PLANNING MALAYSIA:
Journal of the Malaysian Institute of Planners
VOLUME 22 ISSUE 3 (2024), Page 486 – 501

IMPLEMENTATION OF ZERO WASTE CONCEPT IN MALAYSIA: FROM CONTRACTORS' PERSPECTIVE

Habizah Sheikh Ilmi[1], Jing Wen Yee[2], Kenn Jhun Kam[3], Tze Shwan Lim[4] and Lam Tatt Soon[5]

[1,2,3,4,5]*School of Architecture, Building and Design,*
TAYLOR'S UNIVERSITY, MALAYSIA

Abstract

Construction waste is one of the major contributions to severe environmental issues. However, this construction and demolition (C&D) waste issue is often neglected by the stakeholders. Instead, they focus more on cost, time and quality as their priority. In Malaysia, the lack of knowledge and awareness of sustainable zero waste practices have become a major obstacle to sustainable development in the construction industry. To address this, the implementation of Zero Waste concept should be widely promoted to reduce the solid waste production and mitigate the depletion of natural resources. Hence, this study is to identify the challenges of implementing zero waste concept among the contractors. This research focuses on building contractors by using a quantitative research method to collect data from the targeted population. The findings of the study highlight that waste reduction, curbing illegal dumping and reducing public health risks are the primary concerns in relation to the Zero Waste concept. The study reveals that contractor's attitude and reluctant behaviour, inadequate policies and the absence of mandatory zero waste management are the main barriers for the implementation of zero waste concept in Malaysia. The government should play an important role to develop C&D waste concept and to identify suitable C&D waste models which can be used in Malaysia. By adopting zero waste concept, the construction industry in Malaysia can move towards a more sustainable future and develop its sustainability targets under Sustainable Development Goal (SDG) 12.

Keywords: building contractors, Construction and Demolition (C&D) waste, sustainability, waste management, Zero Waste concept

[1] Lecturer at Taylor's University, Malaysia. Email: Habizah.ilmi@taylors.edu.my

INTRODUCTION

Rapid urbanization and industrialization symbolize the accelerated development of the economy and the increasing population growth in a country. However, there are some aftermaths which come along with the evolution and alterations. The rise in community living standards has significantly boosted waste generation in the world, especially in developing countries (Guerrero et al., 2013). It is essential to have an effective approach to the management of solid waste which has been adopted in several developed countries to promote sustainable development, namely Zero Waste concept. This concept is used to reduce the production of solid waste that can mitigate the depletion of natural resources as well as achieve waste minimization to its lowest level (Hairul et al., 2019). Zero Waste is considered a means of waste management, which is also an ambitious goal to cope with waste. Basically, it is about managing the waste by eliminating, minimising and/or recycling waste wherever possible and feasible. The term "Zero Waste" was first introduced in the 1970s by Paul Palmer, a PhD chemist at Yale. This approach is somewhat philosophical because it is impossible to control waste to 0% or completely eliminate waste because there will always be a residue (Christof, 2016).

Construction industry has become a major generator of waste due to the massive amount of waste that can be generated throughout the year. Most of the construction and demolition (C&D) waste being sent to landfills has resulted in several issues in various aspects such as environmental aspect, social aspect and economic aspect and the like. To date, landfilling has been the most common disposal method for C&D waste. The major environmental impacts include land space consumption, resource depletion, pollution in air, noise, soil and water, depletion of landfills, and energy and non-energy resource consumption as well (Chen et al., 2020). According to Chooi et al. (2018), the comparison of the damage assessment on the environmental impacts has clearly stated that the business as usual (BaU) waste flow will keep rising at the rate of 20.2% in the year 2025 without any proper measure. Improper planning management during the construction phase leads to the generation of C&D waste. According to Rahim et al. (2017), people who live in certain places in Malaysia has raised their concern regarding illegal dumping activities which contribute to environmental issues and the negative image of the areas. In March 2021, five contractors were caught for illegal dumping at different sites in Klang, Malaysia and fined RM2,000 each (Rajendra, 2021). In 2020, a waste contractor was found guilty and was fined RM13,000 in the first illegal dumping case carried out in Putrajaya (EdgeProp.my, 2020).

Currently, Malaysia produces an average of approximately 23,000 tonnes of waste per day at a recycling rate of 5% (Sreenivasan et al., 2012). According to Bernama (2022), there are nearly 40,000 tonnes of waste generated per day and an estimated 95% of waste would eventually result in landfills as

well. Furthermore, the implementation of the zero-waste concept in Malaysia is significantly behind other countries, especially the neighbouring country, Singapore. Sustainability is the main consideration for Singapore's development, hence they have built a zero-waste master plan according to three different aspects, for example, climate resilience, resource resilience and economic resilience. Moreover, Singapore converts waste into resources by applying waste-to-energy (WTE) incineration plants (Zero Waste SG, 2020).

PROBLEM STATEMENTS

In the construction industry, construction waste is one of the major contributors to severe environmental issues, especially in developing countries (Eusuf et al., 2012). The generation of C&D waste has been rising continuously which is parallel with the rapid development of the economy in Malaysia. Unfortunately, Malaysia has poor C&D waste management despite introducing several methods to cope with it. Nowadays, limited landfills have created plenty of hardship for local and federal governments to dispose of the waste generated. In addition, the average lifespan of landfills in Malaysia is two years at maximum, whereas landfills in Western countries can last up to ten years. According to Muhamad and Seow (2014), it proved that the city centres have the most solid waste generated each year, compared to other cities such as Kuala Terengganu and Seremban. Until recently, this issue has not been improved and limited landfills availability issue has worsened. The Zero Waste concept and effective waste management approach need to be conducted to tackle the waste problems and mitigate environmental issues since construction waste management is still not widely adopted.

Nagapan et al. (2012) stated that illegal dumping has become a serious issue in Malaysia due to the insufficiency of waste management practices in the related industry. Solid Waste and Public Cleansing Management Act 2007 is one of the regulatory policies of waste management in Malaysia under Solid Waste Management and Public Cleansing Corporation (SWCorp), however, more attention is given to domestic waste instead of construction waste. According to Nazerry and Abdul (2007), illegal dumping has proven to put risks on human health and the environment. There are numerous factors that influence the individual or organizations conducting illegal dumping deliberately, such as increasing waste disposal fees owing to rigorous regulations of waste management and human behaviour towards handling waste and environment conservation. Begum et al. (2009) have demonstrated that a positive attitude and behaviour of a contractor towards waste management practices could influence the performance and growth of the construction industry. Moreover, the data of construction waste material density in Malaysia in which the mixed waste/demolition waste holds the highest density among all the other waste compositions (Shivaraj et al., 2018).

Nevertheless, the implementation of the Zero Waste concept is still not widely practised by most contractors in the Malaysia construction industry. Evidently, there are numerous barriers that the construction players will encounter, and even further developments and alterations are required to execute this practice. The low level of awareness by the contractors in Malaysia has caused the low adoption of the Zero-waste concept. Several challenges such as reluctance to change, financial issues and the like become obstacles for them to move towards sustainable waste management practices. Poor waste management may increase the amount of waste material on site. The execution of reuse, reduce and recycle are recommended to minimise waste production by the contractors at construction sites, hence the need for new resources can be reduced and resulted in cost savings for waste transportation and landfill disposal (Che Ahmad et al., 2014).

Therefore, this research paper will identify challenges faced by contractors to implement the sustainable Zero Waste concept in the construction projects.

CHALLENGES IN IMPLEMENTING ZERO WASTE CONCEPT

1. Human Factor

According to Agamuthu and Fauziah (2010), despite the fast-paced economic growth in Malaysia, public concern and understanding are not growing in parallel. The involvement in Zero Waste approach to sustainable waste management is significantly inadequate. Lack of awareness on the Zero Waste concept is one of the main reasons for not conducting it. This is because the poor implementation of educational programs, training, and awareness campaigns among the contractors leads to a low level of public education hinders the understanding and practice the Zero Waste concept. Besides that, challenges related to the lack of leadership of professionals involved also contribute to the failure of delivering technical knowledge to contractors. Moreover, in the construction industry, poor guidance of the professionals as well as insufficient planning, monitoring and performance evaluation processes are also identified as barriers to effective C&D waste management (Mohd Nasir et al., 2016).

Ng et al. (2017) have noted that it is not an obligatory requirement for construction companies to conduct 3R practices. Some contractors in Malaysia are reluctant to try out new methods which could benefit them since they have been lacking proactivity. They are more comfortable with the current traditional waste disposal approaches and are not concerned about sustainability ways. A research from Moh and Abd Manaf (2014) highlighted that there is approximately 70% to 80% of the waste s recyclable in landfills in Malaysia. Besides the high cost of implementation of the Zero Waste concept, contractors prioritize their project's progress rather than waste minimization (Liyanage et al., 2019). In Malaysia, sustainable waste management remains a low priority among

contractors. Ineffective cooperation among different project stakeholders causes challenges in carrying out new management instead of traditional methods due to poor communication and coordination between various parties (Muhamad and Seow, 2014).

Since Malaysian construction sector remains labour intensive, the attitudes and behaviours of individuals involved in the sector have significant impacts on its development and effectiveness (Begum et al., 2009). The negative behaviour and attitude of contractors determine the effective implementation of the sustainable Zero Waste concept in the construction industry.

2. Institutional Factors

2.1 Policy and Regulation

Zero Waste management in Malaysia is not mandatory which is identified as one of the barriers, and as a result, proper waste management is being neglected and not practiced by the construction players, especially contractors. The lack of institutional factors is largely a result of the lack of a suitable policy to implement regulations or legislation regarding the proper measures of waste management which the contractors should adopt to provide a sustainable waste management system and sustainable landfill practice in the construction sector (Agamuthu and Fauziah, 2010). Besides that, insufficiency in the enforcement of the law on waste management has lowered the level of awareness of zero waste management among contractors. This is because the policy and legislation play significant roles in the 3R (reuse, recycle and reduce) approach of the Zero Waste concept. The Act 672 is enforced by the Solid Waste Management and Public Cleansing Corporation, known as SWCorp Malaysia, which has the power to take control of solid waste management from local authorities. This has resulted in confusion and overlapping of enforcement powers between the corporation and the local authorities (Muhamad and Seow, 2014). In fact, the effective adoption of zero waste management policy reflects the sustainability of the waste management system. To achieve the goal of sustainable development, policy implementation is vital. Additionally, the government does not provide any support such as financial assistance and incentives to contractors for undertaking zero waste management in which these management methods require high budget costs to operate (Ng et al., 2015).

2.2 Facilities

Despite the existent of approximately 289 landfills in Malaysia, it is unfavourable to handle waste by disposing them because it may be discharged into the environment, which is the lowest priority in the sustainable waste management hierarchy (Nazerry and Abdul, 2007). Hence, the lack of waste plants is identified as one of the barriers of adopting the Zero Waste concept. In Malaysia, there are approximately seven mini-incinerators with capacities between 5 to 20 tonnes per

day, but the majority of these incinerators do not have energy recovery systems. Due to high operating costs, these incinerators operate once a week which appears to be unsustainable even though it reduces large volume of waste generated. Additionally, air pollution might occur by applying this method (Aja and Al-Kayiem, 2013). Currently, there is only one existing Energy-from-Waste (EfW) plant in Malaysia located in Semenyih, Malaysia, Kajang Waste-to-Energy (WTE) Plant which was constructed in 2009, in which municipal solid waste (MSW) is transformed into refuse-derived fuel (RDF) to be used in an integrated steam power plant for the purpose of environmentally friendly MSW disposal and generating renewable power (Power, 2010). Furthermore, another WTE facility is called SMART (Solid Waste Modular Advanced Recovery and Treatment) WTE, built for converting solid waste to energy (electricity) in light of the concept of sustainable and integrated waste management. It is located at Ladang Tanah Merah, Port Dickson, Negeri Sembilan (Azman, 2020). However, this WTE facility is not yet officially operational despite obtaining a 98% completion rate (Abdullah, 2022 and The Edge Malaysia, 2023).

2.3 Management Factor

Muhamad and Seow (2014) have highlighted that the waste materials removed from the illegal dumping sites are dumped in landfills which causes the area in the landfill to fill up sooner than expected. Consequently, it hampers the undertaking of sustainable landfilling since the waste materials gathered do not receive any pre-treatment before being disposed. Additionally, in Malaysia, moist and putrescible materials are heavily mixed in with the waste that is dumped into landfills. The waste may contain between 70% to 80% of moisture. Landfill gas generation starts early under tropical circumstances and becomes a crucial aspect to be taken into consideration in landfill management because of the country's warm climate (27-34°C throughout the year), which accelerates the rate of decomposition of putrescible components. The fundamental issue with waste management nowadays is the accumulation of waste in landfills owing to space constraints, resulting in less rigorous environmental protection legislation governing landfilling operations (Liyanage et al., 2019). Poor waste management can be caused by lacking expertise in material handling and inadequate knowledge in the design stage. Waste separation is not a typical practice in Malaysia (Aja and Al-Kayiem, 2013).

Furthermore, the ineffective management system with immature recycling technology challenges undertaking the Zero Waste concept among contractors. It is pivotal for material selection by contractors with quantity reduction of waste while strengthening the quality. The underdeveloped market for C&D waste materials and immature recycling market operation is also identified as the barriers influencing the utilisation of the Zero Waste concept (Huang et al., 2018). Besides that, majority of the landfills in Malaysia have lack

of infrastructure for the collection of landfill gas and leachate that rely primarily on natural clay lining as their landfill liners. The construction of these disposal facilities was mostly established by the conventional concern with waste disposal (Agamuthu and Fauziah, 2010).

RESEARCH METHODOLOGY

In this research, the data collection was done via a questionnaire survey. Quantitative method is applied in this research study. It is a systematic method of gathering and analyzing quantifiable and verifiable data. A larger size of sample will represent the entire target population in the study which will ensure the research finding is impartial and trustworthy.

Likert scale of five (5) points is used in the questionnaire. Choices provided for respondents, such as the preferred level of agreement to a certain question by respondents in a range from strongly disagree to strongly agree are frequently referred to as categories (Samuels, 2020). This method assists them in reflecting their perspectives on the nearest options from a list of possible responses.

Based on Tholibon et al. (2021), Relative Importance Index (RII) is used as the value of the index which specifies the ranked degree of importance. Sakhare and Patil (2019) have stated that researchers in the fields of construction and facilities management frequently utilise the Relative Importance Index (RII) which is a non-parametric technique to analyse structured questionnaire responses for information including ordinal measurement. RII illustrates that the variables' criteria were more significant in line with the higher the RII rating and vice versa.

Reliability which also refers to internal consistency, is measured by Cronbach's alpha. The reliability of surveys with Likert scale questions is evaluated by using Cronbach's alpha tests. It allows to test how closely connected a group of things are to one another because these questions gauge latent variables which have the character of concealed or unapparent that are challenging to measure in real life (Fikri Hasmori et al., 2020). The reliability level of variables varies depending on the value of the coefficient of Cronbach's alpha (Mat Nawi et al., 2020).

Table 1. The Range of Reliability Level and Its Coefficient of Cronbach's Alpha

Coefficient of Cronbach's Alpha	Reliability Level
More than 0.90	Excellent
0.80 - 0.89	Good
0.70 - 0.79	Acceptable
0.60 - 0.69	Questionable
0.50 - 0.59	Poor
Less than 0.59	Unacceptable

Source: Zahreen Mohd Arof et al. (2018)

ANALYSIS AND FINDINGS

Demographic Analysis of Respondents

There is a total of 307 respondents who have participated in the data collection stage. The target population is focused on all grades of building contractors in Malaysia.

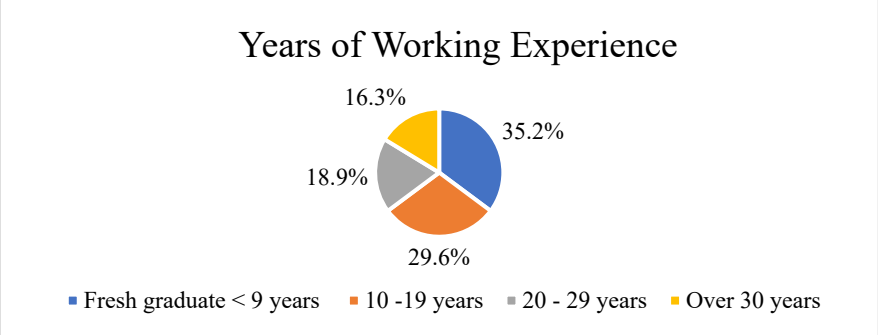

Figure 2. Analysis for Years of Working Experience

Figure 2 demonstrates the years of working experience of the respondents in the Malaysian construction industry. Majority of the respondents have 9 years of working experience (35.2%), followed by 10 - 19 years (29.6%), 20 - 29 years (18.9%) and lastly, 16.3% of respondents acquire over 30 years of working experience. This indicates that data collected is reliable and useful.

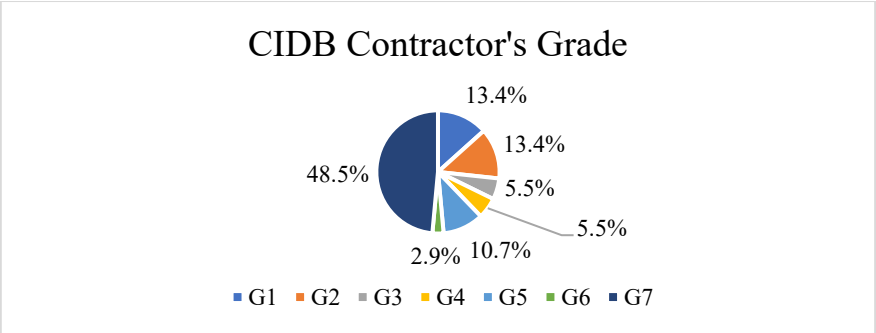

Figure 3. Analysis for Contractor CIDB Grade

According to Figure 3, majority of them are G7 contractors which holds 48.5%. G1 and G2 contractors constitute 13.4% each of the overall respondents, followed by G5 contractors (10.7%); G3 and G4 contractors comprise of 5.5% each and lastly 2.9%of them are G6 contractor. This indicates G7 contractors shows an interest fill in their opinions and find out about Zero Waste concept.

Awareness of Zero Waste Concept in the Malaysian Construction Industry

Figure 4 shows majority of the respondents (67.8%) are aware of the Zero Waste concept in Malaysia. However, there is still low adoption of the concept in the construction industry concept despite knowing the presence of this concept. Thus, there may be some reasons or challenges faced which resulted non-application of the concept.

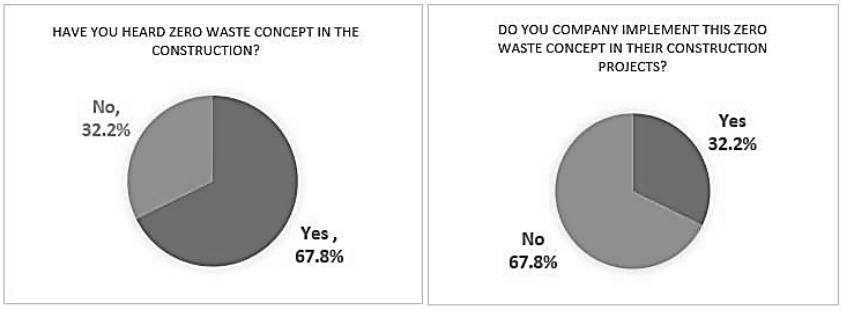

Figure 4. Awareness and Implementation of Zero Waste Concept in the Construction Projects

Perception of Possible Implementation of Zero Waste by the Contractors

Table 2. Perception of Implementation of Zero Waste Concept

	Question on Perception of Implementation of Zero Waste Concept	Mean	RII	Rank
K1	Do you think that Zero Waste concept can benefit the company?	4.162	0.832	2
K2	Do you think that Zero Waste concept can benefit society and the environment?	4.541	0.908	1
K3	Do you think that Zero Waste concept will be a trend in construction industry in the future?	3.946	0.789	3

Table 2 demonstrates the perception of possible implementation of Zero Waste concept for construction projects in Malaysia among the building contractors. The willingness to implement the concept can be realized by appreciating the benefits brought into the construction sectors as well as further development in the future. Most respondents think that Zero Waste concept in the construction industry will benefit society and the environment rather than for the company. Moreover, it can be seen that there are still high chances of the Zero Waste concept becoming a trend in the construction industry in the future.

Challenges of Implementing Zero Waste Concept in Malaysian Construction Industry

Table 3. Analysis on Challenges of Implementing Zero Waste Concept in Malaysian Construction Industry

	Variables	Mean	RII	Rank	Overall Mean	Overall Ranking
B. Human Factor*						
B1	Lack of awareness of Zero Waste concept in Malaysia.	4.135	0.827	3	4.097	1
B2	Absence of leadership of professionals involved.	4.162	0.832	2		
B3	Poor guidance of the professionals.	3.973	0.795	5		
B4	Attitude of reluctance to try out new methods (Zero Waste concept) by contractors as they prefer traditional waste disposal.	4.216	0.843	1		
B5	Ineffective cooperation among different project stakeholders has caused challenges in carrying out new management.	4.000	0.800	4		
C. Institutional Factor*						
C1	Nonmandatory of zero waste management in Malaysia.	4.108	0.822	3	4.081	2

	Variables	Mean	RII	Rank	Overall Mean	Overall Ranking
C2	Insufficiency in the enforcement of the law on waste management.	4.216	0.843	1		
C3	Support by the government such as financial assistance and incentives to contractors.	4.189	0.838	2		
C4	Lack of waste plants.	3.811	0.762	4		
D. Management Factor*						
D1	Improper waste management as the waste materials gathered do not receive any pre-treatment before being disposed of.	4.081	0.816	2	3.955	3
D2	Space constraints for landfills.	3.676	0.735	3		
D3	Ineffective management system with immature recycling technology.	4.108	0.822	1		

* Item is tested for reliability test and is valid to analyse.

According to Table 3, human factor (B) has the highest overall mean value of 4.097 which ranked first among other major barriers of aspect which supports the research by Agamuthu and Fauziah (2010). It is found that the human factor is one of the main elements that challenge the implementation of Zero Waste concept that a proper treatment system is required. The societal mentality regarding the awareness of the significance of the Zero Waste concept remains low. Malaysians tend to prioritize working for direct personal benefits such as incentives for participating in waste management (Harun et al., 2019). Furthermore, institutional factor (C) ranked 2nd with an overall mean value of 4.081. The current policies and regulations in Malaysia make sustainable landfilling hard to perform and achieve. It is also noted that the effective adoption of zero waste management policy reflects the sustainability of the waste management system (Ng et al., 2015). Lastly, management factor (D) ranked last (3rd) with an overall mean value of 3.955, as mentioned by Huang et al. (2018) that the underdeveloped market for C&D waste materials and immature recycling market operation has caused difficulties in adopting Zero Waste concept.

Strategies to Improve Awareness and Application of Zero Waste Concept in Malaysian Construction Industry

There are several suggestions can be considered to address the challenges faced by the contractors in implementing sustainable Zero Waste concept. It is essential that the government plays the role in implementing a new concept since support from the government is required (Abas and Seow, 2014). The government can focus on GHG mitigation efforts related to developing and adopting low carbon construction material as mentioned by CIDB (2022). Good governance, which

influences policy, management and resource allocation, requires the engagement and cooperation of all key stakeholders in the field. As mentioned by Ng et al. (2017), in order to inspire contractors to manage and supervise C&D waste efficiently in the construction sector through the use of the Zero Waste concept, a variety of initiatives including education programmes, awareness campaigns, and training should be promoted. This is also supported by Imroatu et.al (2023) that environmental awareness campaigns can give positive outcome towards appreciation of clean environment and sustainability. It is essential to plan the construction materials throughout the design phase to prevent construction material waste (Huang et al., 2018). Lastly, adopting innovative technologies and market models from developing countries such as prefabrication technologies are useful for the enhancement of sustainability in the construction industry.

CONCLUSION

In conclusion, the research found that majority of the building contractors understand and see the value of Zero Waste concept which brings advantages to them and even to society and the environment. However, in the real world, various kinds of challenges that they have encountered become obstacles in adopting the concept despite the high desire of implementing it is shown by them. Every individual must perform their own role, responsibilities and obligations, hence good coordination and cooperation between various parties can be formed to assist in developing the Zero Waste concept in the Malaysian construction industry. The handling methods of C&D waste in developing countries can be referred to and applied the appropriate and optimal model for Malaysia. For sustainability, some Targets under SDG 12 in Malaysia can be improved and developed like Target 12-2 (sustainable management and use of natural resources), Target 12-4 (responsible management of chemicals and waste), Target 12-5 (substantially reduce waste generation), and Target 12-6 (encourage companies to adopt sustainable practices and sustainability reporting). Although it is impossible to minimize C&D waste to zero, there is a high possibility of utilizing them to the fullest value.

REFERENCES

Abas, M. A., & Seow, T. W. (2014). The issues of policy implementation on solid waste management in Malaysia. *International Journal of Conceptions on Management and Social Sciences Vol. 2, Issue. 3, Sep' 2014; ISSN: 2357 – 2787.* Retrieved from https://www.researchgate.net/publication/271085392_The_Issues_of_Policy_Implementation_on_Solid_Waste_Management_in_Malaysia

Abdullah, F. (2022, September 7). Tapak Pelupusan Sampah Ladang Tanah Merah Dijangka Beroperasi Semula. Negeri Kita. Retrieved from https://negerikita.org/tapak-pelupusan-sampah-ladang-tanah-merah- dijangka-beroperasi-semula/

Agamuthu, P., & Fauziah, S. H. (2010). Challenges and issues in moving towards

sustainable landfilling in a transitory country - Malaysia. *Waste Management & Research: The Journal for a Sustainable Circular Economy,29(1),13–19.* Retrieved from https://doi.org/10.1177/0734242x10383080

Aja, O. C., & Al-Kayiem, H. H. (2013). Review of Municipal Solid Waste Management Options in Malaysia, with an emphasis on sustainable waste-to-energy options. *Journal of Material Cycles and Waste Management, 16(4),693–710.* Retrieved from https://doi.org/10.1007/s10163-013-0220-z

Ali, A. (2021). *Quantitative Data Analysis.* Researchgate.net. Retrieved from https://www.researchgate.net/publication/351637670_Quantitative_Data_ Analysis. DOI: 10.13140/RG.2.2.30033.25442

Azman, N. H. (2020). KPKT: Six WTE plants planned towards 2025 - the Malaysian Reserve. The Malaysian Reserve. Retrieved from https://themalaysianreserve.com/2020/06/22/kpkt-six-wte-plants- planned-towards-2025/

Begum, R. A., Siwar, C., Pereira, J. J., & Jaafar, A. H. (2009). Attitude and behavioral factors in waste management in the construction industry of Malaysia. *Resources, Conservation and Recycling*, *53*(6), 321–328. https://doi.org/10.1016/j.resconrec.2009.01.005

Bernama. (2022). Can Malaysia achieve 40 per cent recycling rate by 2025?-NST Online. NST Online. Retrieved from https://www.nst.com.my/news/nation/2022/03/778625/can-malaysia- achieve-40-cent-recycling-rate-2025

Che Ahmad, A., Husin, N. I., Zainol, H., Abdul Tharim, A. H., Ismail, N. A., & Ab Wahid, A. M. (2014). The construction solid waste minimization practices among Malaysian contractors. *MATEC Web of Conferences*, *15*, 01037. https://doi.org/10.1051/matecconf/20141501037

Chen, K., Wang, J., Yu, B., Wu, H., & Zhang, J. (2020). Critical evaluation of construction and demolition waste and associated environmental impacts: A scientometric analysis. *Journal of Cleaner Production*, *287*, 125071. https://doi.org/10.1016/j.jclepro.2020.125071

Chooi , M. M., Takeshi , F., & Chin , S. H. (2018). Environmental Impacts of Construction and Demolition Waste Management Alternatives. *Chemical Engineering Transactions*, Vol. 63, 343-348. DOI:10.3303/CET1863058. Retrieved from https://www.researchgate.net/publication/325398145_Environmental_Impacts_of_Construction_and_Demolition_Waste_Management_Alterna tives.

Christof, M. (2016). *Introduction: The call for zero waste - JSTOR*. jstor.org. Retrieved from https://www.jstor.org/stable/26241370

Construction Industry Development Board (2020). *GHG Emissions for Construction Industry in Malaysia.* CIDB. Retrieved from https://www.cidb.gov.my/wp-content/uploads/2022/07/207-Carbon-CHG-Emission-for-Construction-Industry-in-Malaysia-min.pdf

Cypark gets nod to operate SMART waste-to-energy plant in Port Dickson. The Edge Malaysia (2023). Retrieved from https://theedgemalaysia.com/node/654048

Eusuf, M. A., Ibrahim, M., & Islam, R. (2012). The construction and demolition wastes in Klang Valley, Malaysia. *PLANNING MALAYSIA JOURNAL*, *10*(3).

https://doi.org/10.21837/pmjournal.v10.i3.103

Fikri Hasmori, M., Faizul Md Zin, A., Nagapan, S., Deraman, R., Abas, N., Yunus, R., & Klufallah, M. (2020). The on-site waste minimization practices for construction waste. *IOP Conference Series: Materials Science and Engineering, 713(1), 012038.* Retrieved from https://doi.org/10.1088/1757-899x/713/1/012038

Guerrero, L. A., Maas, G., & Hogland, W. (2013). Solid waste management challenges for cities in developing countries. *Waste Management*,*33*(1), 220–232. https://doi.org/10.1016/j.wasman.2012.09.008

Hairul, A. H., Norhidayah, M. Y., & Rasyida, R. (2019). *Challenges in the implementation of zero waste concept in Johor Bahru*. utm.my. Retrieved from https://www.utm.my/intrest/files/2019/12/7_CHALLENGES-IN-THE-IMPLEMENTATION-OF-ZERO-WASTE-CONCEPT-IN-JOHOR- BAHRU-CITY-COUNCIL.pdf

Harun, H. A., Yunus, N. M., & Rasul, R. (2019). Challenges In The Implementation Of Zero Waste Concept In Johor Bahru City Council. *International Journal Of Real Estate Studies: INTREST 13(1)/2019, 80-88.* Retrieved from https://builtsurvey.utm.my/intrest/files/2019/12/7_CHALLENGES-IN- THE-IMPLEMENTATION-OF-ZERO-WASTE-CONCEPT-IN- JOHOR-BAHRU-CITY-COUNCIL.pdf

Huang, B., Wang, X., Kua, H., Geng, Y., Bleischwitz, R., & Ren, J. (2018). Construction and demolition waste management in China through the 3R principle. Resources, Conservation and Recycling, 129, 36–44. Retrieved from https://doi.org/10.1016/j.resconrec.2017.09.029

Imroatu Soleheh Suandi, Mohamad Faiz Zainuddin, Latifah Abdul Manaf, Faridzah Jamaludin, Siti Munirah Mohd (2023). Community Knowledge and Perceptions Towards Illegal Waste Disposal: A Case Study Of Sungai Besar. *PLANNING MALAYSIA JOURNAL*, *Vol. 21 Issues 5 (2023), page 296-308.* Retrieved from https://www.planningmalaysia.org/index.php/pmj/issue/view/52/14

Liyanage, K. L. A. K. T., Waidyasekara, K. G. A. S., & Mallawarachchi, H. (2019). Towards the adoption of zero waste concept in the construction industry: A Review of Existing Strategies. Research Gate. Retrieved from https://www.researchgate.net/publication/336036042_Towards_the_Adoption_of_Zero_Waste_Concept_in_the_Construction_Industry_A_Review_of_Existing_Strategies

Mat Nawi, F. A., A. Tambi, A. M., Samat, M. F., & Wan Mustapha, W. M. (2020). A review on the internal consistency of a scale: The empirical example of the influence of human capital investment on Malcom Baldridge Quality Principles in TVET institutions. *Asian People Journal (APJ)*, *3*(1), 19–29. https://doi.org/10.37231/apj.2020.3.1.121

Moh, Y. C., & Abd Manaf, L. (2014). Overview of household solid waste recycling policy status and challenges in Malaysia. *Resources, Conservation and Recycling, 82, 50–61.* Retrieved from https://doi.org/10.1016/j.resconrec.2013.11.004

Mohd Nasir, S. R., Othman, N. H., Mat Isa, C. M., & Che Ibrahim, C. K. (2016). The challenges of Construction Waste Management in Kuala Lumpur. *Jurnal Teknologi, 78(5-3).* Retrieved from https://doi.org/10.11113/jt.v78.8522

Muhamad, A. A., & Seow , T. W. (2014). *The issues of policy implementation on solid*

waste management in Malaysia. researchgate.net. Retrieved from https://www.researchgate.net/publication/271085392_The_Issues_of_Policy_Implementation_on_Solid_Waste_Management_in_Malaysia

Nagapan, S., Rahman, I. A., Asmi, A., Memon, A. H., & Latif, I. (2012). Issues on construction waste: The need for Sustainable Waste Management. *2012 IEEE Colloquium on Humanities, Science and Engineering (CHUSER)*. https://doi.org/10.1109/chuser.2012.6504333

Nazerry, R. R., & Abdul, H. I. (2007). *Illigeal Dumping Site: Case Study in the District of Johor Bahru Tengah, Johor*. researchgate.net. Retrieved from https://www.researchgate.net/publication/277167507_Illigeal_Dumping_Site_Case_Study_in_the_District_of_Johor_Bahru_Tengah_Johor

Ng, L. S., Seow, T. W., & Goh, K. C. (2015). Implementation on solid waste reduction through 3R (NSWM policy) and elements to close gap between policy and contractors in construction industry in Penang. *International Journal of Environmental Science and Development, 6(9), 668–675.* Retrieved from https://doi.org/10.7763/ijesd.2015.v6.678

Ng, L. S., Tan, L. W., & Seow, T. W. (2017). Current practices of construction waste reduction through 3R practice among contractors in Malaysia: Case study in Penang. *IOP Conference Series: Materials Science and Engineering, 271, 012039.* Retrieved from https://doi.org/10.1088/1757-899x/271/1/012039

Power. (2010, December 1). Top plant: *Kajang waste-to-energy plant, Semenyih, Malaysia. POWER Magazine.* Retrieved from https://www.powermag.com/top-plantkajang-waste-to-energy-plant-semenyih-malaysia/

Rahman, M. S. (2016). The advantages and disadvantages of using qualitative and quantitative approaches and methods in language "Testing and assessment" research: A literature review. Journal of Education and Learning, 6(1), 102. https://doi.org/10.5539/jel.v6n1p102

Rahim, M. H., Kasim, N., Mohamed, I., Zainal, R., Sarpin, N., & Saikah, M. (2017). *Construction waste generation in Malaysia construction industry: Illegal dumping activities.* IOP Conference Series: Materials Science and Engineering, 271, 012040. https://doi.org/10.1088/1757- 899x/271/1/012040

Rajendra, Edward. (2021). *Five contractors nabbed for illegal dumping in Klang*. The Star. Retrieved from https://www.thestar.com.my/metro/metro-news/2021/04/08/five- contractors-nabbed-for-illegal-dumping-in-klang

Sakhare, V. D., & Patil, G. S. (2019). *CFD Flow Analysis of Station Pipeline - IRJET-international research ...* irjet.net. Retrieved from https://www.irjet.net/archives/V6/i11/IRJET-V6I1115.pdf

Samuels, P. (2020). *A really simple guide to Quantitative Data Analysis*. Researchgate.net. Retrieved from https://www.researchgate.net/publication/340838762_A_Really_Simple_Guideto_Quantitative_Data_Analysis

Shivaraj Subramaniam, S. S., Abd Halid Bin Abdullah, A. H., Sasitharan Nagapan, S. N., Kumanan Kupusamy, K. K., Haritharan Manian, H. M., & Zawawi Daud, Z. D. (2018). Investigate how construction waste generation rate is different for every

types of project in Peninsular Malaysia using site visit method. *International Journal of Integrated Engineering*, *10*(1). https://doi.org/10.30880/ijie.2018.10.01.022

Sreenivasan, J., Govindan, M., Chinnasami, M., & Kadiresu, I. (2012). Solid waste management in Malaysia – a move towards Sustainability. *Waste Management - An Integrated Vision*. https://doi.org/10.5772/50870

Tholibon, D. A., Md Nujid, M., Mokhtar, H., Rahim, J. A., Aziz, N. F., & Tarmizi, A. A. (2021). Relative importance index (RII) in ranking the factors of employer satisfaction towards Industrial Training Students. *International Journal of Asian Education*, *2*(4), 493–503. Retrieved from https://doi.org/10.46966/ijae.v2i4.187

Waste contractor fined RM13,000 for dumping waste in Putrajaya. EdgeProp.my (2020). Retrieved from https://www.edgeprop.my//content/1638261/waste-contractor-fined-rm13000-dumping-waste-putrajaya

Zahreen Mohd Arof, K., Ismail, S., & Latif Saleh, A. (2018). Contractor's performance appraisal system in the Malaysian construction industry: Current practice, perception and understanding. *International Journal of Engineering & Technology*, *7*(3.9), 46. https://doi.org/10.14419/ijet.v7i3.9.15272

Towards Zero Waste SG (Ministry of the Environment and Water Resources) (2020). *Zero Waste Masterplan Singapore*. Ministry of the Environment and Water Resources and National Environment Agency. Retrieved from https://www.towardszerowaste.gov.sg/files/zero-waste-masterplan-brochure.pdf

Received: 22nd Mar 2024. Accepted: 8th July 2024