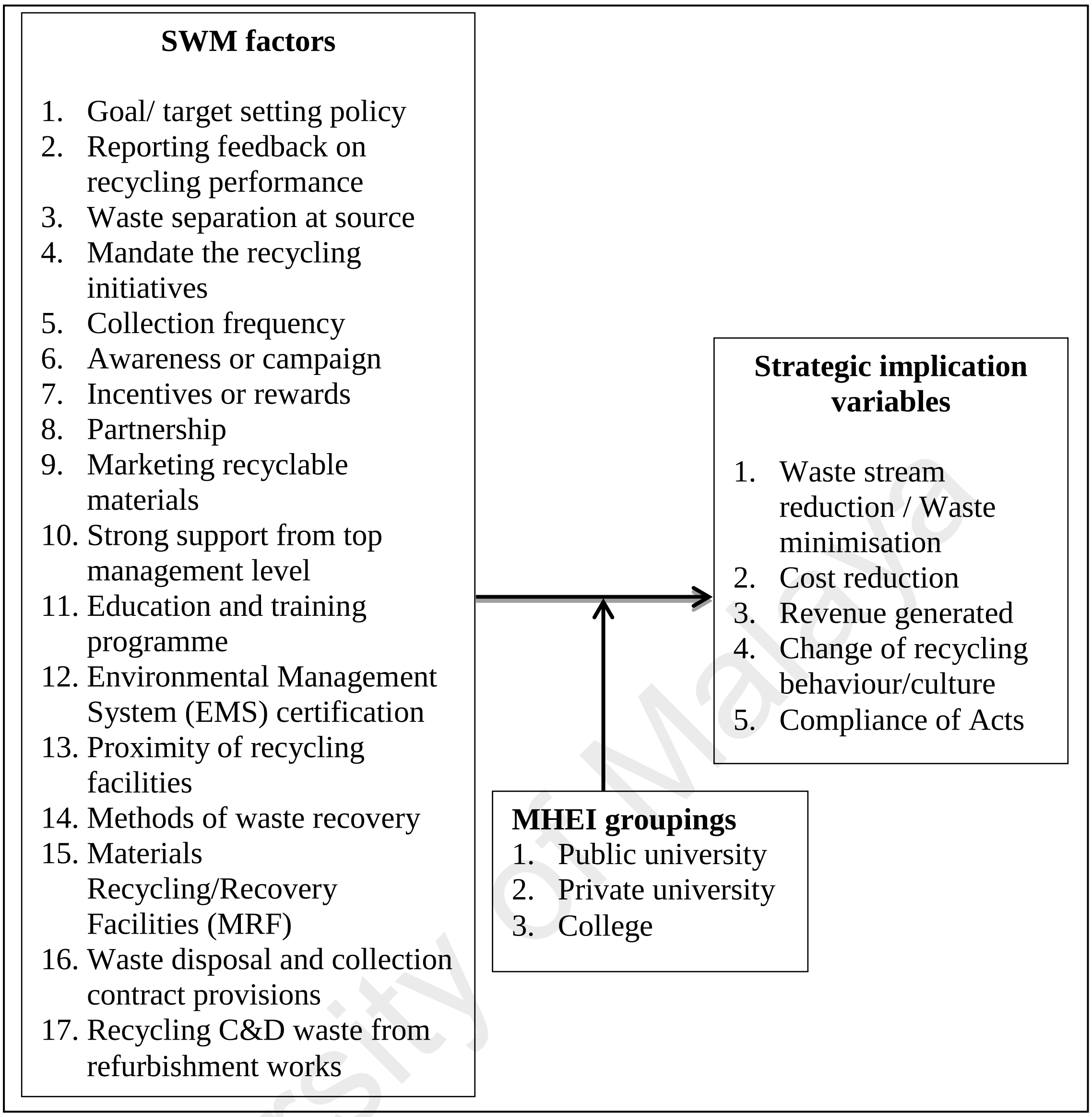


Figure 3.6: Theoretical framework

In this study, researcher is trying to validate the SWM factors and strategic implication variables through exploratory phase of interviews; thus, the framework was modified in the light of interview findings to be presented later in Chapter 5. The strategic implication variables are the outcome variable or called dependent variable, the ones that the researcher is trying to hypothesise or predict. Variation in the moderating variable or dependent variables is what the researcher is trying to explain. These variables are unavoidably influenced; hence, a strategic performance framework will be established in line with empirical findings and statistical analysis to be presented later in Chapter 7. This constructed theoretical framework provides a clear and original conceptualisation of the wide variety of literature, as well as a method for organising the data collection and analysis which will be considered and further developed in the next stage of research. As a consequence, the purpose of the framework is to make sense of the initial structure of the study.

3.7 Summary

In the first part of this chapter, the researcher discussed the overall existing material recycling system in Malaysia and higher education institution waste stream. In the second part, a detailed discussion on SWM factors covered a broad review of literature in the SWM and recycling area to address the principal SWM factors impacting higher education institution recycling programmes. Furthermore, strategic implication variables have been discussed at large in the final part. As a result, this chapter found that there were seventeen (17) SWM factors determining five (5) strategic implication variables towards strategic institution solid waste recycling operation (which are demonstrated in Figure 3.6). To confirm and adapt these factors into the Malaysian context, the factors will be validated via the interview phase and then established which factors and variables are critical to MHEI strategic SWM. This chapter has constructed the theoretical framework, allowing for the proper research designs and methods to be further developed and discussed thoroughly in Chapter 4. Further analysis of factors / variables validation and the findings from the confirmation phase of questionnaire survey are presented in Chapters 5, 6 and 7 of this research.

CHAPTER 4: RESEARCH DESIGN AND METHODOLOGY

4.1 Introduction

This chapter discusses the selection of an appropriate research design in conducting this research methodology issues. The main components include the research questions involved, the research strategies employed, the major phases in the research and the method of analysis employed.

4.2 Research Questions

Following previous discussion in chapter three, this research is based on the following research questions:

Q1: What are the significant factors that contribute to the strategic implementation of higher education institutions solid waste management (SWM)?

Q2: Which factors influence the strategic SWM in local context?

Q3: How are these significant factors to be assessed as criteria factors for strategic SWM?

This research therefore focuses on seeking answers to these key questions raised as above, by investigating MHEIs SWM initiatives at the institutional level.

4.3 Research Design

A research design is a plan to carry out research, and contains the connection of philosophy, strategies of inquiry, and particular approaches (Creswell, 2009). Punch (2005) stated that research design situates the researcher in the empirical world, and links the research questions to data. Bryman and Bell (2007) explained that a research design provides a framework for data collecting and analysing. They further emphasised an adoption of research design manifests decisions about the priority being given to a scope of dimensions of the research process.

The consideration of full range of probabilities of data collection, analysis and interpretation is necessary prior a study is conducted. As shown in Table 4.1, there are several different aspects between qualitative, quantitative and mixed method, For instance, by their extent of pre-established nature, their practice of closed-ended versus open-end questioning, and their focus on numeric versus nonnumeric data analysis.

Table 4.1: Differences between qualitative, quantitative and mixed method (Creswell, 2009)

Qualitative methods	Mixed methods	Quantitative methods
Emerging methods	Both pre-established and emerging methods	Pre-determined
Open-ended questions	Both open- and closed-ended questions	Instrument based questions
Data from interview, observation, audio-visual and documentation	Multiple forms of data drawing on all possibilities	Performance data, observational data, attitude data, and census data
Text and image analysis	Statistical and text analysis	Statistical analysis
Themes, patterns interpretation	Across databases interpretation	Statistical interpretation

Creswell (2009) described the qualitative approach as a method for exploring and knowing the meaning personals or groups ascribe to a social or human problem. This method is more appropriate for investigating personal or group phenomena that involves emotions, motivation, and empathy, which cannot be entirely captured by the number from a quantitative study (Chua, 2012). Creswell (2009) further explained that the process includes emerging questions and procedures, data normally collected in the participant's setting, data analysis inductively building from specifics to general themes, and the researcher making interpretations of the meaning of the data.

The quantitative method is associated with numerical data and accuracy (Chua, 2012). Creswell (2009) defined quantitative method is a method of testing objectives theories by investigating the association among variables whereby these variables can be measured, normally on instruments, so that numbered data can be analysed applying statistical procedures.

On the other hand, Creswell (2009) defined mixed method is "an approach to inquiry that combines or associates both qualitative and quantitative forms. It involves philosophical assumptions, the utilisation of qualitative and quantitative approaches, and the mixing of both approaches in a study". Therefore, it is more than merely collecting and analysing both types of data; it also involves the utilisation of both approaches in tandem so that the overall strength of a study is greater than either qualitative or quantitative method (Creswell & Plano Clark, 2007).

Creswell (2009) emphasised that researcher not only chooses a qualitative, quantitative, or mixed methods study to carry out, the researcher also has to decide the strategies of inquiry for the research. He further explained that strategies of inquiry are "types of qualitative, quantitative, and mixed methods designs or models that provide specified direction for procedures in a research design".

4.3.1 Qualitative Strategies

Qualitative research is interpretive research, with the researcher typically involved in a sustained and intensive experience with respondents. Bryman (2008) defines qualitative research is a research strategy that regularly emphasises words rather than quantification in the data collection and analysis. According to Creswell (2009), there are five strategies in qualitative research: ethnography, grounded theory, case studies, phenomenological research and narrative research.

Ethnography refers to social science writing about particular folks (Silverman, 2011), and to understand how behaviours reflect the culture of a group (Leedy & Ormrod, 2013). The intent of ethnography strategy is to acquire a holistic picture of the study's subject with stress on portraying the everyday experiences of personals by observing and interviewing them and relevant others (Creswell, 2009 quoted from Fraenkel & Wallen, 1990). While grounded theory is a strategy in which a researcher derives a general, abstract theory of a process, action, or interaction grounded in the views of participants (Creswell, 2009). Grounded theory is a research strategy whose purpose is to generate theory from data (Punch, 2005). Punch (2005) further explained that the important idea in grounded theory is that theory will be developed inductively from data and it starts with an open mind, aiming to end up with a theory.

On the other hand, case studies strategy is a strategy of inquiry in which the researcher intends to explore in depth a programme, event, process, or one or more personals (Creswell, 2009; Punch, 2005). Its major weakness is that, especially when only a single case is involved, researcher cannot be confirmed that the findings are generalisable to other situations (Leedy & Ormrod, 2013). While phenomenological research is a strategy of inquiry in which the researcher identifies the essence of human experiences about a phenomenon as described by participants (Creswell, 2009; Leedy & Ormrod, 2013). The purpose of phenomenological research is to understand an experience from the participants' points of view (Leedy & Ormrod, 2013). Lastly, narrative research is a strategy in which the researcher studies the lives of individuals and asks one or more individuals to provide stories about their lives. The information is then often reiterated by the researcher into a narrative chronology (Creswell, 2009).

4.3.2 Quantitative Strategies

Quantitative (or positivist) strategies make use of numeric data and statistical analysis. The key concept for this strategy is quantity, and numbers are used to express quantity (Punch, 2005). Silverman (2011) argued that in quantitative research, observation is not largely seen as very essential approach of data collection, and also is not a very 'reliable' data collection approach because different observers may record different observations. Creswell (2009) pointed out that normally quantitative strategies comprise survey research (non-experimental) and experimental research.

Survey research gives a quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population (Creswell, 2009). Creswell (2009) quoted from Babbie (1990) stated that this research mode comprises cross-sectional and longitudinal studies applying questionnaire or structured interviews for data collection, with the intent of generalising from a sample to a population. In contrast, experimental research seeks to determine if a particular treatment influences an outcome (Creswell, 2009). He further stated that the basic intent of an experimental research is to test the impact of a treatment (or an intervention) on an outcome, controlling for all other factors that might affect that outcome.

4.3.3 Mixed Methods Strategies

The concept of multi-methods measurement by mixing different methods was originated by Campbell and Fisk in 1959. Recognising that all methods have limitations, researchers felt that biases inherent in any single method could neutralise the biases of other methods (Creswell, 2009). As a consequence, triangulating data sources, which is a means for seeking convergence across qualitative and quantitative methods, was born (Jick, 1979). Triangulation suggests using more than one method or source of data in the study of social phenomena (Bryman & Bell, 2007).

In particular, there are three general mixed method strategies. Sequential mixed methods may be applied when the researcher seeks to expand on or elaborate on the findings of one method with another method. Researcher may begin with a qualitative interview for exploratory purposes and subsequent with a quantitative survey with a large sample so that researcher can generalise results to a population; or a researcher may initiate a study with quantitative method in which a theory or concept is tested followed by qualitative method involving thorough exploration with a few cases or individuals (Creswell, 2009).

In addition, the concurrent mixed method will be applied when researcher converges quantitative and qualitative data to provide a thorough analysis of the research problem. Both forms of data are collected at the same time and then integrated into the interpretation of the overall results. Lastly in transformative mixed methods, researcher uses a theoretical lens as an overarching perspective within a design that encompasses both quantitative and qualitative data. This lens gives a framework for topics of interest, approaches for data collection, and outcomes or changes expected by the study. Within this lens could be a data collection method that contains a sequential or a concurrent approach (Creswell, 2009).

4.4 Research Approach

It is essential to develop a sound methodology in order to determine which paradigm is appropriate to undertake an investigation. According to Tashakkori and Teddlie (1998), there are four philosophical paradigms i.e. positivism (quantitative), post-positivism (qualitative), pragmatism and constructivism approaches. Pragmatically oriented theorists and researchers now refer to 'mixed methods' (or mixed methodology), which include elements of both the quantitative and qualitative approaches (Tashakkori & Teddlie, 1998). As this research is based upon three research questions as stated in Chapter 1 and reaffirmed during the introduction to this Chapter, it is believed that the study is exploratory in nature. In order to demonstrate the research design, the methodology moves from grounded results through inductive logic to general inferences, then from those inferences through deductive logic to tentative hypothesis of the research outcomes. From this perspective, the three phased approaches taken for this research implement the pragmatism research paradigms, which takes on aspects of both qualitative and quantitative techniques.

A mixed method approach was employed in this research as the researcher drew liberally from both qualitative and quantitative assumptions. According to Creswell (2009), with pragmatism approach, researcher looks to many methods for collecting and analysing data rather than subscribing to only one method (either quantitative or qualitative). Hammersley (1996) advocated triangulation is one of the proposed mixed method researches which refer to the utilisation of qualitative research to support quantitative research findings or vice versa.

The rationale of using mixed method may include:

i. Collecting multiple data using different strategies, methods and approaches leading to combination is likely to result in additional strengths and non-overlapping weaknesses (Johnson & Turner, 2003; Brewer & Hunter, 1989);
ii. More comprehensive findings can be obtained and increased conclusion validity (Johnson & Christensen, 2004).

A mixed method approach with a sequential strategy was employed in this research. It began with an interpretive method by applying exploratory investigation, to explore and validate the SWM factors and strategic implication variables identified in literature review; and then followed by positivist method by employing confirmatory investigation through questionnaire survey. According to Creswell (2009), when researcher intends to explore the themes with participants at sites, the qualitative data are collected first. After that the researcher enlarges understanding via second stage of positivist approach where data are collected from a large number of people (normally a sample that represents the population). Generally, its two-phase approach (qualitative research followed by quantitative research) (as illustrated in Figure 4.1) makes it simple to implement and straightforward to describe and report (Creswell, 2009). Creswell also highlighted it is suitable to a researcher who intends to explore a phenomenon but also wants to expand on the qualitative findings. After quantitative data analysis, triangulation method is applied during the interpretation and discussion of the entire analysis. Combining both qualitative and quantitative analysis results in a discussion with respect to the related literature.

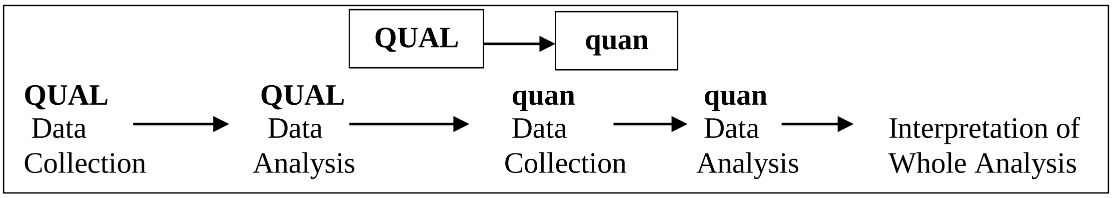


Figure 4.1: Sequential Exploratory Design (Creswell, 2009)

In this research, a purely positivist approach could not be applied because the interviewees were experts who understand the operation of higher education institution SWM and could confirm the findings from the literature. Likewise, since the third research questions of this study is how the significant SWM factors identified to be assessed as criteria factors for SWM to be more strategic, the use of a small sample (as applied in interpretive approach) may give an indication of key factors but it would hard to deduce any reasonable conclusions with regard to the entire Malaysian higher education institution (MHEI) population. Hence, a purely positivist and interpretive approach has not been employed. The combination of both approaches in a social science study could produce robust and valid findings at the end of the study. This is because the positivist approach may complement the results obtained from an interpretive approach, which would make the results more realistic and reliable (Brewer & Hunter, 1989; Johnson & Turner, 2003). To conclude, this research adopted a sequential exploratory approach, began with an interpretive method to explore and validate the factors for higher education institutions SWM in local context, and then followed by positivist method to evaluate the trend of the existing MHEIs SWM and recycling practices.

4.5 Research Phases

An organised research design is required in every research. As outlined in the Table 4.2, a sequential three phased approach was designed for data creation and analysis at every phase. The approach must reflect the first two research objectives which are firstly to determine the principal factors for higher education institutions SWM in local context; and secondly, to develop the relationship between principal factors and strategic implication of MHEI SWM strategy. In order to achieve these research objectives, a mixed methods approach was employed and justified earlier in this Chapter. Relevant procedures applied in every phase of the research together with its justification and resulting outcomes for every phase was emphasised in this section. To ensure the factors identified in the first stage are indeed appropriate and comprehensive set of factors that have impact on MHEIs SWM strategy, the first stage was a wide review of SWM and recycling literature highlighting key areas of investigation with respect to commercial and institution SWM and recycling field.

Table 4.2: Three phased research procedures

Procedures		Justification	Outcomes
First Phase [Secondary data review]	Review of SWM factors and strategic implication variables	To establish development of existing research in area of commercial and institution SWM and recycling.	To date no much research on higher education institutions solid waste and recycling in Malaysia; most of the past researches focus on household sector; development of theoretical framework for higher education institution SWM.
	Identification of most common SWM factors	Various literature on those factors – focus on factors identified which have impacts on strategic SWM; **[Objective 1]** *To determine the principal factors for higher education institutions SWM in the local context.*	Identification of **17** key SWM factors that have impacts on SWM.
Second Phase [Exploratory via qualitative approach]	Semi-structured interviews with 10 respondents from MHEIs	To confirm findings from Phase One of the research, and allow new variables to be presented in this phase.	Confirmation of **14** out of **17** SWM factors and **5** strategic implication variables identified in literature review.
	Use of content analysis to analyse interview	Typical method of analysing qualitative interview data.	Development of **14** constructs regarding SWM factors and **5** strategic implication variables.
	Validation of the 14 themes from the content analysis's result	Validation of these themes are required to suit the local context.	**6** out of **10** interviewees verified these themes are appropriate for local context.
	Development of theoretical framework based on local context	**[Objective 2]** *To develop the relationship between the principal factors and strategic implication of MHEI SWM strategy.*	Development of refined theoretical framework for SWM performance.

Table 4.2, continued

Procedures		Justification	Outcomes
Third Phase [Confirmatory via quantitative approach]	Development of research hypothesis	Allow for testing of research findings	Development of **5** research hypotheses that can be tested throughout quantitative method.
	Choice of survey tool	**[Objective 3]** *To establish the extent to which these principal factors have an impact on the strategic solid waste operation at the institutional level in MHEIs.*	No pre-validate tool existed for all variables for Malaysian context, as the pre-validated tools employed in different sectors that mostly used in municipal sector, and now for different purpose, thus new survey instrument need to be developed.
	Development of survey instrument based on interviews	Need to incorporate findings from Phase Two into development of survey tool	Establishment of new survey instrument.
	Various types of data collection in questionnaire survey	Use of various types of questionnaire giving out reaches wider audience throughout MHEIs, increase ability to confirm findings from interviews.	**129** completed questionnaires from respondents in MHEIs.
	Data analysis using statistical analysis method	Confirm results from large scale survey.	Analysed results established relationship between MHEIs SWM factors and strategic implication variables; supporting the **5** hypotheses tested.

The critical literature review identified a broad range of factors expected to have an influence on strategic SWM in MHEI. Thus, the next stage was an iterative process, where each factor was assessed separately to determine which of these SWM factors were occurred repeatedly in the literature and where linked to the strategic institution SWM. A final outcome of the iterative literature search process was the identification of SWM factors. A total of 17 SWM factors were identified as being related to strategic SWM.

Afterwards, the next stage utilised the results of the literature review to validate the findings from the first phase. Since this research concentrated on specific issues regarding SWM themes in the context of MHEIs, this research looked for an in-depth understanding of the social process related to critical issues with regard to SWM, which would be extracted from research interviewees' views, not only from statistical data. Consequently, the second phase of this research was exploratory via qualitative approach. Hence, ten (10) representatives, who from the MHEIs, were interviewed.

The first objective of this research was to determine the principal factors were believed as imperative for higher education institutions SWM in local context. Therefore, the interpretivist research approach was utilised, as an exploratory venture, in order to establish and validate the factors to be used in the research. This was done through the analysis of findings from semi-structured interview. The interviews process had the aim of capturing the understanding that participants held for the principal factors / variables. This was an essential procedure in this research as the identified constructs are very wide and require further elucidation to be able to reach at useful conclusions and acceptable to local context. Hence, the interviews served to validate the constructs on SWM and recycling operation as perceived by the experts in the sector.

Content analysis from the interviews clearly pointed out fourteen (14) out of seventeen (17) constructs and five (5) strategic implication variables identified from literature review, being perceived by the experts from MHEIs as having impact on their recycling operation. In sum, fourteen (14) constructs and five (5) strategic implication variables would be carried forward and tested into the confirmatory phase, since this research covered the higher education institutional sector in Malaysia only.

After having reviewed the literature and analysed the interview results, the final phase was a confirmatory stage by which a large-scale survey was carried out with the aim of evaluating the existing trend of recycling operation in MHEIs; establishing the relationship between the fourteen (14) SWM constructs and five (5) strategic implication variables; and identifying how these constructs have strategic implication on MHEIs solid waste recycling practices. Measurement of certain variables is one of the key characteristics of the positivist approach. Besides, the development and testing of the research hypotheses developed as a result of interviewing MHEIs gives further confidence to the use of this methodology formulation and testing of hypotheses is a main feature of the positivist approach.

To date, no study has been presented which totally compares the constructs of SWM between MHEIs. Although the study of Baharum and Pitt (2010) did the comparison on the constructs of recycling between shopping centre organisations, however the study was applied the Critical Success Factors (CSFs) method and for UK context, whereby the survey instrument is not applicable for this research. In addition, the pre-validated tools are used in different contexts and for different purposes, as there are mainly from municipal recycling studies (Isa et al., 2005; Murad & Siwar (2007); Saeed et al., 2009; Afroz et al., 2013; MHLG, 2010; Agamuthu et al., 2011; Zen et al., 2014; Moh & Abd Manaf, 2014). As a consequence, no pre-validated survey tool was relevant to the current research; hence, a new survey instrument was developed. The new survey instrument was informed by the feedback and responses from interviewees with regard to the different constructs and their perception of institution SWM as a whole. Principally, pre-testing was carried out to ensure the validity and reliability of the survey tool while validation process of the survey tool was conducted to make sure the accuracy of the constructs and internal consistency of the data to be measured.

In a research, it is important to identify evidently what instruments and procedures are to be applied in collecting and analysing data. The three-phased approach to research design permitted the identification of principal SWM factors and strategic implication variables in MHEIs SWM. Table 4.2 summarises the key phases and the process in this investigation. The following sections elaborate the three research phases employed.

4.6 Phase 1: Development of Theoretical Framework

The first phase of this research is attempted to attain the first objective, which is determining the principal factors for higher education institutions SWM in local context. A theoretical framework has been developed based around a global collection of review derived from principal SWM factors, together with its strategic implication variables; this is illustrated in Figure 3.6, Section 3.6. According to Sekaran and Bougie (2009), a theoretical framework is the foundation on which research is based. They further stated that a framework is reasonably established, described and elaborated network of relationship among the variables believed applicable to the problem situation and identified through such processes as interviews and literature review. In principle, the theoretical elements within the framework are essential in this exploratory study, where at this early stage of the research, the researcher has limited understanding about the current trends exists. The theoretical framework for a research should include this basic feature which is the variables reflected relevant to the study should be clearly defined (Sekaran & Bougie, 2009).

Given the size and scope of the literature concerning SWM, the major focus of the literature review was to reveal the SWM factors that have strategic implications on the institution SWM and to ensure the SWM factors identified worldwide are indeed precise and comprehensive.

Chapter Two contained a broad review which highlighted sustainable development in business and education globally, which specifically has given the attention on positioning higher education institutions business and service towards sustainability. The review of policies framework for commercial solid waste has identified the policy gap between developed countries and developing countries. From the review of past literatures, Viebahn (2002) stressed universities and colleges have a distinctive responsibility, particularly regarding to youth education and public awareness about sustainability. In addition, the progressive importance of strategic FM and the limited landfill sites in Malaysia prompt the SWM to be planned in strategically and adopted the best practices from developed countries.

As discussed in Chapter Three, there is vast research examining SWM globally in both the municipal sector (Suttibak & Nitivattananon, 2008; Perrin & Barton, 2001; Thomas, 2001; Folz, 2004; Barr et al., 2003; Zhang et al., 2010; Isa et al., 2005; Murad & Siwar, 2007; Saeed et al., 2009; Afroz et al., 2013) and institutional sector (Armijo de Vega et al., 2008; Kelly et al., 2006; Smyth et al., 2010; Zhang et al., 2011; Kaplowitz et al., 2009; Amutenya et al., 2009; Barnes & Jerman, 2002; Dahle & Neumayer, 2001; Elfithri et al., 2012; Zain et al., 2012). A substantial amount is already understood regarding SWM and recycling initiatives. However, how the higher education institutions SWM relates to strategic FM is still relatively understudied. A prime example was Baharum's (2011) exploratory study on the UK shopping centre recycling strategies, which evaluated the association between recycling factors and its implementation success at operational level.

The critical review of literature in Chapter Three reveals a number of factors that potentially could have the strategic implications on institutions SWM and recycling initiatives. Nevertheless, certain factors had been categorised under one comprehensive heading as different research gave different themes to similar areas. For instance, convenient, easy-to-use infrastructure, storage space and easy access were all grouped under the proximity of recycling facilities. In the aggregate, the literature review reached at seventeen (17) SWM factors identified as related to the strategic facility planning of higher education institutions SWM.

As a consequence, the findings from the literature review process have created a research framework for higher education institutions SWM that conceptualises the links between the seventeen (17) SWM factors, MHEI groupings and strategic implication variables. This is detailed in Section 3.6 and forms one of the original contributions to knowledge of this study.

Based on the theoretical framework created for this research, the next phase is sought for proving the importance of the identified principal SWM factors and strategic implication variables. Thus, the seventeen (17) SWM factors and five (5) strategic implication variables identified in the literature are carried forward to the next phase, to be validated via interviews with the experts in the higher education institutions in Malaysia.

4.7 Phase 2: Exploratory Phase of Interviews

The key aim of this exploratory phase was to identify a comprehensive set of significant SWM factors associated with attaining the strategic implications on higher education institution SWM. As Sekaran and Bougie (2009) mentioned, interviewing is a useful data collection method, specifically during the exploratory stages of research. Moreover, this phase is required to validate the literature review findings; confirm the SWM factors and strategic implication variables which reflect the existing phenomenon in the MHEI SWM. As mentioned, there is lack of research in MHEI SWM; hence, it was believed essential to explore whether the SWM factors and strategic implication variables proposed by the past researches from the relevant sectors were utilised by those implementing SWM in MHEIs. This is also imperative to discover the main barriers during implementation and whether these SWM factors can bring to strategic implications on MHEIs SWM.

4.7.1 Selected MHEI Profiles

To validate the factors / variables, semi-structured interviews are conducted to address the particular topic and also to permit any themes to be developed (Jankowicz, 2005). Leedy and Ormrod (2013) also mentioned that semi-structured interviews revolve around central questions. Bryman (2008) agreed that by using semi-structured interview which is referred as in-depth interview, researcher shall have relatively specific topics to be covered. In this research, the identified factors / variables from the literature phase can be confirmed and other pertinent issues can be presented via semi-structured interviews as well.

A sample of population for traditional scheme format of public and private higher education institutions based on the Ministry of Higher Education Malaysia (2014) was used to identify the interviewees and participants from the industry. According to the Ministry of Education Malaysia (2014), the total population of registered higher education institutions in Malaysia is 20 *Universiti Awam* (UA) and 397 *Institusi Pengajian Tinggi Swasta* (IPTS). UA consists of 20 public universities while IPTS comprises 71 private universities and 326 colleges. A total of ten (10) MHEIs were selected for semi-structured interviews. The characteristics and achievement on SWM-related activities of MHEIs was used to identify the interviewees or participants from the MHEIs since to date, no research has been conducted on evaluation on MHEIs SWM performance. Finally, ten (10) MHEIs were selected based on the characteristics and achievement gained from their best practise in the recent years, as summarised in Table 4.3. The ten (10) selected MHEIs are from the different categories of MHEIs so that this research covers different type of higher education institutions to minimise the bias in the selection of variables to be employed in the study.

Since 90% of the expenses of public universities are government subsidies (Ministry of Education Malaysia, 2015), it is believed that public universities have capital to invest in SWM. Therefore, most of the interviewees were chosen from public universities. When compared to colleges, private universities have larger scale of organisation, so it is expected that interviewees from private universities have more experiences on institution SWM. As a result, six (6) interviewees are from public universities, three (3) interviewees are from private universities, and one (1) interviewee is from a college. With the anticipated competencies and experience gained by these interviewees, the researcher assumed the selected interviewees capable to provide productive response throughout the interview process. The selected MHEIs for interviews were coded as "MHEI 1, MHEI 2, MHEI 3…." instead of revealing the higher education institution names to protect the identity of the respondents and their respective institution. As Chua (2012) stated, the researcher must protect the identity and personal information of respondents; guarding the privacy of respondents is an essential aspect of ethical research practice.

Table 4.3: Characteristics of selected MHEIs

MHEI	Characteristics	Achievement
MHEI 1	▪ Public university; research university ▪ There is a special secretariat that manages campus sustainable environment initiatives under administration of the Vice Chancellor office ▪ Secretariat is responsible to establish long term strategies to transform the University into an environmentally sustainable campus ▪ Flagship project: Zero Waste Campaign (ZWC) is a long-term campaign aims to attain campus with zero waste to landfill with the establishment of integrated waste management instrument ▪ Developed an in-house composting centre	▪ Ranked 160th in the UI-Green Metric World University Ranking in 2012; ranked 213th in 2013; ranked 72th in 2014 ▪ From September 2011 until December 2012, composted 32,703kg of food waste, equal to more than RM7,000 saving in the decrease of waste disposal cost for University which is also equivalent to save more than 10 tons of carbon emitted
MHEI 2	▪ Public university; comprehensive university ▪ Largest university in Malaysia in terms of size and student enrolment ▪ Landscape unit, which under the Facilities Management Office responsible on the collection of domestic waste and recycling programme ▪ Launched environmental week by student association	▪ Obtained the award for national Institutional Environment Category in 2013
MHEI 3	▪ Public university; focused university ▪ The 1st Technical Public University in Malaysia ▪ Occupational Safety and Health Office (OSHA) responsible on SWM ▪ Initiating Green Café project; “University recycling day”	-
MHEI 4	▪ Public university; research university ▪ 1st Malaysian university obtained EMS certification ▪ Occupational Safety and Health (OSH) Management Office manages solid waste disposal and management	▪ Ranked 19th place in the UI-GreenMetric World University Ranking 2012; ranked 16th place in 2013; 41th place in 2014

Table 4.3, continued

MHEI	Characteristics	Achievement
MHEI 4	▪ Establishment of Green Policy with policy statement ▪ Green Mandate – one of the milestones towards Green Campaign is initiated afterwards	▪ One of the seven paper manufacturers to obtain reward from the WWF (World Wide fund for Nature) in the group of 'Transparency' during 2012 WWF Environmental Paper Awards ▪ Received a RM5 million research contract award from a fertiliser manufacturer to come out with a green and sustainable fertiliser ▪ Obtained the EU's Sustainable Energy Europe Award 2014 in 'Travelling group for the renewable, energy efficiency and clean transport ▪ Total amount of university solid waste sent to landfill had decreased by over 10% during the last ten year.
MHEI 5	▪ Launched Sustainable Campus and then Office of Campus Sustainably is established afterwards ▪ Launch of 'Monday is University Recycling Day', 'Green Office' and 'Arked Lestari' ▪ Sustainable Campus Policy was developed to provide guidelines of campus sustainability ▪ "Sustainable Campus Community" is highlighted via the policy ▪ Sustainable Arcade initiated to introduce the Sustainable Culture Campaign 'Clean, Healthy & Green' ▪ 'Zero Waste Concept' is adopted via Sustainable Arcade, required food waste separation and continuous with the composting process.	▪ Achieved 139th out of 215 universities participated in the UI-GreenMetric Ranking and improved to 98th place in 2013 ranking; ranked 86th in 2014
MHEI 6	▪ Sustainable Campus Unit ▪ Sustainability Policy guidelines was developed ▪ Energy audit report, energy usage and sustainability metric data is issued since 2013 ▪ FM Department deals with the solid waste collection in the campus.	-

Table 4.3, continued

MHEI	Characteristics	Achievement
MHEI 7	▪ A private university established under a not-for-profit organisation	▪ Ranked as one of the top 300 universities in Asia in 2012 and 2013 by QS World University Rankings: Asia ▪ Champion in GreenTech Forum in 2014 ▪ Ranked 93th in the UI-Green Metric World University Ranking in 2014
MHEI 8	▪ 1st private university in Malaysia	-
MHEI 9	▪ A leading British university ▪ Malaysia campus is the green campus with the green construction materials ▪ One of the university's Environmental Policy Objectives is to "reduce waste and make sure that there is effective control, which advocates recycling where possible and provides responsible disposal elsewhere".	-
MHEI 10	▪ A college was established by a Group of companies since 1992 where the Group is one of Malaysia's biggest locally established private higher education institutions; ▪ This college is the largest subsidiary of the Group.	-

A Total of ten (10) MHEIs were interviewed over the period of four months. The semi-structure interview commenced in January 2014 and lasted until April 2014. Davies (2007) stated that the core sample size of a qualitative research sampling may be from 1 to 20: the smaller the sample, the more detailed and intense will be the process of exploring psychosocial reality. According to Sekaran and Bougie (2009) and Davies (2007), in qualitative data collection, researcher may stop to sample when the researcher has reached data saturation and is not getting any new information or are no longer gaining new insights. Thus, ten (10) MHEIs are considered satisfactory and acceptable because the principal SWM factors and strategic implication variables that reflect the trend of existing MHEI SWM were emerged after the ten (10) MHEI interviews.

4.7.2 Interview Process Development

As this research obtained information from specific target group which were the expert who responsible for managing solid waste and recycling initiatives in higher education institutions, therefore this research adopted purposeful sampling design. Sekaran and Bougie (2009) indicated that purposeful sampling limited to specific types of personal who are able to provide the needed information because they are the sole ones who have it or meet to some criteria set by researcher. Bryman (2008) and Creswell (2009) also mentioned that by using purposeful sampling (or purposive sampling), researcher samples on the basis of wanting to interview people who are relevant to the research questions. The interview procedure was pre-tested with the supervisory team and minor changes were made as a consequence.

In this study, the interviewees were people who responsible for SWM in their respective institutions. Therefore, the ten (10) interviewees were selected based on their position and job scope in the respective institution. With the anticipated competencies and knowledge possessed by these interviewees towards SWM and recycling operation in the higher education institution, the researcher assumed the selected interviewees to be capable providing productive responses during the interview process.

The interviewees were contacted for interview appointment by phone using the phone number obtained from each higher education institution website or via email. Meanwhile, the interviewees were also told the purpose of the research. The interviewees from the selected higher education institutions came from the similar working background as illustrated in Table 4.4. An official covering letter from Faculty of Built Environment, University of Malaya (Appendix A) and interview sheet was emailed to the interviewees before the interview conducted. A call was also made as a reminder to the interviewees a day before the fixed date of interview and also to inform the approximate time length of interview so that the interviewees were well-prepared and their schedule will not be interrupted. As mentioned, the interviews were semi-structured and the principal SWM factors were the common themes in the questions that were asked, with the aim of answering the research questions and objectives of the study (see detailed interview questions in Appendix B). Meanwhile, the interviewees had a chance to comment regarding the current trend of the solid waste being managed and the relevant processes involved. Besides, the interviewees were asked to provide any document, report or useful material that showed the process of implementing recycling initiatives. Confidentiality and anonymity were assured to the interviewees. Assent was taken from the interviewees to access documents concerning the initiatives.

Table 4.4: Interviewees' details

Interview code	Current employment	Type of MHEI where interviewee is employed
MHEI 1	Manager of Zero Waste Campaign	Public university
MHEI 2	Head of Facilities Management Department; Landscape architect	
MHEI 3	Director of Centre for Sustainability and Environment	
MHEI 4	Publication officer for Recycling Initiatives	
MHEI 5	Director of Campus Sustainability	
MHEI 6	Director of Sustainable Campus Unit	
MHEI 7	Registrar officer managing solid waste disposal contract	Private university
MHEI 8	Technical assistant of Building Cleaning/Landscape/Waste Disposal Unit	
MHEI 9	Associate director of international development	
MHEI 10	Manager	Colleges

All interviews were carried out face-to-face with the director or manager, or those with position equivalent to recycling coordinator, with knowledge and experiences in their SWM, at each MHEI. Thus, 9 of the 10 interviews were digitally-recorded by consent of the interviewees; however, one interviewee refused to be recorded digitally and the researcher made written notes during the interview period. On average, each interview lasted 40-45 minutes. To ensure no information loss along the procedure, a follow-up phone call was made to cover some aspects that were not thoroughly covered during the interview.

Audio recording was used to fully capture the content of the interviews. Digital recordings can easily be backed up and permit more thorough examination of what people say (Bryman, 2008). Bryman (2008) also asserted that digital recording allows repeated examinations of the interviewees' answers. Another advantage of using audio recordings is that interviewer could concentrate on the conservation with the interviewee without concern about taking notes, which seemed to be helpful during the interviews. Permission to record was sought before the interviews were started. To minimise interviewer bias and validate responses, rephrasing of interviewees feedback was carried out repeatedly along the interviews. Jankowicz (2005) elucidated this technique was applied to confirm the understanding of responses and reduce the interviewer bias. Sekaran and Bougie (2009) stated that to obtain honest information and avoided the bias from the interviewees, it is essential to state the purpose of the interview and assure complete confidentially about the source of responses.

4.7.3 Analysis of Interview

In this research, the qualitative data originated from the ten (10) interviews were transcribed from the audio recorder and some extra documents collected from participating higher education institutions. Inductive approach was adopted in analysing the qualitative data. According to Chua (2013), inductive approach presents the evidence collected from the interviewees before drawing a conclusion from the event under study. He further explained that this approach could give a big picture of the event and to draw conclusions and implications of the event. A content analysis method was employed to analyse the semi-structured interview questions after the transcripts were done. Chua (2013) indicated that this method is used for studying the content of communication presented in verbal or visual documents and is generally used by researchers in social science research to analysis recorded interview transcripts. Other authors define content analysis as:

- "an accepted method of textual investigation, particularly in the field of mass communication" (Silverman, 2011);
- "an approach comprises a searching-out of underlying themes in the materials being analysed" (Bryman, 2008).

This technique was employed to analyse the qualitative data and explore any unknown factors that could lead the higher education institutions to manage solid waste and recycling practices strategically and effectively. Content analysis was developed for each interview transcript used a coding strategy (Robson, 1993; Silverman, 1993) that reflects key points of the transcripts and core elements of significant factors. Coding is the process of organising the material into chunks or sections of text before bringing meaning to information (Creswell, 2009 quoted from Rossman and Rallis, 1998). At the beginning, the researcher pre-scanned and read through the transcribed data to get a general sense and a rough picture of the material. After that, researcher analysed the data by coding it and themes were assigned to the data. The themes were re-examined and compared to other themes so as to eradicate any possible overlap that existed. When overlap indicated that the themes were re-analysed and collapsed or expanded as regarded appropriate. Once the transcripts were coded to proper themes, the researcher grouped the themes based on the similarity in meaning to allow for further interpretation. The process of qualitative data analysis in the study is summarised in the figure below:

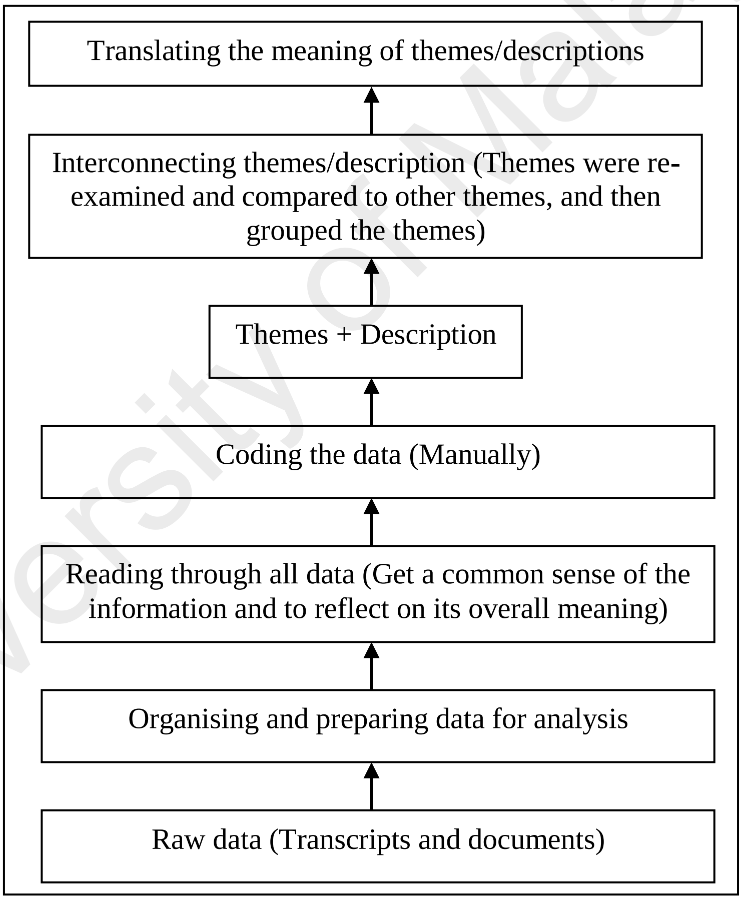


Figure 4.2: Data analysis process

Resulting from the content analysis, only fourteen (14) SWM factors were apparent of the seventeen (17) SWM factors identified from literature review while all five (5) strategic implication variables were validated. As described in earlier chapters, the research focuses on the current practices of MHEIs SWM and recycling initiatives, hence only fourteen (14) SWM factors that confirmed by the respondents through interviews were be considered as significant to the MHEIs SWM in Malaysia. A validation of the fourteen (14) SWM factors and five (5) strategic implication variables was performed by distributing the validation sheet to all the interviewed respondents (see validation sheet in Appendix C). Six out of ten respondents returned the feedback and agreed with the fourteen (14) SWM factors and five (5) strategic implication variables which confirmed through the interviews. As the validation is based on the voluntary basic and majority of respondents consistently agreed with the variables identified via interviews, the fourteen (14) SWM factors and five (5) strategic implication variables are verified and adopted into the Malaysian context.

In short, the result obtained from this second phase included exploration and validation of the variables identified in phase one together with an exhaustive understanding of the major obstacles perceived by the interviewees in the industry. Moreover, this process allowed for the development of the hypotheses testing in the following phase and a survey instrument is discussed in the following section.

4.8 Phase 3: Confirmatory Phase of Questionnaire Survey

The third objective of this study is to acquire a better understanding of what combination of factors constitutes strategic SWM in MHEIs. A cross-sectional study is applied where the data is collected at one point in time. Apart from the interview, the questionnaire survey was employed as major data collection instrument in this study because questionnaire survey allows researcher to examine and explain correlations between variables in depth (Saunders et al., 2007). The questionnaire survey covered the variables identified during the second phase of research and also testing the hypothesis developed as a result of the exploratory phase – second phase of the research. Given the questionnaire survey can be used to generalise the qualitative findings to the large samples (Creswell, 2009), and hence is deemed to be the most appropriate method by which to collect data.

4.8.1 Piloting the Questionnaire

Before questionnaires are distributed to the respondents, pre-testing of questionnaire survey is important to ensure that the questionnaires reach all the data gathering objectives and to test the ease of understanding of the questions. In addition, it was also taken into account whether the time allocated to complete the survey is acceptable and any vagueness appeared from the wording of the questions were also addressed. Most importantly, pilot tests ensure the validity and reliability of the questionnaire survey instrument (Chua, 2012). Chua (2012) further explained that internal validity of the research instrument can be increased through a pilot study in these following steps, including record the time needed to answer the questionnaire to determine its suitability, modify or eliminate confusing items, evaluate if the choices for each research item (for instance the single-choice or multiple-choice items) are reasonable and so on. Creswell (2009) concurred that pilot testing is essential to establish the content validity of the instrument and to ameliorate questions, format and scales.

After the questionnaire was conceptually developed, it was reviewed by the researcher's supervisor and after that tested by the experts in the area of FM and SWM. Their invaluable comments were summarised in below table (Table 4.5). After considering all the comments, amendments were made accordingly.

Table 4.5: Pilot testing comments

Experts	Comments	Overall content	Action taken
Supervisor	▪ Add in UM logo; ▪ Arrange the questions sequence properly; ▪ Highlight the mandatory questions to be answered; ▪ Use Likert scale to measure the significant variables; ▪ Design the questionnaire in bilingual.	▪ Design according to the Malaysian context.	▪ Questionnaire is designed and amended orderly.
Waste Management Consultant OWD Consultancy	▪ Clarify the facilities management setting asked is for overall facilities management or only for waste facilities management; ▪ It is hard to get the data/statistics for past 5 years.	▪ Acceptable and suit to Malaysia higher education institutions.	▪ The questionnaire only focuses on SWM and recycling initiatives; ▪ Since the study is testing for the strategic SWM, the result obtained will be more evident and persuasive with 5 years' statistics.
Engineer from Sustainable Waste/3R Division of Solid Waste and Public Cleansing Management Corporation	▪ Make sure the respondent is the right person who can answer all the questions; ▪ Add on a column for the tick box at question 3.2 for the materials that are recycled; ▪ Make sure the recyclable list is based on the SIRIM standard; ▪ Remind the respondents do not include anything related to the academic research; ▪ Amend the terms/words of the waste disposal and recycling factors according to the Malaysian context.	▪ Acceptable.	▪ The respondents are asked for his/her position with the years of experiences; ▪ A column for the tick box at question 3.2 for the materials that are recycled is added; ▪ The recyclable list at question 3.2 refers the SIRIM standard (MS2505:2012), Corporation's solid waste composition report (2013) and journal article;

Table 4.5, continued

Experts	Comments	Overall content	Action taken
Engineer from Sustainable Waste/3R Division of Solid Waste and Public Cleansing Management Corporation	▪	▪	▪ Respondent is given instruction at the front page so that do not include the elements or infrastructures used in the particular academic research purpose; ▪ The terms/words of the waste disposal and recycling factors are amended according to the Malaysian context.
Assistant environment control officer from Health & Environment Department of Kuala Lumpur City Hall	▪ For question 3.1, researcher requests the data from year 2010 is difficult to retrieve; ▪ For question 3.2, add on the examples of the recyclable items to give the clearer understanding for the respondents; ▪ For the part of views and opinions, researcher could add on one question for respondents to suggest the strategies to encourage public to join the recycling activities; ▪ Questionnaire sent by email is considered fine.	▪ The content is suitable.	▪ As mentioned earlier, the result obtained will be more evident and persuasive with 5 years' statistics; ▪ Examples of the recycling items have been added; ▪ Questionnaire are sent either by post, email or online to suit the convenience of respondents.
Senior lecturer from Facilities Management field	▪ Some grammar errors.	▪ Acceptable.	▪ Rectify correspondingly.

4.8.2 Questionnaire Design

In a questionnaire, Olsen (2012) stressed that closed questions make a questionnaire work much more quickly than open questions (Olsen, 2012). Sekaran and Bougie (2009) also agreed that closed questions assist the respondents to make quick decisions to choose among the several alternatives before them. Besides, closed questions do permit for better detection of similarities and differences among the sample population (Converse & Presser, 1986). However, many questionnaires end with a final open-ended question that invites respondents to comment on topics that might not have been covered fully or adequately (Sekaran & Bougie, 2009). Following this recommendation, the questionnaire of this study starts with closed questions and then end with final open-ended questions.

The questionnaire comprises six (6) parts over nine (9) pages. The questionnaire is designed in bilingual after considering the education background of the respondents. A combination of closed and open-ended questions is applied, and almost all questions require respondents to answer by ticking appropriate box. Several types of closed format questions were used in this study which included single answer, multiple answers, rank-ordering question, numerical and Likert style questions. The respondents were allowed to skip the question(s) if they found it difficult to release the information due to confidentially. The structure of the questionnaire is described in Table 4.6 while the questionnaire sample is attached as Appendix D.

Table 4.6: The structure of the questionnaire

Part	Question No.	Description
1.General information	1.1 - 1.6	This part seeks to understand the basic information of the respondents and their respective higher education institution.
2. Institution solid waste management and recycling initiatives	2.1 - 2.13	This part reveals the current operation of the SWM in MHEIs and their recycling activities.
3. Institution waste trends	3.1- 3.2	Data or statistics of solid waste generated and recycled reveals the current implementation of SWM in MHEIs.
4. Institution solid waste management factors	4.1 - 4.14	This part measures the factors in terms of their importance and implementation on a five point Likert scale. It also accesses ranking of these factors from overall perceptions.
5. Views and opinions	5.1 – 5.3	Respondents' opinion may disclose extra information which not included in this study.
6. Respondent contact	-	Respondents are required to provide contact details on voluntary basic.

4.8.3 Sampling Determination

It is crucial to determine the research population that reflects the true picture of this study. Basically, the population is the universe of units from which the sample is to be chosen (Bryman, 2008). Sampling is the process of choosing a number of subjects from a population as research respondents (Chua, 2012). Prior to this procedure is carried out, the size of population must be identified and a list of subjects in the population must be acquired. Sekaran and Bougie (2009) also pointed out that sample is a subset of the population, therefore the researcher will be able to draw conclusions that are generalisable to the population of interest.

Since higher education institution is acknowledged as shouldering the leadership for environment protection (Dahle & Neumayer, 2001) and as discussed earlier, by referring to scholar (Yahaya & Larsen, 2008), and Ministry of Education Malaysia

(2015), financial source and financial capability of the MHEIs is deemed as main element that influence the function of an institution, the researcher believes that classifying the type of respondent based on type of MHEI is appropriate to minimise respondent bias.

In addition, there is no standard format for SWM organisation in each MHEI, therefore the implementation of SWM is usually executed by a specific unit or a small unit under the FM department. According to the Ministry of Education Malaysia (2014), total population of registered MHEIs consist of 20 public universities, 71 private universities and 326 colleges (as illustrated in Table 4.7).

Table 4.7: Number of respondents based on MHEIs schemes (Department of Higher Education, Ministry of Education Malaysia, 2014)

Ownership of MHEI	MHEI group	Population	Responded
Public	Public university	20	13
Private	Private university	71	35
	College	326	81
Total		**417**	**129**

With total population of 417 MHEIs format, the study covers all MHEIs. As a result, a sample of 417 MHEIs was selected, which categorised into Public University, Private University and College scheme types of traditional MHEI format (as detailed in Table 4.7) based on the financial capability to operationalise the SWM initiatives. As mentioned earlier in Section 3.6, MHEIs were grouped into 3 types of traditional MHEI formats after the consideration of the financial capability of public sector and private sector which may affect the operation of their SWM. The researcher believes that differences in public and private funding determines their operating expenses on SWM initiatives.

4.8.4 Conducting the Survey

Once the final version of questionnaire was completed, a formal letter from the Faculty of Built Environment, University of Malaya (as shown as Appendix A) and a cover letter (as shown as Appendix E) containing the objectives of the research, the importance of the information required are attached together as well. In this study, the respondent from the respective institution is the person who responsible for the SWM in the MHEI. Firstly, the researcher called each higher education institution to identify the name and position for the targeted respondent. After that, the researcher asked the type of preferable and convenience method for the respondents to receive questionnaire. A set of questionnaires was printed out and posted with self-addressed prepaid return envelopes after confirming the respondents prefer the questionnaire is sent out by post. However, the respondents were also permitted to return their completed questionnaire by e-mail. The questionnaires posted out were using Faculty of Built Environment, University of Malaya address as a return address to reflect the importance of the work and to show that the survey was official in nature.

Apart from postal questionnaire, e-mail questionnaire survey is used concurrently as most of the respondents prefer the questionnaire was sent via e-mail. As Chua (2012) stated, e-mail brings many benefits to the researcher, such as easy research procedure, low cost of management, quick and easy data collection method, and user-friendly features. For the purpose to facilitate the response rate and ensure adequate sample size for statistical analysis, the original questionnaire format was adapted using the Google Forms online survey. The data collection was carried out between January and August 2015. Call reminder was made to all the respondents after the questionnaires sent via e-mail to confirm the respondents received the questionnaire. After that, call reminders were made every two weeks to make sure all the respondents replied. However, only 40 of questionnaires were returned after three months; it was far from the targeted sample size. To increase the response rate, call reminders and e-mail reminders were sent out every week to those who had not returned the questionnaire. Some of the respondents claimed that they always forgot to answer the questionnaire; therefore, phone interviews were conducted in which the questions from questionnaire were asked and the respondents answered through phone. Through phone interview, researcher was able to explain questions which were unclear (Chua, 2012).

After eight months of data collection, a total of 129 questionnaires returned for this study as shown in Table 4.7. This number does not meet the targeted sample size as stated by Krejcie and Morgan (1970). It was found that no any official department or unit for SWM was the reason of unsatisfactory response rate. However, a minimal response rate was achieved, at 30% as suggested by Sekaran and Bougie (2009).

Filtration was undertaken to examine the questionnaire that could be used for data analysis. 129 questionnaires or 30.9% were identified as appropriate to be applied for data analysis, where 13 were Public University scheme, 35 were Private University scheme, and 81 were College scheme (as detailed in Table 4.7). Margin of error for this pooling sample is 7.18%, with a confidence level of 95% to be evaluated. The rate is considered adequate for statistical analysis to be applied per Field (2009).

For the data transformation purposes in the questionnaire survey, the Software Package of Social Science (SPSS) version 22.0 was applied for data analysis. An in-depth analysis of the questionnaire results is presented in Chapter 6 of this thesis.

4.9 Methods for Statistical Data Analysis Employed

In the present study, data obtained in the questionnaire survey were analysed applying the Statistical Package for the Social Science (SPSS) software, version 22.0. Statistical techniques were selected appropriately based on the type of data and approach of hypothesis testing. In order to attain the third objective of the research (i.e. to establish the extent to which the principal SWM factors have an impact on the strategic solid waste operation at institutional level in MHEIs), several hypothesis tests are developed to assess the current practice. As Creswell (2009) stated, the inferential hypothesis relates variables or compare groups in terms of variables so that inferences can be drawn from the sample to population. The statistical analysis which are ANOVA, MANOVA, Pearson's correlation and hierarchical multiple linear regression procedure were employed as applicable methods to test the hypothesis. As several data from the questionnaire survey was nominal in nature, the descriptive analysis was employed to analyse such data. The following sections discusses in detail about the statistical techniques employed for quantitative data analysis in the study.

4.9.1 Frequency Distributions and Descriptive Statistics

Descriptive statistics are used to describe the characteristics of a variable (Chua, 2013). This descriptive analysis should indicate the means, standard deviations, and range of scores for the variables (Creswell, 2009). The frequency distribution method has been applied to present the profile of the response obtained in the questionnaire survey. The data are presented in tables and graphic forms, which provide a complete view of the profile of the findings with the percentage of responses given. Chua (2013) stated that descriptive statistics able to make a conclusion about a variable based on numerical data. Besides, to rank some of the variables, calculation of the mean was conducted. Five-point scale used in the questionnaire was transformed to mean readings to determine the ranks of each variable, following the procedure used by Baharum (2011) and Chua (2014) in their studies.

4.9.2 Reliability Test: Cronbach's Alpha Internal Consistency Method

In quantitative study, reliability refers to the ability of all the variables in the research tool to dependably measure the concept (Chua, 2012). It largely determines the possible accuracy of the measurements (Vogt, 2007). This capability is called internal consistency reliability (Chua, 2012). This reliability method has been used in the first hypothesis in this study to test the reliability of the both independent variables and dependent variables, which are SWM factors and strategic implication variables. Through this method, variables with high correlation values with the test index score have high reliability while variables with low correlation values have low reliability and will be removed from the test (Chua, 2013). By calculating the Cronbach's alpha reliability coefficient, the reliability level of the research instrument will be identified. Besides, Sekaran and Bougie (2009) pointed out that in almost every case, Cronbach's alpha is an adequate test of internal consistency reliability. An alpha value of 0.65 to 0.95 is satisfactory and the data is considered reliable (Chua, 2013). In the present study, the Cronbach's alpha coefficient shows a reading of 0.871, which indicates that the scale and data obtained is reliable.

4.9.3 Pearson's Correlation Procedure

To test the strength of the relationship between the two variables, a correlation test is the best option. Statistical measure of the extent of which varies to the value of one variable predict change to the value of another is called correlation coefficient. A coefficient of +1 indicates that the two variables are perfectly positively correlated, so as one variable increases, the other increases by a proportionate amount, and vice versa; a coefficient of -1 means that there is a perfect negative relationship (Field, 2009). The second and third hypothesis tests are developed to examine any significant relationship between the variables, Pearson's correlation analysis was believed as the most appropriate method. Normality test of data distribution is required for this correlation test and the data distribution of variables was found to be normal based on the results from normality test. The resulting correlation coefficients (r values) from the Pearson's correlation analysis indicate the strength of relationship for each individual construct between the two variables tested. Detailed procedures on relationship analysis and results from two Pearson's correlation tests are presented in Section 6.5 and 6.6 respectively.

4.9.4 ANOVA Procedure

Analysis of variance (ANOVA) test is always the best statistical test option when the researcher needs to compare groups for differences in the variables' means. ANOVA is a hypothesis testing procedure used to compare the mean difference between two or more groups (Latifah et al., 2004). An ANOVA test allows the researcher to conduct an analysis on two (or more) independent variables simultaneously to see if there is an interactive effect between the independent variables (Chua, 2013).

Based around the fourth hypothesis, testing was developed to evaluate the effectiveness level of strategic solid waste operation perceived by three respondent groups. One-way ANOVA was used to test the effect of three MHEI groupings' variation on effectiveness level of strategic solid waste operation. ANOVA tests show whether two or more means are the same, so it tests the null hypothesis that all group means are equal (Field, 2009). Since one way ANOVA is used to identify the effects of one independent variable which affect the dependent variable, a single criterion is applied for this test. The same procedure was used by Baharum (2011) in his study to evaluate recycling implementation success as perceived by three respondent groups.

Prior to the ANOVA test, to determine the variations on effectiveness level of strategic solid waste operation between respondent groups, it is imperative to conduct a composite variable to define a dependent variable in this test. The composite variable can be defined by the following equation:

Strategic implication variable (DV) = (DV1+DV2+DV3+DV4+DV5)/5 = mean score.

Equation 4.1

Analysis of variance on the effect of strategic solid waste operation on three MHEI groupings was based on the hypothesis test 4 in Section 6.7. Variation is computed as the ratio of mean square deviation between respondent groups and within respondent groups, which known as the (F) statistic. In other words, it is the ratio of how good the model is against how bad it is (how much error there is) (Field, 2009). The extent or how significant or insignificant the calculated variation is reflected by the significance value (or p-value); where $p < 0.05$ then the level of variation is said to be statistically significant. The results of this test are presented in Table 6.18, Section 6.7.1 of Chapter Six which indicate the sum of squares, degrees of freedom (df), mean square (average amount of variation), F value (F) and significance value of F (Sig.). Significance value indicates whether the null hypothesis has to be rejected or not. Social scientists have traditionally deemed a probability level of 0.05 as a suitable cut-off point for rejecting the null hypothesis (Latifah et al., 2004). The 0.05 level is ordinarily an accepting level for scholarly journals (Latifah et al., 2004). Therefore, results having significance value less than 0.05 are assumed to be conclusive. Null hypothesis will be rejected when the result has a 0.05 probability level or less.

Since one way ANOVA is unable to find out which particular respondent groups were significantly different from each other, a post hoc analysis with Tukey procedure was conducted to identify differences between the composite variable (strategic implication variable) and respondent groups, and also specify which groups differed from each other. A detailed procedure and the results from ANOVA test are presented in Section 6.7 of Chapter Six.

4.9.5 MANOVA Procedure

Based around the fifth hypothesis test developed, multivariate analysis of variance (MANOVA) was employed to evaluate the effect of respondent variation with on perception of importance with respect to the SWM factors. The study employed the general linear model (GLM), because the MANOVA in multivariate GLM extends the ANOVA by taking into account multiple dependent variables. Hypothesis tests with the general linear model can be conducted in two ways, which are multivariate or as several independent univariate tests. The normality test of data distribution is conducted since most of the data generated from questionnaire survey were in ordinal scale (responses were mostly ratings measured on the Likert scale). This group of data were at first subjected to a normality test which indicated that the data were normally distributed. Detailed MANOVA procedure and the results are presented in Section 6.8 of Chapter Six. Results having significance value less than 0.05 are assumed to be conclusive. That is, the null hypothesis will be rejected when the result has a 0.05 probability level or less.

4.9.6 Hierarchical Multiple Linear Regression Analysis Procedure

To examine the influential factors involved, multiple linear regression analysis was believed as appropriate method by investigating the effects of the independent variables on the dependent variable (Field, 2009). Multiple linear regression is a logical extension of simple linear regression principles to situations in which there are several predictors (Field, 2009). In this study, having more than one predictor variable is useful when predicting respondents' perceptions, as our thoughts, actions and emotions are likely to be influenced by some combination of several factors. Thus, multiple linear regression was chosen so that the researcher can test theories (or models) which recycling factors are influencing the strategic solid waste operation.

Furthermore, multiple linear regression is still considered as appropriate method although the variables tested are ordinal scale in nature. As many scientists treated the variables which dimension is evaluated using a 5-point scale and the different between rating of 1 and 2 is identical to the difference between ratings of 3 and 4, as interval (Field, 2009), hence a linear regression test is suitable to be used. In multiple linear regression analysis, the independent variable (X) is known as predictor variable whereas the dependent variable is known as the criterion variable ($\hat{Y}$). The criterion variable score ($\hat{Y}$) is predicted using k predictor variables (X_1, X_2…and X_k), where $k > 2$. The prediction of $\hat{Y}$ is accomplished by the following equation:

$$\hat{Y} = a + b_1X_1 + b_2X_2 + \dots + b_kX_k + a$$

Equation 4.2

Where b values are regression coefficient for each predictor variable and a value is regression constant.

In this case, the predictor variables which found significant correlation with each strategic implication variable in the Pearson's correlation are only taken into account in this model. The researcher referred the fourteen (14) SWM factors as independent variables or predictors, and the strategic implication variables as dependent variable ($\hat{Y}$). The predictors and dependent variable were then computed under the multiple linear regression equation, as given in the *equation 4.2*. Value for dependent variable, $\hat{Y}$, is referred to the strategic implication variables which comprise waste stream reduction / waste minimisation, cost reduction, revenue generated, change of recycling behaviour/culture and compliance of Acts. Therefore, five regression models were produced for these five strategic implication variables respectively.

The strength of correlation between the variables is measured by the coefficient of determination (R^2). This measures the percentage of total variation in the dependent variable that is 'observed' by the variation in the independent variables. A R^2 of 1 represents a situation I which the model perfectly predicts the observed data (Field, 2009). It R equals to 0, then there is lack of relationship between the independent variables (predictors) and the dependent variable.

It is essential to clarify the types of variables available for this analysis. In the present study, besides the fourteen (14) SWM factors, it is imperative to note the occurrence of the variance of three different respondent groups may affect the relationship between predictors and criterion variable. As stated by Chua (2012), confounding variable is a variable which exists unexpectedly and affects the relationship between the independent and dependent variables.

Examining the information available from the output of the questionnaire survey, 14 SWM factors and 3 groups of MHEIs (confounding variable) were identified. According to Chua (2009), hierarchical multiple regression allows the inclusion of predictor variables into a regression equation based on the level of importance of each predictor variable to variable criterion (based on information theory and previous studies). As a general rule, known predictors (from other study) should be entered into the model first in order of their importance in predicting the outcome. After known manner, or hierarchically (such that the new predictor suspected to be the most important is entered first) (Field, 2009).

In this study, the significant correlation of SWM factors with the strategic implication variables from the results of Person's correlation analysis were only entered into the regression test. Hierarchical multiple linear regression was performed for the significant SWM factors (entered at step 2 – Stepwise method) to examine whether these factors accounted for the variance in strategic implication variables over and above the variance explained by three MHEI groupings (entered at step 1 – Enter method). A stepwise method was employed subsequently after the Enter method is important when researcher wanted to know the minimum number of variables the researcher would need to measure in order to predict the criterion variable (Chua, 2009). Detailed procedures and results from each regression test are presented in Section 6.9 of Chapter Six.

4.10 Reliability and Validity

In a research, the researcher must ensure the concepts defined and measured are identical (validity) and the research instrument is capable of yielding consistent data (reliability) (Chua, 2012). One of the aspects of data analysis in mixed methods research is the series of steps taken to check the reliability and validity of both the quantitative data and the accuracy of the qualitative findings (Creswell, 2009). Reliability refers to the data for the study being sufficient, dependable and consistent quality for decision making (Greene & Tonjes, 2014). Validity refers to whether an instrument measures what it was designed to measure (Field, 2009).

To be valid, the instrument must first be reliable (Field, 2009). In qualitative research, findings can be strengthened in this way by using recording devices as evidence. Interview voice or video recorders can be used to record the results of an interview (Chua, 2012). On the other hand, in quantitative research, reliability refers to the ability of all elements in the research tool to persistently measure the concept, which known as internal consistency reliability (Chua, 2012). In this study, digital recordings are conducted during the interviews and the Cronbach's alpha internal consistency method was employed to test the reliability of constructs in questionnaire survey.

In general, validity comprises internal validity and external validity. Internal validity regards to the issue of authenticity of the cause-and-effect relationship, and external regards to the generalisability to the extent environment (Sekaran & Bougie, 2009). In the exploratory (qualitative) phase, interview questions were pre-tested by the academic and industrial point of view to ensure the right context and terminologies were used in the instrument. After the interviews were completed, another validation was conducted to ensure the results are appropriate to be adopted in local context. On the other hand, validity of the confirmatory (questionnaire) phase may include sample population, time and instrument sensitivity. Thus, appropriate procedures were envisaged throughout the development of the questionnaire instrument to ensure internal validity of the survey instrument for the present study. Prior to the distribution of questionnaire survey, questionnaire was pre-tested by the experts in the area of FM and SWM to ensure the questionnaire are appropriate and can be applied in current phenomenon. Grazhdani (2015) also mentioned that questionnaire that was sent to a panel of experts is to check the content and construct validity. Lastly, convergence of research findings was considered through which information was synthesised from literature review, interview and questionnaire survey to ensure the findings are robust.

4.11 Summary

This chapter has reviewed the research methodology applied in this study. A three-phased research mixed method approach was employed using qualitative and quantitative strategies. First of all, detailed literature review was conducted to construct seventeen (17) SWM factors and five (5) strategic implication variables in SWM. This served to further validate the seventeen (17) SWM factors and five (5) strategic implication variables identified from the existing literature and explore other issues arising in the sector by conducting semi-structured interviews. As a result, only fourteen (14) SWM factors and five (5) strategic implication variables were considered significant in the strategic MHEIs solid waste operation.

After that, a set of questionnaire were designed to draw perceptions from three MHEI groupings (i.e. public university, private university and college). The purpose was to obtain data regarding validated significant factors in relation to strategic solid waste operation in MHEIs. Prior to a macro level of questionnaire survey throughout the MHEI population, pre-testing or piloting of the questionnaire was conducted to establish the content validity of the instrument.

Data collected via questionnaire survey was analysed using the Statistical Package for the Social Sciences (SPSS) software version 22.0. Main statistical tests carried out included the Analysis of Variance (ANOVA), Multivariate Analysis of Variance (MANOVA), Pearson's correlation and hierarchical multiple linear regression analysis. The output of the data analysis and conclusions in this research addresses the overall aim and objectives. Recommendations for best practices have been presented in accordance with the strategic SWM framework for the MHEIs.

CHAPTER 5: QUALITATIVE DATA ANALYSIS AND FINDINGS – INTERVIEW RESULTS

5.1 Introduction

As mentioned in Chapter 4, the first stage of the data collection is carrying out semi-structured interviews with ten (10) Malaysian higher education institutions (MHEIs). The factors discussed in Chapter 3 provided insights into critical factors of solid waste management (SWM) globally. These previous studies provided knowledge relevant to higher education institutions SWM and recycling implications. However, limited information and researches exists to provide a clear and comprehensive cognition of the factors involved and which those factors could make their recycling initiatives to have strategic implications for local context. Specifically, this is due to the lack of present knowledge and practices regarding recycling performance measurement in MHEIs; hence, strategic implication variables cannot be generalised in the term of achievement, but were validated in the respect of the contribution towards MHEIs aims.

Most importantly, the chapter aims to meet the second objective of this research. This chapter also discusses the higher education institution SWM factors that identified by the interviewees and argues with those identified via literature. The interview results validate the literature findings presented in Chapter 3 and then establish a validated theoretical framework based on the validated factors and variables that would be adapted in the Malaysian context.

Basically, this chapter briefly describes the interview process which outlined in Chapter 4, and a brief explanation of analysis technique employed. This chapter then followed by the discussion of interview feedbacks and integrated with secondary data (literature review). In addition of the principal SWM factors and strategic implication variables, the difficulties and challenges faced in pursuing the initiatives reported by the interviewees are discussed. A validated theoretical framework for this research is developed at the end of this chapter.

5.2 Qualitative Analysis of MHEI Industry's Expert: Semi-Structured Interviews

The qualitative research method was explained in detail earlier in Section 4.7 of Chapter 4. The technique of interview process used was semi-structured face-to-face interview. This can assure the interviewees provided productive detailed on specific aspects of relevant subjects. Only one interview was carried out without the use of audio recorder due to the refusal of interviewee, the rest of interviews were digitally-recorded. On average, the interviews were carried out by the researchers over a four month period and each interview lasted 40-45 minutes. Each interview began with a short introduction of the research and then followed by the questions on institution background information and institution aims behind the initiatives.

5.2.1 Data Analysis Techniques

The audio recorded interviews were transcribed word for word while the only non-digitally recorded interview was transcribed from detailed notes prior to the coding process. The transcribed interviews were then analysed using content analysis technique as elucidated in detail in Section 4.7.3 of Chapter Four.

5.3 MHEI Industry's Expert Feedback

For the purpose of exploring and confirming the higher education institution SWM factors and strategic implication variables identified in literature, primary data was gathered from the semi-structured interviews. Table 5.1 shows a summary of interview responses where the responses of the questions are discussed in detail after the Table. Details profiles of the interviewees are provided in Table 4.4, in Section 4.7.2.

As identified through the content analysis technique used, the interview questions explored a number of essential key responses pertaining to the rationale of conducting recycling initiatives, which include the overall waste management related policy, its contribution, key factors as well as the difficulties and challenges. During the content analysis process, the elements from the key responses regarding the SWM factors and strategic implication variables were grouped according to its themes (as illustrated in Appendix F). Outcomes from the interviews represent the different categories of MHEIs as six institutions (MHEI 1, MHEI 2, MHEI 3, MHEI 4, MHEI 5, and MHEI 6) represent the UA and another four institutions (MHEI 7, MHEI 8, MHEI 9 and MHEI 10) represent the IPTS.

The following sections discuss the findings from the interviews employed.

Table 5.1: Summary of interview responses

Items	MHEI 1	MHEI 2	MHEI 3	MHEI 4	MHEI 5	MHEI 6	MHEI 7	MHEI 8	MHEI 9	MHEI 10
MHEI	- Public university	- Public university	- Public university	- Public university	- Public university	- Public university	- Private university	- Private university	- Private university	- College
Waste management policy	- No policy (voluntary concern)	- No formal statement of policy; - Ensure 4% from the collected waste to be recycled	- No official policy; - Main idea is to reduce the paper use	- Green Policy started in year 2011, is the goal or objective towards sustainability; - Target to be a green university	- Sustainability policy; - Main focus is waste minimisation; - KAI (*Key Amal Indicator*) reduction of waste generation	- General sustainability policy guidelines	- Simple procedure for waste management, no actual policy; - Follow contractor's policy	- No formal policy; - To reduce/ minimize negative environment in campus; - To ensure disposal of waste material is in environmentally responsible manner	- Part of the overall environmental tool policy objective of the university; - One of the policy objectives is to minimise waste and ensure that there is effective control, which promotes recycling where possible and provides responsible disposal elsewhere	- None
Most component(s) on SWM (waste stream)	- C&D waste with the generation of 6-7 ton/day	- Most of the waste are sent to landfill; - Most successful method for recovery is composting (Food waste and green waste)	- Paper	- Chemical waste	- Recyclables items for solid wastes and food waste	- Food waste and paper, cardboard waste	- Chemical waste from engineering lab	- Majority are paper, cardboard, tins	- No individual category focus about	- Paper
Recycling definition to the MHEI	- No specific definition	- Recycling non-organic waste; - Composting	- Reduce instead of going towards recycling	- Recycling is the small part that included in Green Policy	- Reduce solid waste which is recyclable items; - Avoid the waste generated by distributing the recyclable collector	- Process to change materials (waste) into new products to prevent waste of potentially useful materials, reduce the consumption of fresh raw materials, reduce energy use, reduce the need for "conventional" waste disposal	- To shred the paper and sell to the third party	- Reduce, reuse the items, recycle; - Risk minimisation	- To reduce the packaging and going to be environmental friendly resources	- Basically is 3Rs (reduce, reuse, recycle) concept; - They try to reuse whatever possible which can be reused.
Drivers and contribution to MHEI aims	- Environmental sustainability; - No significant contribution to the university	- To reduce the cost; - To minimise the wastes; - Number of trip is reduced;	- Minimise the waste; - Going towards low carbon campus;	- Aims to be green university; - For environmental friendly	- Conservation and reduction of carbon monoxide (CO) elimination; - Environmental sustainability;	- No significant contribution to the university	- Cleaner, security, safe; - No major income from recycling initiatives	- No major contribution because no support from top management	- Legislation; - No direct sense for the contribution of recycling to the overall university aim	- No major contribution because do not have policy

Table 5.1, continued

Items	MHEI 1	MHEI 2	MHEI 3	MHEI 4	MHEI 5	MHEI 6	MHEI 7	MHEI 8	MHEI 9	MHEI 10
Drivers and contribution to MHEI aims		- Operation cost is reduced	- The operation cost is less than what we use before		- Economic incentives; - Sustainability and more efficient operation					
Management measures for recycling performance	- No available	- MKSP *(Mesyuarat Kajian Semula Pengurusan)* for ISO 9000:2008 audit; - Diversion rate; - Year 2012: 3200tonnes to landfill; - Year 2013: up to September 2200tonnes to landfill	- No measurement for recycling rate; - 90% of the food waste are going to landfill	- Benchmark with ISO 14001; Green Matric	- Kg per person per day; - 55%-58% reduction of paper consumption since 2008	- No measure for recycling	- Using checklist to monitor the contractor's performance	- No measure for recycling	- No measure for the campus in Malaysia due to the small size of the campus, therefore hard to define the recycling team	- No measure
SWM factors	- Participation such as stakeholders' participation; - Cost-effective; - Collection system (commingled or kerbside sort); - Institutionaliza tion (policy adoption); - Control of information involvement; - Provision and management of facility (especially storage).	- Partnership with NGO organisation and local authority in knowledge transfer; - Attitude change; - Top management can do the campaign, awareness campaign to teach student how to do recycling; - Composting is the most successful method because the process of composting can be controlled;	- Corporate with Perbandanan Teknologi Hijau Melaka in cooking oils collection; - Awareness is better compare previously after starting green café initiative; - Establish leadership development programme; - Establish property environment and green technology committee; - Mandatory for reducing the use of paper;	- Applying EMS (ISO 14001) to manage environment; - Collaboration faculty with Coca-cola Malaysia, for example the corporate programme "recycle to cycle"; - Collaboration with municipal council in [place name] Biomass Township, Knowledge Transfer Programme, recycling campaign;	- Setting KAI/KPI for reduction of waste generation; - Go for the waste reduction target of 0.30kg per person per day; - Green managers work together with cleaners to collect all the recyclable items in each PTj; - Waste management contractor collect the recyclable materials weekly; - Educational awareness campaign;	- Conducting roadshow regarding environmental recycling for awareness programme; - Campaign for zero polystyrene; - Wastes separated through 3-colour recycling bins; - Each faculty or PTJ is provided with one set of recycling bins which is considered easy to access	- Focus to safety and clean timing and dispose in proper way; - Outsource to the waste collection contractor; - Checklist and schedule for waste collection contractor; - Campaign is important to create awareness of students; - Educate and teach students and staffs to recycle all the wastes;	- Partnership with Sepang Municipal Council, provides recycling bins in campus; - Contractor collects the wastes daily; - Waste disposal contract is amended by inserting new specification, which is contractor needs to provide recycling bins starting April 2014; - Awareness campaign held once for year 2013;	- Setting a policy and procedure from the university exactly; - Environmental Policy Statement states that the university will set appropriate target to encourage continual improvement within the key aspects of the university environmental activities; - Checklist and schedule for the collection of recyclable items, construction waste, e-waste, food waste and chemical waste is prepared by the landlord; - Awareness raising programme is held by the landlord;	- Educate the community about the recycling function and how to recycle; - Would like to have third parties to educate the community; - Must have an intensive programme initiated by the top management; - The size of recycling bins provided must be based on the standard

Table 5.1, continued

Items	MHEI 1	MHEI 2	MHEI 3	MHEI 4	MHEI 5	MHEI 6	MHEI 7	MHEI 8	MHEI 9	MHEI 10
SWM factors		- Operating composting machine to compost food waste, shorten the compost period compare to *takakura* composting; - By composting and recycling, reduce 24% or 25% of wastes from going to landfill; - The compost product can replace the chemical fertilizer and then can reduce the cost of contract; - Convert the food wastes and green wastes into compost product, packaging it and then sell in 1kg for RM2; - Lots of recycling bins around campus and more than hundreds of the collection points in the campus; - Report the recycling data monthly.	- Prioritise the separation of paper and cooking oil; - Set for recycling paper and workshop waste (small part) once a month	- Biomass programme partnership with Kyutech of Japan; - Website "Green@[university name] is created to handle on creating awareness; - Provide stickers as signage sticks on the switch and printers in order to create awareness; - Green campus campaign launched by university's champion cover cycling programme and zero use of polystyrene within campus; - Waste separated via 3-colour recycling bins; - Composting site and machines for composting programme; - Produced paper bags and notepad which the cover is produced from recyclable materials;	- Green office talk; - Student Representative Council help in promoting recycling; - Provide training for green managers; - Green managers help to do the indoor recycling bins; - Sustainable Arcade as one of the strategic key initiatives to reduce food waste generation; - Green office initiatives; - Establish a waste management group; - Southern Waste Management collects the waste every Monday; - Cleaning station in the food outlet for the consumers to put their food wastes; - Composting inside campus but still in small scale;		- Highlight eco-friendly by switching off light when leaving the room	- Source separation by using 3-colour recycling bins	- Follow the policy procedure of the main campus which mandate the university community to recycle; - Wastes such as glass or plastics which can be recycled will be separated; - Set up the incentive scheme, deposit the waste can or bottle to get cash refund	

Table 5.1, continued

Items	MHEI 1	MHEI 2	MHEI 3	MHEI 4	MHEI 5	MHEI 6	MHEI 7	MHEI 8	MHEI 9	MHEI 10
SWM factors				- Reporting the feedback is necessary because of the Green Matric and EMS audit	- Separate wastes by providing indoor recycling bins; - Recycling bins are located at corridor, considered easy to access; - Green manager reports recycling quantity every month; - Economic incentive for respective PTj					
Difficulties and challenges	- The existing recycling programs are done by many parties in an ad-hoc, piece meal approach which is unsustainable; - Formal recycling collection infrastructure is not available in the campus; - 3-colour recycling bins are not functioning.	- People easy influenced by other; - End-users don't care about the programme because all facilities provided are free and they abuse the facilities; - Lack of end-users' awareness; - It is hard to get the people to follow the rules because it is voluntary; - The location of the collection area quite far, needs to take a lot of time to travel the wastes; - Lack of facilities to do sorting;	- Vandalism; - Attitude	- Attitude or habit of the people	- Lack of facility (recycling bins); - The connection between the green manager with recycling contractor	- No proper and specific policy about recycling; - Some of the faculties don't follow the recycling programme; - Low awareness	- Students and staffs mindset; - No strict enforcement; - Difficult to monitor faculty recycling initiatives	- Less participant (students); - Lack of awareness; - Lack of in-house staffs; - Difficult to control informal recycling, hard to control the cleaners from taking away the waste from campus	- People mindset and habit; - Budget constraint	- No education; - No awareness; - No measure; - No instruction from the management; - All the waste management processes are initiated by individual body; - People does not treat recycling is important; - Do not have recycling bins; - Cleaners do the recycling; - Recycling is costly.

Table 5.1, continued

Items	MHEI 1	MHEI 2	MHEI 3	MHEI 4	MHEI 5	MHEI 6	MHEI 7	MHEI 8	MHEI 9	MHEI 10
Difficulties and challenges		- Sub-contractor doesn't have competent and resources to do recycling.								
Resources	- Expertise in analysis, technical, economic, social, financing, public relation and so on; - Supporting unit that support the expertise; - Commitment from top management.	- Education; - Staff training for the contractors	- Top down policy; - One-stop centre for students and staffs to put their wastes that can be recycled;	- Campaigns and roadshow for awareness	- Strategic stakeholders; - Centralise recycling programme among the PTjs; - More awareness campaign.	- Must have proper policy to create awareness; - The mindset of people	- Procedure to force students and staffs to recycle; - Education; - Top campaign; - Outreach programmes	- Awareness campaign	- Management resource; to ensure the series of recycling as an important action for the university to address; - Physical resource; - Money resource; - incentivise the people to recycle	- Policy; - Intensive programme; - Education; - Top to bottom management.

5.3.1 Waste Management-Related Policy in MHEI

Policy is an important instrument for a programme to be succeeded; hence, this question is to find out the availability of the SWM related policy in MHEIs that enforce them to embark the recycling programme. Most of the interviewees conveyed similar point that their institution does not have formal policy for waste management in their institution. Only three (MHEI 4, MHEI 5 and MHEI 9) out of ten interviewees mentioned that SWM is one of the part of the green policy or sustainability policy in their institution. As one interviewee (MHEI 4) mentioned, "*We have Green Policy since year 2011 which the objective of the policy is towards sustainability*" and interviewee from MHEI 5 expressed that, "*We have Campus Sustainability Policy which focuses on waste minimisation through effective waste management*". However, one interviewee (MHEI 7) commented that "*we have simple procedure for waste management since no actual policy in institution*".

Corporate social responsibility (CSR) has started to play an increasing role in the realisation of sustainability (Henderson, 2007; Williamson et al., 2006) and it is considered as one of the strategic policies. One interviewee (MHEI 10) highlighted CSR as they are planning to initiate CSR programme as the effort towards the environmental friendly, he mentioned that "*...we have planning for CSR programme for students in year 2015 for example cleaning up mosques or temples or churches….*" Henderson (2007) advocated CSR as the actions of the business that profit the economy, society and the environment, with wider responsibilities beyond commerce.

Besides, the main focus for the higher education institution in managing solid waste is to reduce (MHEI 3, MHEI 4, MHEI 5 and MHEI 9), followed by reuse (MHEI 6 and

MHEI 9), recover (MHEI 2) and lastly, ensure that the disposal of waste is in environmentally responsible manner (MHEI 8). Both of the interviewees (MHEI 5 and MHEI 9) highlighted waste minimisation as the objective or focus in their policy, as "*the policy states that we need to reduce and minimise waste through effective waste management*" (MHEI 5), and "*one of the policy objectives is to minimise waste and ensure that there is effective control, which promotes recycling where possible and provides responsible disposal elsewhere*" (MHEI 9).

On the other hand, while there is no official or formal policy specifically for 4Rs initiatives enforced in higher education institutions, it is indeed that implementing the reducing of the use of origin resources will indirectly reduce the institution cost. The examples of this initiative implemented are "*conducting the e-meeting and limiting the paper use of the staffs. The number of paper rim is recorded when they want to take the paper*" (MHEI 3); "*we issue the biennial prospect [institution name] in e-book for cost savings purpose, and thus reduce the publication of 200 scripts…there is the minimisation of paper use*" (MHEI 4). There is a significant cost savings when reducing the use of origin resources implemented throughout the campus, not only among staff, but also the students and visitors.

Given that no strict enforcement of the policy obliges the institutional community to proper manage the recyclable items, the initiative of reuse is carried out via voluntary or personal basic. As one interviewee (MHEI 6) revealed that "*the lecturers will reuse the cardboard to put their lectures' stuffs when moving from one building to another building*". Interviewee from MHEI 6 further to explain that "*…in institution, sometimes we cannot say recycle because recycle is the change of the old newspaper to a paper; but at current situation we tend to reuse*". Another interviewee (MHEI 9) indicated that

"*…we have the responsible to educate the staff involved to understand it is possible to make reuse of the equipment….*" Recover is considered in the infancy stage in Malaysia since the implementation of SWM focuses on 3Rs (reduce, reuse, recycle). However, one interviewee (MHEI 2) highlighted "*the recover initiative via composting can be said is most successful compare to recycling initiative, it is because we can control the process of composting. After packaging the composting product (fertiliser), we sell at 1kg for RM2. It is indeed reducing the cost of purchasing fertiliser*". On the other hand, owing to no initiatives regarding the SWM from top management, interviewee from MHEI 8 commented that "*basically for waste management, we want to reduce or minimise negative environment in campus and also ensure the disposal of waste material is in environmentally responsible manner*".

5.3.2 Definition of Recycling to the MHEI

The interpretation of recycling term is essential for the success of recycling strategy. According to DERFA (2011), recycling means any recovery operation by which waste materials are reprocessed into goods, materials or substances whether for the original or other purposes. Van Beukering and Bouman (2001) also stressed that recycling is normally used as a collective term for recovery as well as the utilisation of secondary material. However, in Malaysia, according to the PPSPPA, recycling includes the elements of reduce, reuse, recycle as well as recovery; but the implementation only includes reduce, reuse and recycle which is also called 3Rs. One interviewee (MHEI 10) displayed similar view stated that "*recycling basically is 3Rs concept…try to reuse whatever possible which can be reused…if the people really aware, they can get income from that by collecting paper, plastics, aluminium cans and so on*".

Nonetheless, another interviewee (MHEI 8) deemed that recycling includes **reduce and reuse** initiatives only, and said that "*first is to reduce…the second is reuse the items that can be used. For instance, we reuse the beds, mattresses, hangers and others after the refurbishment of the hostel. Then the third is to recycle*". However, MHEI 7 said that "*recycling is shred the paper and sell to the 3rd party*".

A number of interviewees (MHEI 3, MHEI 4, MHEI 5 and MHEI 9) demonstrated on the emphasis on implementation of **reduce** initiative in their respective institution. As described by interviewee from MHEI 3 who said that "*in terms of recycling, which is trying to produce another product from the recyclable items, however at university level, we are trying to reduce instead of going towards recycling*". Another interviewee (MHEI 5) also indicated, "*Recycling means we reduce the solid waste which is recyclable items and also avoid the waste generation*". In addition, the interviewee from MHEI 4 emphasised that "*recycling is the small part of the policy and on the other hand, reduce the utility use and paper use is also included in our Green Policy*". Meanwhile, interviewee from MHEI 9 revealed that "*recycling maybe…is to reduce the packaging and go to be environmental friendly resources*".

Furthermore, interviewee MHEI 2 recognised **recovery** is one of the recycling initiatives as he commented that "*recycling is to recycle non-organic waste and maybe also includes composting*". Another interviewee (MHEI 6) also mentioned that "*recycling is the process to change materials (waste) into new products to prevent waste of potentially useful materials, reduce the consumption of fresh raw materials, and reduce energy usage…by reducing need for 'conventional' waste disposal*". CM Consulting (2013) displayed similar definition of recycling which stated that recycling is the process of collecting, cleansing, sorting, treating, and reconstituting materials that would otherwise become solid waste, and reverting them to economic mainstream in the form of raw material for new, reused, or reconstituted product which meet the quality standards necessary to be used in the market place. Indeed, a sustainable SWM only can be achieved by integrating 4R (reduce, reuse, recycle and recovery) initiatives with the support of the policy and also infrastructures in the supply chain.

5.3.3 Drivers and Contributions of SWM towards MHEI Overall Aims

This section reports the drives and contributions of SWM to overall aims of institution business. The results shown also validated the strategic implication variables which were identified through literature review.

Five themes are emerged based on the responses of all the ten interviewees. First, interviewees highlighted environment (MHEI 1, MHEI 4, MHEI 5), waste minimisation and reduction of resources use (MHEI 2, MHEI 3, MHEI 4); cost reduction (MHEI 2) and **legislation** (MHEI 9) are the main drivers for them to embark recycling initiatives. Interviewee MHEI 9 stated that "*waste management policy is part of the overall environment total policy objective of the university...where one of the policy objectives is to minimise waste and ensure there is effective control, which promotes recycling where possible and provides responsible disposal elsewhere."* Two interviewees (MHEI 1 and MHEI 5) recognised that due to the lack of supply chain on infrastructure, environmental sustainable is the main driver when managing solid waste in their institution. MHEI 5, a Director of the institution sustainability unit, said "*…it is for environmental sustainability…and also for the reduction of carbon monoxide (CO) elimination*".

In spite of that, **reductions of waste and resources use** are also the main aims for the higher education institutions to manage solid waste in sustainability. As one interviewee (MHEI 3) mentioned, "*The first aim is…we are trying to minimise the waste and the second is going to low carbon campus*". He further stated that "*…as I mentioned just now there is no key performance indicator (KPI) so university didn't set any goal yet. However, we can say that in terms of reduction…the use of paper is getting less in overall.*" While interviewee MHEI 4 also stated that "*…since we aim to be a green university, therefore this is the main driver for us to manage waste in sustainability, by minimising the use of resources such as paper and polystyrene…and also for environmental friendly as well*". Only one interviewee (MHEI 2) highlighted that **cost reduction** is one of the main aims to be achieved. As he elucidated, "*We aim for cost reduction and waste minimisation…we plan to reduce the cost via composting programme. For instance, we will request our contractor to use our fertiliser (composting product) for the plant and then we can reduce the operation cost*". Two interviewees (MHEI 2 and MHEI 10) emphasised on the aim of **changing community culture to recycle** by educating the community, as interviewee MHEI 2 emphasised that "*attitude change is necessity because our society is not yet ready to do recycling…they abuse the facilities…they simply throw any kind of wastes to the bins, food wastes mixed with other types of waste and then throw into the bins although there states that which bin is for paper, plastics, general waste and so on. It makes the operation of waste sorting become more difficult.*" Another interviewee MHEI 10 suggested that "*we would like to have the experts in waste management to educate the institutional community to recycle….*" However, another two interviewees (MHEI 7 and MHEI 8) stated that regarding SWM, they only have to make sure the waste is disposed of in a proper way.

In the aspect of contribution, all interviewees recognised that to date, there is no major contribution from the recycling programme in the higher education institution. To date, recycling programme is considered for environmental friendly, not for a business purpose. As a result, **profit generation** is not the focal point for the higher education institutions SWM and recycling programme in Malaysia. A Director (MHEI 5) pointed out that "*we are not targeting for a business purposes for recycling, it is only for making the operation more sustainability*". Another interviewee (MHEI 7) concurred that "*…no major income from recycling programme in our university*". Interviewee MHEI 4 also displayed similar view noted that "*since the policy only focus on green, the income generated is not the main focus*". However, interviewee MHEI 10 strongly believed recycling activities can generate income and pointed out that "*if institution aware of the importance of waste management and recycling, they can generate income…they can start practice it by collecting wastes such as paper, aluminium, cans and so on.*" Profit generation from recycling activities can become a reality if a higher education institution integrates the strong enforcement of policy, supply chain of infrastructure, awareness and so on into recycling programmes.

While there is no major income yielded for the higher education institution, it could also help the institution to reduce the operation cost via minimising the resources use. As interviewee MHEI 3 commented, "*By looking at the cost, as we are in the effort to reduce the resources use such as paper, hence the operation cost is less than what we spent previously*". Interviewee MHEI 4 further pointed out that "*there is a small contribution by reducing the book publication…which is the minimisation of paper use*". However, they (MHEI 3 and MHEI 4) do not intend to measure the operation cost and quantity of paper use. Another small contribution is mentioned by interviewee MHEI 2 is "*number of trips to travel out the wastes is reduced since the composting programme* *embarked*". On the other hand, three interviewees (MHEI 9, MHEI 8 and MHEI 10) revealed there is no contribution towards university since no much efforts given for the recycling programme. Interviewee MHEI 9 indicated that "*no direct sense of the contribution of recycling to the overall institution aim in Malaysia campus*". Interviewee MHEI 8 commented, "*I cannot see any contribution so far because our recycling programme is not much. If the institution has the proper solid waste collection and management, it actually can generate income*".

5.3.4 Measuring Recycling Performance

This section reports the methods or measurements used by the MHEIs in measuring their recycling performance. In response of this question, the interviewee (MHEI 7) stated that "*we are using checklist to monitor contractor's performance*", which implied that they are evaluating contractor's performance instead of institution recycling performance. Weight of the waste and quantity recovered are deemed as the most common methods used for measuring the recycling performance as two interviewed institutions (MHEI 2 and MHEI 5) implemented. Interviewee MHEI 2 revealed that a simple formula for calculating recycling rate is applied for all the solid waste, "*we use the number of recycled weight (per month) divided by total number of waste and then multiple 100*". Similar measurement is applied by another higher education institution (MHEI 5), which is quantity recovered. As mentioned by interviewee MHEI 5 "*…at the moment, we are evaluating based on recycling quantity reported by green managers per month for all solid waste. In terms of paper consumption, we have 55%-58% reduction since year 2008*". One the other hand, one interviewee (MHEI 4) commented that they evaluate recycling performance based on the "*benchmark of Green Matric...where the benchmark is for world university ranking*". At last, majority of the interviewees (MHEI

1, MHEI 3, MHEI 6, MHEI 7, MHEI 8, MHEI 9and MHEI 10) said that to date, no data or documentation reporting recycling performance in their respective institution. Since no any MHEI discloses the data of recycling performance; therefore, measurement indicators are excluded in this study.

5.3.5 Institution SWM Factors

A wide range of factors were considered to be crucial in the planning of higher education institutions recycling initiatives across the different interviewees. All the interviews were transcribed and the result shows that a total of fourteen (14) SWM factors were identified and validated through interviews.

A majority of the interviewees recognised that **awareness or campaign** is the most important factor in higher education institutions recycling initiatives. Interviewee MHEI 1 mentioned that, "*awareness is an important factor in the consideration to develop integrated waste management system*". One interviewee (MHEI 4) stated that, "*By creating awareness among institutional community, lots of initiatives have been conducted, for example we create a website called 'Green@ [institution name]' and also put the sticker on the wall as the signage to remind the people for saving energy*". Interviewee MHEI 4 further highlighted "*awareness is progressively increased in our campus...for instance it can be shown in the bicycle programme, the use of bicycle is increasing year by year, now around 3000 bicycles in the institution campus. With the increase of the bicycle use, there is minimisation of the use of buses and then decrease the smoke from the buses as well*". Another awareness raising programmes conducted include "*educational awareness campaign and green office talk to [unit name]*" (MHEI 5) and "*roadshow*" (MHEI 6). However, many initiatives have failed due to the culture and the attitude of people, especially student's attitude, as interviewees commented that, "*People don't care the programme because everything provided is free…so they don't feel the responsibility to properly handle the facilities, they abuse the facilities*" (MHEI 2), "*sometimes people have awareness and knowledge about recycling, but the problem is practise*"(MHEI 6) and "*awareness is the major factor for us especially dealing with students*" (MHEI 7). Interviewee MHEI 8 also pointed out, "*Awareness in our campus is not strong. Although we provide refuse chamber centre, majority of the staffs and students just put the wastes front of their door and asked the cleansers help them to carry the wastes to the refuse chamber centre…so we cannot confirm whether the wastes were put inside the refuse chamber.*" One interviewee (MHEI 3) on the other hand stated that, "*Awareness is better now compared to previously after initiating green café programme, so people are getting more information via the programme*". As one of the efforts towards the success of recycling initiatives, interviewee MHEI 3 continues highlighted "*it is enforcement for everybody to minimise the use of paper*", this could able to increase the recycling awareness and reduce the cost of purchasing papers indirectly. Interviewee (MHEI 9) also indicated, "*In Malaysia campus, we follow the policy procedure of the main campus which enforces the institutional community to recycle…*" so that the awareness among institutional community in Malaysia campus could be increased. A few studies have also highlighted raising awareness is the key factor and imperative measure in recycling programme (Dahle & Neumayer, 2001; Bolaane, 2006; Grodzinska-Jurczak et al., 2006; Agamuthu et al., 2011; Hooi et al., 2012; Elfithri et al., 2012; Afroz et al., 2013). The students' mindset towards recycling objectives is not strong and they are easy influenced by their friends lead to the failure of the recycling initiatives. Since the students are the largest group in the campus, therefore lots of efforts should be executed by the institutions management to increase the students' awareness for the environmental sustainability.

Other factor believed to have influence on strategic institution SWM is the **education and training programme**, as interviewee MHEI 2 mentioned that, "*we need the personnel that can educate the students and the society to do recycling*". Interviewee MHEI 10 has displayed similar view and mentioned that "*the community needs to be educated in recycling…educate them about the recycling function…educate them how to recycle….*" Interviewee MHEI 10 further pointed out that "*we would like to have third parties whom are the experts in waste management come to educate the institutional community*". Interviewee MHEI 5 commented that "*training is provided for our green managers*". Another two interviewees (MHEI 3 and MHEI 8) stated the seminar and training had ever been conducted in the institutions for the students and staffs respectively to teach them how to recycle and manage waste, but it is not effective. Dahle and Neumayer (2001) also claimed that lack of environmental education within the campus community is the barrier on the programme's success. Few studies emphasised knowledge about the specifics of recycling is more familiarly related to recycling behaviour (Zhang et al., 2010; Barr et al., 2003; Kelly et al., 2006; Kaplowitz et al., 2009). Indeed, by educating people, they will know their responsibility towards the environmentally sustainability. Especially for the students, higher education institutions shall educate them how to do recycling so that they can apply the recycling practices in their future working places.

Goal or **target setting policy** is essential and can have impact on strategic institutions SWM. A study by McCaul and Kopp (1982) found that goal setting raised beverage container recycling by college students. As interviewee MHEI 1 also mentioned that "*[institution name] can formulate own internal policy on waste management to achieve self-imposed targets in a voluntarily basis or to achieve national targets*". On the other hand, three out of ten interviewees have the specific targets for their institution SWM. One interviewee (MHEI 2) mentioned that, "*We have goal setting…for example 4% from the collected wastes to be recycled in year 2013*". Interviewee MHEI 5 also pointed out that "*we have KAI (Key Amal Indicator) reduction of waste generation from our campus routine activities…currently we go for 0.30kg per person per day for the reduction of waste generation*". Furthermore, interviewee MHEI 9 mentioned that [policy name] has already set the appropriate target for waste reduction. In fact, almost all of the MHEIs do not have formal and specific waste management policy, only voluntary concern. In addition, the existing institutions recycling programmes are conducted by many parties in an ad-hoc, piece meal approach which is unsustainable. Only with the strict enforcement can recycling initiatives from each department or faculty be monitored freely and improved to achieve the objectives such as waste stream reduction and cost reduction.

The implementation of **feedback on recycling performance** is deemed to have impact on strategic implication of higher education institutions recycling programme. One interviewee (MHEI 2) explained that the recycling statistics/data of the higher education institution is reported monthly. Another interviewee (MHEI 4) commented "*reporting feedback is necessary because we need to submit the data and statistics for the evaluation of Green Matric for international ranking and (EMS) ISO 14001 audit as well*". In addition, interviewee MHEI 5 stated that, "*green manager collects and reports the recycling quantity to us every month…and then we report to our university management group about the performance of each green manager in terms of selling used paper and recycling rate…*". Moreover, few previous studies also highlighted the importance of reporting feedback of recycling performance for the improvement of recycling initiatives (Armijo de Vega et al., 2008; Golob & Bartlett, 2007). At this junction, no mandatory SWM and recycling performance report is required by the government of Malaysia. As a consequence, only a few higher education institutions request a feedback report for the best practices on their recycling performance.

Strong support from top management level is perceived as essential for the strategy of institution recycling programme. As three interviewees (MHEI 1, MHEI 2 and MHEI 10) highlighted, "*commitment from top management is necessary to be required*" (MHEI 1), "*disseminate knowledge to the students is under the responsibility of the higher level of management*" (MHEI 2) and "*the intensive recycling programme shall from the top to bottom*" (MHEI 10). Example of the initiatives from the top management for the strategy of institution SWM include "*setting committees such as leadership development programme committees which establish green café programme for managing food waste*" (MHEI 3), "*green campus campaign launched by institution's champion comprise cycling programme and rebate scheme when purchasing bicycle, and food and drinks using Tupperware containers*" (MHEI 4) and "*establishing Sustainable Arcade as one of the strategic key initiatives of campus sustainability to reduce food waste generation*" (MHEI 5). Interviewee MHEI 5 further demonstrated that "*university is trying to establish a waste management group to help us in establishing more workable target in terms of recycling rate*".

Partnership was also considered as a significant factor for strategic institutions recycling programme. A good partnership relationship with the government, non-government organisations (NGOs), private sectors, the faculties and retail units is vital to successful recycling initiatives in some studies (Troschinetz & Mihelcic, 2009; Schoot Uiterkamp et al., 2011; Zhang et al., 2011; Envirowise, 2002a; Suttibak & Nitivattananon, 2008; Dahle & Neumayer, 2001; Elfithri et al., 2012). Four out of ten interviewees (MHEI 2, MHEI 3, MHEI 4 and MHEI 8) collaborate with external organisations such as "*collaborate with NGO organisation and Shah Alam City Council in knowledge transfer*" (MHEI 2), "*collaborate with Green Technology Corporation Malacca in cooking oil collection*" (MHEI 3), "*partnership with Sepang City Council in providing recycling bins in the campus for waste collection*" (MHEI 8). One of the interviewed institutions has a few external partnership projects, such as "*collaboration with Coca-cola Malaysia in 'recycle to cycle' programme*", "*collaborate with Subang Jaya Municipal Council in knowledge transfer programme, recycling campaign*" and "*biomass programme partnership with Kyutech of Japan*" (MHEI 4). Furthermore, partnership within institution departments/units is encouraged and important. As interviewee MHEI 5 commented, "*green managers have to work together with the cleaners…cleaners collect all the recyclable items and gather them together for the collection by contractor*". Through partnership, higher education institutions and the partnership organisations can share the environmental responsibility. With the progressive important of corporate social responsibility (CSR), partnership can be conducted in terms of knowledge transfer, provision of facilities or staffs.

Four out of ten interviewees (MHEI 1, MHEI 2, MHEI 4 and MHEI 5) deemed the utilisation of **method of waste recovery** such as **composting** to have significant impact on the strategy of institutions recycling programme. As interviewee MHEI 2 commented, "*I can say the most successful is composting compare to recycling because we can control composting process, but cannot for recycling….With composting, we can reduce somewhere 24% or 25% of wastes but for recycling, just only 2% or 3% contribute to the reduction of waste from going to landfill….We can reduce the operation cost by using the fertilisers produced from the composting*". Besides, interviewee MHEI 1 also commented that, "*we are actively developing strategy to divert organic waste to landfill with biological treatment such as composting and* *anaerobic digestion….*" Another interviewee (MHEI 4) stated that "*we also have composting site and machines for composting programmes*". Interviewee MHEI 5 commented in terms of the size of its composting programme that "*we have composting programme within campus, but it is still in small scale and we used the rest of waste for livestock for animal…we are still conducting natural composting, however there is mechanical composter inside the lab for lecturer's researches, yet it is not widely practised as well…but we are in the way to expand the composting practise by setting up bio-recycling centre*". On the other hand, two interviewees (MHEI 3 and MHEI 6) stated that their institutions are in the planning to initiate composting activity. As interviewee MHEI 3 mentioned that "*at this moment, food waste is just disposed to the landfill. However, we are now slowly trying to convert food wastes to compost. To date, we do not have composting site, but we are moving towards that….*" Interviewee MHEI 6 mentioned that "*regarding the methods of recovery, we are currently proposing few initiatives which outsourcing to the consultant to assist in the setting up.*" Indeed, by composting, soil structure around the campus can be improved and also reduce the need for fertilisers (Dahle & Neumayer, 2001). MHLG (2005) also stressed that by composting, a significant waste reduction at source can be achieved and the compost produced can be used as soil additive. Apparently, with these alternative recovery methods, the organisation could reduce the cost and even generate the extra income for higher education institution.

Another theme arose during the interview processes was **waste separation at source**. One interviewee (MHEI 1) commented that, "*…waste separation at source is one of the most important components to develop successful recycling programme*". Another higher education institution is prioritising waste separation for few types of waste, for instance "*separation of paper and cooking oil is our priority, we also separate the* *plastics, workshop waste and electronic waste*" (MHEI 3). Few higher education institutions are carrying out the waste separation solely using the 3-colour recycling bins, for instance, as interviewee MHEI 4 stated "*3-colour recycling bins are provided by institution for a long time*"; interviewee MHEI 6 mentioned "*…waste separated via 3-colour recycling bins in campus*"; interviewee MHEI 5 also commented that "*we provide the indoor recycling bins; the bins are located inside of the building instead of outside of the building…and we remove all the waste bins*" and interviewee MHEI 8 pointed out "we *do the source separations by using 3-colour recycling bins*". Furthermore, one interviewee (MHEI 9) also commented "*wastes like glass or plastics which can be recycled will be separated in advanced and the landlord's cleaner will take away the wastes*". Many authors advocated the prioritising of source separation of wastes because enables the attainment of the high recovery and recycling rate (Zhang et al., 2010; UNEP, 2004; Bolaane, 2006; Agamuthu et al., 2011). Moreover, in order to encourage students to practise the waste separation, the facilities such as recycling bins must be prepared in advanced and sufficient.

Proximity of recycling facilities is believed to have significant impact on higher education institutions SWM. As one interviewee (MHEI 2) commented, "*retailers complain the location of the collection are quite far from their shop, so they feel that it is difficult and it takes a lot of time to transport the wastes. This is one of the reasons why recycling programme is not successful*". In terms of the provision of recycling bins, interviewee MHEI 8 mentioned that "*we will engage the landscaping and building cleaning contractors…require them to provide the set of recycling bins and signage around campus*". Interviewee MHEI 10 stated that the size of the recycling bins provided must be based on a standard. Another interviewee (MHEI 5) stated that "*the number of recycling bins is not much in the campus…*" but in terms of its location, interviewee MHEI 5 further stressed that "*recycling bins are located at corridor which is considered easy to access*". Interviewee MHEI 5 continues to highlight, "*cleaning station is established in our cafeteria to collect all the food wastes, hence all the customers and visitors have to put their food wastes in the cleaning station after having their meal*". Besides, one interviewee (MHEI 6) also commented "*each faculty is provided one set of recycling bins…which is considered enough and easy to access as well*". Indeed, Zhang et al. (2011) highlighted effective recycling programme needs a convenient and easy-to-use infrastructure. Akil et al. (2015) stated that the accessibility of an effective recycling infrastructure that enabled community to recycle their waste was undoubtedly a critical part of any recycling programme. People always like to give the excuses and complain the recycling bins are far away and have no time to convey the wastes. Indeed, providing the facilities at the appropriate places with the signage will make the people have no excuse to resist practising recycling.

Waste disposal and collection contract provision are expected to have an influence on the strategy of institutions recycling system. All the interviewed institutions (MHEI 1, MHEI 2, MHEI 3, MHEI 4, MHEI 6, MHEI 7, MHEI 8 and MHEI 10) outsource waste collection services to waste disposal contractors, except MHEI 5 and MHEI 9. Interviewee MHEI 5 stated that institution implements the waste management contract for the SWM; while interviewee MHEI 9 pointed out that the SWM is managed by the landlord therefore no waste-related contract implemented. This factor was viewed to have strategic impact on the recycling programmes because one interviewee (MHEI 2) commented that, "*sub-contractor that was appointed by the contactor doesn't have competent and resources to do recycling*". Examples of the characteristics of waste disposal contract provision may include the aspects of service coordination such as the "*sorting of the wastes*" and also "*supply of recycling bins*". Interviewee MHEI 7 believed that performance of the current waste disposal contractor was satisfactory as he mentioned, "*to date, the outsource contract is the best practice in university….We are using open tender to choose the contractor, all the procedures are transparent*". In Malaysia, waste disposal contact is currently practised in most of the higher education institutions. In order to have an integrated SWM, higher education institutions shall insert some specifications in the contract to mandate the contractors to recycle the wastes after collection.

Collection frequency was deemed to have an influence on the strategy of higher education institutions solid waste recycling system because "*recycling collection system is one of the most important components to develop successful recycling programme*" (MHEI 1). In terms of the waste collection, the '*checklist for the waste collection method*' (MHEI 7) and "*schedule and frequency for waste collection*" (MHEI 3 and MHEI 8) are the characteristics for the recyclables collection methods provision. As one interviewee (MHEI 5) commented, "*we engage waste management company for our recyclable items collection, we set up 'Monday is our institution recycling day' therefore they come to collect every Monday*". Another interviewee (MHEI 8) stated that "*our waste disposal contractor comes around 8am-10am every day to collect the wastes*". Since MHEI 9 possessed tenancy agreement, the interviewee mentioned that "*checklist and schedule for the waste collection such as construction waste, e-waste and food waste were prepared by the landlord, we just follow the checklist and schedule*". However, all the interviewees mentioned that they do not know where the wastes going to after the collection. Likewise, Folz (2004) stressed that recycling convenience may be measured by materials collection methods, for example collection frequency, collection-day schedule and collection point. The systematic schedule and checklist for each waste collection will make the recycling collection system effective and efficient.

Two out of ten interviewees (MHEI 5 and MHEI 9) perceived providing **incentives or rewards** could have significant impact to the strategic institution SWM. In order to improve and encourage the institutional community to recycle, interviewee MHEI 5 commented that "*we are trying to implement economic incentives to the green managers as an instrument to encourage the recycling at faculty level. It is just a small percentage but perhaps this could help them to initiate the recycling project at their respective faculty*". Likewise, another interviewee (MHEI 9) indicated, "w*e will set up the system around the campus…when people deposit the wastes can or bottle, they can get the cash refund*". Interviewee MHEI 9 further explained that "*we need to incentivise people to follow good recycling practices*". This is supported by few scholars (Bolaane, 2006; Amutenya et al., 2009; Moh & Abd Manaf, 2014; Greene & Tonjes, 2014; Chaplin & Wyton, 2007; Suttibak & Nitivattananon, 2008) who advocated the financial incentives for recycling activities.

Obtaining **Environmental Management System (EMS)** certification is deemed as an important certification in the effort towards the sustainable institution campus and the strategic institution SWM. Although EMS certification has not yet been adopted in institution MHEI 1, the interviewee (MHEI 1) stated that "*with ISO 14000, an organisation has to comply with all existing federal/state/local legislation on environment, and waste management related laws if it is applicable, depending on the nature of industry (for company)*". Only one interviewee (MHEI 4) asserted that "*we are the first university to implement EMS (ISO 14001), which applied to all the environmental management including SWM*". Interviewee MHEI 4 further mentioned, "*ISO 14001 is a certification for us to maintain the quality of environmental management since we aim to be a green university*".

Two interviewees (MHEI 2 and MHEI 3) deemed **marketing recyclable materials** is a critical factor for the strategic institution SWM. Interviewee MHEI 2 revealed that "*green wastes and food wastes are converted into compost product after the process and it becomes more valuable. After packaging it, we sell it in 1kg for RM2*". By composting the food wastes, the products can be used as the fertiliser for institution use and also can sell to outside and then generate profit for higher education institution. Collection of used cooking oil has also provided some incentives for the higher education institution, as interviewee MHEI 3 mentioned that "*…initially it is only 25 cent per kilogram for used cooking oil collection, now the price has risen to RM 1 per kilogram*". As stressed by Chen et al. (2009), the overwhelming need for recycled materials plays a crucial role in prospering recycling market.

5.3.6 Difficulties and Challenges

Every SWM can confront barriers during implementation which result in low participation rate. Recycling in Malaysia has a long way to go with main challenges and barriers to be resolved, before an effective recycling programme can be in place (Hassan et al., 2000; Tarmudi et al., 2012). The obstacles to inclusive waste management comprise poor responsive policies, low quality and quantity of secondary materials, unhygienic waste collection procedures and scarcity of evidence to support activities (Oguntoyinbo, 2012). Moh and Abd Manaf (2014) also highlighted other limitations such as lack of recyclables market, diminished public confidence owing to inferior collection services, deficient of public awareness and publicity programme, lack of participation by the stakeholders, lack of local authority personnel dedicated to the programme and lack of policy and master plan directing on recycling initiatives. The interviewees highlighted some factors regarding programme elements that appear as hurdles when no strategic recycling operation is implemented in higher education institutions.

The major barrier for higher education institutions SWM identified by the majority (MHEI 2, MHEI 3, MHEI 4, MHEI 6, MHEI 7, MHEI 8, MHEI 9 and MHEI 10) is of recycling **awareness**. Although awareness is recognised as the most essential factor of SWM among participants, it is however also the primary obstacle faced in most of the higher education institutions. Attitude, mindset, habit and vandalism are the key elements of the awareness issue. This is reflected in the comment made by eight interviewees, who mentioned that, "*First challenge is the attitude…for instance students are easy influenced by others or their friends.*" (MHEI 2). Interviewee MHEI 4 also indicated that, "*The first obstacle is the attitude or habit of the people…we did our responsibility to create awareness by establishing green website and stickers, however if nobody participates then recycling programme cannot be succeeded*". Interviewee MHEI 9 also agreed that "*the biggest challenge is people mindset…waste is people buy too much and then doesn't use it, and lastly just throw away*". Another interviewee (MHEI 6) also revealed "*sometimes the head of faculties or offices don't want to follow the recycling programme…that's why I say awareness is important. If our staffs and students have awareness on recycling programme and then we can get more recyclable materials to recycle*".

Another obstacle highlighted is that no **policy** is being enforced in higher education institution SWM. Without strict enforcement, there is no mandatory for people to participate on recycling programmes in MHEIs. The institutional community may feel that they do not have a responsibility for the recycling programme. As mentioned by one interviewee (MHEI 7), no strict enforcement results in low awareness and lack of participation. MHEI 2 also concurred that one of the difficulties in recycling programme is "*hard to get people to follow the instructions because it is voluntary*". Moreover, another interviewee (MHEI 6) stressed that "*we have no proper policy about recycling. After the academic audit for students' academic works, there is no proper way on how to dispose all those students' academic works. Hence, some of the lecturers are just selling to the buy-back centres*". Interviewee MHEI 6 further emphasised "*if there is the proper policy for recycling programme, we must have the proper way and guidelines to dispose those wastes*". Lack of a formal policy also leads to the complementary negative effects on SWM such as monitoring recycling programme becomes more puzzling. As interviewee MHEI 7 claimed that "*It is difficult to monitor faculty recycling initiatives because of no strict enforcement*". Another consequence is uncontrollable of informal recycling programme. The reality of this situation was commented on by interviewee MHEI 8, who asserted that "*it is very hard to control the informal recycling, while we give the warning to the cleaners that don't simply take away the wastes from the university because it is the university's property*". Same situation is faced by MHEI 10, as interviewee MHEI 10 pointed out "*cleaners maybe do recycling…so no recycling performance report.*" Another interviewee (MHEI 1) also mentioned "*formal recycling collection infrastructure is not available in the campus. Even though we can find 3-colour recycling bins around campus, however those are not functioning*". Interviewee MHEI 1 further described "*the existing recycling programmes are done by many parties in an ad-hoc, piece meal approach which is unsustainable*". Interviewee MHEI 10 also agreed and said that "*all the management process is initiated by the individual party….*" The issue of informal recycling phenomenon has been indicated in the studies of Zen et al. (2014) and Campos (2014) found that informal recycling practices have been performed by the collection crews from the solid waste company as additional source of incomes in developing countries. Campos (2014) emphasised that in low and middle-income countries, millions of workers earn a living by collecting and processing urban waste via informal systems and the waste pickers are not acknowledged as legitimate economical actors. Campos (2014) suggested that there is necessity to integrate the informal waste sector, by ensuring sufficient work conditions, increasing collection efficiency and enhancing waste treatment methods. Zen et al. (2014) also commented that how to formalise the informal sector recycling requires being addressed in future Malaysian recycling scenarios.

Another issue identified by the interviewees is **inconvenience** for people to dispose of recyclable items on campus. The failure to locate the recycling facilities or collection points in strategic could make the institutional community has no intention to dispose the recyclable materials in the recycling bins. As interviewee MHEI 2 commented "*the location of the collection area is quite far, hence the shopkeepers feel difficult and takes a lot of time to travel the wastes*". Interviewee MHEI 5 emphasised that a lack of recycling bins presents a big problem to them, as she said "*we aware that sometimes the facility is not there, hence the people still get to dispose the waste into waste bins instead of recycling bins, therefore we shall provide recycling bins as much as possible around the campus*".

In spite of that, interviewee MHEI 8 stressed although the location of **facility** is strategic, the recycling programme is not successful, as he said "*previously we put the recycling bins in each faculty; indeed, the location is strategic but the participation of the staffs and students are very low…awareness very low…they simply throw all the wastes inside the bins*". Majority of Malaysians are not able to relate the benefits of source separation and recycling as well as consequences of not recycling to their daily routine (Prestin & Pearce, 2010). Besides, the people doesn't appreciate what has been provided by the institution management, as interviewee MHEI 2 mentioned "*the end users don't care about the programme as all facilities provided are free and they abuse the facilities as well*" (MHEI 2); while interviewee MHEI 3 stated "*instead of supporting the initiatives, they just have 'don't care' attitude. For instance, for the used cooking oil collection, what the people did is they put all various garbage inside the bins instead of putting the oil inside the bin*". Interviewee MHEI 7 also said that "*students like to throw all the rubbish on the cover of the recycling bins*". Further, lack of participant (students) and awareness is interrelated, as one interviewee (MHEI 8) revealed "*students have no awareness and knowledge on recycling. When we organise the green campaign or recycling campaign, we cannot receive high response from students*". Interviewee MHEI 7 explained "*all of these are because of no strict enforcement towards students' mindset*". However, another interviewee (MHEI 4) argued that "*this problem actually can be solved, but it will take a long period to solve it*".

Budget constraint has been identified by as one of the difficulties in planning recycling programme, especially for private higher education institutions. As interviewee MHEI 9 commented "*I think budget constraint is a difficulty as well…it will be wonder how a waste management push the campaign those things but it is a budget constraint….*" Another interviewee MHEI 10 deemed cost to be the major obstacle causing the institution management does not want to initiate recycling, as he mentioned that "*the management will not do recycling mostly because it costs money, they want to buy recycling bins but it costs huge amount of money.*" In order to have a strategic recycling operation, the huge expenditure is needed for the facilities, human resource, outreach programme, operation and so on.

In addition, two out of ten interviewees (MHEI 2 and MHEI 8) emphasised on the **human resource** issue which could influence the strategic recycling operation. The characteristics of human resources include "*lack of in-house staffs*" (MHEI 8), "*staffs are not willing to do manual composting because of smelly*" (MHEI 2) and "*no competency of staffs to do sorting activities*" (MHEI 2). Especially for the composting initiatives, human resources are very important. The staff should be competent in operating the composting machine and also capable in managing composting manually. Besides, sorting task is also vital so that the waste collection could be carried out in efficient and productive.

5.3.7 Resources Required

In responses to this question, each interviewee proposes the resources needed in connection with their problems faced when conducting the recycling programme. Principally, policy is the first and foremost to be required prior to any solid waste recycling programme. This is reflected in the comments made by interviewee MHEI 6 and MHEI 10; while interviewee MHEI 6 said that "*Everything must have policy so that every faculty can follow the rules and activity easily. We want the standard policy in the institution; if not, they just ignore and don't know how to do recycling*". Another interviewee (MHEI 7) concurred that "*we need procedure to force the community to recycle and teach students how to recycle*". Since there is no formal solid waste and recycling related policy for Malaysia higher education institutions, the recycling initiative is based on the voluntary basic. Hence, "*we must overcome the policy barrier. It should be top down policy, cannot be from the staffs or student to initiate the recycling…*" (MHEI 3).

Three out of ten interviewees (MHEI 1, MHEI 9 and MHEI 10) highlighted on management resource of institution SWM and recycling programme. "*Commitment from top management*" (MHEI 1) is necessary which top management shall lead the organisation/unit towards the success of recycling operation. Interviewee MHEI 10 also agreed that "*…to do recycling, is not from the bottom, is from the top*". Further, interviewee MHEI 9 commented "*we need to ensure the series of recycling as an important action for us to address and then develop the procedure for recycling…all those things*".

Nevertheless, one interviewee (MHEI 6) strongly emphasised "*the fundamental resources is people*". He further mentioned that "*the critical resource is people; the mindset of the people, the culture which influences the attitude of people…This is the fundamental issue*". In order to change the habit of the institutional community, "*campaigns and the talk for students' awareness*" (MHEI 5 and MHEI 8), "*education for community on how to do recycling*" (MHEI 10), "*roadshow*" (MHEI 4) as well as "*the top campaign and outreach programme*" (MHEI 7) are required to be carried out in long term period. It is hoped that those efforts could able "*to change public attitude and get support from public for recycling programme*" (MHEI 4 and MHEI 7).

Another resource indicated is partnering with the organisation/stakeholders either externally or internally. This effort is being striven by one interviewed institution (MHEI 5), who revealed "*we are trying to engage strategic stakeholder to work together with us to establish more visible recycling or suggested e-waste programme. Hence, we need to centralise recycling programme among stakeholders or PTjs (Pusat Tangguangjawab)*". Besides, experts from various fields are also necessary to strengthen a recycling programme. As one interviewee (MHEI 1) advocated "*expertise* *from various fields for the analysis, technical, economic, social, financing and public relation are required to sustain the recycling programme, additionally, supporting unit is also required to support the expertise*". Another interviewee (MHEI 2) commented that "*personnel that can educate the students and also the society to do recycling*" and "*staff training for the contractor*" are needed as well. A suitable and convenient facility for waste collection is essential as well. As an interviewee (MHEI 3) described "*we should have one-stop centre for students and staffs to put their things that can be recycled. For instance, the centre can be a small building so that the contractor can collect all the wastes there*". As a result, the wastes would be managed properly and efficiently.

Another resource identified, which related to the rewards from recycling, is that of giving the incentives to people. Providing incentive is considered as a new strategy in Malaysia higher education institutions, as only one out of ten interviewees (MHEI 9) commented "*…money resource is required…which is incentivising people to recycle. It is a financial incentive for encouraging people to recycle, is good to practise recycling as a requirement*". In contrast, another interviewee (MHEI 6) argued that "*money cannot do anything, people still throw rubbish anywhere…Everything goes back to the basic*". He strongly asserted the local culture of recycling and the mindset of people is the most critical issue to be solved at current stage.

5.4 Other Documents

No consistency on operation of SWM in MHEIs causes each institution to have its own SWM operation on campus. Two out of ten interviewees (MHEI 1 and MHEI 9) provided documents about the operation of SWM in their respective institutions.

According to the interviewee from MHEI 1, the existing recycling programmes are conducted by many parties in an ad hoc basis, which is unsustainable; while the recovery initiatives are carried out in small scale. The institution is also practising reuse initiatives by selling the old furniture collected from each faculty (as illustrated as Appendix G). Each type of used furniture is listed out with quantity, price and photos for the buyers' options. This could generate some extra income for the institution. However, it is difficult to achieve strategic outcome without the formal and systematic SWM.

MHEI 9 is an overseas higher education institution Malaysia campus which occupies a leasing building where the building is managed by the landlord. According to the interviewee, there are the standard operation procedures (SOP) for waste management provided by the landlord to all the tenants to follow. The SOP comprises the flow chart of wastes collection, responsibilities of each party, waste collection procedure, collection frequency, collection location and its pick-up frequency. The wastes collected consist of recyclable items, e-wastes and food wastes (retail); each type of wastes has particular SOP to follow (as illustrated as Appendix H). Interviewee further stated that institution MHEI 9 does not has own waste management team and only follows the tenancy agreement and SOP. The institution only makes sure that waste is thrown in the proper places for the collection by the landlord management team.

5.5 Interview Results: Main Findings of Objective Two

Analysis of interviewees' responses was performed using content analysis and resulting from the above analysis, fourteen (14) SWM factors and five (5) strategic implication variables were validated via interviews and summarised in Table 5.2. As described in the prior chapters, the present study is looking into the current practises of the MHEIs SWM, fourteen (14) SWM factors and five (5) strategic implication variables validated were considered to be of significant in the strategy of institutions recycling operation in Malaysia.

Table 5.2: Identifying MHEI SWM factors and strategic implication variables

Institution SWM factors	Literature review	Interview
1. Goal or target setting policy	√	√
2. Reporting feedback on recycling performance	√	√
3. Waste separation at source	√	√
4. Mandate the recycling initiatives	√	-
5. Collection frequency	√	√
6. Awareness or campaign	√	√
7. Incentives or rewards	√	√
8. Partnership	√	√
9. Marketing recyclable materials	√	√
10. Strong support from top management level	√	√
11. Education and training programme	√	√
12. Environmental Management System (EMS) certification	√	√
13. Proximity of recycling facilities	√	√
14. Methods of waste recovery	√	√
15. Materials Recycling/Recovery facilities (MRF)	√	-
16. Waste disposal and collection contract provisions	√	√
17. Recycling C&D waste from refurbishment work	√	-
Total	**17**	**14**
Strategic implication variables	**Literature review**	**Interview**
1. Waste stream reduction / Waste minimisation	√	√
2. Cost reduction	√	√
3. Revenue generated	√	√
4. Change of recycling behaviour/culture	√	√
5. Compliance of Acts	√	√
Total	**5**	**5**

As mentioned earlier in Chapter One, objective two of this research is to establish a theoretical framework on the principal SWM factors affecting the strategic implication of MHEIs SWM strategy. The interviews also served to validate findings from literature review as well as identify existing recycling issues in MHEIs. After that, a validation of the interview findings was carried out. A validated theoretical framework for this research was established at last as illustrated in Figure 5.1. The validated theoretical framework conceptualised the quantitative research design in determining the independent variables and dependent variables for the next phase. Strategic performance framework will be developed after the quantitative analysis as the final output of this research, which could assist the facilities managers or waste managers in decision making on planning for strategic SWM. Consequently, the findings from this phase of research are applied to assist the establishment of the questionnaire survey in the next phase of the research process.

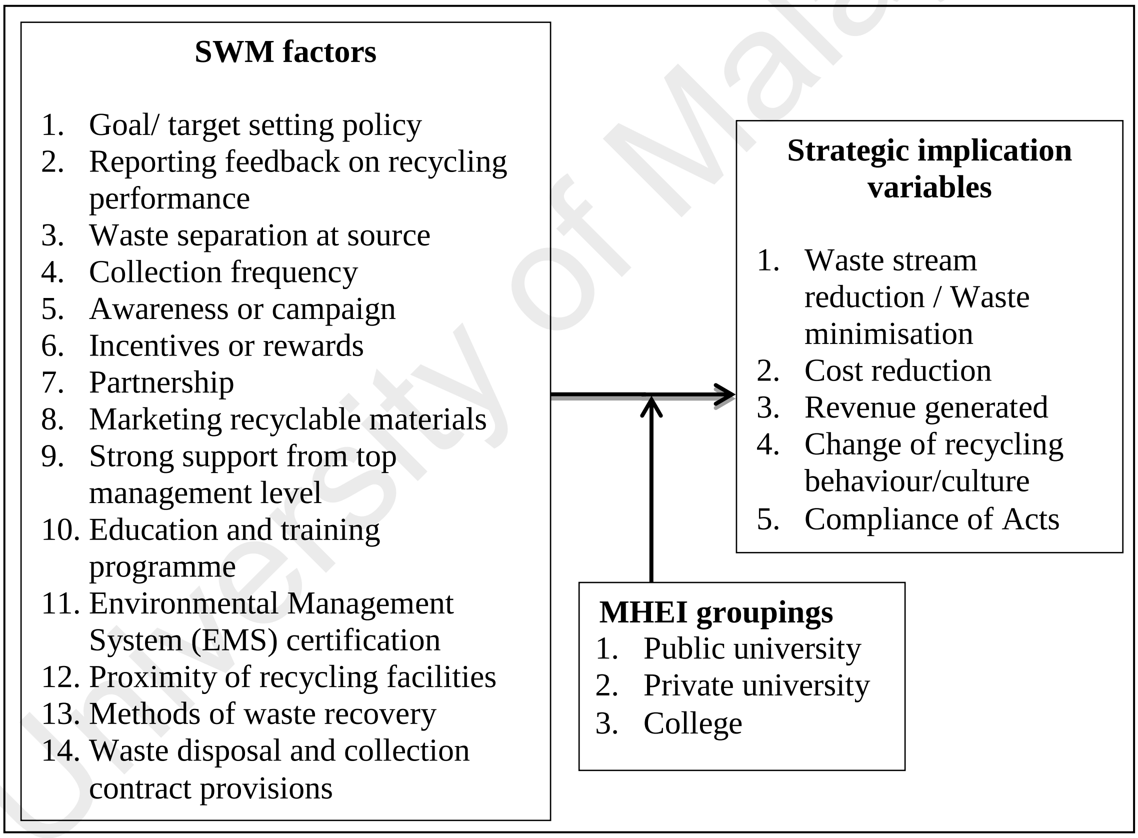


Figure 5.1: Validated theoretical framework

5.6 Summary

This chapter accomplished the second objective of this research which is to develop relationship between the principal SWM factors and strategic implications of MHEIs

SWM strategy. This chapter has presented the qualitative findings (inductive strategy) by the methods of semi-structured interviews undertaken with ten (10) MHEIs. Besides, this chapter also focuses mainly on responses made by the interviewees relating to the principal institution SWM factors and strategic implication variables. The discussion also determined the definitions of recycling to institution organisation, drives and contributions of SWM towards MHEI overall aims, the challenges faced during the implementation as well as the resources required.

Based on the interview findings, fourteen (14) SWM factors and five (5) strategic implication variables were identified and perceived as principal factors/variables appropriate for MHEIs. These determined factors/variables are discussed in Section 5.3.3 and Section 5.3.5 respectively. Validation of these fourteen (14) identified SWM factors and five (5) strategic implication variables has been done by sending the validation sheet to all the interviewees. The remaining three SWM factors namely, mandate the recycling initiatives, materials recycling/recovery facilities (MRF) and recycling C&D waste from refurbishment work were not confirmed as a result of the exploratory interview phase. Hence, these three SWM factors will be withdrawn for the confirmatory phase of this research.

The next chapter will present the result of confirmatory phase of the research which to achieve the third objective of this research: to establish the extent to which these SWM factors impact strategic solid waste operation at the institutional level in MHEIs.

CHAPTER 6: QUANTITATIVE DATA ANALYSIS AND FINDINGS – SURVEY RESULTS

6.1 Introduction

This chapter describes the results from the questionnaire survey carried out to confirm the key factors through the use of quantitative data to generate and test the hypothesis. The data collated is presented based around the third research objective to establish the extent to which the principal SWM factors have an impact on the strategic solid waste operation at the institutional level in Malaysian higher education institutions (MHEIs).

This chapter describes the background of the quantitative data collection and analysis (Section 6.1 and 6.2). Then followed with part two (Section 6.3) of the chapter which discusses on the descriptive analysis of respondents' profiles and the operation of MHEI solid waste management (SWM) and recycling initiatives. The third part (Section 6.4 to Section 6.9) of this chapter reports the primary result of the statistical analysis with appropriate hypothesis testing.

6.2 Data Collection and Analysis

Questionnaire survey data was collected via electronic and postal media, between January and August 2015. The survey was mainly targeted to all the higher education institutions registered under Department of Higher Education, Ministry of Higher Education Malaysia. The total population is 417 registered MHEIs; 129 questionnaires were returned, representing a 30.9% total response rate. The total of 129 questionnaires was from public universities, private universities and colleges throughout Malaysia.

The collected data was analysed using the Statistical Package for Social Science (SPSS) version 22.0. Descriptive statistics for instance frequencies, standard deviation, mean and percentages were applied. Besides, inferential statistical analysis was used for Analysis of Variance (ANOVA), Multivariate Analysis of Variance (MANOVA), Pearson's correlation analysis and Hierarchical multiple linear regression to analyse the data obtained from Likert-scale questions of the questionnaire. Both ANOVA and MANOVA methods were expected to investigate differences within the SWM factors and strategic implication variables between the three MHEI groupings which are believed to be of critical importance to strategic solid waste operation. Besides, two Pearson's correlation analyses were conducted. The first is to examine the relationship between the perceptions of importance attached to SWM factors and the extent to which SWM factors are implemented by MHEIs, and the second is to examine the relationship between the implementation level of SWM factors and the effectiveness level of strategic implication variables. Finally, hierarchical multiple linear regression was also conducted to permit a better understanding of what combination of SWM factors constitutes the best practise towards strategic solid waste operation for MHEIs. Detailed examination of each hypothesis is presented in Sections 6.4, 6.5, 6.6, 6.7, 6.8 and 6.9.

6.3 Descriptive Analysis for MHEI Feedback

The following sections provide a description and analysis of each part of the survey instrument in detail. The total sample size consists of 129 responses (30.9%).

6.3.1 Characteristics of MHEI Respondents' Particular and Background

The analysis of the data shows that majority (38.8%) of the respondents are manager of the respective department/unit as shown in Figure 6.1, followed by 20.9% of facilities/operation managers. In fact, managers of departments and facilities/operation managers are the personnel primarily responsible for support services and operational aspects for the establishment, and assist in planning solid waste programmes. This is followed by 17.8% of the directors of department/unit, which predominantly manage the administration and operations of the department and also assist the institution in planning the strategy and direction of the institution. There are 14.7% of the respondents who selected the category of "other", are landscape architects, executives, engineers, administrators, principal, senior manager or building supervisors. It shows that there are diverse organisations to manage institution solid waste. Assistant managers cover the lowest percentage, which are 7.8%. It can be concluded that all the respondents are involved in waste management on a day-to day basis. Therefore, the researcher may summarise that the response on the questionnaire are reliable and provide the study with valuable information.

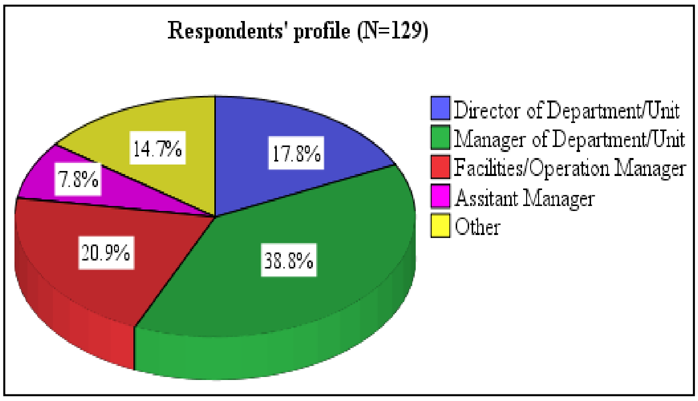


Figure 6.1: Respondents' profile

Basically, working experience is reflected by the number of years that the respondents have been involved in higher education institution SWM. Table 6.1 shows that overall, 64.3% of the respondents have experience more than 5 years in their appointed position. Since MHEI SWM is considered in its infancy stage, personnel who have working experiences of 5 years and above are known to be experienced in waste management field. Hence, the surveys returned could be deemed as reliable due to the participants experience in waste management within their organisations.

Table 6.1: Working experience in the position

Working Experience	Frequency	Percentage (N=129)
Less than 5 years	46	35.7
5 to 10 years	59	45.7
11 to 15 years	19	14.7
16 to 20 years	5	3.9
Total	**129**	**100.0**

As can be seen in Table 6.2, a majority of the respondents were non-academician as they are professionals in their respective field. 16.3% of the respondents are involved in an academic field. Hence, it is fair to say that all of the respondents have satisfactory knowledge in providing required information.

Table 6.2: Position type of respondents

Position type of respondents	Frequency	Percentage (N=129)
Academician	21	16.3
Non-academician	108	83.7
Total	**129**	**100.0**

6.3.2 Characteristics of Responding Mheis Background

Figure 6.2 indicated the ownership of the higher education institutions that the respondents involve. As can be observed in Figure 6.2, majority of the MHEIs are private institutions, covering 89.1%; as most of the universities and colleges are established by private organisations. This is followed by 10.9% of government institutions.

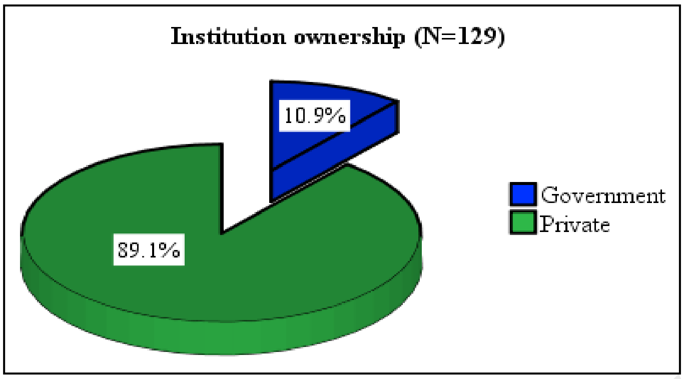


Figure 6.2: MHEI ownership

Since the study covers all the higher education institutions registered under Department of Higher Education, Ministry of Higher Education Malaysia, the MHEIs are categorised into three different groups which are public university, private university and college. According to the survey results, there are 129 MHEIs in the present study. Figure 6.3 indicates the MHEIs groupings based on the type of responding institutions. Majority of the respondents are from colleges, covering 62.8% which is 81 out of 129 MHEIs. This is followed by 27.1% of the respondents from private universities and 10.1% of the respondents from public universities.

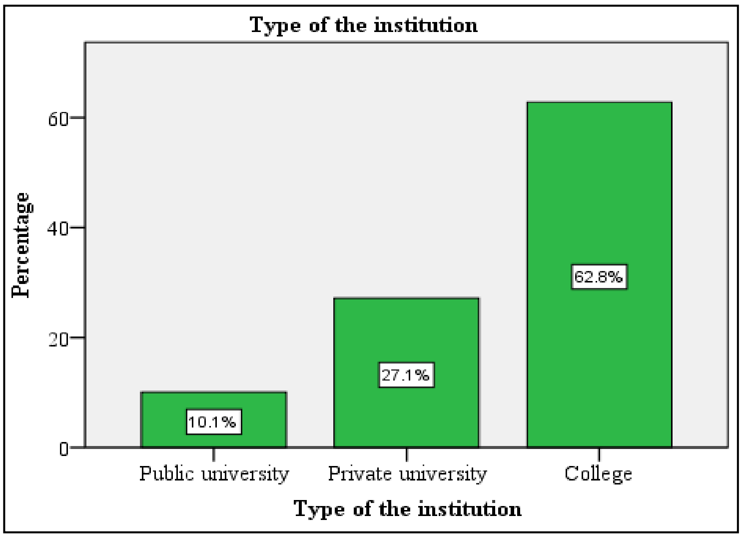


Figure 6.3: MHEI groupings

Figure 6.4 indicates that most (58.9%) of the MHEIs that participated in this study occupied their own-site campus, while 41.1% of the MHEIs occupied typical leasing/renting building. The SWM of MHEIs that occupied typical leasing/renting building may be restricted by the tenancy agreement.

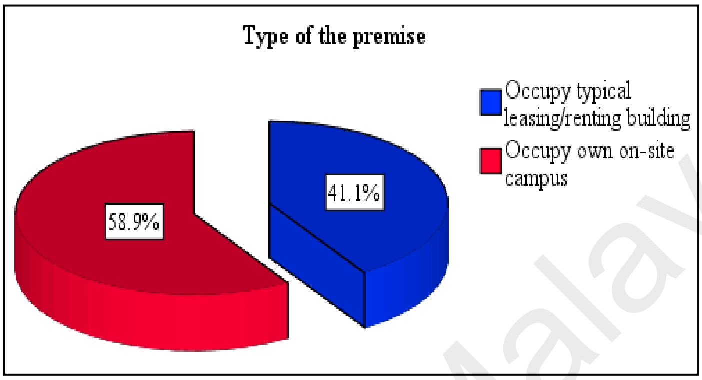


Figure 6.4: Premise type of the responding MHEIs

Institution communities are believed to be similar to small town communities because of their population and the numerous complex activities taking place on campuses (Alshuwaikhat & Abubakar, 2008; Kaplowitz et al., 2009), huge amounts of waste are generated as a consequence of the big population and those activities. Based on the survey result (Table 6.3), 62.8% of the responding MHEIs have the smallest population less than 5,000 people. Only 1.6% of the responding MHEIs have the largest population of 25,001 – 30,000 people. Additionally, 19.4% of the MHEIs populations of 5,001 – 10,000 people, while 10.1% of the MHEIs have populations of 10,001 – 15,000 people, 3.9% MHEIs have 20,001 – 25,000 people, and 2.3% MHEIs have 15,001 – 20,000 people.

Table 6.3: Population of MHEIs

Population	Frequency (N=129)	Percentage (%)
≤ 5,000 people	81	62.8
5,001 - 10,000 people	25	19.4
10,001 - 15,000 people	13	10.1
15,001 - 20,000 people	3	2.3
20,001 - 25,000 people	5	3.9
25,001 - 30,000 people	2	1.6
Total	**129**	**100.0**

Table 6.4 shows that most (55.8%) of the MHEIs that participated in this research occupied less than 40,000m² usable space area. A total of 4 MHEIs occupied each size of usable space area. 2 MHEIs occupied 50,001-60,000m² and 2 MHEIs occupied 80,001-90,000m². Besides, there 19 MHEIs occupied 40,001-50,000 m² usable areas, 15 MHEIs occupied more than 100,001 m² usable areas, 9 MHEIs occupied 60,001-70,000 m² usable areas, 7 MHEIs occupied 70,001-80,000 m² usable areas and 3 MHEIs occupied 90,001-100,000 m² usable areas. This indicates that the higher education institutions participated in this survey were mostly small.

Table 6.4: Approximate size of MHEIs usable space

Usable space size (m²)	Frequency (N=129)	Percentage (%)
≤ 40,000m²	72	55.8
40,001-50,000m²	19	14.7
50,001-60,000m²	2	1.6
60,001-70,000m²	9	7.0
70,001-80,000m²	7	5.4
80,001-90,000m²	2	1.6
90,001-100,000m²	3	2.3
≥100,001m²	15	11.6
Total	**129**	**100.0**

6.3.3 Policy Implementation on SWM

Policy is the most important criteria before any strategic plan is created. Any effective plan cannot be succeeded without the policy. In principle, policy framework from the global is adopted from the UN perspective cascaded down to the individual countries and the down to the regional municipalities and corporation involved. Focusing on the studied MHEIs, Figure 6.5 shows that only 7.8% of participating MHEIs have the enforcement of Waste Management Policy in their institutions. Meanwhile, majority (92.2%) of the responding MHEIs do not enforce Waste Management Policy in their respective institutions. This is most likely that the waste management in MHEIs is still in its infancy stage.

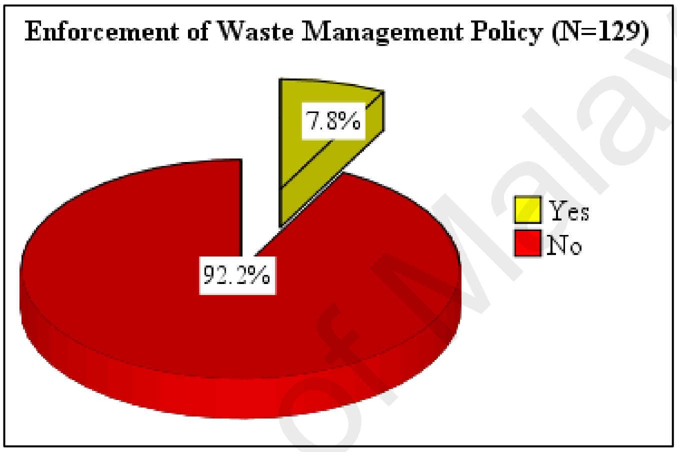


Figure 6.5: Waste Management Policy of responding MHEIs

Analysis on existence of recycling activities reveals that 55.0% of responding MHEIs are conducting recycling activities while 45.0% of them do not conduct recycling initiatives in the campus, as shown in Figure 6.6. The result shows that more than half of the responding MHEIs have the sense of protecting the environment from SWM perspective.

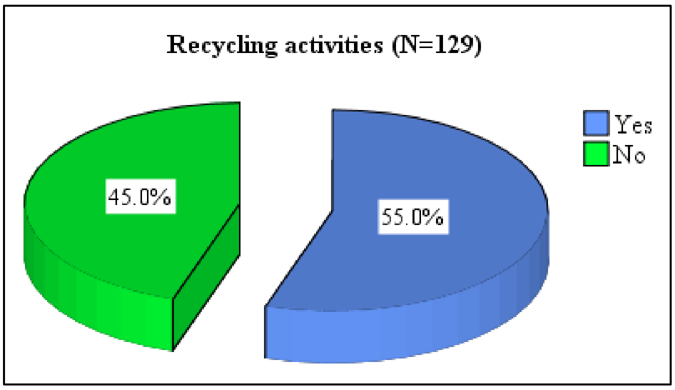


Figure 6.6: Recycling activities at responding MHEIs

Recycling policy may formalise and standardise an institution recycling initiative and then bring to the strategic implication. However, survey result shown in Figure 6.7 reveals that majority of the respondents (90.7%) do not implement recycling policy in their institutions. Only 9.3% of respondents stated they have implemented recycling policies in their respective institutions.

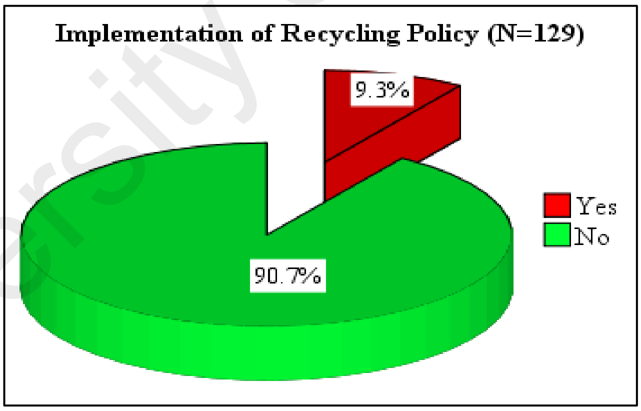


Figure 6.7: Implementation of recycling policy at responding MHEIs

From the result obtained from Figure 6.8, 51.9% of the MHEIs participating in this survey have intention to implement recycling initiative at strategic level in their respective institution. There is nearly half (48.1%) of the MHEIs participated do not have intention to implement their recycling initiative at strategic level, this may because of the small size of their institution, financial problem and no SWM team to plan and conduct the recycling activities strategically.

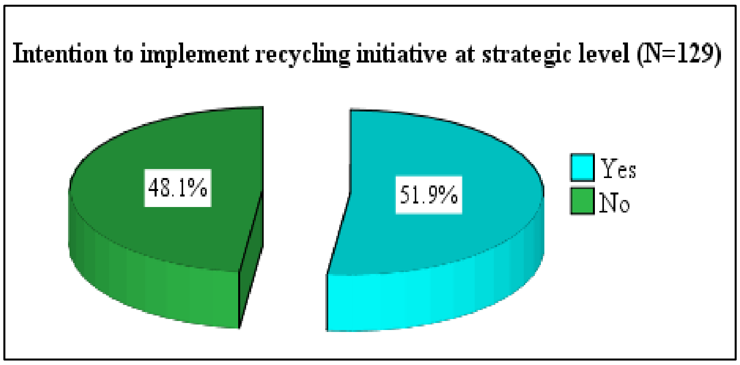


Figure 6.8: Intention to implement recycling initiative at strategic level

6.3.4 Indicators Used for Measuring Recycling Performance

An analysis on recycling performance measurement of the respondents is carried to determine the current states of recycling performance documentation. Survey results shown in Table 6.5 reveal that only 7.0% of the respondents stated they are measuring and recording institution waste generated. Many respondents (93.0%), however, stated non-participation in measuring and recording wastes generated. Out of 9 respondents who measure and record the wastes generated, most of the indicators applied to evaluate their recycling performance are diversion rate which are 35.3% (as shown in Table 6.6). Other indicators applied consist of 23.5% of quantity recovered, 11.8% of participation rate, benefit/cost ratio and utilisation rate respectively, and 5.9% of net cost/ton. It can be seen that the availability of Malaysia institutional recycling performance data and statistics are still questionable since most of the MHEIs do not apply any indicator to measure their wastes generated and recycling performance.

Table 6.5: Respondents participation in measuring and recording wastes generated

Participation in measuring and recording wastes generated	Frequency (N=129)	Percentage (%)
Yes	9	7.0
No	120	93.0
Total	129	100.0

Table 6.6: Recycling indicators at responding MHEIs

Indicator	Responses		Percent of cases (%)
	Frequency	Percentage (%)	
Participation rate	2	11.8	20.0
Quantity recovered	4	23.5	40.0
Diversion rate	6	35.3	60.0
Net cost/ton	1	5.9	10.0
Benefit/Cost ratio	2	11.8	20.0
Utilisation rate	2	11.8	20.0
Total	17	100.0	170.0

6.3.5 Corporate Social Responsibility Report towards Recycling Performance

Corporate social responsibility (CSR) is a measure through which organisations can represent a change from the traditional view of companies merely providing services and products, to contribute to the welfare of the society (Steiner & Steiner, 1997) and consequently "achieve" sustainable development (DTi, 2004). Indeed, CSR has started to portray an increasing role in the realisation of sustainability (Henderson, 2007; Williamson et al., 2006) and CSR policy is a mandatory regulation for any organisation or company. Survey results shown in Figure 6.9 reveal that majority (76.0%) of the respondents stated that CSR report does not reflect their organisational recycling performance. However, 24.0% of the respondents stated that CSR report does reflect the organisational recycling performance in their institutions. It can be seen that CSR activity in MHEIs are still not effective in recycling programmes.

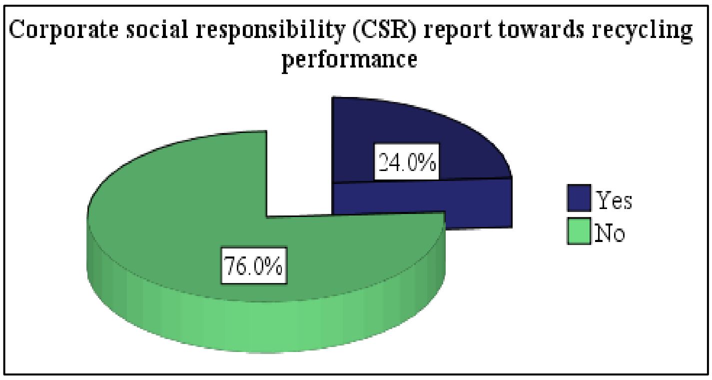


Figure 6.9: Corporate social responsibility (CSR) report towards recycling performance

6.3.6 Characteristics of SWM Expenditure

In creating future benefits and achieving strategic implication, capital expenditure (CapEx) is required to acquire assets or upgrade existing facilities so their value as an asset increases. Enhancing collection services, processing and treatment facilities, and maintaining disposal sites require huge investment and financial stability to achieve optimum recovery and recycling as well as minimising solid waste disposal at landfills (Moh & Abd Manaf, 2017). Survey results shown in Figure 6.10 found majority (80.6%) of the responding MHEIs do not have CapEx spent from the past 5 years for waste disposal and recycling facilities provisions, where 14.7% spent less than RM 100,000; 2.3% spent between RM 100,000 to RM 250,000; 1.6% spent between RM 250,000 to RM 500,000; and 0.8% spent between RM 500,000 to RM 1 million. From the analysis, it can be seen that many MHEIs do not have intention to invest on SWM facilities. It may because the constraint of budget and the usable campus areas.

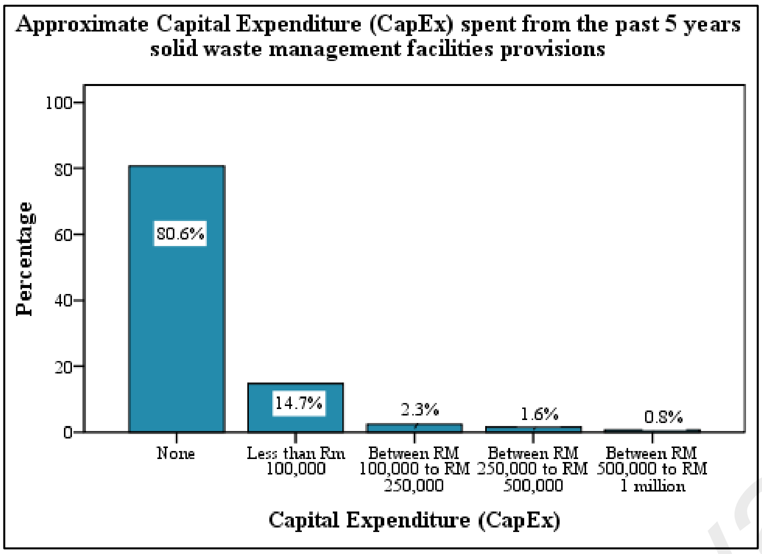


Figure 6.10: Approximate Capital Expenditure (CapEx)

In addition to CapEx, operational expenditure (OpEx) is a necessary expense incurred in the course of ordinary business, for instance general and administrative expenses, wages of operators, maintenance and repair of machinery and utilities. These fundamental expenses could influence the success of any recycling programme. However, 45.7% of the responding MHEIs did not spend any money for the operation of SWM facilities (as shown in Figure 6.11). There are 31.8% of the respondents stated that the OpEx spent annually for SWM facilities purpose is less than RM 10,000. Another 17.8% of the responding MHEIs spent between RM 10,000 to RM 50,000 annually for solid waste operation. Only 2.3% of the responding MHEIs spent more than RM 150,000 annually for the solid waste operation. Survey results reflected that many MHEIs still overlook the importance of environmental sustainability through strategic SWM.

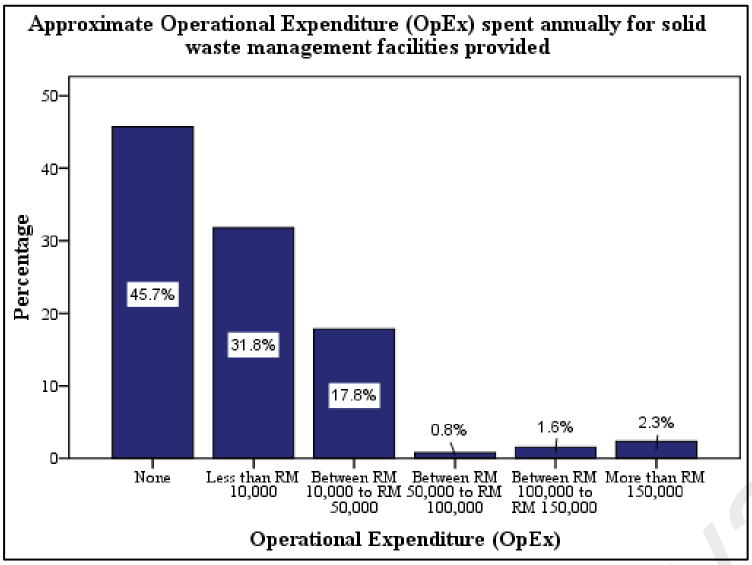


Figure 6.11: Approximate Operational Expenditure (OpEx)

6.3.7 Characteristics of Recyclables Collection Service Contracts

Recyclables collection service is a main issue for a long time in various sectors. Recyclables collection may help to minimise the waste disposed to the landfill. Survey results shown in Table 6.7 indicated that 76.7% of the respondents stated that there is contracted collector or other body comes to collect the recyclables from the institution. Another 23.3% of the respondents however stated that no any party or body collects the recyclables items from institutions.

Table 6.7: Respondent contracted service for recyclables collection

Recyclables collection from third party	Frequency (N=129)	Percentage (%)
Yes	99	76.7
No	30	23.3
Total	129	100.0

Cross-tabulation is also performed to determine which type of service contracts are mostly employed in different MHEIs. The results in Table 6.8 revealed that out of 99 respondents who have third party comes to collect recyclables, most are from colleges.

As for the colleges, most (28.3%) of the recyclables collection is unofficial/informal recycling. The major problem is the cleaners collect the recyclables items without permission and then sell the recyclables outside to earn extra money. They do not bother about the campus rules and warning given to them caused the management hard to control the recycling activities. Same problem is happened in public universities and private universities caused the unofficial/informal recycling get the highest percentage in overall, which is 36.4%. Besides, another 36.4% of the respondents employ waste disposal collection contract in their institution, where majority (21.2%) of them are from private universities. The respondents claim that they do not know the final destination of those recyclables items. Other type of service contracts has 16.2% in overall which include waste management contract, cleansing contract and housekeeping contract.

Table 6.8: Relationship between the MHEI groupings and type of service implemented

MHEI groupings	Type of service				Total percentage (N=99)
	Landfill contract	Waste disposal collection contract	Unofficial/informal recycling	Other	
Public university	1.0%	2.0%	2.0%	3.0%	8.1%
Private university	3.0%	21.2%	6.1%	2.0%	32.3%
College	7.1%	13.1%	28.3%	11.1%	59.6%
Total	11.1%	36.4%	36.4%	16.2%	100.0%

6.3.8 Information Related to Recyclables Sale

An analysis on the type of organisation structure for recyclables sale indicates that more than half (57.4%) of the responding MHEIs are using centralised structure for their recyclables sale while 18.6% of the responding MHEIs are using decentralised structure for collecting and selling recyclables (as shown in Table 6.9). Out of 57.4% of the respondents, majority (40.3%) are from colleges (as shown in Figure 6.12).

Centralised structure may be the best method for colleges because of its small size of campus and financial constraint, it can easier to coordinate and control the collection and sale of recyclables.

Table 6.9: Methods of collecting and selling recyclables

Collection method	Frequency (N=129)	Percentage (%)
Centralised	74	57.4
Decentralised	24	18.6
None	31	24.0
Total	129	100.0

As for the decentralised structure, 7.8% of the private responding universities and 7.0% of the public responding universities are using this type of structure for recyclables sale (as shown in Figure 6.12). Each of the faculty/unit/department in the university manages their own solid wastes. They can make decision on recycling business for their respective faculty/unit/department. This would indirectly create the competitive environment between faculties/units/department to improve the recycling performance. On the other hand, out of 24.0% of the respondents, 18.6% from colleges, 3.9% from private universities and 1.6% from public universities stated that no sale of recyclables items by the individual faculty/unit/department.

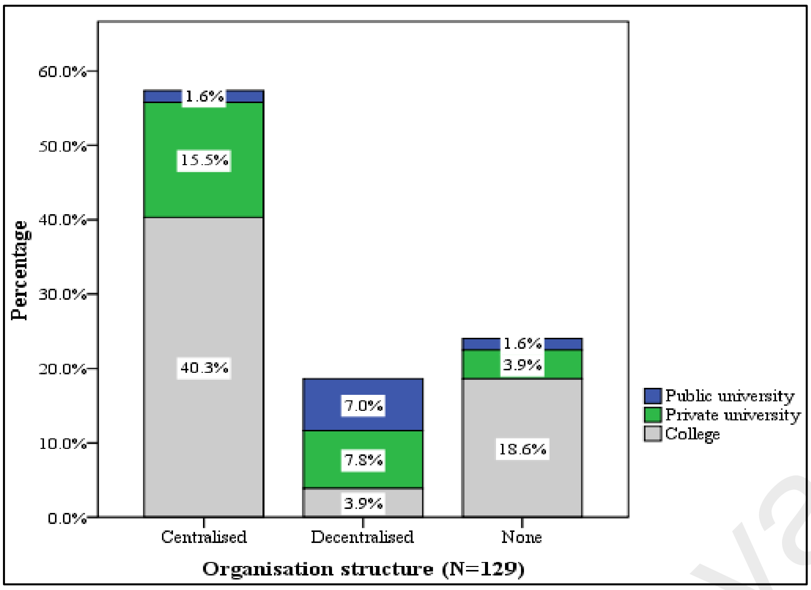


Figure 6.12: Methods of collecting and selling recyclables in three MHEI groupings

Based on the survey response, out of 98 respondents who have the recyclables sale, 70.0% of them state that the recyclables sale is conducted informal mode (as shown in Figure 6.13). This denotes that the cleansing contractors or cleansers collect and sell the recyclables items without permission. Only minority (30.0%) of the responding MHEIs are collecting and selling the recyclables items in formal mode.

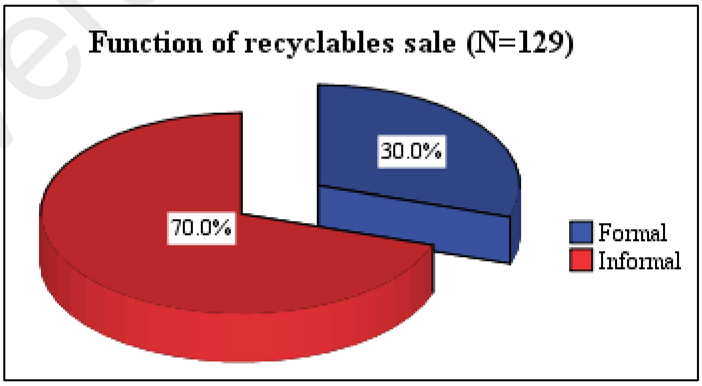


Figure 6.13: Function of recyclables sale

In addition, another analysis on the revenue of recyclables sale reveals that majority (72.8%) of the responding MHEIs still could not generate revenue from the sales of recyclables items (as illustrated in Figure 6.14). Less than half (27.2%) of the responding MHEIs could generate income from the recyclables sales. It can be seen that the recycling initiatives in MHEIs are still at its initial stage and insufficient to generate revenue for institution use.

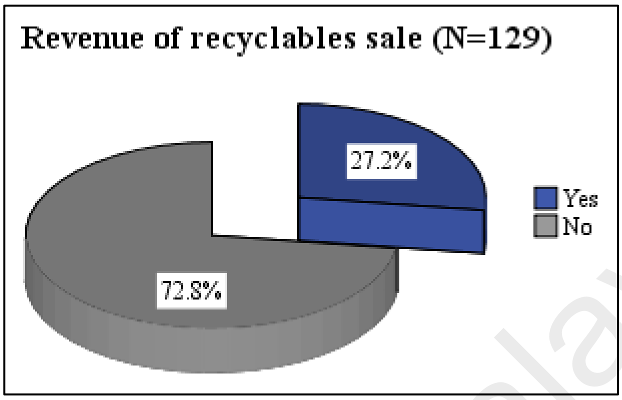


Figure 6.14: Revenue of recyclables sale

6.3.9 Information Related to Recyclables Sorting Activities

The success of recycling initiatives is largely dependent on the recyclers (campus community) participation and sorting activities. Convenient drop-off recycling by sorting recyclables items on-site could increase the success of recycling programmes. Moh and Abd Manaf (2017) agreed that recycling after all, is about separating and placing the right recyclable materials into the right bin. The survey is conducted to observe respondents' approach for sorting their wastes. The results in Figure 6.15 indicate that majority (65.1%) of the responding MHEIs separate their recyclables items off-site, whereas another 34.9% of the responding MHEIs sort their recyclables materials on-site.

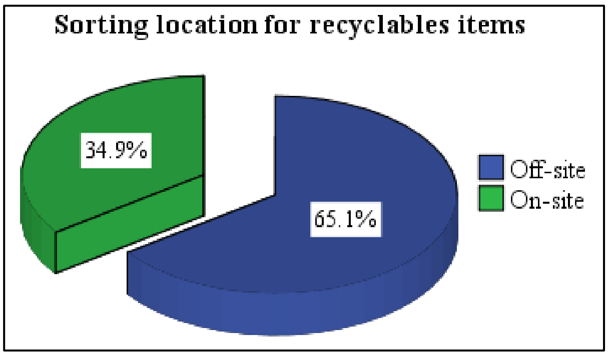


Figure 6.15: Sorting location for recyclables items

Respondents were asked about the method of sorting recyclables items. As shown in Figure 6.16, out of 129 responding MHEIs, 76.7% of the respondents state that the recyclables sorting activities are conducted in informal mode; mostly conducted by the cleansers without permission. The cleansers always collect and sell the recyclables themselves to earn extra money. Another 23.3% of the responding MHEIs sort their recyclables materials formally by locating the recycling bins in the campus.

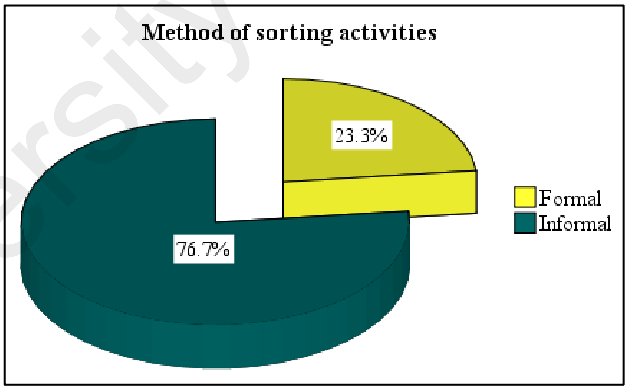


Figure 6.16: Method of sorting activities

6.3.10 Characteristics of Solid Waste Recycling Facilities

Multiple response analysis is employed to determine the most frequent used facilities to recycle the institution wastes. Figure 6.17 highlights the fact that majority (88.0%) of the responding MHEIs have no access to any waste recycling facility in their institutions.

It can be believed that all the wastes are transported outside to recycle or dispose to landfill. There are 6.8% of MHEIs use other type of recycling facilities, which include wood waste for paper mill's boiler for hydro-pulper and 3-colour recycling bins. Since there is lack of advanced recycling infrastructures and facilities in Malaysia, the respondents deem that 3-colour recycling bin is one of the waste recycling facilities. Besides, four respondents (3.0%) make use of composting facility for diverting food wastes into nutrient or fertilisers. The survey also finds that anaerobic digester, Material Recycling/Recovery Facility (MRF) and biodiesel plant are used by one MHEI only (0.8%). However, none of MHEI makes use of incinerator at this moment.

Table 6.10: Solid waste recycling facilities used by responding MHEIs

Solid waste recycling facilities type	Responses		Percent of cases (%)
	Frequency	Percentage (%)	
Composting facility	4	3.0	3.1
Anaerobic digester	1	0.8	0.8
Material Recycling/Recovery Facility (MRF)	1	0.8	0.8
Biodiesel Plant	1	0.8	0.8
Other	9	6.8	7.0
None	117	88.0	90.7
Total	133	100.0	103.1

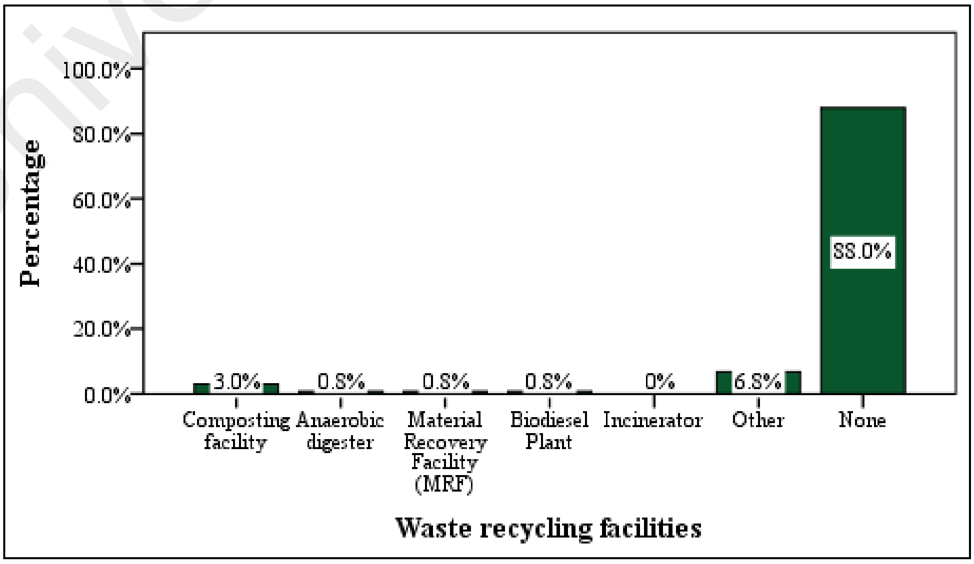


Figure 6.17: Solid waste recycling facilities used by responding MHEIs

6.3.11 Characteristics of Responding Mheis Solid Waste Data: Estimated Solid Wastes Generated and Recycled

The waste characterisation is a basic prerequisite in the efforts of mitigating environmental effects related to solid waste recycling. The survey aims to evaluate the higher education institution recycling performance in strategic way by measuring the solid waste generated and recycled. However, the recycling performance cannot be measured since majority (80.6%) of the responding MHEIs do not record the amount of solid waste generated and recycled (as shown in Figure 6.18). Another 17.8% of the respondents state that the data is not to be disclosed due to the sensitivity of wastes statistics. Only 1.6% of the respondents are willing to disclose their solid waste data, however the result cannot be generalised in this study.

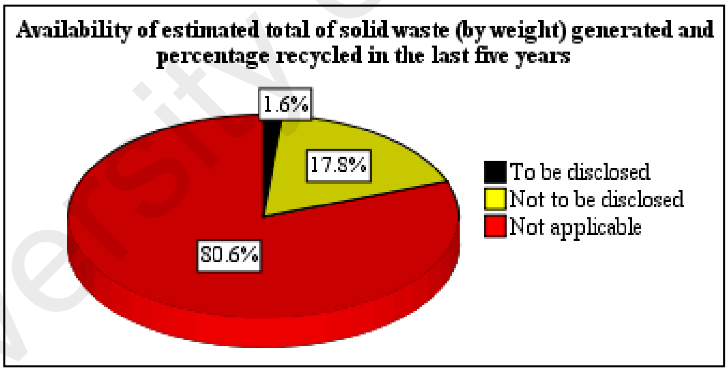


Figure 6.18: Availability of estimated of total solid waste generated and percentage recycled

The data of recyclables materials generated also cannot be obtained since the data is not applicable in most (78.3%) of the responding MHEIs (as shown in Figure 6.19). Besides, 20.2% of the respondents also report that the data cannot be disclosed. Only 1.6% of the respondents report that their solid waste data can be disclosed, however the result cannot be generalised in this study.

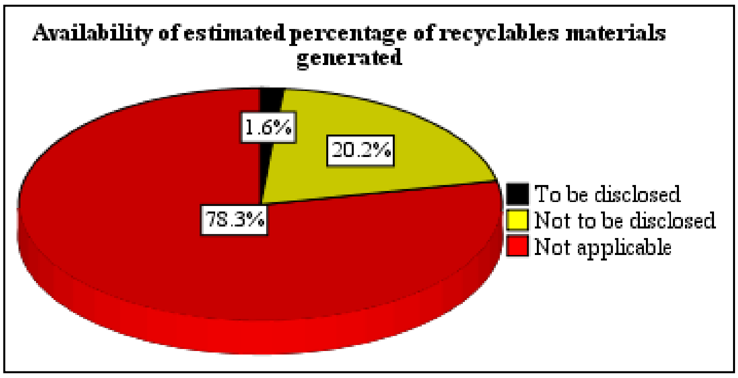


Figure 6.19: Availability of estimated percentage of recyclables materials generated

6.3.12 Ranking for the Critical Importance of Institution SWM Factors

Likert scale and ranking analysis were applied to rate the importance of SWM factors. There are fourteen (14) SWM factors to be considered in this study after the factors validation through semi-structured interviews. The respondents were asked to rate the degree of importance of SWM factors for strategic SWM in MHEIs. The Likert scales of 5, from which 1 indicates "not important" to 5 which indicates "extremely important" were employed. Ranking of the importance of SWM factors use the mean score to indicate the degree of importance of these factors. Descriptive statistics from the Table 6.11 identified eight (8) SWM factors to have a mean value of 4.0 and above were ranked according to their means.

Table 6.11: Ranking of SWM factors

SWM Factor	N	Range	Mean	Std. Deviation	Ranking
Waste separation at source	**129**	**3**	**4.46**	**.810**	**1**
Strong support from top management level	**129**	**3**	**4.35**	**.797**	**2**
Awareness or campaign	**129**	**3**	**4.33**	**.904**	**3**
Collection frequency	**129**	**4**	**4.29**	**.859**	**4**
Feedback on recycling performance	**129**	**4**	**4.13**	**1.078**	**5**
Goal/target setting policy	**129**	**4**	**4.12**	**1.075**	**6**
Education and training programme	**129**	**3**	**4.09**	**.952**	**7**
Proximity of recycling facilities	**129**	**4**	**4.01**	**1.057**	**8**
Partnership	129	4	3.91	.884	9
Waste disposal and collection contract provisions	129	4	3.80	.823	10
Marketing recyclable materials	129	4	3.47	1.111	11
EMS certification	129	4	3.36	1.256	12
Incentives or rewards	129	4	3.33	1.288	13
Methods of waste recovery	129	4	3.20	1.208	14

The role of institution recycling coordinator is essential in the strategic SWM. Principally, prioritise waste separation at source was ranked the highest mean score, with the value of 4.46. Definitely, all the wastes are needed to be separated before being process in recycling infrastructure to maximise its usefulness. Acquiring strong support from top management level factor was ranked as the second highest factor with 4.35 value of mean score. The support from top management either is financial support or human resource support would make the institution recycling activities more successful. In spite of these two factors, awareness or campaign raising, recyclables collection frequency, regular feedback on recycling performance, goal/target setting policy, provide education and training programme, and proximity of recycling facilities to some extent are found to be critical to institution strategic SWM.

6.3.13 Ranking for the Effectiveness of Institution Strategic Implications

Likert scale was also used to rate the effectiveness of each strategic implication variable. All five (5) strategic implication variables were validated during the exploratory phase. Ranking analysis was also performed to indicate the degree of effectiveness of strategic implication variables in SWM as shown in Table 6.12. The results showed that the mean score of the effectiveness of all MHEIs strategic implication variables were very low and below 4.00. This is because SWM is still in operation level in Malaysia, most of the MHEIs carried out recycling programmes based on their voluntary initiatives and contributions.

Among the five of strategic implication variables, compliance of Acts is ranked the highest, with a mean score of 3.21. Definitely, compliance of Acts is mandatory for every organisation in managing solid waste. However, the waste-related Acts in Malaysia only mandates the organisations to dispose the waste in proper way. No recycling target is imposed. This implies that recycling initiatives are conducted on voluntary basis. As a result, the existing waste-related Acts are considered to be complied readily at this juncture.

Waste stream reduction / Waste minimisation variable is ranked more effective than the variables of cost reduction, change of recycling behaviour/culture and revenue generated. Since sustainable environment is the main objective and drive of the recycling initiatives advocated by the government, this would be the reason that waste stream reduction is also the main goal of the most organisations to conduct recycling programmes. By achieving the sustainable environment from SWM perspective, all strategic implication variables are believed as critical and to be included in further analysis.

Table 6.12: Ranking of MHEI strategic impacts

Strategic implication variables	N	Mean	Std. Deviation	Ranking
Compliance of Acts	129	3.21	1.021	1
Waste stream reduction/Waste minimisation	129	2.53	.969	2
Cost reduction	129	2.51	1.039	3
Change of recycling behaviour/culture	129	2.41	.973	4
Revenue generated	129	1.84	.837	5

6.4 Reliability Analysis for SWM Factors and Strategic Implication Variables

This section intends to test the instrument reliability based on different respondent groupings. The Cronbach's alpha internal consistency method was employed to determine the reliability of the research instrument in this study. In determining the reliability of the instruments based on the Cronbach's alpha reliability method, the alpha value between .65 and .95 is satisfactory and the instrument is considered reliable (Chua, 2013). Hypothesis test 1 is used for reliability analysis.

Hypothesis test 1

Does all the SWM factors and strategic implication variables in this study reliable based on different respondent groupings?

Null hypothesis (H_0)

All fourteen (14) SWM factors and five (5) strategic implication variables in this study are not reliable based on different respondent groupings.

Alternative hypothesis (H_1)

Fourteen (14) SWM factors and five (5) strategic implication variables in this study are reliable based on different respondent groupings.

Based around the abovementioned hypothesis testing, this section represents the result of the Cronbach's alpha internal consistency method procedure used. The result shown in Table 6.13 reveals that for this research instrument, the Cronbach's alpha reliability coefficient is 0.871. This reliability value is satisfactory. Besides, the "Cronbach's alpha if item deleted" values of all variables are not larger than 0.871 (as shown in Table 6.14). It means deletion of any of the variable will not increase the reliability level of the instrument. It reflects the consistency of the reliability of the instruments. Therefore, the reliability is strong and perceived fairly across the variables. Hence, all variables are included in this research instrument. Since both SWM factors and strategic implication variables were measurable, the groupings of MHEI as moderating variable was not necessary. However, the following analysis was continued with the MHEI groupings based on MHEI financial capability.

Table 6.13: Reliability statistics

Cronbach's Alpha	N of Items
.871	19

Table 6.14: Item-Total statistics

	Factor/Variable	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Institution SWM factors (Independent variables)	Goal/target setting policy	63.22	94.890	.688	.857
	Partnership	63.43	100.731	.504	.864
	Strong support from top management level	62.99	100.602	.577	.863
	Awareness or campaign	63.01	101.070	.472	.865
	Education and training programme	63.26	100.379	.481	.865
	Waste separation at source	62.88	101.307	.521	.864
	Proximity of recycling facilities	63.33	95.927	.648	.858
	Collection frequency	63.05	101.895	.452	.866
	Methods of waste recovery	64.14	95.980	.550	.862
	Incentives or rewards	64.02	99.328	.369	.871
	Waste disposal and collection contract provisions	63.54	104.750	.299	.871
	Marketing recyclable materials	63.88	99.875	.421	.867
	Feedback on recycling performance	63.21	98.073	.526	.863
	EMS certification	63.98	96.085	.520	.864
Strategic impact variables (Dependent variables)	Waste stream reduction/Waste minimisation	64.81	99.559	.515	.864
	Cost reduction	64.83	99.393	.482	.865
	Revenue generated	65.50	102.518	.428	.867
	Change of recycling behaviour/culture	64.93	101.956	.385	.868
	Compliance of Acts	64.13	102.803	.320	.871

6.5 Relationship Analysis between SWM Factors and Its Performance Level

This section intends to find out whether there is any significant correlation between the perceived importance level of the SWM factors and the extent to which these factors are implemented by the responding MHEIs. This data was obtained from Part 4 of the questionnaire. The following hypothesis test 2 was developed for this correlation test.

Hypothesis test 2

Is there relationship between importance level of each SWM factor and the extent to which the factor has been implemented by the MHEIs based on the financial capability?

Null hypothesis (H_0)

There is no relationship between the importance level of each SWM factors and the extent to which the factor has been implemented based on the financial capability.

Alternative hypothesis (H_1)

There is relationship between the importance level of each SWM factors and the extent to which the factor has been implemented based on the financial capability.

The hypothesis test is reflected from the third objective for the whole population. Results having a significance of 0.05 probability level downwards are assumed to be conclusive. On the other words, if a particular result which has a 0.05 probability level or less or has occurred by chance then the null hypothesis will be rejected.

6.5.1 Correlation Analysis

The Pearson's correlation coefficient was performed to detect the relationship between two variables from the perspective of importance level of SWM factors (Independent variables) and the extent to which these factors are implemented (Dependent variables). Parametric statistics are appropriate to be used and valid when the data is normality distributed (Field, 2009; Chua, 2013). The data distribution of the fourteen (14) SWM factors tested were found to be normal (referred to Appendix I), therefore it is reasonable and permitted to use parametric statistics. As highlighted earlier in Section 6.6, if the correlation is significant at 0.05 probability level, then null hypothesis is rejected and alternative hypothesis is accepted.

A Pearson's correlation analysis was performed to measure the strength of relationship between the importance of fourteen (14) SWM factors and its implementation perceived by the respondents. As shown in Table 6.15, 7 out of 14 SWM factors have significant correlation at the 0.01 probability level and only one factor has significant correlation at the 0.05 probability level, between the variables (i.e. importance level of the SWM factors and its implementation perceived). It also means that the relationships are significant.

Table 6.15: Summarised results of Pearson's correlation between the importance level and its implementation for 14 SWM factors

SWM Factors	Variables type	N	Sig. (2-tailed)	Correlation coefficient (r)
Goal/target setting policy	Importance (IV) Implementation (DV)	129	**.000**	**.345****
Partnership	Importance (IV) Implementation (DV)	129	**.001**	**.280****
Strong support from top management level	Importance (IV) Implementation (DV)	129	**.001**	**.286****
Awareness or campaign	Importance (IV) Implementation (DV)	129	.894	.012
Education and training programme	Importance (IV) Implementation (DV)	129	.061	.165
Waste separation at source	Importance (IV) Implementation (DV)	129	.239	.104
Proximity of recycling facilities	Importance (IV) Implementation (DV)	129	**.000**	**.397****
Collection frequency	Importance (IV) Implementation (DV)	129	**.000**	**.424****
Methods of waste recovery	Importance (IV) Implementation (DV)	129	**.000**	**.335****

Table 6.15, continued

SWM Factors	Variables type	N	Sig. (2-tailed)	Correlation coefficient (r)
Incentives or rewards	Importance (IV) Implementation (DV)	129	**.000**	**.362****
Waste disposal and collection contract provisions	Importance (IV) Implementation (DV)	129	**.026**	**.196***
Marketing recyclable materials	Importance (IV) Implementation (DV)	129	.371	.079
Feedback on recycling performance	Importance (IV) Implementation (DV)	129	.544	.054
EMS certification	Importance (IV) Implementation (DV)	129	.567	.051

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed)

The correlation test results in Table 6.15 reveal that all fourteen (14) SWM factors have positive relationship between the factors tested, thus those respondents give a relatively high to importance to dealing with these factors tend to implement the factors effectively.

Since 8 out of 14 SWM factors have significant correlation between their importance and implementation level, thus the alternative hypothesis is retained. The factors which are significantly correlated at the 0.01 probability level include *goal/target setting policy*, *partnership*, *strong support from top management level*, *proximity of recycling facilities*, *collection frequency*, *methods of waste recovery* and *incentives or rewards*. While the only one factor that significantly correlated is *waste disposal and collection contract provisions*.

On the other hand, there are weak correlation results discovered for another remaining six (6) SWM factors. The factors include *awareness or campaign*, *education and training programme*, *waste separation at source*, *marketing recyclable materials*, *feedback on recycling performance* and *EMS certification* which in general showed weak positive correlations between importance level and the extent to which the factors have been implemented by the MHEIs.

6.6 Relationship Analysis between the SWM Performance and Its Strategic Impacts

This section is going to fulfil the third objective, which intends to find out the extent to which these principal SWM factors have association with the strategic implication variables of SWM at institutional level. This data was obtained from Part 2 Question 2.7 and Part 4 of the questionnaire. The associations employed consist of achieved implementation compared to the expected effectiveness and has led to the hypothesis test 3.

Hypothesis test 3

Does the implementation level of each SWM factor has association with the effectiveness of each strategic implication variable based on the financial capability?

Null hypothesis (H_0)

There is no association between the implementation level of each SWM factor and the effectiveness level of each strategic implication variable based on the financial capability.

Alternative hypothesis (H_1)

There is association between the implementation level of each SWM factor and the effectiveness level of each strategic implication variable based on the financial capability.

Similar with the previous tests, results having a significance of 0.05 probability level downwards are assumed to be conclusive. On the other words, the null hypothesis is rejected at a 5% significance level. The outcomes are reported with table from the Pearson's Correlation test undertaken.

6.6.1 Correlation Analysis

The Pearson's correlation was performed to detect the relationship between the implementation level of SWM factors (independent variables) and the effectiveness level of strategic implication variables (dependent variables). Both data distribution of the fourteen (14) SWM factors (referred to Appendix I) and strategic implication variables (referred to Appendix J) tested were found to be normal, therefore it is reasonable and permitted the use of parametric statistics.

The results from Table 6.16 show that generally more positive correlations were detected in the test. This indicates that the implementation of SWM factors influence the institution solid waste operation strategically.

Table 6.16: Pearson's correlation results between the implementation level of SWM factors and the effectiveness level of strategic implication variables

Factors / Variables	Waste stream reduction/ Waste minimisation	Cost reduction	Revenue generated	Change of recycling behaviour /culture	Compliance of Acts
Goal/target setting policy	**.619****	**.631****	**.589****	**.413****	.132
Partnership	**.468****	**.434****	**.453****	**.443****	**.280****
Strong support from top management level	**.560****	**.532****	**.518****	**.394****	.141
Awareness or campaign	**.448****	**.360****	**.409****	**.328****	.165
Education and training programme	**.449****	**.403****	**.546****	**.327****	.011

Table 6.16, continued

Factors / Variables	Waste stream reduction/ Waste minimisation	Cost reduction	Revenue generated	Change of recycling behaviour /culture	Compliance of Acts
Waste separation at source	**.590****	**.559****	**.532****	**.434****	.170
Proximity of recycling facilities	**.441****	**.461****	**.388****	**.394****	**.321****
Collection frequency	**.240****	**.292****	.166	**.286****	**.357****
Methods of waste recovery	**.315****	**.361****	**.477****	.127	-.006
Incentives or rewards	**.251****	**.304****	**.490****	**.184***	-.084
Waste disposal and collection contract provisions	**.450****	**.408****	**.397****	**.353****	**.205***
Marketing recyclable materials	**.272****	**.355****	**.531****	**.292****	-.085
Feedback on recycling performance	**.387****	**.470****	**.580****	**.259****	.070
EMS certification	.166	**.194***	**.376****	**.194***	-.093

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Based on the results in Table 6.16, all the SWM factors are significantly correlated with the *cost reduction* variable. This reflects that the effectiveness of this strategic implication variable is closely correlated to every SWM factor. While for another variable such as *waste stream reduction / waste minimisation* variable, all the SWM factors implemented are significantly correlated with this strategic implication variable except the EMS certification factor. For the *revenue generated* variable, only one factor is not significantly correlated with this strategic implication variable that is collection frequency factor. On the other hand, for the *change of recycling behaviour/culture* variable, all SWM factors show significant relationship except the methods of waste recovery factor.

Lastly, 4 out of 14 SWM factors are significantly correlated with *compliance of Acts* variable. From these four SWM factors, all are positive correlated thus show that these factors if are well-implemented will lead to the Acts enforced effectively, the factors include partnership, proximity of recycling facilities, collection frequency, and waste disposal and collection contract provisions factors. Negative but not significant relationships have appeared in few SWM factors, such as methods of waste recovery, incentives or rewards, marketing recyclable materials and EMS certification factors.

Based on the findings of the above results, alternative hypothesis (H_1) is retained as all SWM factors have significant correlations towards the strategic solid waste operation. Regression analysis is then conducted in the next section to identify the effects of these SWM factors (independent variables) on the strategic implication variables (dependent variables).

6.7 Strategic SWM Performance Level between MHEI Groupings

This section deals with measuring participants' perceived effectiveness level of strategic implications in SWM. There are currently no mechanisms by which to measure the recycling performance in the aspect of strategic implications based on the MHEI groupings, so the aim of this section is to avoid using a single criterion to measure the recycling performance. Hypothesis test 4 is used for ANOVA analysis.

Hypothesis test 4

Is there any variation in effectiveness level of strategic implications across the three MHEI groupings based on the financial capability?

Null hypothesis (H_0)

There are no differences of the mean scores of strategic implications effectiveness level across three MHEI groupings based on the financial capability.

Alternative hypothesis (H_1)

There are differences of the mean scores of strategic implications effectiveness level across three MHEI groupings based on the financial capability.

Based around the abovementioned hypothesis testing, this section represents the result of the ANOVA procedure employed. ANOVA was used to evaluate the effect of respondent variation with respect to strategic implication effectiveness level of SWM. This technique was applied because one-way ANOVA can be used to compare more than two mean scores of the research samples. As stated by Latifah et al. (2004) and Chua (2013), a probability level of 0.05 is a suitable cutoff point for rejecting the null hypothesis. That is, results having a significance of 95% downwards are deemed to be conclusive.

In this construct, respondents were asked to rate their effectiveness level of strategic implication variables listed on a five-point Likert scale (1 – not effective, 5 – extremely effective). This was designed to measure the effectiveness level of strategic implications in SWM derived from the previous findings. All five (5) strategic implication variables were pooled together as a *composite variable* for overall effectiveness level of strategic implication variables. Prior to the ANOVA test analysis, normality test for data distribution was conducted. As stated by Chua (2013), normality of data collected from the respondents should be identified as the basic condition for inferential statistics such as ANOVA test. According to Chua (2013), for a data to be normally distributed, the skewness and kurtosis values should be in the range of -1.96 to +1.96. In this case, the distribution of data is normal because both the skewness (0.134) and kurtosis (-0.893) values are within the normal distribution range (referred to Appendix K).

6.7.1 Identifying Significant Difference of Strategic Implication across MHEI Groupings

Table 6.17 portrays the output from the analysis outlining three key descriptive statistical parameters: mean values, standard deviation, standard errors at the 95% confidence interval, and the number of responses from each group. The total number of responses analysed (N), for three MHEI groupings was 129.

Table 6.17: Means, standard deviations and standard error comparing three MHEI groupings

Strategic implication

MHEI	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Public university	13	2.7231	.68575	.19019	2.3087	3.1375	1.60	3.60
Private university	35	2.7714	.64924	.10974	2.5484	2.9945	1.60	3.80
College	81	2.3457	.73757	.08195	2.1826	2.5088	1.00	4.00
Total	129	2.4992	.73234	.06448	2.3716	2.6268	1.00	4.00

Based on the result in Table 6.18, the value of F (df = 2, 126, $p < 0.05$) = 5.1 is significant. As a result, the null hypothesis is rejected and the alternative hypothesis is retained. Thus, ANOVA test shows that there are significant differences in effectiveness level of strategic implication variables across three MHEI groupings.

Table 6.18: One-Way ANOVA in strategic implication tests by MHEI groupings

ANOVA

Strategic implication

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5.154	2	2.577	5.114	.007
Within Groups	63.495	126	.504		
Total	68.650	128			

Since the p-value of the test is less than 0.05, at least one pair of means differ significantly. Hence, there is a need to identify the pair(s) that differs significantly. A post hoc test is employed to reveal which means differ from each other.

6.7.2 Test of Homogeneity of Variances of Strategic Implication

The test of homogeneity of variances is presented in Table 6.19. The Levene statistic is employed to test whether the variances between MHEI groupings are the same. The p-value for the Levene's test for equality of variances is 0.794, which is more than 0.05. Thus, the equality of variances is assumed. Since equality of variance can be assumed, the Tukey method for post hoc test is often used to detect homogeneous subsets and used for pairwise comparisons (Chinna et al., 2012).

Table 6.19: Test of homogeneity result for interaction between MHEI groupings on overall effectiveness level of strategic implication on SWM

Strategic implication

Levene Statistic	df1	df2	Sig.
.231	2	126	.794

6.7.3 Comparing Mean between MHEI Groupings

The result obtained from ANOVA test (refer in Table 6.18) helped to determine the statistical significance of variance between the factors, it did not point out the actual point of variation or how these factors differed. Therefore, a post hoc test was required and used to compares the means of the respondent groups. As stated by Chinna et al. (2012), Tukey procedure was used when the Levene's Test is not significant (p = 0.794).

The pairwise comparison result through Tukey's post hoc method is presented in Table 6.20. Column 1 and 2 of the table presents the factors being tested. The third column gives the difference in mean values between the compared groups. The p (sig.) values for the mean difference are given in column 5. Where the p (sig.) value (column 5) is less than 0.05, the variation in the means between factors is assumed to be statistically significant.

Table 6.20: Post hoc result with equal variances assumed (Tukey HSD) test

Multiple Comparisons

Strategic implication
Tukey HSD

(I) MHEI groupings	(J) MHEI groupings	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Public university	Private university	-.04835	.23057	.976	-.5952	.4985
	College	.37740	.21210	.181	-.1256	.8804
Private university	Public university	.04835	.23057	.976	-.4985	.5952
	College	.42575*	.14359	.010	.0852	.7663
College	Public university	-.37740	.21210	.181	-.8804	.1256
	Private university	-.42575*	.14359	.010	-.7663	-.0852

*. The mean difference is significant at the 0.05 level.

Table 6.21: Result of homogeneous subsets (Tukey HSD[a,b]) for overall effectiveness level of strategic implication

Strategic implication

Tukey HSD[a,,b]

MHEI groupings	N	Subset for alpha = 0.05
		1
College	81	2.3457
Public university	13	2.7231
Private university	35	2.7714
Sig.		.086

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 25.458.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Result from the post hoc comparison indicated statistically significant variation was found (as shown in Table 6.20). Only the p (sig.) value for the pair of *private university* and *college* was less than 0.05, and is statistically significant. According to Field (2009), homogeneous subset test which portrayed an adjusted Tukey test was appropriate when group sizes were not similar. Therefore, the homogeneous subset test that is appropriate for non-familiar group sizes is presented in Table 6.21. The homogeneous subset table shows that the mean score of college is the lowest among the mean scores of the other groups. Note that there was not statistically significant difference ($p = 0.086$) among college, public university and private university means as shown in subset 1.

6.8 Perception of Significant Importance of SWM Factors between three MHEI Groupings

This section reports the preliminary findings from statistical analysis by using hypothesis test 5 which was derived from the third research objective. A brief description dealing with the hypothesis testing with the statistical results are performed in the following sections.

Hypothesis test 5

Is there any variation in critical importance of each SWM factor across the three MHEI groupings based on the financial capability?

Null hypothesis (H_0)

There are no differences between the critical importance of each SWM factor across three MHEI groupings based on the financial capability.

Alternative hypothesis (H_1)

There are differences between the critical importance of each SWM factor across three MHEI groupings based on the financial capability.

Based around the abovementioned hypothesis testing, this section represents the result of the MANOVA procedure used. MANOVA was employed to evaluate the effect of respondent variation with respect to the SWM factors. This technique was applied because MANOVA can be used to analyse more dependent variables (SWM factors) simultaneously. As stated by Latifah et al. (2004) and Chua (2013), a probability level of 0.05 is a suitable cutoff point for rejecting the null hypothesis. That is, results having a significance of 95% downwards are deemed to be conclusive.

In this construct, respondents were asked to rate their level of importance for SWM factors listed on a five-point Likert scale (1 – not important, 5 – extremely important). Prior to the MANOVA test analysis, normality test for data distribution was conducted. Normality of data collected from the respondents should be identified as the basic condition for inferential statistics such as MANOVA test (Chua, 2013). As mentioned earlier, for a data to be normally distributed, the skewness and kurtosis values should be in the range of -1.96 to +1.96 (Chua, 2013). In this case, the data distribution is normal because both skewness and kurtosis values of each SWM factor are within the normal distribution range (referred to Appendix I).

6.8.1 General Linear Model (GLM) of MANOVA Procedure

In regard to the present study, multivariate analysis was used to conduct comparison analysis of SWM activities among the three responded MHEI groupings (i.e. Public University, Private University and College) as presented in Table 6.22. N represents the number of responses (N shows indication of unequal group sizes). Based on the results from Table 6.22, the output from the analysis outlines three main descriptive statistical parameters which are mean, standard deviation and number of responses from each group, based around the Likert scale across the fourteen (14) SWM factors observed.

Table 6.22: Descriptive statistics comparing three responding MHEI groupings

SWM Factors	MHEI groupings	Mean	Std. Deviation	N
Goal/target setting policy	Public university	4.38	.650	13
	Private university	4.11	1.105	35
	College	4.09	1.120	81
	Total	4.12	1.075	129
Partnership	Public university	3.92	.760	13
	Private university	3.80	.868	35
	College	3.96	.914	81
	Total	3.91	.884	129
Strong support from top management level	Public university	4.38	.650	13
	Private university	4.34	.838	35
	College	4.35	.809	81
	Total	4.35	.797	129
Awareness or campaign	Public university	4.00	1.000	13
	Private university	4.23	.942	35
	College	4.43	.865	81
	Total	4.33	.904	129

Table 6.22, continued

SWM Factors	MHEI groupings	Mean	Std. Deviation	N
Education and training programme	Public university	3.85	1.068	13
	Private university	4.03	.923	35
	College	4.15	.950	81
	Total	4.09	.952	129
Waste separation at source	Public university	4.08	.862	13
	Private university	4.40	.651	35
	College	4.54	.852	81
	Total	4.46	.810	129
Proximity of recycling facilities	Public university	3.92	.862	13
	Private university	3.89	1.022	35
	College	4.07	1.104	81
	Total	4.01	1.057	129
Collection frequency	Public university	3.85	.689	13
	Private university	4.06	.938	35
	College	4.46	.807	81
	Total	4.29	.859	129
Methods of waste recovery	Public university	3.77	1.092	13
	Private university	3.49	1.245	35
	College	2.99	1.167	81
	Total	3.20	1.208	129
Incentives or rewards	Public university	3.38	1.261	13
	Private university	3.63	1.190	35
	College	3.19	1.324	81
	Total	3.33	1.288	129
Waste disposal and collection contract provisions	Public university	3.23	.832	13
	Private university	3.86	.810	35
	College	3.86	.802	81
	Total	3.80	.823	129
Marketing recyclable materials	Public university	3.54	1.127	13
	Private university	3.63	1.165	35
	College	3.38	1.091	81
	Total	3.47	1.111	129
Feedback on recycling performance	Public university	4.23	.832	13
	Private university	4.14	1.061	35
	College	4.11	1.129	81
	Total	4.13	1.078	129

Table 6.22, continued

SWM Factors	MHEI groupings	Mean	Std. Deviation	N
EMS certification	Public university	3.77	1.013	13
	Private university	3.69	1.157	35
	College	3.16	1.299	81
	Total	3.36	1.256	129

6.8.2 Identifying Significant Effect of MHEI Groupings towards SWM Factors

The multivariate test in Table 6.23 shows the way to find the actual result of the one-way MANOVA. If the Wilks' Lambda (shaded) test statistic in the row of "MHEI groupings" is significant, which would indicate that overall there is a significant effect of MHEI groupings towards all fourteen (14) SWM factors. As shown in Table 6.23, the p-value (sig.) of Wilks' Lamba (shaded) is 0.064, which is higher than 0.05. Therefore, it can be said that there was not significant effect of MHEI groupings towards all fourteen (14) SWM factors.

Table 6.23: Multivariate tests

Multivariate Tests[c]

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.972	284.662[a]	14.000	113.000	.000
	Wilks' Lambda	.028	284.662[a]	14.000	113.000	.000
	Hotelling's Trace	35.268	284.662[a]	14.000	113.000	.000
	Roy's Largest Root	35.268	284.662[a]	14.000	113.000	.000
MHEI groupings	Pillai's Trace	.303	1.452	28.000	228.000	.073
	Wilks' Lambda	.714	1.479[a]	28.000	226.000	.064
	Hotelling's Trace	.377	1.506	28.000	224.000	.056
	Roy's Largest Root	.297	2.421[b]	14.000	114.000	.005

a. Exact statistic

b. The statistic is an upper bound on F that yields a lower bound on the significance level.

c. Design: Intercept + MHEI groupings

6.8.3 Test of Homogeneity of Variances of SWM Factors

The test of homogeneity of variances is presented in Table 6.24. As mentioned earlier, the Levene statistic is employed to test whether the variances between MHEI groupings are the same. The p-value for the Levene's test for equality of variances of all SWM factors is more than 0.05. Thus, the equality of variances is assumed. Since equality of variance can be assumed, the Tukey method for post hoc test is often used to detect homogeneous subsets and used for pairwise comparisons (Chinna et al., 2012).

Table 6.24: Test of homogeneity result for interaction between MHEI groupings on SWM factors

Levene's Test of Equality of Error Variances[a]

SWM Factors	F	df1	df2	Sig.
Goal/target setting policy	1.894	2	126	.155
Partnership	.558	2	126	.574
Strong support from top management level	.666	2	126	.516
Awareness or campaign	.228	2	126	.796
Education and training programme	.750	2	126	.475
Waste separation at source	.632	2	126	.533
Proximity of recycling facilities	.910	2	126	.405
Collection frequency	.607	2	126	.547
Methods of waste recovery	1.089	2	126	.340
Incentives or rewards	.699	2	126	.499
Waste disposal and collection contract provisions	.032	2	126	.969
Marketing recyclable materials	.262	2	126	.770
Feedback on recycling performance	.792	2	126	.455
EMS certification	1.021	2	126	.363

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a. Design: Intercept + MHEI groupings

6.8.4 Identifying Variance of Importance of SWM Factors

A test of Between-Subjects Effects (see Appendix L) is summarised in the Table 6.25. Each item in the model is tested for its ability to account for variation on the SWM factors. The significant value (p) for each item is less than 0.05 ($p < 0.05$). This marks that a significant statistical variation in importance level among the respondent groups on the listed factors exits. Table 6.25 reveals the variation (Type III Sum of Square), the degree of freedom (df), the variance (Mean Square), F value (F) and the significance value (Sig.). The Sig. shows whether the null hypothesis should be rejected or not.

The test result shows that the p-value of the three (3) SWM factors, i.e collection frequency, methods of waste recovery and waste disposal and collection contract provisions is less than 0.05. This reveals that the mean values of these three (3) SWM factors differed or varied significantly across MHEI groupings. Thus, null hypothesis (H_0) is rejected and the alternative hypothesis (H_1) that **there is difference between the critical importance of some SWM factors in the sample across MHEIs groupings** is retained.

Table 6.25: Summarised model for Tests of Between-Subjects Effects

Source	SWM factors	Type III Sum of Squares	df	Mean Square	F	Sig.
MHEI groupings	Goal/target setting policy	1.001	2	.500	.429	.652
	Partnership	.650	2	.325	.412	.663
	Strong support from top management level	.019	2	.009	.014	.986
	Awareness or campaign	2.619	2	1.309	1.617	.203
	Education and training programme	1.176	2	.588	.645	.526
	Waste separation at source	2.594	2	1.297	2.007	.139
	Proximity of recycling facilities	.971	2	.485	.431	.651
	Collection frequency	6.711	2	3.355	4.822	**.010**
	Methods of waste recovery	10.721	2	5.361	3.837	**.024**
	Incentives or rewards	4.855	2	2.428	1.474	.233
	Waste disposal and collection contract provisions	4.660	2	2.330	3.576	**.031**
	Marketing recyclable materials	1.555	2	.778	.626	.536
	Feedback on recycling performance	.166	2	.083	.071	.932
	EMS certification	9.112	2	4.556	2.978	.054

Result indicated there are significant differences in the perceptions by the MHEI groupings for:

1. Collection frequency [$F(2,126)= 4.82$; $p < 0.05$];
2. Methods of waste recovery [$F(2,126)= 3.84$; $p < 0.05$];
3. Waste disposal and collection contract provisions [$F(2,126)= 3.58$; $p < 0.05$]

To further indicate which means differ from each other, a post hoc comparisons test procedure for identified SWM factors was presented (see Section 6.6.6).

The EMS certification factor [$F(2,126) = 2.98$; $p < 0.05$] shows a borderline significant which indicates that a small difference exists between the perception of MHEI groupings in relation to the level of importance of this initiative.

6.8.5 Estimated Marginal Means and Standard Error

Table 6.26 summarises the model of estimated marginal means and standard errors at 95% confidence interval for the three (3) SWM factors in the previous section that differed significantly across three MHEI groupings. Table 6.22 (as presented in Section 6.8.1) shows an outline of grand mean for the dependent variables. From Table 6.26, it is possible to disclose interaction effects among all three MHEI groupings (i.e. Public University, Private University and College). For instance, Public University scheme's level of importance for *methods of waste recovery* is at mean of 3.77; while College scheme has a much lower mean of 2.99. However, the factors pattern for *collection frequency* and *waste disposal and collection contract provision* indicated that College schemes have a greater margin between the each of the respondents' mean. This suggests an interaction effect between the perceived importance level for institution SWM with respect to these three MHEI groupings from respondents.

Table 6.26: Summarised model for estimated marginal means and standard error

MHEI groupings

SWM factors	MHEI groupings	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Collection frequency (Grand mean = 4.29)	Public university	3.846	.231	3.388	4.304
	Private university	4.057	.141	3.778	4.336
	College	4.457	.093	4.273	4.640
Methods of waste recovery (Grand mean = 3.20)	Public university	3.769	.328	3.120	4.418
	Private university	3.486	.200	3.090	3.881
	College	2.988	.131	2.728	3.248
Waste disposal and collection contract provisions (Grand mean = 3.80)	Public university	3.231	.224	2.788	3.674
	Private university	3.857	.136	3.587	4.127
	College	3.864	.090	3.687	4.042

6.8.6 Comparing Variation in the Means of SWM Factors between Three MHEI Groupings

The result obtained from test of between subjects effects (refer in Table 6.25 and Appendix L) helped to determine the statistical significance of variance between the MHEI groupings, it did not point out the actual point of variation or how these factors differed. Therefore, a post hoc test was required to carry out. According to Field (2009), when Levene's test is not significant ($p > 0.05$) then the variances are roughly equal and the assumption is tenable. Hence, the Tukey HSD test was used since Levene's test is not significant ($p < 0.05$) (refer to Table 6.24).

The result of post hoc comparison with Tukey HSD test is presented in Table 6.27. The table shows the differences in model predicted means for each pair of institution level. Column 2 and 3 of the table present that pairs of institutions being tested. When p

(Sig.) value is less than 0.05, variation in the means between MHEI groupings is said to be statistically significant.

From the Table 6.27, it is noteworthy that significant differences existed in the observed 2 factors, except the *methods of waste recovery* factor. Considering the level of importance of the *collection frequency* factor, the variation level between *college and public university schemes* was statistically significant (p = 0.041), with mean difference of 0.61. However for the *college and private university schemes* in the *collection frequency* factor, although p-value is 0.05, the mean difference is not statistically significant. In addition, for the *waste disposal and collection contract provisions* factor, there were statistical variation in the level of importance between *public university and private university schemes* (p = 0.048), with mean difference of -0.63; and also between *public university and college schemes* (p = 0.026), with mean difference of -0.63.

Table 6.27: Post Hoc result with equal variances assumed (Tukey HSD) test

Multiple Comparisons
Tukey HSD

SWM factors	(I) MHEI groupings	(J) MHEI groupings	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Collection frequency	Public university	Private university	-.21	.271	.717	-.85	.43
		College	-.61*	.249	.041	-1.20	-.02
	Private university	Public university	.21	.271	.717	-.43	.85
		College	-.40	.169	.050	-.80	.00
	College	Public university	.61*	.249	.041	.02	1.20
		Private university	.40	.169	.050	.00	.80

Table 6.27, continued

SWM factors	(I) MHEI groupings	(J) MHEI groupings	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Methods of waste recovery	Public university	Private university	.28	.384	.741	-.63	1.19
		College	.78	.353	.073	-.06	1.62
	Private university	Public university	-.28	.384	.741	-1.19	.63
		College	.50	.239	.097	-.07	1.07
	College	Public university	-.78	.353	.073	-1.62	.06
		Private university	-.50	.239	.097	-1.07	.07
Waste disposal and collection contract provisions	Public university	Private university	-.63*	.262	.048	-1.25	.00
		College	-.63*	.241	.026	-1.21	-.06
	Private university	Public university	.63*	.262	.048	.00	1.25
		College	-.01	.163	.999	-.39	.38
	College	Public university	.63*	.241	.026	.06	1.21
		Private university	.01	.163	.999	-.38	.39

Based on observed means.
The error term is Mean Square (Error) = 1.530.
*. The mean difference is significant at the .05 level.

The homogeneous Subset tables (as shown in Appendix M) were presented since group sizes were not similar. The adjusted Tukey test (refer Appendix M) reveals that in the importance level of *collection frequency* factor, there was no statistically significant relationship between public university and private university schemes (p = 0.640), as well as between the highest group (college scheme; mean = 4.46) and average group (private university scheme; mean 4.06), with p (Sig) value 0.206. Furthermore, for the *waste disposal and collection contract provisions* factor, there was not a statistically significant different (p = 1.000) in public university scheme as shown in Subset 1. While in Subset 2, there were also not significantly different (p = 0.999) between private university scheme (mean = 3.86) and college scheme (mean = 3.86).

Based on the findings of the above results, it can be concluded that there were only three (3) SWM factors of critical importance of perceived differently across respondent groups, those factors were *collection frequency*, *methods of waste recovery* and *waste disposal and collection contract provisions*.

6.9 Best Fit Approach for SWM Strategies for MHEI in Malaysia

The section intends to ascertain the third research objective by predicting significant factors involved in the strategic solid waste operation. This section is also the extension of the above test in Section 6.6, which intends to access whether the fourteen (14) independent variables (SWM factors) can significantly predict each strategic implication variable.

As many scientists treated the variables which dimension is evaluated using a 5-point scale and the different between rating of 1 and 2 is identical to the difference between ratings of 3 and 4, as interval (Field, 2009), hence a linear regression test is suitable to be used. As explained in Section 6.8, the data distribution of fourteen (14) SWM factors is normal as both skewness and kurtosis values of each factor are within the normal distribution range (referred to Appendix I). While the data of strategic implication variables are normally distributed as well since the skewness and kurtosis values are in the range of -1.96 to +1.96 (referred to Appendix J). Therefore, multiple linear regression test is appropriate.

This regression analysis is used so that the inferences can be made about the linear correlation which exists between each strategic implication variable (criterion variable), 14 significant SWM factors (predictor variables) and 3 groups of MHEIs (confounding variables). Hierarchical regression analysis is used for testing theoretical assumptions and examining the influence of several predictor variables in a sequential way, such that the relative importance of a predictor is judged on the basis of how much it adds to the prediction of a criterion, over and above that which can be accounted for by other important predictors (Petrocelli, 2003). The purpose of applying this hierarchical regression is to determine the degree to which factors entered later in the analysis account for variance in the criterion. Two steps of this method are arranged to reflect the principle of causal priority and to test the hypothesis.

Hypothesis test 6

Does all the SWM factors implemented by three groups of MHEIs have effects towards each strategic implication variable based on the financial capability?

Null hypothesis (H_0)

All fourteen (14) SWM factors implemented by the three groups of MHEI do not have effects towards each strategic implication variable based on the financial capability, where the variables include:

- Waste stream reduction / waste minimisation
- Cost reduction
- Revenue generated
- Change of recycling behaviour/culture
- Compliance of Acts

Alternative hypothesis (H_1)

SWM factors implemented by the three groups of MHEI have effects towards each strategic implication variable based on the financial capability.

Hierarchical multiple linear regression analysis is carried out to ascertain the implementation of the fourteen (14) SWM factors that would affect the strategic solid waste operation. Five regression analyses are conducted towards five strategic implication variables. This empirical analysis would validate the existing trend in relation to the influenced strategic implication variables towards overall strategic solid waste operation.

6.9.1 Regression Analysis

Hierarchical regression is an extension of multiple linear regression where the confounding variable together with 14 independent variables were analysed together throughout to predict the dependent variable. Theoretically, this technique is to use both confounding variable (three groups of MHEIs) and independent variables (implementation of 14 SWM factors) whose values are known to predict each dependent variable (5 strategic implication variables). The procedure has been discussed earlier in Section 4.9.6.

This study applied the hierarchical multiple linear regression that enter the variables into the model in a specified order; 2 steps: first is the enter method, second is the stepwise method. In the first step, the researcher specifies the three groups of MHEIs (confounding variable) by using the Enter method to engage inferences of the three groups of MHEIs. This is the case using three difference groupings of data. Then the stepwise method is used in the second step to analyse the predictor variables. Using the stepwise method is essential to disclose the minimum number of factors that the researcher would forecast the influential parameters out of the fourteen (14) SWM factors. The following sections discussed in detail the analysis results of fourteen (14) SWM factors towards each strategic implication variable.

6.9.1.1 Waste Stream Reduction / Waste Minimisation

Based on the correlation results in Section 6.6.1, 13 out of 14 SWM factors were found significantly correlated with waste stream reduction / waste minimisation variable, except EMS certification factor. Therefore, EMS certification factor is excluded for this test. Based on the result from first step – Enter method, the significant value for eleven (11) SWM factors are less than 0.05 (referred to Appendix N), thus these factors are then entered into next step – Stepwise method. Table 6.28 shows the number of variables that the researcher would foresee the influential parameters of the implementation of factors.

Table 6.28: Variables Entered/Removed[a] (both Enter and Stepwise method)

Model	Variables Entered	Method
1	MHEI groupings[b]	Enter
1	Goal/target setting policy	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	Waste separation at source	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	Strong support from top management level	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: Waste stream reduction/Waste minimisation
b. All requested variables entered.

Table 6.29 and Table 6.30 show the hierarchical regression analysis summary for effectiveness of waste stream reduction / waste minimisation. The results also show all the three regression models provided built upon the criterion variable (waste stream reduction / waste minimisation) and its predictor variables (SWM factors) can be generalised against the population. It can be concluded that the regression model 3 demonstrates the *implementation of goal/target setting policy*, *implementation of waste separation at source* and *implementation of strong support from top management level* were the only three SWM factors related to the criterion variable, at $p < 0.05$. Overall correlation between the criterion variable and the three predictors as resulted in the regression model (Model 3), $R = 0.685$ with 46.9% of the variance is related.

Table 6.29: Model summary and coefficients results for effectiveness of waste stream reduction / waste minimisation on the SWM factors

Model summary					Coefficients[d]		
Model		**R**	**R^2**	**Adjusted R^2**	**β**	**t**	**Sig.**
Stepwise method							
1	(Constant)					10.590	.000
	Goal/target setting policy	.619[a]	.384	.379	.619	8.892	.000
2	(Constant)					8.401	.000
	Goal/target setting policy	.668[b]	.447	.438	.410	4.750	.000
	Waste separation at source				.327	3.793	.000
3	(Constant)					7.358	.000
	Goal/target setting policy				.291	2.934	.004
	Waste separation at source	.685[c]	.469	.457	.293	3.407	.001
	Strong support from top management level				.207	2.304	.023

a. Predictors: (Constant), Implementation of Goal/target setting policy
b. Predictors: (Constant), Implementation of Goal/target setting policy, Implementation of Waste separation at source
c. Predictors: (Constant), Implementation of Goal/target setting policy, Implementation of Waste separation at source, Implementation of Strong support from top management level
d. Dependent Variable: Effectiveness of Waste stream reduction/Waste minimisation

Table 6.30: ANOVA[d] results for effectiveness of waste stream reduction / waste minimisation on the SWM factors

Model		Sum of Squares	df	Mean Square	F	Sig.
Stepwise method						
1	Regression	46.104	1	46.104	79.069	.000[a]
	Residual	74.051	127	.583		
	Total	120.155	128			
2	Regression	53.693	2	26.847	50.897	.000[b]
	Residual	66.462	126	.527		
	Total	120.155	128			
3	Regression	56.401	3	18.800	36.861	.000[c]
	Residual	63.754	125	.510		
	Total	120.155	128			

a. Predictors: (Constant), Implementation of Goal/target setting policy

b. Predictors: (Constant), Implementation of Goal/target setting policy, Implementation of Waste separation at source

c. Predictors: (Constant), Implementation of Goal/target setting policy, Implementation of Waste separation at source, Implementation of Strong support from top management level

d. Dependent Variable: Effectiveness of Waste stream reduction/Waste minimisation

The result in Model 3 (shown in Table 6.29) represents 46.9% of the variation in waste stream reduction / waste minimisation is explained by these three SWM factors. The adjusted R^2 provides some idea of how well the model generalises and it is ideal if its value is the same, or very close to, the value of R^2 (Field, 2009). In this test, the difference for the Model 3 is small (difference between the values is 0.469 - 0.457 = 0.012 (about 1.2%). This shrinkage means that when the model was derived from the population rather than the sample, it would account for approximately 1.2% less variance in the outcome. However, in Model 2, the value of R^2 = 0.447 described 44.7% of the variance in the waste stream reduction / waste minimisation influenced by the variance of *goal/target setting policy* and *waste separation at source*. When the additional component was entered into the multiple regression model, the percentage of variance explained increase by 2.2% to 46.9%, with *strong support from top management level*, *goal/target setting policy* and *waste separation at source* variables being statistically significant.

Besides, t-test is used for checking the significance of individual regression coefficients in the model. Results shown in Table 6.29 found that t-test value shows the variable coefficients are significant at $p < 0.05$. There are only three predictor variables, which are *goal/target setting policy*, *waste separation at source* and *strong support from top management level*, are the predictors for the effectiveness of waste stream reduction / waste minimisation. Therefore this regression results reject the null hypothesis but accept the alternative hypothesis as there are three SWM factors with effects on waste stream reduction / waste minimisation.

The *implementation of goal/target setting policy* is the main factor which significantly [$F(1,127) = 79.069$, $p < 0.05$] contributes 38.4% of the variance (R^2 = 0.384) in the effectiveness of waste stream reduction / waste minimisation. This means *goal/target setting policy* (β = 0.291. $p < 0.05$), or set the recycling target to be accomplished, is the main indicator of the waste stream reduction / waste minimisation for the MHEIs. The combination of *implementation of goal/target setting policy* and *waste separation at source* (β = 0.293, $p < 0.05$) accounts for 6.3% change (44.7% - 38.4%) of the variance (R^2 = 0.447) in waste stream reduction / waste minimisation [$F(2,126) = 50.897$, $p < 0.05$]. However, the *implementation of strong support from top management level* does not contribute much to the change in waste stream reduction / waste minimisation because combination of the *strong support from top management level* (β = 0.207, $p < 0.05$) predictor variable with *goal/target setting policy* (β = 0.291. $p < 0.05$) and *waste separation at source* (β = 0.293, $p < 0.05$) only accounts for 2.2% (46.9% - 44.7%) change of variance (R^2 = 0.469) in waste stream reduction / waste minimisation [$F(3,125) = 36.861$, $p < 0.05$].

The hierarchical multiple regression model 1 for effectiveness of waste stream reduction /waste minimisation is:

Predicted variable (waste stream reduction / waste minimisation) = 0.291(goal/target setting policy) + 0.293(waste separation at source) + 0.207(strong support from top management level)

6.9.1.2 Cost Reduction

All the fourteen (14) SWM factors were included in this regression test as all SWM factors have significant relationship with cost reduction variable (refer to the correlation results in Section 6.6.1). From the first step – Enter method's result, 13 SWM factors are included and entered into next step – Stepwise method as their significant values are less than 0.05 (referred to Appendix O). Table 6.31 shows the number of variables that the researcher would foresee the influential parameters of the implementation of factors.

Table 6.31: Variables Entered/Removed[a] (both Enter and Stepwise method)

Model	Variables Entered	Method
1	MHEI groupings[b]	Enter
1	Goal/target setting policy	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	Waste separation at source	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: Cost reduction
b. All requested variables entered.

Table 6.32 and Table 6.33 show the hierarchical regression analysis summary for effectiveness of cost reduction. The results also show two regression models provided built upon the criterion variable (cost reduction) and its predictor variables (factors) can be generalised against the population. It can be said that the regression model 2 demonstrates the *implementation of goal/target setting policy* and *implementation of waste separation at source* were the only two SWM factors related to the criterion variable, at $p < 0.05$. Overall relationship between the criterion variable and the two predictors as resulted in the regression model (Model 2), R = 0.662 with 43.9% of the variance is associated.

Table 6.32: Model summary and coefficients results for effectiveness of cost reduction

Model summary					**Coefficients[c]**		
Model		**R**	**R^2**	**Adjusted R^2**	**β**	**t**	**Sig.**
Stepwise method							
1	(Constant)	.631[a]	.398	.393		9.207	.000
	Goal/target setting policy				.631	9.163	.000
2	(Constant)	.662[b]	.439	.430		7.259	.000
	Goal/target setting policy				.463	5.324	.000
	Waste separation at source				.262	3.019	.003

a. Predictors: (Constant), Implementation of Goal/target setting policy
b. Predictors: (Constant), Implementation of Goal/target setting policy, Implementation of Waste separation at source
c. Dependent Variable: Effectiveness of Cost reduction

Table 6.33: ANOVA[c] results for effectiveness of cost reduction

Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Stepwise method						
1	Regression	55.014	1	55.014	83.957	.000[a]
	Residual	83.219	127	.655		
	Total	138.233	128			
2	Regression	60.629	2	30.314	49.220	.000[b]
	Residual	77.604	126	.616		
	Total	138.233	128			

a. Predictors: (Constant), Implementation of Goal/target setting policy
b. Predictors: (Constant), Implementation of Goal/target setting policy, Implementation of Waste separation at source
c. Dependent Variable: Effectiveness of Cost reduction

As presented in Model 2 (shown in Table 6.32), 43.9% of the variation in cost reduction is explained by these two SWM factors. In this test, the difference between R^2 and adjusted R^2 for the Model 2 is small (difference between the value is 0.439 – 0.430 = 0.009 (about 0.9%). This shrinkage means that when the model was derived from the population rather than the sample, it would account for approximately 0.9% less variance in the outcome. In Model 1, the value of R^2 = 0.398 described 39.8% of the variance in the cost reduction influenced by the variance of *goal/target setting policy*. When the additional component was entered into the multiple regression model, the percentage of variance explained increase by 4.1% to 43.9%, with *goal/target setting policy* and *waste separation at source* variables being statistically significant.

In addition, the results shown in Table 6.32 also found that t-test value reveals the variable coefficients are significant at $p < 0.05$. Only two predictor variables that are *goal/target setting policy* and *waste separation at source* were found as the predictors for the effectiveness of cost reduction. Therefore, null hypothesis is rejected while the alternative hypothesis is accepted since there are two SWM factors have effects towards cost reduction.

The *implementation of goal/target setting policy* is the primary factor which significantly [$F (1,127) = 83.957$, $p < 0.05$] contributes 39.8% of the variance ($R^2 = 0.398$) in the effectiveness of cost reduction. This means *goal/target setting policy* ($\beta = 0.463$, $p < 0.05$) is the major indicator of the cost reduction for the MHEIs. The combination of *implementation of goal/target setting policy* and *waste separation at source* ($\beta = 0.262$, $p < 0.05$) accounts for 4.1% change (43.9% - 39.8%) of the variance ($R^2 = 0.439$) in cost reduction [$F (2,126) = 49.220$, $p < 0.05$].

In sum, the hierarchical multiple regression model 2 for effectiveness of cost reduction is:

Predicted variable (cost reduction) = 0.463(goal/target setting policy) + 0.262(waste separation at source)

6.9.1.3 Revenue Generated

From the correlation results presented in Section 6.6.1, 13 out of 14 SWM factors were significantly correlated with revenue generated variable, except collection frequency factor. Collection frequency is excluded from this regression test since it was not significantly correlated. From the regression result attained at first step – Enter method, the significant value for all thirteen (13) SWM factors are less than 0.05 (referred to Appendix P), hence these factors are then entered into Stepwise method. Table 6.34 shows the number of variables that the researcher would foresee the influential parameters of the implementation of factors.

Table 6.34: Variables Entered/Removed[a] (both Enter and Stepwise method)

Model	Variables Entered	Method
1	MHEI groupings[b]	Enter
1	Goal/target setting policy	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	Marketing recyclable materials	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	Strong support from top management level	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
4	Waste separation at source	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: Revenue generated
b. All requested variables entered.

The hierarchical regression analysis summary for effectiveness of revenue generated is presented in Table 6.35 and Table 6.36. All the four regression models provided built upon the criterion variable (revenue generated) and its predictor variables (SWM factors) can be generalised against the population. It can be deduced that the regression model 4 shows the *implementation of goal/target setting policy*, *implementation of marketing recycling materials*, *implementation of strong support from top management level* and the *implementation of waste separation at source* were the only four SWM factors associated to the criterion variable, with significant value less than 0.05. In whole the relationship between the criterion variable and the four predictors as resulted in the regression model (Model 4), R = 0.694 with 48.1% of the variance is associated.

Table 6.35: Model summary and coefficients results for effectiveness of revenue generated on the SWM factors

Model summary					Coefficients[e]		
Model		**R**	**R^2**	**Adjusted R^2**	**β**	**t**	**Sig.**
Stepwise method							
1	(Constant)					7.843	.000
	Goal/target setting policy	.589[a]	.346	.341	.589	8.203	.000
2	(Constant)					5.102	.000
	Goal/target setting policy	.661[b]	.437	.428	.440	5.898	.000
	Marketing recyclable materials				.336	4.507	.000
3	(Constant)					3.953	.000
	Goal/target setting policy	.680[c]	.463	.450	.292	3.078	.003
	Marketing recyclable materials				.335	4.588	.000
	Strong support from top management level				.219	2.457	.015
4	(Constant)					3.330	.001
	Goal/target setting policy	.694[d]	.481	.464	.208	2.040	.043
	Marketing recyclable materials				.313	4.299	.000
	Strong support from top management level				.187	2.094	.038
	Waste separation at source				.180	2.085	.039

a. Predictors: (Constant), Implementation of Goal/target setting policy
b. Predictors: (Constant), Implementation of Goal/target setting policy, Implementation of Marketing recyclable materials
c. Predictors: (Constant), Implementation of Goal/target setting policy, Implementation of Marketing recyclable materials, Implementation of Strong support from top management level
d. Predictors: (Constant), Implementation of Goal/target setting policy, Implementation of Marketing recyclable materials, Implementation of Strong support from top management level, Implementation of Waste separation at source
e. Dependent Variable: Effectiveness of Revenue generated

Table 6.36: ANOVA[e] results for effectiveness of revenue generated on the SWM factors

Model		Sum of Squares	df	Mean Square	F	Sig.
Stepwise method						
1	Regression	31.026	1	31.026	67.293	.000[a]
	Residual	58.555	127	.461		
	Total	89.581	128			
2	Regression	39.155	2	19.578	48.918	.000[b]
	Residual	50.426	126	.400		
	Total	89.581	128			
3	Regression	41.479	3	13.826	35.929	.000[c]
	Residual	48.103	125	.385		
	Total	89.581	128			
4	Regression	43.108	4	10.777	28.756	.000[d]
	Residual	46.473	124	.375		
	Total	89.581	128			

a. Predictors: (Constant), Implementation of Goal/target setting policy
b. Predictors: (Constant), Implementation of Goal/target setting policy, Implementation of Marketing recyclable materials
c. Predictors: (Constant), Implementation of Goal/target setting policy, Implementation of Marketing recyclable materials, Implementation of Strong support from top management level
d. Predictors: (Constant), Implementation of Goal/target setting policy, Implementation of Marketing recyclable materials, Implementation of Strong support from top management level, Implementation of Waste separation at source
e. Dependent Variable: Effectiveness of Revenue generated

The regression Model 4 (as shown in Table 6.35) denotes 48.1% of the variation in revenue generated is explained by these four SWM factors. In this case, the difference between R^2 and adjusted R^2 in the Model 4 is small (difference between the values is 0.481 - 0.464 = 0.017 (about 1.7%). This shrinkage means that when the model was derived from the population rather than the sample, it would account for approximately 1.7% less variance in the outcome. The value of R^2 in Model 3 = 0.463 explained 46.3% of the variance in the revenue generated influenced by the variance of *goal/target setting policy*, *marketing recyclable materials* and *strong support from top management level*. When the additional component was entered into the multiple regression model, the percentage of variance explained increase by 1.8% to 48.1% with *waste separation at source*, *goal/target setting policy*, *marketing recyclable materials* and *strong support from top management level* factors being statistically significant.

Furthermore, t-test value in Table 6.35 shows the variable coefficients are significant at $p < 0.05$. There are only four predictor variables that are *goal/target setting policy*, *marketing recyclable materials*, *strong support from top management level* and *waste separation at source*. Hence, this regression results reject the null hypothesis and then accept the alternative hypothesis as there are four SWM factors have effects towards revenue generated.

The implementation of *goal/target setting policy* is the major factor which significantly [$F(1,127) = 67.293$, $p < 0.05$] contributes 34.6% of the variance ($R^2 = 0.346$) in the effectiveness of revenue generated. This means *goal/target setting* ($\beta = 0.208$, $p < 0.05$) is the main indicator of the revenue generated for the MHEIs. The combination of implementation of *goal/target setting policy* and *marketing recyclable materials* ($\beta = 0.313$, $p < 0.05$) accounts for 9.1% change (43.7% - 34.6%) of the variance ($R^2 = 0.437$) in revenue generated [$F(2,126) = 48.918$, $p < 0.05$]. However, the predictor variables of *implementation of strong support from top management level* and *waste separation at source* do not contribute much to the change in revenue generated because the combination of the *strong support from top management level* ($\beta = 0.187$, $p < 0.05$) and *waste separation at source* ($\beta = 0.180$, $p < 0.05$) predictor variables with *goal/target setting policy* ($\beta = 0.208$, $p < 0.05$) and *marketing recyclable materials* ($\beta = 0.313$, $p < 0.05$) only accounts for 4.4% (48.1% - 43.7%) change of the variance ($R^2 = 0.481$) in revenue generated [strong support from top management level: $F(3,125) = 35.929$, $p < 0.05$; waste separation at source: $F(4,124) = 28.756$, $p < 0.05$].

The hierarchical multiple regression model 3 for effectiveness of revenue generated is:

Predicted variable (revenue generated) = 0.208(goal/target setting policy) + 0.313(marketing recyclable materials) + 0.187(strong support from top management level) + 0.180(waste separation at source)

6.9.1.4 Change of Recycling Behaviour/Culture

According to the correlation test results in Section 6.6.1, 13 out 14 SWM factors were significantly correlated with change of recycling behaviour/culture, except methods of waste recovery factor. As a result, methods of waste recovery factor are excluded for this test. From the first step's (Enter method) result of regression analysis, all thirteen (13) SWM factors are significant at $p < 0.05$ (referred to Appendix Q), thus these SWM factors are then entered into Stepwise method. Table 6.37 shows the number of variables that the researcher would foresee the influential parameters of the implementation of factors.

Table 6.37: Variables Entered/Removed[a] (both Enter and Stepwise method)

Model	Variables Entered	Method
1	MHEI groupings[b]	Enter
1	Partnership	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	Waste separation at source	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	MHEI groupings	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
4	Marketing recyclable materials	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: Change of recycling behaviour/culture
b. All requested variables entered.

Hierarchical regression analysis summary for effectiveness of change of recycling behaviour/culture was presented in Table 6.38 and Table 6.39. The results show that all four regression models provided built upon the criterion variable (change of recycling behaviour/culture) and its predictor variables (SWM factors) can be generalised against the population. It can be said that the regression model 4 demonstrates the *implementation of partnership*, *waste separation at source*, *MHEI groupings* and *marketing recyclable materials* were only the four SWM factors related to the criterion variable, at $p < 0.05$. Overall correlation between the criterion variable and the four predictors as resulted in the regression model (Model 4), R = 0.574 with 33.0% of the variance is related.

Table 6.38: Model summary and coefficient results for effectiveness of change of recycling behaviour/culture

Model summary					Coefficients[e]		
Model		**R**	**R^2**	**Adjusted R^2**	**β**	**t**	**Sig.**
Stepwise method							
1	(Constant) Partnership	.443[a]	.197	.190	 .443	8.159 5.576	.000 .000
2	(Constant) Partnership Waste separation at source	.504[b]	.254	.242	 .299 .280	6.722 3.329 3.116	.000 .001 .002
3	(Constant) Partnership Waste separation at source MHEI groupings	.545[c]	.297	.280	 .388 .306 .232	.447 4.159 3.477 2.759	.656 .000 .001 .007
4	(Constant) Partnership Waste separation at source MHEI groupings Marketing recyclable materials	.574[d]	.330	.308	 .392 .245 .293 .206	-.617 4.281 2.724 3.403 2.467	.538 .000 .007 .001 .015

a. Predictors: (Constant), Implementation of Partnership
b. Predictors: (Constant), Implementation of Partnership, Implementation of Waste separation at source
c. Predictors: (Constant), Implementation of Partnership, Implementation of Waste separation at source, MHEI groupings
d. Predictors: (Constant), Implementation of Partnership, Implementation of Waste separation at source, MHEI groupings, Implementation of Marketing recyclable materials
e. Dependent Variable: Effectiveness of Change of recycling behaviour/culture

Table 6.39: ANOVA[a] results for effectiveness of change of recycling behaviour/culture

Model		Sum of Squares	df	Mean Square	F	Sig.
Stepwise method						
1	Regression	23.844	1	23.844	31.096	.000[b]
	Residual	97.381	127	.767		
	Total	121.225	128			
2	Regression	30.810	2	15.405	21.469	.000[c]
	Residual	90.414	126	.718		
	Total	121.225	128			
3	Regression	35.999	3	12.000	17.600	.000[d]
	Residual	85.226	125	.682		
	Total	121.225	128			
4	Regression	39.987	4	9.997	15.259	.000[e]
	Residual	81.238	124	.655		
	Total	121.225	128			

a. Dependent Variable: Effectiveness of Change of recycling behaviour/culture
b. Predictors: (Constant), Implementation of Partnership
c. Predictors: (Constant), Implementation of Partnership, Implementation of Waste separation at source
d. Predictors: (Constant), Implementation of Partnership, Implementation of Waste separation at source, MHEI groupings
e. Predictors: (Constant), Implementation of Partnership, Implementation of Waste separation at source, MHEI groupings, Implementation of Marketing recyclable materials

Based on the results in Table 6.38, Model 4 indicates 33.0% of the variance in change of recycling behaviour/culture is explained by these four SWM factors. In this test, the difference between the R^2 and adjusted R^2 for the Model 4 is small (difference between the value is 0.330 - 0.308 = 0.022 (about 2.2%). This shrinkage means that when the model was derived from the population rather than the sample, it would account for approximately 2.2% less variance in the outcome. However in Model 3, the value of R^2 = 0.297 described 29.7% of the variance in the revenue generated influenced by the variance of *partnership*, *waste separation at source* and *MHEI groupings*. When the additional component was entered into the multiple regression model, the percentage of variance explained increase by 3.3% to 33.0% with *marketing recyclable materials*, *partnership*, *waste separation at source* and *MHEI groupings* variables being statistically significant.

The hierarchical multiple regression analysis results show that the four predictor variables, which are *partnership*, *waste separation at source*, *MHEI groupings* and *marketing recyclable materials*, are the predictors for the effectiveness of change of recycling behaviour/culture. Therefore, null hypothesis is rejected while alternative hypothesis is accepted as there are four SWM factors have effects towards change of recycling behaviour/culture.

The *implementation of partnership* is the critical factor which significantly [F (1,127) = 31.096, $p < 0.05$] contributes 19.7% of the variance ($R^2 = 0.197$) in the effectiveness of change of recycling behaviour/culture. This means *partnership* ($\beta = 0.392$, $p < 0.05$), or the cooperation between higher education institutions and internal/external organisations, is the main indicator of the change of recycling behaviour/culture in the institutions community. The combination of *implementation of partnership* and *waste separation at source* ($\beta = 0.245$, $p < 0.05$) accounts for 5.7% change (25.4% - 19.7%) of the variance ($R^2 = 0.254$) in the change of recycling behaviour/culture [F (2,126) = 21.469, $p < 0.05$]. The *MHEI groupings* and *implementation of marketing recyclable materials* predictor variables do not contribute much to the variation of the change of recycling behaviour/culture; however the combination of these two predictor variables are contributed much to the variation of the change of recycling behaviour/culture because the combination of the *MHEI groupings* ($\beta = 0.293$, $p < 0.05$) and *implementation of marketing recycling materials* ($\beta = 0.206$, $p < 0.05$) predictor variables with *partnership* ($\beta = 0.392$, $p < 0.05$) and *waste separation at source* ($\beta = 0.245$, $p < 0.05$) accounts for 7.6% (33.0% - 25.4%) change of the variance ($R^2 = 0.330$) in change of recycling behaviour/culture [MHEI groupings: $F(3,125) = 17.600$, $p < 0.05$; marketing recyclable materials: $F(4,124) = 15.259$, $p < 0.05$].

The hierarchical multiple regression model 4 for effectiveness of change of recycling behaviour/culture is:

Predicted variable (change of recycling behaviour/culture) = 0.392(partnership) + 0.245 (waste separation at source) + 0.293(MHEI groupings) + 0.206(marketing recyclable materials)

6.9.1.5 Compliance of Acts

Based on the correlation results in Section 6.6.1, only four (4) SWM factors were found significantly correlated with compliance of Acts variable. Therefore, only these four SWM factors were included in the regression test. From the regression result (Enter method), the significant value for all four (4) SWM factors are less than 0.05 (referred to Appendix R), thus these factors are then entered into next step – Stepwise method. Table 6.40 shows the number of variables that the researcher would foresee the influential parameters of the implementation of factors.

Table 6.40: Variables Entered/Removed[a] (both Enter and Stepwise method)

Model	Variables Entered	Method
1	MHEI groupings[b]	Enter
1	Collection frequency	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: Compliance of Acts
b. All requested variables entered.

Table 6.41 and Table 6.42 show the hierarchical regression analysis summary for effectiveness of compliance of Acts. The results show that only one regression model from Stepwise method demonstrates the *implementation of collection frequency* was the only SWM factors related to the criterion variable, at $p < 0.05$. The correlation between the criterion variable and the predictor as resulted in the regression model (Model 1), $R = 0.357$ with 12.8% of the variance is related.

Table 6.41: Model summary and coefficient results for effectiveness of compliance of Acts on the factors

Model summary					**Coefficients[b]**		
Model		**R**	**R^2**	**Adjusted R^2**	**β**	**t**	**Sig.**
Stepwise method							
1	(Constant)					7.554	.000
	Collection frequency	.357[a]	.128	.121	.357	4.311	.000

a. Predictors: (Constant), Implementation of Collection frequency
b. Dependent Variable: Effectiveness of Compliance of Acts

Table 6.42: ANOVA[b] results for effectiveness of compliance of Acts on the factor

Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Stepwise method						
1	Regression	17.020	1	17.020	18.581	.000[a]
	Residual	116.329	127	.916		
	Total	133.349	128			

a. Predictors: (Constant), Implementation of Collection frequency
b. Dependent Variable: Effectiveness of Compliance of Acts

From the Table 6.41, the result in Model 1 indicates 12.8% of the variation in compliance of Acts is explained by the factor. The adjusted R^2 provides some idea of how well the model generalises and it is ideal if its value is the same, or very close to, the value of R^2 (Field, 2009). In this test, the difference for the Model 1 is small (difference between the value is 0.128 - 0.121 = 0.007 (about 0.7%). This shrinkage means that when the model was derived from the population rather than the sample, it would account for approximately 0.7% less variance in the outcome.

The hierarchical multiple regression analysis results show that only one predictor variable that is *collection frequency*, is the predictor for the effectiveness of compliance of Acts. Therefore, this regression results reject the null hypothesis and accept the alternative hypothesis as there is a SWM factor has effects compliance of Acts. It also means that *implementation of collection frequency* is the main factor which significantly [F (1,127) = 18.581, $p < 0.05$] contributes 12.8% of the variance ($R^2 = 0.128$) in the effectiveness of compliance of Acts. Besides, collection frequency ($\beta = 0.357$, $p < 0.05$) is also the only indicator of the compliance of Acts.

The hierarchical multiple regression model 5 for effectiveness of compliance of Acts is:

Predicted variable (compliance of Acts) = 0.357 (collection frequency)

6.10 Summary

Several statistical procedures were conducted to assess the trends and relevant hypothesis findings based around the data collected from the 129 respondents who have experience in SWM in MHEIs. The overall response rate is 30.9% from the three MHEI groupings.

Since the role of institution management is very important in the strategic solid waste operation, a statistical investigation was conducted to find the factor ranking of the SWM factors and the strategic implication variables based on the respondents' perception. Descriptive statistics from Table 6.11 of Section 6.3.12 revealed 8 SWM factors have a mean of 4.0 and above which are ranked according to their means. Those factors include waste separation at source (mean = 4.46), strong support from top management level (mean = 4.35), awareness or campaign (mean = 4.33), collection frequency (mean = 4.29), feedback on recycling performance (mean = 4.13), goal/target setting policy (mean = 4.12), education and training programme (mean = 4.09), and proximity of recycling facilities (mean = 4.01). While from a descriptive statistics from Table 6.12 of Section 6.3.13, compliance of Acts variable is ranked the highest, with a mean score of 3.21.

The first hypothesis using Cronbach's alpha internal consistency method revealed that the research instrument in this study was considered reliable. The reliability is strong and perceived fairly across the variables. The second hypothesis test using Pearson's correlation analysis of 14 SWM factors revealed only 8 SWM factors were correlated with the extent to which the factors were implemented by respondents. These include *goal/target setting policy* ($r= 0.345$, $p < 0.05$), *partnership* ($r= 0.280$, $p < 0.05$), *strong support from top management level* ($r= 0.286$, $p < 0.05$), *proximity of recycling facilities* ($r= 0.397$, $p < 0.05$), *collection frequency* ($r= 0.424$, $p < 0.05$), *methods of waste recovery* ($r= 0.335$, $p < 0.05$), *incentives or rewards* ($r= 0.362$, $p < 0.05$) and *waste disposal and collection contract provisions* ($r= 0.196$, $p < 0.05$), which were the only 8 to demonstrate relationship with the factors presented.

Another Pearson's correlation analysis was conducted for the third hypothesis test to examine the relationship between the SWM performance and its strategic impacts based on the financial capability. The results show that for *waste stream reduction / waste minimisation* variable, only EMS certification factor is not significantly correlated. While all 14 SWM factors are significantly correlated with the *cost reduction* variable. For the *revenue generated* variable, only collection frequency factor is not significantly related. On the other hand, for the *change of recycling behaviour/culture* variable, only the factor of methods of waste recovery is not significantly correlated. Lastly, only 4 SWM factors are significantly correlated with *compliance of Acts* variable, which are partnership, proximity of recycling facilities, collection frequency, waste disposal and collection contract provisions.

The fourth hypothesis test using ANOVA analysis indicated there is significant difference in strategic solid waste operation across the three respondent groupings based on the financial capability. The results show that the significant difference occurred between private university and college. Besides, a comparison was made between three MHEI groupings (i.e. *Public University*, *Private University* and *College*) to identify any differences regarding the critical importance of SWM factors between respondents. Based on the fifth hypothesis test, the MANOVA results revealed that there were only three SWM factors of critical importance perceived differently across the respondent groupings based on the financial capability. These are:

1. Collection frequency [$F(2,126)= 4.82$; $p < .05$];
2. Methods of waste recovery [$F(2,126)= 3.84$; $p < .05$];
3. Waste disposal and collection contract provisions [$F(2,126)= 3.58$; $p < .05$]

The above results present that the general trend of the data related to the aforementioned factors varies according to the MHEI groupings, whereas the remaining 11 SWM factors were perceived equally across the three respondent groupings.

Lastly, to identify the influential variables involved regarding the strategic solid waste operation for MHEIs, the analysis of hierarchical multiple linear regression was carried out by considering the three MHEIs groupings based on the financial capability. Five regression models were produced for every strategic implication variable to predict the performance of solid waste operation. The regression models would be useful for the institutions management to predict the recycling outcome based on the significant SWM factors.

Overall, these results based on analytical methods to ascertain the third research objective have provided a general trend based on the population (N=129) under study. Detail discussions of these results will be elaborated upon in the following chapter.

CHAPTER 7: DISCUSSIONS

7.1 Introduction

This chapter discusses the present research findings of actual Malaysian higher education institution (MHEI) solid waste management (SWM) with theoretical ideals, comparing the critical elements which lead to strategic solid waste operation in MHEIs. The discussions in this chapter focus on the overarching findings in relation to existing knowledge and current initiatives adopted by MHEIs SWM. As a result, this research has arrived at five (5) specific findings based on the three (3) research objectives outlined in Section 1.5 of Chapter 1.

I. Determination of SWM factors and strategic implication variables for MHEIs;
II. Implementation trend of MHEI SWM;
III. Evaluation of effectiveness level of strategic implication perceived by the MHEIs;
IV. Identification of variation in critical importance of SWM factors across three MHEI groupings;
V. Establishing regression models that predict significant SWM factors involved in the strategic solid waste operation.

Briefly, the numbered findings are based on comprehensive discussion in relation to the analysis of results from both qualitative and quantitative data which has been presented in Chapter 5 and 6 of this thesis, and then analysed with aspects of relevant related literature.

7.2 Determination of SWM Factors and Strategic Implication Variables for MHEIs

The first findings reveal the SWM factors and strategic implication variables that suitable for MHEIs. Since not much past researches focused on MHEI SWM, a validation of the SWM factors and strategic implication variables is necessary to explore potential variables.

The identification of SWM factors and strategic implication variables was first carried out through literature review. As a result, a total of 17 SWM factors and 5 strategic implication variables were identified. An interview process on MHEIs was conducted to validate the SWM factors and strategic implication variables. The result showed that three (3) SWM factors were withdrew and not carried forward to the next stage of research. The three (3) SWM factors included *mandate the recycling initiatives*, *recycling C&D waste from refurbishment works* and *materials recycling/recovery facilities (MRF)*. To confirm the validity of the factors and variables, a validation sheet was sent to the interviewees again (refer to Appendix C). Seventeen (17) SWM factors were shortlisted into fourteen (14) SWM factors, while five (5) strategic implication variables were retained. The flow of research findings is presented in Figure 7.1.

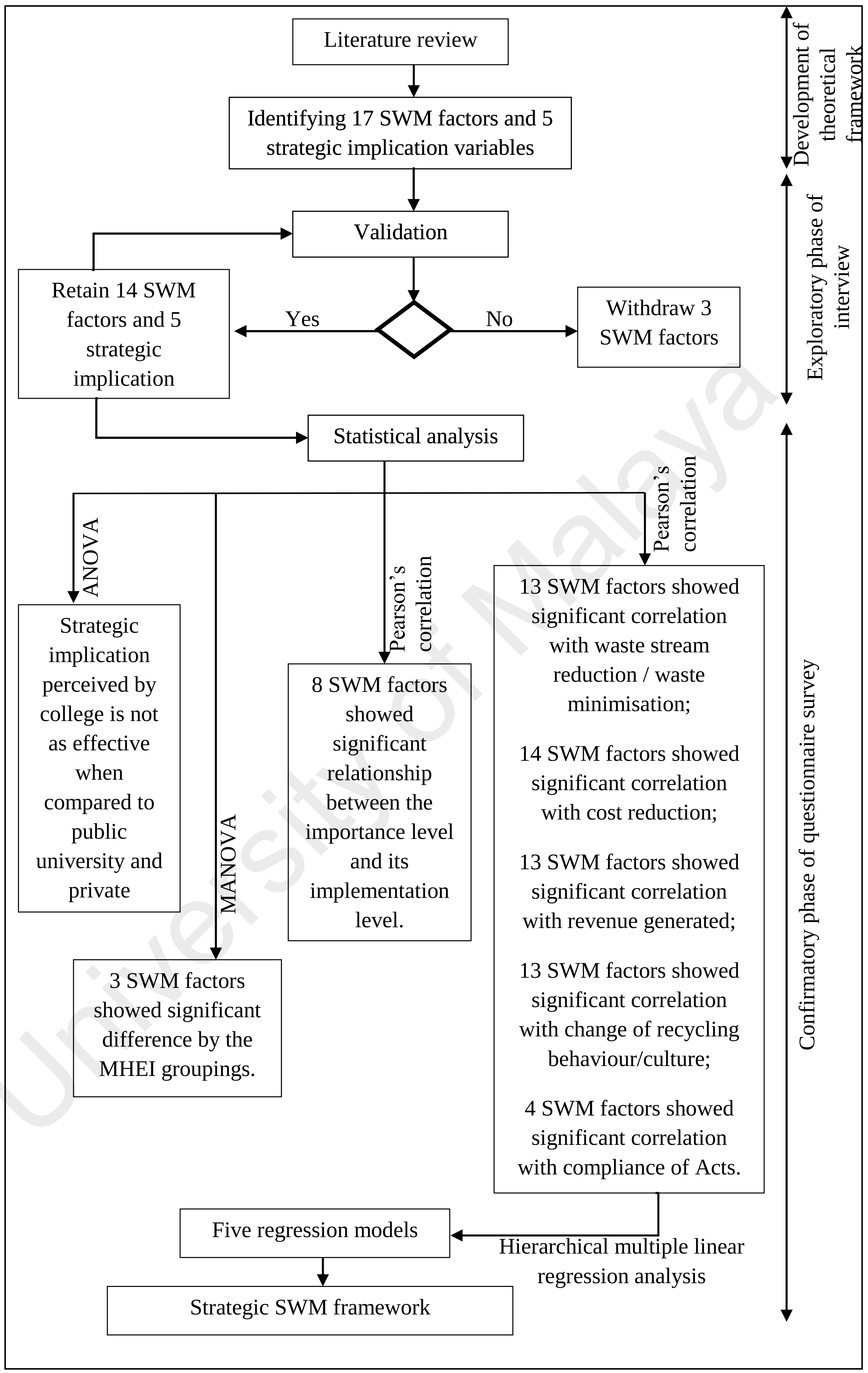


Figure 7.1: Research findings flow

7.3 Implementation Trend of MHEI SWM

The second finding from this work is the perception of the extent to which the fourteen (14) SWM factors are implemented in MHEIs. The findings may allow speculation with respect to the implementation trend based on the second hypothesis (highlighted in Section 6.5). The results of this test are summarised in Table 7.1 and Figure 7.1.

Table 7.1: Hypothesis tests results from relationship analysis between importance level of fourteen SWM factors and the extent to which the factors have been implemented by MHEIs based on the financial capability

Hypothesis Test *Is there relationship between importance level of each SWM factor and the extent to which the factor has been implemented by the MHEIs based on the financial capability?*	**Null Hypothesis (H_0)**	**Alternative Hypothesis (H_1)**
Goal/target setting policy	Rejected	**Retained**
Partnership	Rejected	**Retained**
Strong support from top management level	Rejected	**Retained**
Awareness or campaign	Retained	Rejected
Education and training programme	Retained	Rejected
Waste separation at source	Retained	Rejected
Proximity of recycling facilities	Rejected	**Retained**
Collection frequency	Rejected	**Retained**
Methods of waste recovery	Rejected	**Retained**
Incentives or rewards	Rejected	**Retained**
Waste disposal and collection contract provisions	Rejected	**Retained**
Marketing recyclable materials	Retained	Rejected
Feedback on recycling performance	Retained	Rejected
EMS certification	Retained	Rejected

To investigate the trend, Pearson's correlation analysis was first applied to explain the degree of relationship between levels of importance and the extent to which the SWM factors have been implemented. As detailed earlier in Section 6.5.1 of Chapter 6, the hypothesis test discloses that a greater levels of importance was positively correlated with the implementations of goal/target setting policy ($r = 0.345$, $p < 0.01$), proximity of recycling facilities ($r = 0.397$, $p < 0.001$), collection frequency ($r = 0.424$, $p < 0.001$), methods of waste recovery ($r = 0.335$, $p < 0.001$), incentives or rewards ($r = 0.362$, $p < 0.001$), partnership ($r = 0.280$, $p < 0.001$), strong support from top management level ($r = 0.286$, $p < 0.001$), waste disposal and collection contract provisions ($r = 0.196$, $p < 0.05$), education and training programme ($r = 0.165$, $p = 0.061$), waste separation at source ($r = 0.104$, $p = 0.239$), marketing recyclable materials ($r = 0.079$, $p = 0.371$), feedback on recycling performance ($r = 0.054$, $p = 0.544$), EMS certification ($r = 0.051$, $p = 0.567$), awareness or campaign ($r = 0.012$, $p = 0.894$) at the higher education institution organisations.

With all fourteen (14) SWM factors of importance shows a relationship with the extent to which the factors have been implemented by MHEI organisations, only eight (8) demonstrate a significant relationship with the variables, as presented in Figure 7.1 and Table 7.1, which have the alternative hypothesis retained.

Despite all the fourteen (14) SWM factors are positively correlated with its implementation, awareness or campaign ($r = 0.012$, $p = 0.894$) reported the least significant for implementation. According to Agamuthu et al. (2011), every year about 60% of the allocation (around RM 70 million) is using to increase recycling awareness among Malaysians. However, public responses are disappointed on the recycling initiatives (MHLG, 2005b). This is probably because the public or campus communities have not been trained to practise recycling initiative since childhood; the behaviour of recycling cannot be created in short term and it takes a long-term period to change the culture of recycling. As a result, this factor is not deemed a critical requirement for the current implementation.

Similar to EMS certification (r = 0.051, p = 0.567) factor and feedback on recycling performance (r = 0.054, p = 0.544) factor, as these were also reported to hold less significant for its implementations. It seems that EMS is relatively a less popular standard for MHEIs and most of the MHEIs have not prepared to employ EMS. This may also because there is no provision or interest for higher education institutions who obtain this certification.

Regarding feedback on recycling performance (r = 0.054, p = 0.544) factor, the results concur with a study done by National Solid Waste Management Department (2013) which found that waste collectors or enterprises in Malaysia for instance traders or middlemen do not have appropriate record-keeping system and then the data given by them were solely based on estimates rather than real figures. Additionally, few scholars (Hassan et al., 2000; Moh & Abd Manaf, 2014) found that the number of obtainable data on SWM and recycling programme in Malaysia is considerably restricted with no systematic analysis and regular documentation countrywide from any local authorities which results in imprecise and outdated database. This coincides with the results from interviews which reveal that out of ten interviewees, only three interviewees pointed out that they are practising to report feedback on recycling performance for their institution's SWM.

7.4 Evaluation of Effectiveness Level of Strategic Implication Perceived by MHEIs

The third finding discloses the perceptions regarding the effectiveness level of strategic solid waste operation by MHEIs. Since 90% of expenditure from public higher education institutions is Government funded (Ministry of Education Malaysia, 2015), researcher believed that by classifying the respondent types based on MHEI groupings and MHEI financial capability was appropriate to minimise respondent bias. In the final database, a total of 417 MHEIs were included for the respondent pool.

The fourth hypothesis test was carried out using the ANOVA test procedure to determine the variation of overall effectiveness level of strategic implication between three MHEI groupings based on the financial capability. Hypothesis result described in the Table 7.2 indicates the alternative hypothesis of the mean scores for effectiveness level of strategic implication varies across three MHEI groupings based on the financial capability was accepted. Thus, further analysis of post hoc procedures (as detailed in Section 6.7.3) was necessary to reveal the actual point of variation of the effectiveness level of strategic implication perceived by three MHEI groupings. The result shows that the significant difference occurs between the perception of private university and college. The ANOVA and post hoc comparison test show that the strategic implication perceived by colleges is not as effective when compared to the other two MHEI groupings (as shown in Figure 7.1).

Table 7.2: Hypothesis test result from Analysis of Variance (ANOVA) for identifying variation of overall strategic implication between three MHEI groupings based on the financial capability

Hypothesis Test *Is there any variation in strategic implication across the three MHEI groupings based on the financial capability?*	**Results**
Null Hypothesis (H_0) There are no differences of the mean scores of strategic implication across three MHEI groupings based on the financial capability.	Rejected
Alternative Hypothesis (H_1) There are differences of the mean scores of strategic implication across three MHEI groupings based on the financial capability.	**Accepted**

This finding justifies that there is relationship between the MHEI groupings and the way of SWM and recycling initiatives being implemented in Malaysia. Besides, the results also reveal there is difference on effectiveness level of strategic implication between private university and college although both are from private sector. Without doubt, the universities are equivalent to large commercial regarding to their larger amount of waste generation (Viebahn, 2002); more initiatives are needed to be carried out to deal with large quantities of wastes, thus universities require greater waste management organisation and development to initiate effective recycling programmes. In contrast, colleges have smaller scale of organisation and ordinarily focus on daily operation such as cleaning or housekeeping. Colleges may not have adequate basic facilities and human resource to conduct recycling. Hence, it is anticipated that there is less effective of solid waste operation and recycling programmes in colleges.

7.5 Identification of Variation in Critical Importance of SWM Factors across Three MHEI Groupings

According to Armijo de Vega et al. (2003), recycling alone will not form an environmentally sustainable waste management programme. Recycling is one portion of SWM. As Dahle and Neumayer (2001) stated, SWM comprises many initiatives that can be commenced to minimise the quantities of solid waste on campus, for instance recycling and reusing materials, composting and source reduction. In regard to higher education institutional community, it is therefore essential to understand facilities mangers or waste managers' decision to plan and manage solid waste and recycling programmes that suit a typical campus community. Underlined by the theoretical framework of this research, statistical analysis method such as MANOVA procedure was employed to identify the exact practices regarding the SWM factors across the three respondent groups based on the financial capability.

Based on the MANOVA analysis that summarised in Figure 7.1 and Table 7.3, eleven (11) SWM factors across the three MHEI groupings showed no significant differences between the levels of critical importance, while three (3) did in fact significant differences. These three (3) SWM factors identified are collection frequency, methods of waste recovery, and waste disposal and collection contract provisions.

Table 7.3: Hypothesis test result from multivariate analysis of variance (MANOVA) of SWM factors between three MHEI groupings based on the financial capability

Hypothesis Test *Is there any variation in critical importance of each SWM factor across the three MHEI groupings based on the financial capability?*	**Null Hypothesis (H_0)**	**Alternative Hypothesis (H_1)**
Goal/target setting policy	Retained	Rejected
Partnership	Retained	Rejected
Strong support from top management level	Retained	Rejected
Awareness or campaign	Retained	Rejected
Education and training programme	Retained	Rejected
Waste separation at source	Retained	Rejected
Proximity of recycling facilities	Retained	Rejected
Collection frequency	Rejected	**Retained**
Methods of waste recovery	Rejected	**Retained**
Incentives or rewards	Retained	Rejected
Waste disposal and collection contract provisions	Rejected	**Retained**
Marketing recyclable materials	Retained	Rejected
Feedback on recycling performance	Retained	Rejected
EMS certification	Retained	Rejected

Collection frequency was deemed as important because it provides convenient recycling service. Folz (2004) also agreed that recycling convenience was measured by collection frequency, collection day schedule, and point of collection. This research finds the importance of collection frequency to be perceived differently across the MHEI groupings mainly between public university and college (as detailed in Section 6.8.6, Table 6.27). This aligns with the interview results where interviewees from public universities commented that recycling collection system is one of the important components to develop successful recycling programme, and setting up a day in week as recycling day for collecting wastes. However the interviewee from college did not perceive collection frequency is an important factor.

This research also found different perceptions regarding the importance of methods of waste recovery initiative across the MHEI groupings. However, the result of Post Hoc Test showed that the mean difference is not statistically significant among the three MHEI groupings (as detailed in Section 6.8.6, Table 6.27). By comparing the means, public university scheme’s level of importance for methods of waste recovery is at mean of 3.77 whereas college scheme has a much lower mean of 2.99 (as shown in Section 6.8.5, Table 6.26). The initiative requires the support of facilities and infrastructures such as incinerator and anaerobic digestion to recover wastes which need large amount of investment. It is thought that the small institution organisations could not afford the high cost of investment towards their SWM. Hence, the initiative will not be taken into consideration under their development plan.

The final factor considered to bring about different perceptions on the levels of importance to strategic solid waste operation of MHEIs is waste disposal and collection contract provisions. As demonstrated in Section 6.8.6, Table 6.27, this factor is perceived differently between public university and private university; and between public university and college. Pitt (2005) highlighted that service provider contracts provision for recycling operation is vitally important. A contractor’s suitability should be comprehensively evaluated based on objective, technical expertise, experience, facilities and environmental protection practices (Zhang et al., 2011). Based on the interview results, outsourcing the waste collection services is currently favoured by majority of MHEIs. Waste management contract is the preferred option for public universities because they are practicing towards a green campus. In contrast, private sectors are only choosing waste collection contract services because of financial issue, which is one of the main issues. Another issue is private sectors only want to make sure their campus is clean and wastes are disposed in proper way. Furthermore, some of the private higher education institutions' campus is located at rented building; therefore its SWM is handled by landlord. In conclude, waste disposal and collection contract provision is perceived differently between public sector and private sector in higher education institution.

7.6 Establishing Regression Models that Predict Significant SWM Factors Involved in the Strategic Solid Waste Operation

Another significant finding in this study is the prediction of strategic implication variables in higher education institution solid waste operation. This was also the extension of the second Pearson's correlation test in Section 6.6, which intended to access whether the fourteen (14) independent variables (SWM factors) can significantly predict each strategic implication variable. These were identified using the hierarchical regression procedures (elaborated in Section 6.9.1). The strategic implication variables consist of waste stream reduction / waste minimisation, cost reduction, revenue generated, change of recycling behaviour/culture and compliance of Acts, which were tested separately on significant SWM factors (independent variable) (as summarised in Figure 7.1). As a result of this analysis, regression model for each strategic implication variable was established. Based around the established regression models, the relationship between significant contribution of SWM factors towards strategic implications is illustrated as Figure 7.2. Detailed discussions on each model are conducted in the following sections.

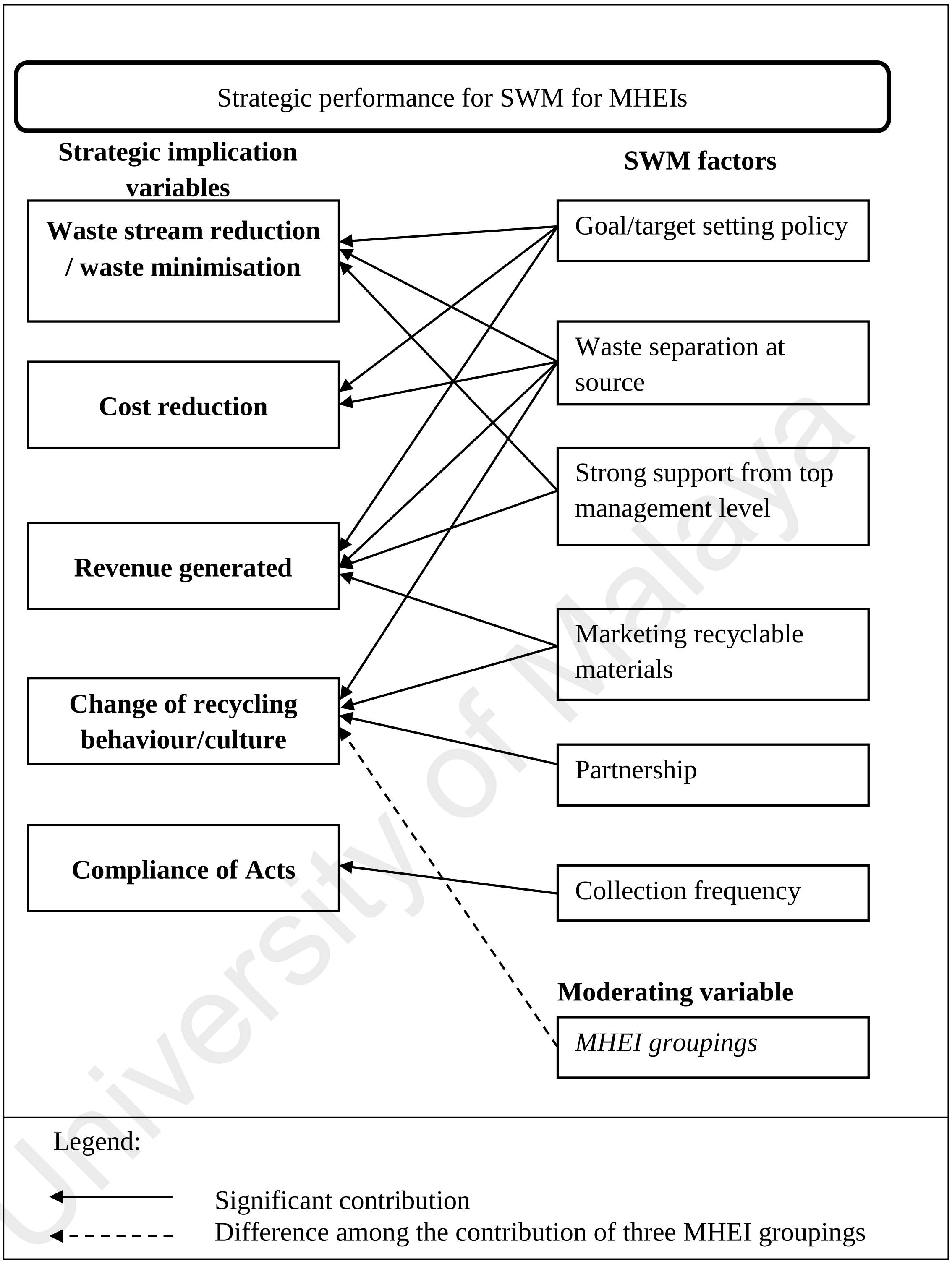


Figure 7.2: Relationship between the SWM factors and strategic implication variables

7.6.1 Model 1: Prediction of Waste Stream Reduction / Waste Minimisation

Based around the results from Section 6.9.1.1 of Chapter 6, a regression model revealed the combination of three SWM factors, i.e. *goal/target setting policy*, *waste separation at source* and *strong support from top management level* were considered to have significant effect towards waste stream reduction / waste minimisation.

The relevance of goal/target setting policy to achieve waste stream reduction concurs with Amutenya et al. (2009) which suggested that university could formulate a policy for all handouts to be printed on both sides, as a method of minimising paper use. Grazhdani (2015) also suggested another policy such as pay-as-you-throw helps increase recycling and reduce waste disposal. Reichenbach (2008) concurred that pay-as-you-throw was treated as a practical, equitable and sustainable method of reducing waste. The result of this factor is essential to make recycling activities at higher education institutions more successfully and then help to reduce the wastes.

Furthermore, waste separation at source was also recognised as significant SWM factor contributing to the overall effect of waste stream reduction / waste minimisation. Successful case was shown in study of Zhang et al. (2010) where commercial waste in Berlin, Germany has decreased to 10-fold over the period 1992-2007 with the efforts of waste separation. While Lu et al. (2006) pointed out that the accomplishment of solid wastes reduction lies principally in sorting at source is enforced by law, which has shown in Taiwan’s SWM. Lee and Paik (2011) in other view mentioned that many countries have source separation activities (by either residents or community), which emphasise on community participation, collaboration between government and corporations, environmental education, financial investment for related measures, and door-to-door collections. With the dominance of recyclable materials in the disposed waste, waste separation for recycling offers a more feasible option (Moh & Abd Manaf, 2017). Huang et al. (2014) agreed that minimisation of waste generated by community can be attained if they shift some to recycling by separating it 'at source' – but this mostly requires wide community mobilisation and engagement. Given the current waste separation policy in Malaysia is only implemented in municipal SWM, higher education institutions shall take initiative to implement waste separation programme in each institution to give the support in the effort of minimising the wastes.

Lastly, strong support from top management level was also identified as one of the SWM factors brings about waste stream reduction. However, Huang et al. (2014) argued that in the introduction and conduct of relevant system for waste separation and reduction, top down system from the top management is always the problem, which cause insufficient sense of responsibility and enthusiasm for engagement at lower levels. In this regard, communication between the levels is vitally important. It is beyond doubt that with the supports or commitments from top management, recycling programme will be conducted more comprehensive rather than in ad hoc approach; and then higher education institution will able to manage the wastes strategically.

7.6.2 Model 2: Prediction of Cost Reduction

Referring to the second regression model produced in Section 6.9.1.2 of Chapter 6, the results disclosed the combination of two SWM factors, i.e. *goal/target setting policy* and *waste separation at source* were considered to have significant effect towards cost reduction. Previous researcher (Highfill & Mcasey, 1997) pointed out that recycling cost decreases relative to disposal over time (as landfill costs will increase as available capacity decrease), this is predicated on the assumption that landfill space is finite. Moh and Abd Manaf (2017) also highlighted that with these increasing solid waste generation rate, source separation offers a viable option through effective and concise policy and plan strategies implementation.

Goal/target setting policy was recognised as the primary factor contributing to the overall effect of cost reduction. At this juncture, most of the MHEIs still do not have recycling goal/target in their policy. Even there is no policy, the interviewee MHEI 2 and interviewee MHEI 4 mentioned that the initiatives conducted such as composting and reduction of paper printing have successfully helped them to reduce the cost for higher education institution. However, in the study of Lombrano (2009) researched the case of Italy illustrated that an incorporation of policies for waste separating, reuse as resource, and waste management system is good for reducing the waste disposal cost. The researcher also believed that to have strategic SWM and sustainable campus, recycling initiatives conducted must be tied up with the strong and firm target/goal policy.

Another SWM factor recognised as critical that could affect the cost reduction is waste separation at source. Even through the respondents perceived this factor as highly important, the implementation of this factor was less effective (as elaborated in Section 6.5.1 of Chapter 6). This may because the institutions only use 3-colour recycling bins to separate the wastes and not all MHEIs are practising this activity. This is in line with the interview results as the interviewees commented that waste separation is conducted by using 3-colour recycling bins, which are provided and located in campus area. In fact, waste segregation can provide enhanced opportunities for recycling and reuse with resultant savings in raw materials costs (UNEP, 2004). In spite of that, waste segregation also provides more range for recycling and reuse while at the same time lowering treatment costs (UNEP, 2004). The waste separation activity can be succeeded with the active participation of the whole higher education institutional community.

7.6.3 Model 3: Prediction of Revenue Generated

As result of the regression analysis (Section 6.9.1.3 of Chapter 6), a regression model revealed the combination of four SWM factors, i.e. *goal/target setting policy, marketing recyclable materials, strong support from top management level* and *waste separation at source* were considered to have significant effect towards revenue generated.

Goal/target setting policy was also recognised as primary factors in the prediction of revenue generated. Amutenya et al. (2009) emphasised that introducing and implementing a policy at senior management level will set the tone for all staffs to participate. Therefore, the role of top management is important in implementing and achieving the recycling goal/target; where the factor of strong support from top management level was also recognised as critical to contribute to the overall effect of revenue generated. Goal/target setting policy shall equip with the recycling facilities and initiatives to achieve the strategic recycling – generate revenue for the higher education institution organisation.

The relation of marketing recyclable materials to generate revenue is apparent as the future of the recycling industry is very much dependent on market forces (MHLG, 2005c), where the market depends on the demand and supply of a product. Previous researchers (Walker & Preuss, 2008; Walker et al., 2015; Zhu & Sarkis, 2006) concurred that market pressures encompass the customer demand for sustainable products. Business-driven recycling centres, which only consider certain recyclable materials that have high market values for trade and export (JICA, 2006). Chen et al. (2009) also stated that products with more recyclable value, reducing processing costs and higher value added in quality and prices could result in higher financial returns. In contrast, recycling with low resale value (and low raw material costs) and high costs of material management product may not be economically sustainable in the long run (Marques et al., 2014; Lavee, 2007; Lakhan, 2015). Murakami et al. (2015) proved that recycling materials such as metal and zinc have the market value and generate income for the company or producer. Hence, Campos (2014) commented that the waste recycled by industry exclusively meets the demands of economic production chains of the sector and is not of importance to environmental management. However, the implication of this factor is essential to make the recycling activities at higher education institutions more competitive that help to create the market of recyclable materials and thus bring about high profit for institution.

As discussed earlier in this Section, strong support from top management level is important in contributing to the overall effect of revenue generated. The company context such as participation of the top managers (Walker et al., 2015) could set a paradigm and motivate the staffs. This is in line with Hooi et al. (2012) mentioned that the concept and understanding of the strategies not only need to be known and employed by the top management, but have to be disseminate to the whole organisation's section (Hooi et al., 2012). However, there are few barriers related to managerial and organisation aspect, such as the absence of a strong top management support (Moors et al., 2005), and refuse to change (Calia et al., 2009; Stone, 2000; Neto & Jabbour, 2010), lack of organisational capabilities which include insufficient top management leadership and lack of employee participation (Murillo-Luna et al., 2011).

The increased effectiveness of strong support from top management level can be only achieved if all the people in the community can active in participating the recycling programmes and collaborating with top management.

Lastly, the relevance of waste separation at source to achieve strategic recycling – revenue generated concurs with many researchers who advocated the prioritising of source separation of wastes because it enables the attainment of the high recovery and recycling rate (Zhang et al., 2010; UNEP, 2004; Bolaane, 2006; Agamuthu et al., 2011). Huang et al. (2014) in their study at Shanghai, China also found that currently, sorters in the community and recycling enterprises of waste textiles and glass have a positive income. Moh & Abd Manaf (2017) also stated that between disposal and collection services, the latter is considered more significant not only to the public, but also to the private concessionaires, as they are business-driven considering their revenues are based on the quality of their services in solid waste collection and transportation. As such, researcher believed that profit generated either for institution or single department/unit operation can be achieved if waste separation at source initiative is carried out widely in all the departments/units in higher education institution.

7.6.4 Model 4: Prediction of Change of Recycling Behaviour / Culture

Based around the result of regression analysis in Section 6.9.1.4 of Chapter 6, a regression model showed the combination of four factors, i.e. *partnership*, *waste separation at source*, *MHEI groupings* and *marketing recyclable materials* were considered to have significant effect towards change of recycling behaviour/culture amongst the three different MHEI groupings (refer Section 6.9.1.4).

The *MHEI groupings* was identified as one of the main factors that contributes to overall effect of change of recycling behaviour/culture. *MHEI groupings* as the moderating variable consist of public university, private university and college. Previous researches (Grazhdani, 2015; Saphores et al., 2012; Sidique et al., 2010) found that higher education increases the willingness to recycling. Thus, it is believed that grade of higher education institution could help to change the community's recycling culture. Besides, the result of ANOVA test in Section 6.7.1 of Chapter 6 also found that there are significant differences in effectiveness level of strategic implication variables across three MHEI groupings based on the financial capability. Thus, it is clearly that *MHEI groupings* has contribution to the overall effect of change of recycling behaviour/culture.

Partnership was identified as main factor that contribute to overall effect of change of recycling behaviour/culture. Collaborations with the internal department/units or external organisations are essential to boost the recycling activities. Examples of partnership projects consist of knowledge transfer by organising workshops or talks, infrastructure or facilities supply, human resource supply. Suttibak and Nitivattananon (2008) agreed that the cooperation with non-governmental organisations (NGOs) in terms of technical assistance (such as MRF) and inspiring people to sort their compostable waste impose the great influence on recycling performance. The company context such as the integration and collaboration with the supply chain members (Klassen & Vachon, 2003; Saavedra et al., 2013; Walker & Preuss, 2008) has the influence on recycling performance in an organisation. An investigation had been conducted on the behavioural components of waste management as indices for understanding how to positively change such behaviours. The result showed that there was a relationship of recycling behaviour between the involvements of non-profit organisations, newspaper reading, politics and religious activities (Martin et al., 2006). Therefore, this factor is essential to promote the community to participate recycling programmes in campus, and then change the community culture and behaviour.

Furthermore, waste separation at source activity in campus was also identified as one of the primary factors contributes to overall effect of change of recycling behaviour/culture. It was concurred with Akil et al.'s study (2015) who found that community would more likely to recycle if the municipality provides the facilities for waste separation. Hernandez et al. (1999) also found that sorting waste permitted the citizens to be progressive. The citizens learned new habits and showed their level of participation in community development affairs. However, Zhang et al. (2011) argued that comingled recycling schemes (where all dry recyclables are sited into just one receptacle or bag by students) are deemed to be more convenient than source sorting schemes in terms of time or effort students require to spent on recycling. Attitude remains the main challenge that significantly influences an action of separating waste for recycling (Moh & Abd Manaf, 2017). Given the current recycling attitude and culture of community doesn't prompt the effective recycling programmes, the researcher expects the effect of waste separation at source programme can change the recycling behaviour and culture of the community if this sustain.

Lastly, marketing recyclable materials was also recognised as one of the primary factors contributes to overall effect of change of recycling behaviour/culture. The development of local market should be a priority to move to sustainable development (Pitt, 2005). When setting up new market for recycling, Bor et al. (2004) anticipated that thousands of jobs will be created; at this moment, thousands of people will be hired in the recycling programmes as well. The researcher expects that when a person involves in recycling activity for long time, he/she will be motivated and his/her behaviour and attitude towards recycling will also be changed. Such changes will help to boost the recycling activities in the community and then increase the recycling performance.

7.6.5 Model 5: Prediction of Compliance of Acts

Referring to the results from Section 6.9.1.5 of Chapter 6, a regression model showed that only one SWM factor, which is *collection frequency* was considered to have significant effect towards compliance of Acts. It was argued that there have been many previous studies attempting to document how an adequate legal framework contributes positively to the development of the integrated waste management system (Asase et al., 2009; Beigl et al., 2008; Hong & Adams, 1999), however it was impeded by the absence of satisfactory policies (Mrayyan & Hamdi, 2006; Bach et al., 2004) and ineffective regulations (Seng et al., 2010; Moh & Abd Manaf, 2017). Tarmudi et al. (2012), EPSM (1979), Ogawa (2000) and Schoot Uiterkamp et al. (2011) also commented that the waste collection system in SWM system in developing counties lead to various issues, including hygiene issue, inappropriate disposal manner, and informal waste picking problems. Existing provisions in Malaysia such as the Local Government Act 1976, Street, Drainage and Building Act 1974, and Environmental Quality act 1974 only prevent and control environmental pollution. They are not adequate to deal with management of solid waste including discharges and emissions from landfills and solid waste facilities (Moh & Abd Manaf, 2017).

It was suggested that the collection frequency factor would able to improve the condition by conducting proper planning and scheduling the timetable for waste collection and always do the cleansing at the collection points, this would able to comply the current Acts, which highlight that all the solid waste includes institutional solid waste should be stored, treated or disposed solely at the licensed SWM facilities (refer Clause 71, 72 and 73 of SWPCM Act 2007). Besides, the enforcement of the new policy is that of the households have to separate their wastes in 2+1 system starting in 1st September 2015; it is believed that the policy will be seen effective if frequent waste collection is provided at the beginning stage so as to track whether household comply the policy by separating their wastes. Given the current Acts or policies are still in deficiency, the researcher expects the effect of collection frequency can make the community complies the current Acts.

7.7 Developing Strategic SWM Framework

The aim of this research is to develop a strategic SWM framework for MHEIs. The proposed strategic SWM framework was produced and shown in Figure 7.3. The development of the framework includes employment of SWM factors, strategic implication variables and integrating of three MHEI groupings as development tool.

In this study, the effectiveness of strategic implication variables is predicted by adopting regression analysis method. As discussed in Chapter 5, fourteen (14) SWM factors and five (5) strategic implication variables were validated via interviews in exploratory phase. After that in confirmatory phase, those fourteen (14) SWM factors were first be analysed with five strategic implication variables through correlation test. Those have significant relationship with the strategic implication variables were then brought forward to regression analysis tests to investigate which factors were contributing to overall effect of each strategic implication variable. As a result, five regression models were produced. A strategic SWM framework for MHEIs was developed based on the five regression models (as shown in Figure 7.3).

SWM and recycling initiatives in Malaysia has been researched widely in the past. However, previous researchers (Isa et al., 2005; Murad & Siwar, 2007; Saeed et al., 2009; Afroz et al., 2013; MHLG, 2010; Agamuthu et al., 2011; Zen et al., 2014; Moh & Abd Manaf, 2014; Akil et al., 2015) mainly focused the studies on municipal wastes. Although few past studies (Elfithri et al., 2012; Zain et al., 2012) were concentrated on institution wastes but they only studied on particular university (Elfithri et al., 2012), not studied on whole higher education institutional sector. Hence, the strategic performance framework produced in the present study could benefit the organisations from both public and private higher education institutions to manage their solid waste strategically.

Referring to the strategic performance framework (Figure 7.3), the effects of five strategic implication variables were contributed by the significant SWM factors. A strategic MHEI SWM was formed by integrating these five models of strategic implications. The moderating variable – MHEI groupings was predicted to have difference contribution towards the effect of change of recycling behaviour/culture. In the present study, it was also found that in order for facilities management (FM) in higher education institutions to adequately achieve sustainability and other business implications, key factors that have significant contribution must be identified. Most importantly, the strategic SWM framework for MHEIs used for this research has sought to contribute to this area of research and practice.

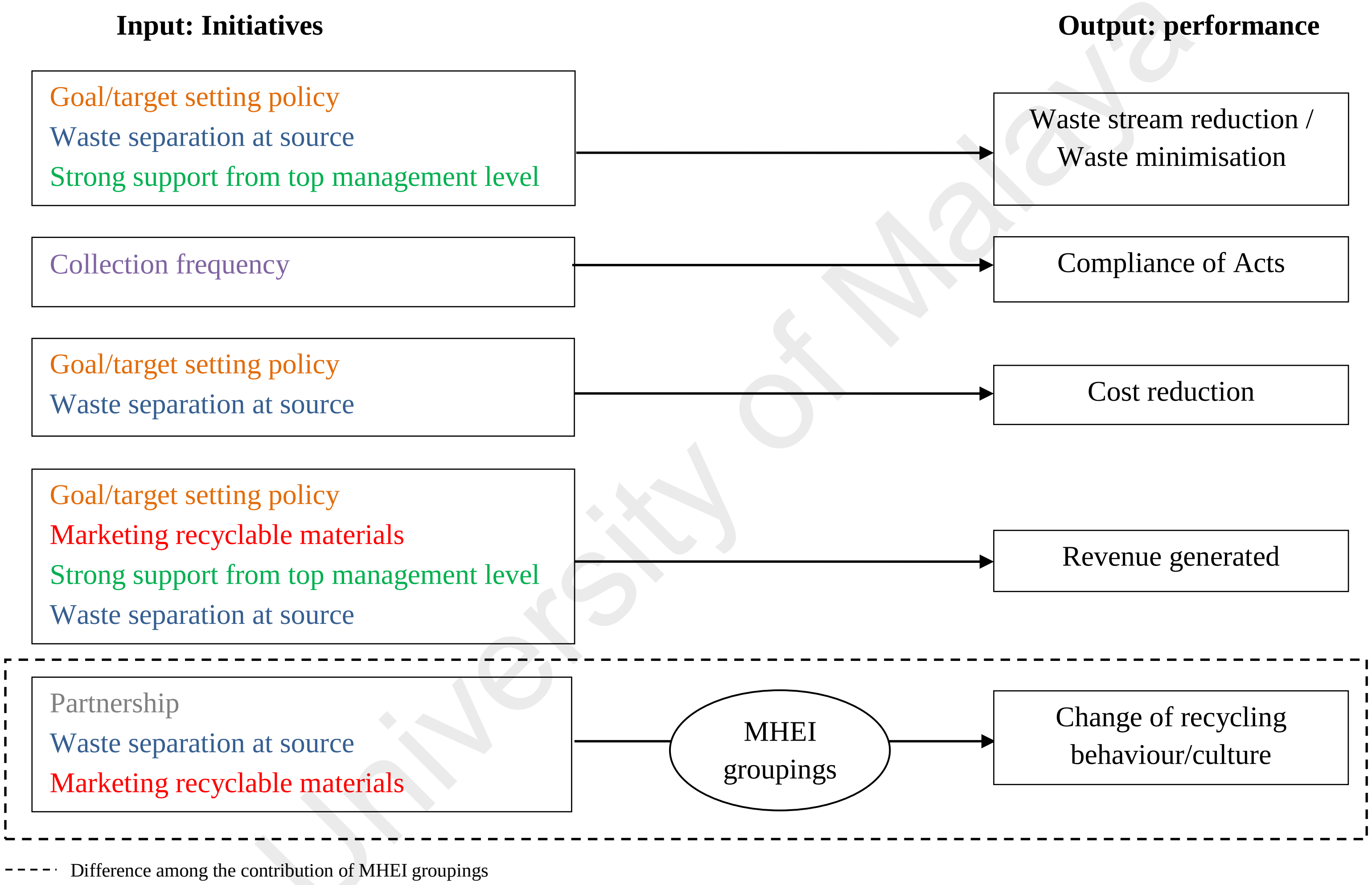


Figure 7.3: Strategic SWM framework for MHEIs

7.8 Summary

In conclusion, this research has put forward five (5) critical findings and one research output that will be contributed to the knowledge in the area of MHEI recycling initiatives. One of the key findings identified from this research is the identification of primary SWM factors that have significant contribution to the overall effect of each strategic implication variable. With the establishment of five regression models, strategic SWM framework for MHEIs is developed.

It is also imperative to note that the evidence from this research describes the current information and implementation trend of the MHEI SWM factors that have been practiced, with emphasis on three MHEI groupings. Principally, the development of strategic SWM framework for MHEIs may guide waste managers and facilities managers at institution organisations to focus on particular actions necessary for achieving strategic implication of institutions recycling in near future.

CHAPTER 8: CONCLUSION AND RECOMMENDATION

8.1 Introduction

This chapter presents the conclusion and recommendation for the study. The conclusions are drawn from the findings which were discussed in the previous chapter in the present study. This chapter will discuss on the overall summary of the objectives and make some recommendations for potential area in solid waste management (SWM).

8.2 Summary of Findings

The study initiated with the investigation on the issue in managing solid waste. Based on the literature review search, there is limited study found for SWM and recycling in Malaysian higher education institutions (MHEIs). Most researches on SWM and recycling initiatives are largely focusing on municipal solid wastes. In addition, it was found that relatively few professionals fully understood the importance of solid waste recycling and would be unable to manage the solid waste in strategically. Many MHEIs just make sure the wastes are disposed in proper place without considering the strategic implication towards its business practices.

Speedily deterioration of environment resulting the emergence of sustainability responsibility of all sectors towards strategic SWM. Thus, it is a challenging for the waste manager to plan the SWM in achieving strategic implications. In fact, some researches indicated few recycling initiatives, but for specific waste. The comprehensive list of SWM factors towards strategic implications and lack of research in this area provide an impetus for this research.

This research adopted mixed method approach with the sequential strategy, which is the combination of both qualitative and quantitative method. The summary of the overall research framework was presented in Figure 8.1. This study was divided into three main phrases whereby phase 1 is literature review to get an overview of the study and most importantly to identify two important components that were SWM factors and strategic implication variables. From the literature review, a theoretical framework was produced to reflect the framework for the study. There were seventeen (17) SWM factors and five (5) strategic implication variables were identified from literature review.

After that, the study was followed by semi-structured interviews to validate the SWM factors and strategic implication variables obtained from phase 1 and investigate the issues faced and current solid waste recycling practices adapted in MHEIs. The semi-structure interview process was carried out with ten (10) MHEIs selected. The validation done by the ten (10) MHEIs revealed that a total of fourteen (14) SWM factors and five (5) strategic implication variables were found suitable in local context. As a result, a validated theoretical framework was constructed and appropriate for the present study.

The study moves on with phase 3 by questionnaire survey to generalise the qualitative findings to the large samples and develop strategic SWM framework for MHEIs. The questionnaire survey was conducted among MHEIs with 30.9% response rate. The finding of this research proven that the current SWM and recycling practices by institution organisations are in its infancy and not strategic as there are no national policy and supply chain of infrastructures for the higher education institutions to rely on.

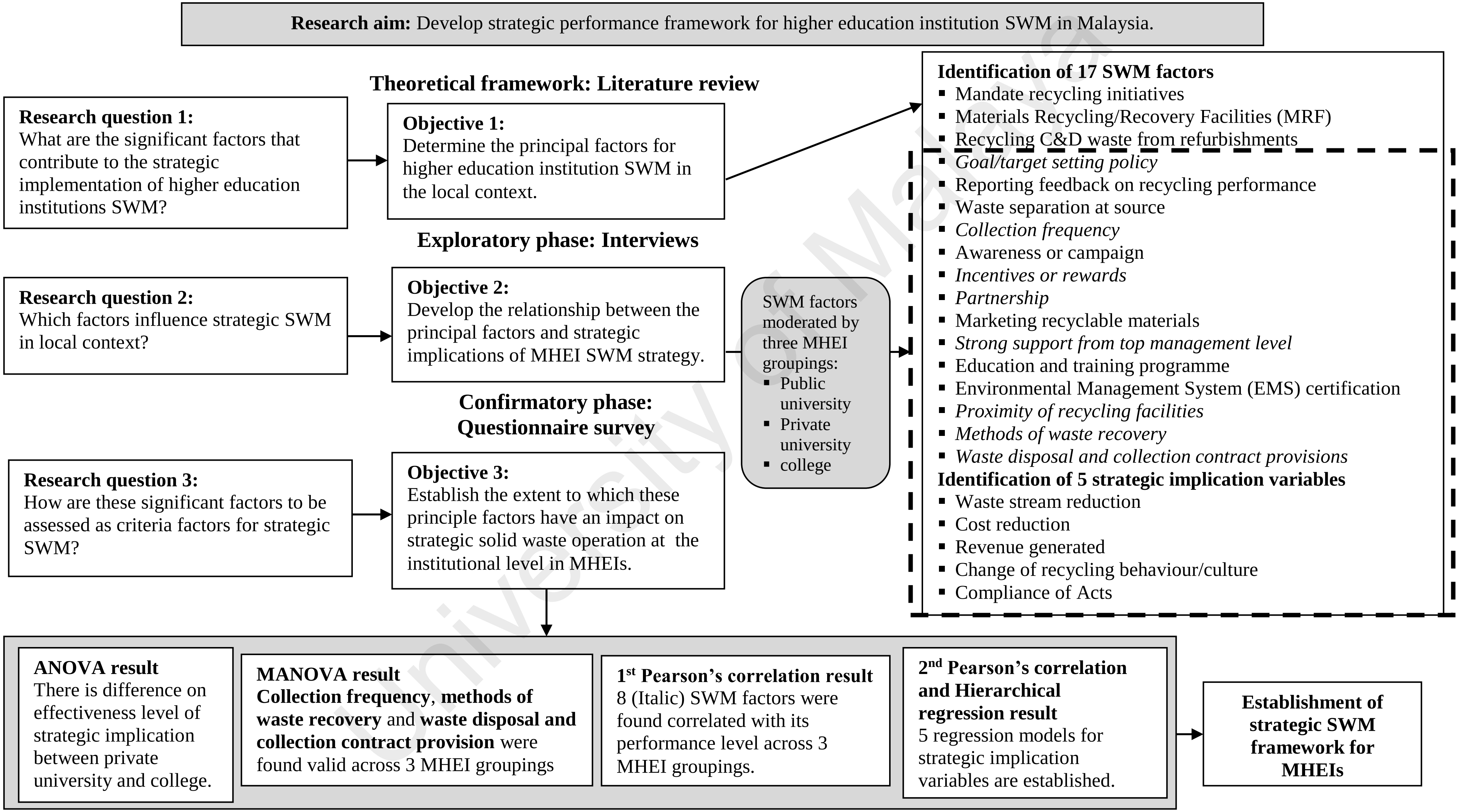


Figure 8.1: Summary of research framework

In this research, the objectives have been achieved and discussed as below:-

8.2.1 Objective 1: To Determine the Principal Factors for Higher Education Institutions SWM in the Local Context

There were seventeen (17) SWM factors and five (5) strategic implication variables identified from literature review. The seventeen (17) SWM factors were listed as follows:

1. Goal or target setting policy
2. Partnership
3. Strong support from top management level
4. Awareness or campaign
5. Education and training programme
6. Waste separation at source
7. Proximity of recycling facilities
8. Collection frequency
9. Methods of waste recovery
10. Incentives or rewards
11. Waste disposal and collection contract provisions
12. Environmental Management System (EMS) certification
13. Marketing recyclable materials
14. Feedback on recycling performance
15. Mandate the recycling initiatives
16. Material recycling/recovery facilities (MRF)
17. Recycling construction and demolition (C&D) waste from refurbishment works

Meanwhile, the five (5) strategic implication variables which identified in literature search were listed as follows:

1. Waste stream reduction / Waste minimisation
2. Cost reduction
3. Revenue generated
4. Change of recycling behaviour / culture
5. Compliance of Acts

The factors and variables were then validated in terms of their applicability for local context and shortlisted in phase 2 (interviews). In order to derive a set of SWM factors and strategic implication variables that were considered essential, only those SWM factors and strategic implication variables validated were found as appropriate for MHEIs and included in this study for further evaluation in phase 3 (questionnaire survey).

8.2.2 Objective 2: To Develop the Relationship between the Principal Factors and Strategic Implications of MHEI SWM Strategy

From the literature search, seventeen (17) SWM factors and five (5) strategic implication variables were found. In Malaysia, higher education institutions consist of three groups, which are public university, private university and college. Researcher believed that the management organisation among these three groups may vary in the financial aspect. Thus, a theoretical framework was produced based on these three components which are SWM factors (act as independent variable), strategic implication variables (act as dependent variable) and three MHEI groupings (act as moderating variable) as shown in Figure 3.6.

However, after the SWM factors were then validated through phase 2 (interviews process); the results showed that only fourteen (14) SWM factors were deemed to have impacts on strategic institution SWM and found appropriate to be adopted in MHEIs. The SWM factors were shortlisted as below:

1. Goal or target setting policy
2. Partnership
3. Strong support from top management level
4. Awareness or campaign
5. Education and training programme
6. Waste separation at source
7. Proximity of recycling facilities
8. Collection frequency
9. Methods of waste recovery
10. Incentives or rewards
11. Waste disposal and collection contract provisions
12. Environmental Management System (EMS) certification
13. Marketing recyclable materials
14. Feedback on recycling performance

Besides, strategic implication variables were also validated through interview process and all five (5) strategic implication variables were found important and appropriate to be included in this study. As a result, a validated theoretical framework that showed the relationship between the validated SWM factors and strategic implication variables for MHEIs was established. The validated theoretical framework is also moderated by MHEI groupings (as shown in Figure 5.1) and applied to assist the establishment of questionnaire survey in phase 3.

8.2.3 Objective 3: To Establish the Extent to Which These Principal Factors Have an Impact on Strategic Solid Waste Operation at the Institutional Level in the MHEIs

To achieve this objective, five hypothesis tests were carried out to define the current practise perceived by the higher education institution organisations. Based on the five hypotheses, several statistics analysis tests were applied to analyse the data obtained from questionnaire survey. The statistics tests used were Pearson's correlation analysis, analysis of variance (ANOVA), multivariate analysis of variance (MANOVA) and hierarchical multiple linear regression analysis.

The second and third hypothesis tests employed Pearson's correlation analysis. From the results of second hypothesis test, the study discovered there are relationship between the importance level of eight (8) SWM factors and the extent to which these factors have been implemented by the higher education institution population in general (as shown in Figure 8.1 and detailed in Section 7.5). This evidence implies that institution management shall give more attention to these eight (8) SWM factors, considering them to be the most important factors in their solid waste recycling programme.

The third hypothesis tests employed second Pearson's correlation analysis to detect the significant relationship between the implementation level of SWM factors and the effectiveness level of strategic implication variables. Those SWM factors significantly correlated with particular strategic implication variable were brought forward to the regression analysis test (which is sixth hypothesis test).

The fourth hypothesis test employed ANOVA analysis. The study discovered there are differences of strategic implication across the three MHEI groupings (detailed in Section 7.4). The result further showed that the significant difference occurs between the perception of private university and college (as shown in Figure 8.1); and the strategic implication perceived by college was not as effective when compared to the other two MHEI groupings. Fifth assessment was carried out to identify variations across the three MHEI groupings where studied using the MANOVA procedure. The fifth hypothesis was tested and revealed collection frequency, methods of waste recovery and waste disposal and collection contract provisions are the three factors perceived differently across the three MHEI groupings (as shown in Figure 8.1 and detailed in Section 7.5).

Sixth hypothesis test was employed hierarchical multiple linear regression analysis to ascertain the implementation of those significant correlated factors that would affect the strategic solid waste operation. Five regression models for each strategic implication variable were established as a result. The established models entirely indicate which SWM factors were considered to have significant effect of the strategic implication variables. The five models developed were shown as follow:

1. Predicted variable (waste stream reduction / waste minimisation) = 0.291(goal/target setting policy) + 0.293(waste separation at source) + 0.207(strong support from top management level)
2. Predicted variable (cost reduction) = 0.463(goal/target setting policy) + 0.262(waste separation at source)
3. Predicted variable (revenue generated) = 0.208(goal/target setting policy) + 0.313(marketing recyclable materials) + 0.187(strong support from top management level) + 0.180(waste separation at source)

4. Predicted variable (change of recycling behaviour/culture) = 0.392(partnership) + 0.245 (waste separation at source) + 0.293(MHEI groupings) + 0.206(marketing recyclable materials)
5. Predicted variable (compliance of Acts) = 0.357 (collection frequency)

Based on these five models, a strategic performance framework was developed and proposed which was expected to be a useful tool for the waste management organisations that provide a guide in planning their solid waste recycling initiatives strategically (as illustrated in Figure 7.3).

8.3 Contribution of the Research

From the research, it was found that there are several important contributions that are beneficial to the waste management organisations. The contributions are as follow:

1. The identification of the set of SWM factors may guide the waste practitioners to focus on the particular actions necessary to assist the development of recycling service.
2. Several statistically significant associations between SWM factors and their implementations are identified, this could prove useful to practitioners in analysing a particular factor in detail.
3. Most researches for SWM and recycling are focusing more on municipal solid waste. This research has bridged the gap in the existing research and also contributed to the knowledge on solid waste recycling initiatives for strategic SWM.

4. The established regression models can help the managers or decision makers forecast future conditions and provide new insights into how the solid waste recycling initiatives will affect their institution businesses.

5. The proposed strategic SWM framework for MHEIs in this study can be utilised and adapted as a decision-making tool by waste administrators or facilities managers in planning their solid waste recycling initiatives strategically. For instance, nowadays quality is the most important objective that more decision makers consider to; this can be assured by identifying and eliminating the factors that cause poor performance of SWM based on the strategic SWM framework for MHEIs.

From the theoretical side, this research is focused on the conceptualisation of the strategic SWM framework which was guided by a wide review of literature and relevant theoretical construct. The set of fourteen SWM factors for this community were generalised. These characteristics have contributed to the novelty of this research. The researcher also wishes that the findings from this research can be a useful guide for future progress of research in SWM area. Besides, this research has introduced strategic implication variables to report the strategic SWM studied herein that could lead to future research in assessing performance of any SWM.

8.4 Limitations of the Study

In identifying the contribution of this research, it is important to acknowledge key limitations. During the selection of MHEIs for interviews, it was difficult to select the appropriate organisation or person for interviews as most of the MHEIs do not have a central waste-related organisation to administer institutional wastes.

In addition, limitation of time for questionnaire survey is one of the considerations in this study. The questionnaire survey took around eight months to get the feedback from respondents, therefore the survey was stopped after achieving a 30.9% response rate.

Apparently, the results will not remain valid if the SWM factors change rapidly in the near future; rapid changes and development are now occurring in the business environment. These changes and development will definitely affect the solid waste recycling programme attributes and the means of recycling programmes as managed by the MHEIs. Some significant factors might be disappearing due to the new policy reviews and invention of new technologies, while factors related to other recycling program attributes might also become more critical. As a consequence, future values of the proposed strategic performance framework may decline and its applicability for the future will be limited.

8.5 Recommendations for Future Research

This research has introduced a strategic SWM framework for MHEIs. It would be useful to continue this study in the following areas:

1. Further investigation on those significant SWM factors towards strategic solid waste operation should be conducted from the view of FM tactical and operational points. This is because despite fourteen SWM factors identified, at this juncture, the study has generalised that only certain SWM factors have a

significant effect on the certain strategic implication of SWM in regard to the three MHEI groupings.

2. An in-depth study on developing an appropriate policy framework, together with technical guidelines on waste recovery operations, to properly guide local bodies in effective SWM.
3. A detailed study on the performance measurement is appropriate to evaluate the recycling performance in future. In current practice, the industry is still lacking implementation and information on measurement indicators in recycling performance assessment.
4. Detailed study on developing waste information and monitoring systems, together with introducing mandatory waste audit processes. Transparency of data management plays an essential role in improving planning of effective SWM by the local bodies.
5. Further study can be conducted on different sectors such as other commercial or industrial sector. This would allow a comparative analysis to be made for different sectors.
6. An in-depth study can be carried out by selecting a university as pilot study to develop a SWM guideline which is applicable to all the universities.
7. The similar study could be carried out in other countries to have a comparative study to further validate the research findings and theoretical framework.

The researcher believes that it is essential to explore other characteristics of MHEI schemes such as number of population, size of institution campus and others which have not been covered in the current research sample in future research since the cross-sectional investigations were reported in the current research. This will enable clearer and more robust conclusions to be drawn. Besides, due to the limited resource and time, the researcher was not able to complete several investigations related to this study and it is suggested to conduct future research on the detailed waste streams composition of MHEIs to fully understand the character of waste, and then to increase the precision of analysis and finally to enable firmer conclusions to be drawn.

8.6 Summary

In conclusion, this research has achieved is aim and objectives as formulated. The research proposed a strategic SWM framework to assist the waste managers and facilities managers at institution organisations to focus on particular actions necessary for achieving strategic implication of institutions recycling in near future. The proposed strategic SWM framework is expected to be a useful tool for the waste management organisations and provide a guide for strategically planning their SWM and recycling initiatives.

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