UNIVERSITI TEKNOLOGI MARA Cawangan Perak

KUTAI

GRESAFE_CITIES
Green Safe Cities, Research Group

6th UNDERGRADUATE SEMINAR ON BUILT ENVIRONMENT AND TECHNOLOGY (USBET) 2023

SUSTAINABLE BUILT ENVIRONMENT

25 - 27 SEPTEMBER 2023

E-PROCEEDING

USBET 2023

e-Proceeding

6th UNDERGRADUATE SEMINAR ON BUILT ENVIRONMENT AND TECHNOLOGY (USBET) 2023

SUSTAINABLE BUILT ENVIRONMENT

Published by,
Department Of Built Environment Studies And Technology
Faculty Of Architecture, Planning & Surveying
Universiti Teknologi MARA Perak Branch, Seri Iskandar Campus
usbet.fspuperak@gmail.com

Copyright @ 2023
Department Of Built Environment Studies And Technology
Faculty Of Architecture, Planning & Surveying
Universiti Teknologi MARA Perak Branch, Seri Iskandar Campus

This work is subject to copyright. All rights are reserved by the Publisher. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording or any information storage and retrieval system without permission in writing from the copyright owners.

eISSN 2821-3076

02 October 2023 | Perak, Malaysia
Universiti Teknologi MARA, Perak Branch, Seri Iskandar Campus

EDITORIAL BOARD

Editors-in-Chief

SR. NORAZURA MIZAL AZZMI (BS)

NADIRA AHZAHAR (BS)

Editors

TS. ZURAIHANA AHMAD ZAWAWI (BS)

SR. NAZHATULZALKIS JAMALUDIN (BS)

SR. SITI ZUBAIDAH HASHIM (BS)

NURHIDAYAH SAMSUL RIZAL (BS)

SR DR. NURUL FADZILA ZAHARI (BS)

NUR FADHILAH BAHARDIN (BS)

SR TS. DR. ALIA ABDULLAH SALLEH (BS)

SR TS. DR. SURIANI NGAH WAHAB (BS)

SR TS. DR. HASNAN HASHIM (BS)

SR NOORAZLINA KAMARUZZAMAN (BS)

SR MARIATY MOHD BAHARI (BS)

SR AIDA AFFINA ABDUL GHANI (BS)

DR. NOR DIANA AZIZ (BS)

SR AMIR FASHA MAT ISA (BS)

SR DR. NOR AMIN MOHD RADZUAN (BS)

PROF. MADYA SR DR. MOHD FADZIL YASSIN (BS)

SR TS. KHAIRUL AMRI RAMLY (BS)

SR. MOHD ASRUL HASIN (BS)

SR TS. MOHD KHAZLI ASWAD KHALID (BS)

SR MOHD DZULKARNAEN SUDIRMAN (BS)

SR DR. IRWAN MOHAMAD ALI (BS)

SR DR. MOHAMMAD HASZIRUL MOHD HASHIM (BS)

DR NURHASYIMAH BT AHMAD ZAMRI (BCT)

DR. PUTERI YULIANA SAMSUDIN (TP)

Editors-in-Chief

6th Undergraduate Seminar on Built Environment and Technology 2023

- E- Proceedings-

Organized by,

College of Built Environment (KAB) UiTM Perak Branch

SMART WASTE SORTER CHUTE

Nur Syifaa Binti Hashim[1], Hasni Suryani Binti Mat Hasan[1*]

[1]Department of Built Environment Studies and Technology,
College of BuiltEnvironment,
University of Technology MARA, Perak Branch,
32610 Seri Iskandar, Perak, Malaysia

nsyifaashim@gmail.com, *hasnisuryaniuitm@gmail.com

ABSTRACT

High-rise buildings nowadays are a symbol of a country's rapid growth. The rapidly growing construction sector in Malaysia has produced numerous types of waste products that caused a negative impact on the environment and increased the amount of waste in landfills. The considerable volume of garbage produced during the construction of high-rise buildings makes waste management a crucial component of the project. Due to the lack of a systematic approach to managing construction waste, reducing waste as the building construction industry grew into what it is now became a significant environmental issue. The objectives of this innovation project are to identify the suitable method of waste management for high-rise building construction, propose sustainable element of waste chute in high-rise building construction, and determine the marketability of proposing sustainable waste chute in high-rise building construction in order to achieve the aim of this study which is, to develop an innovative product to manage waste in construction industry as sustainable waste management. The technology requires an expertise in order to provide the high-quality performance. Sustainable future may be brought by technological advancements, which help to protect the environment and conserve resources by reducing waste generation and improving resource efficiency.

Keywords: *High-rise buildings, Construction, Waste chute, Smart*

© 2023 USBET, JABT, UiTM Perak Branch, All rights reserved

INTRODUCTION

The Malaysian building construction sector has expanded quickly and significantly improved. Poor planning process may lead to unsustainable urban development processes, such as inefficient land usage, pollution, and waste generation, and government involvement is required to fix the causes of strong and inefficient (Mohammed et al., 2020). Hence, this study attempts to develop an innovative product to manage waste in construction industry as sustainable waste management.

The construction industry is regarded as an important economic driver in an economy due to its significant contribution to the gross national product as well as employment and business chances. Although the construction industry is one of the biggest pollutants, it also has problems in minimising the production of construction waste. Waste management in the construction sector is a necessary initiative to minimize the intensity of environmental harm caused by wastes and the rate at which they are produced, which is disproportionately expanding faster than urbanisation. The construction industry has a significant environmental impact because of the strong demand for big infrastructure projects, housing, and commercial buildings, which generate large amounts of construction waste (Lachimpadi et al., 2012).

Sustainable Development Goal (SDG) act as an outline for national policies, strategies, and initiatives in Malaysia to promote sustainable development. Smart Sorter Waste Chute aligned with SDG9 which is Industry, Innovation, and Infrastructure by providing an effective and safe way to dispose of construction waste and other materials on construction sites or in urban area since the chute already sort the wastes into its category.

LITERATURE REVIEW

Overview of Waste

Depending on who defines it, waste is garbage, rubbish, discards, or junk. Engineers define this waste as garbage discarded from the residential and commercial sectors (Khan et al., 2022). The intensive growth of construction and the revival of industry caused increasing of emissions of all kinds of waste including industrial, agricultural and domestic origin as shown in Figure 1.

Figure 1: The Origin of Waste (Rajangu et al., 2019)

Mining Waste

Due to the significant increase in population and the rising demand for natural resources globally, mining activity has significantly increased (Aznar-Sánchez et al., 2018). According to Tayebi-Khorami et al., (2019), mining operations generate large volumes of mining waste each year. The most frequent types of waste produced during mineral extraction are tailings, waste rock, slag, and tail ends, while under some conditions vegetation and overburden may also be regarded as waste (Aznar-Sánchez et al., 2018). Tayebi-Khorami et al., (2019) stated greater quantities of tailings per tonne of product and an increase in the fines content of the tailings are both results of mining lower grade and/or complicated ores.

Agriculture Waste

Agriculture is one of the major biological industries and produces the most biomass, which makes it an essential part of the bioeconomy (Duque-Acevedo et al., 2020). Organic wastes include animal composts, crop residues, food wastes, municipal biosolids, and waste from some industries. Organic wastes are generally results of agricultural, industrial, or municipal activity and are typically referred to as "wastes" because they are not the main product (Westerman & Bicudo, 2005). (Martins et al., 2022) believed that the forestry aspects of the production supply chain are similar to those of the textile, metallurgical, ceramic, and glass sectors, among others. Other than the forestry process, there are other leftovers from different types of wood processing.

Industrial Waste

Arockiam JeyaSundar et al., (2020) expressed waste is produced through procedures including raw material extraction, intermediate or final product processing, final product consumption, and other human activities. He also explained industrial waste is created throughout the manufacturing process and includes sludges, product residues, slags, and ashes by three industries—metallurgy, nonmetal lurgy, and food processing. Non-hazardous industrial waste is the by-product of industrial activity that

doesn't endanger the public's health or the environment. the surroundings, such as cardboard, plastic, metals, and glass likewise organic waste. Contrarily, hazardous waste is a by-product of industrial activity that poses a risk to the public such as combustible, corrosive, or harmful to the environment poisonous and active materials waste's qualities (Millati et al., 2019).

Household and Commercial Waste

Domestic waste and certain commercial waste are the majority of what is referred to as "municipal solid waste" (MSW). Domestic activities including cooking, sweeping, cleaning, burning fuel, making repairs, and gardening produce garbage that is referred to as household waste. It also includes discarded items and materials like outdated apparel, furniture, appliances, glass, old metal packaging, old books, and old newspapers (Viljoen et al., 2021). Besides that, medical waste and pharmaceutical agents are the examples of materials that are included in MSW (Daniels & Priefer, 2020). Wang et al. (2020) believed that 75% of the trash generated by hospitals are considered to be general health care wastes, with the remaining 25% being classified as hazardous infectious wastes.

Construction and Demolition Waste

Construction waste is generated in two times the amount than demolition debris is. In a developing nation, excessive demolition projects will result in an excessive amount of demolition waste, and the impact of this waste will undoubtedly be more severe than the impact of construction waste (Wong and Roslan, 2019). Aslam et al., (2020) believed the construction and demolition waste (CDW) is regarded to be the most critical problem in the building industry because economic and environmental factors. (López Ruiz et al., 2020) agreed with the statement due to the rising amount of waste being created and the effects it has on the environment, CDW is a significant concern for the construction industry consisting of buildings, bridges, and other civil engineering projects such as concrete, wood, plastics, glass and rock from clearing sites are frequently found in construction waste products.

Wastewater Treatment Waste

Whether a wastewater discharge comes from a municipality or an industry determines its categorisation. Chemical, physical, and biological characteristics can be used to characterise wastewater quality. Some wastewater discharges affect organisms toxically, depending on their constituents. Hossain et al., (2020) claimed wastewater treatment incurring low-cost and low-energy investment is desired. The authors added many conventional and high-tech approaches have been practiced treating wastewater. The majority of treatment procedures, whether for water or wastewater, include coagulation and flocculation stages as integral parts of the procedure.

Issues on The Waste of High-Rise Building Construction

Rapid economic growth, urbanisation, and population growth have led to an increase in the consumption of (materially intensive) resources and, as a result, in the release of significant volumes of waste into the environment. Construction companies continue to find high-rise structures appealing because of their significant presence in the built environment and due to their height, clarity, and dominance over other landscape features, high-rise structures have a special significance and visible feature (Al-Janabi et al., 2021).

Waste storage capacity on high-rise construction sites is frequently limited, especially in highly populated urban regions. It might be difficult to locate sufficient storage for various waste category such as inert or non-inert waste. In addition, wasted materials from the construction phase has a negative effect on the environment and project cost. High-rise construction projects usually take place in urban environments, where noise and disturbances may leave a negative effect on surrounding properties, companies, and inhabitants. If the construction waste is not handled in a timely manner, it will have a significant impact on the whole building construction schedule.

According to Hasmori et al., (2020), the most typical method of handling construction waste in Malaysia is to dispose of it at landfill sites. The mismanagement of construction waste was caused by inability to adopt effective waste management by the contractors. The common types of construction waste usually found at site is concrete, bricks, tiles, cement, and metallic waste. Also, the existing of the waste chute cannot sorting the waste or material resulting it bulking at the final chute or blockages. From all the issues above, the idea of Smart Sorter Waste Chute was developed due to the issue on construction to achieve sustainable management in the construction industry.

MATERIALS AND METHOD

Literature Review

The literature review is a common method used for analysed and observed published articles or journals with different opinion of researchers through numerous websites such as SpringerLink, ScienceDirect, and etc enhancing the credibility of proposed innovation product. Data for this study was gathered by scanning a numerous of articles of construction wastes, issues and effects of construction wastes to the surrounding. The articles of the management of construction wastes on site, the waste management hierarchy were reviewed to collect more data and information about construction waste including 3R concept, “Reduce, Reuse, and Recycle,” which are widely promoted as a way to minimize waste generation and promote sustainable practices.

Design thinking

Design thinking is an approach to working and thinking that goes beyond the field of design. This method used for tackling vague problems by using techniques and viewpoints normally associated with developers, adapting them to actual situations, and adopting a human-centred and prototype-driven approach. The idea of this waste chute innovation develops within this design thinking based on the issue of waste construction on high-rise building site. The waste chute idea was developed after observing the problems and lack of technology innovation used in managed the waste of high-rise building construction.

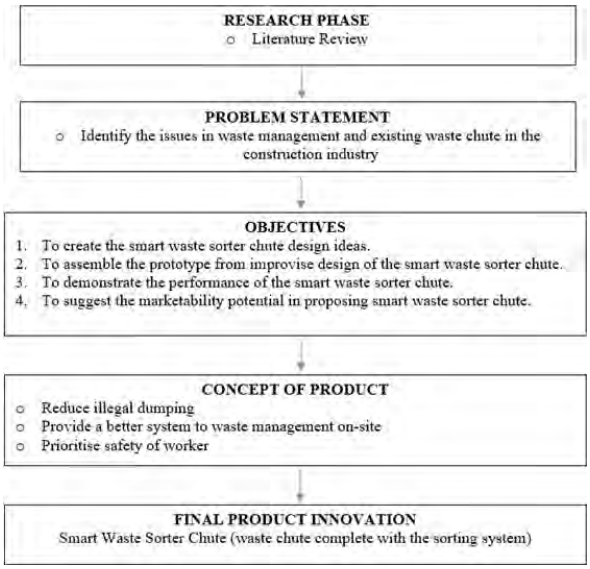


Figure 2: Framework idea of innovation product

Simulation

Simulation used in this study is a 3D model which can be produced using sets of single or many images that are produced by optical image-based sensors when properly merged. This method can produce precise, thorough, realistic 3D models, but many steps in the procedure are still done manually or semi-manually.

Desk Study

A desk study involves conducting research and compiling relevant information regarding current technology, industry standards, and other aspects of smart waste management of high-rise building construction. The waste chutes been investigated and analysed by other country implementation and the actual performance. The data also collected by reviewing the various innovations approach in waste construction management including normal construction and high-rise building construction.

RESULT AND FINDINGS

The amount or composition of construction waste are always changing due to the rapid growth of construction activities. This makes it challenging to measure various construction waste materials precisely. This innovation idea was inspired by the concept of domestic waste chute, which discharge domestic waste from the residential level directly to the ground level and separate the waste into dry and wet waste (Figure 3). The creation of this waste chute sorting the inert and non-inert waste simplify the waste management in the construction industry. The additional equipment or material as the innovation or improvise from the existing product presented in Figure 4.

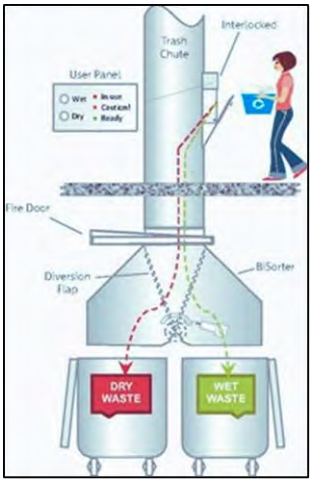


Figure 3: Existing Domestic Waste Chute (Sangir, 2022)

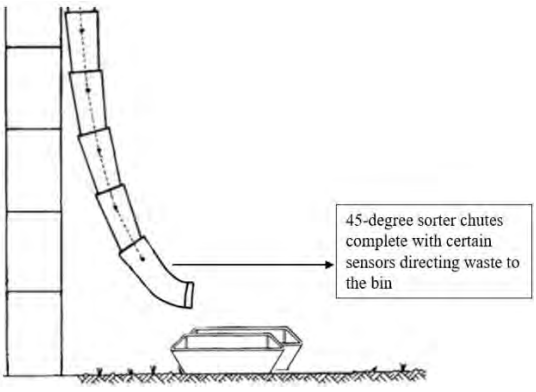


Figure 4: Visualisation of Smart Waste Sorter Chute

Proposed Materials and Component of the Smart Waste Chute

Chute

The chute consisting three types of sections which is chute section, hopper section and sorter section. The proposed material for these sections is high-density Polyethylene (HDPE). This material is suitable for the proposed chute as it is the most stiffness and least flexibility passing the construction waste through it. Apart from that, the HDPE capable reducing noise of the waste process through the chute. HDPE is proving to be a valuable material as we work to create a more sustainable society, contributing significantly to the development of various sectors and supporting sustainability goals.

Chains

Chain as a supporter or securing the connections body chutes one another and sorter section are made from material stainless steel that are suitable with demanding environment in construction site such as exposure to moisture and extreme temperatures. In addition to strength and durability appropriate for the chute, this material offers outstanding corrosion resistance to provide long-lasting functioning without the need for extra protective coatings or routine maintenance. This material also known as sustainable material with the ability to be recycled repeatedly without losing its qualities.

Fixing Frame for Chute

Fixing frame are used as attached the chutes in one place giving the chute system stability, strength, and the right alignment. The framing is made of stainless steel where excellent in corrosion resistance even it exposed to moisture, chemicals, or other corrosive materials compared to galvanised steel. The framing designed improves the waste chute safety by reducing the possibility of accidents or equipment damage. The fixing frame strengthen by welding or bolting the frame together with slab or scaffolding.

Arduino Uno Microcontroller Board

The preferred component for the innovation of waste chute is Arduino, an open-source electronics platform based on the Microchip ATmega328P. It is the foundation of the open-source Arduino Uno microcontroller board which linking with other sensors used in this innovation waste chute. This board offers advanced features including wireless connection, motor control, and sensor integration with the programming code to the board controlling the other components work well in sorter section.

Figure 5: Arduino Uno Ultrasonic Sensors

Ultrasonic sensors work based on the reflection of high-frequency sound waves. They emit ultrasonic waves and measure the time taken for the waves to bounce back from objects. It is suitable for the Waste Chute because ultrasonic sensor capable identify items in a dusty or dirty environment like construction site since they send these sound waves in a wider range than a capacitive sensor does.

Servo Motor

The direction and flow of materials can be precisely and easily controlled by integrating a servo motor into a chute system. The servo motor may dynamically modify the position of the chute sorter outlet by receiving control signals from a microcontroller board, ensuring that the waste directing into correct bin. In order to set the right position, the servo motor can be set to alter the angle of the chute outlet to redirect the waste to specified bin.

Simulation on Assembling of Smart Waste Sorter Chute

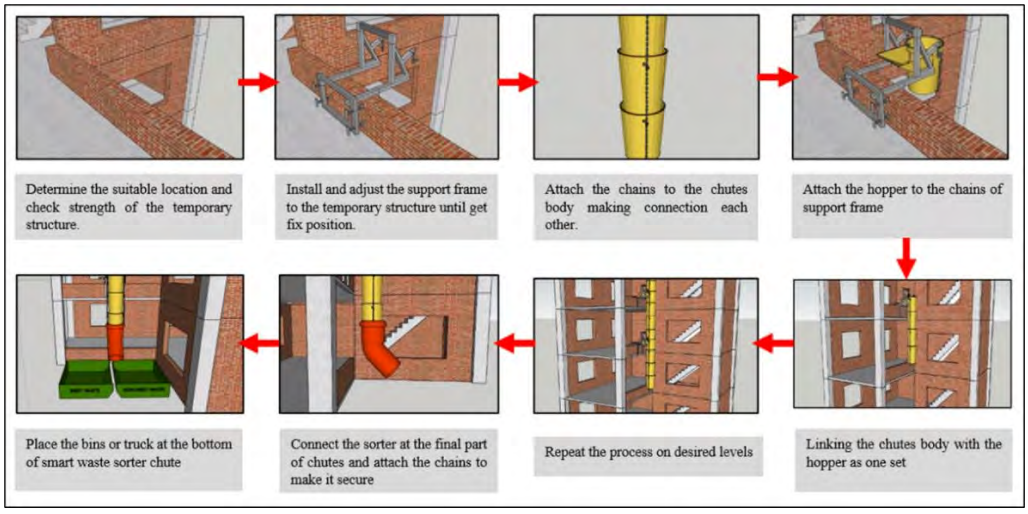


Figure 6: Assembling procedures of Smart Sorter Waste Chute

Operational Procedure of Smart Waste Sorter Chute

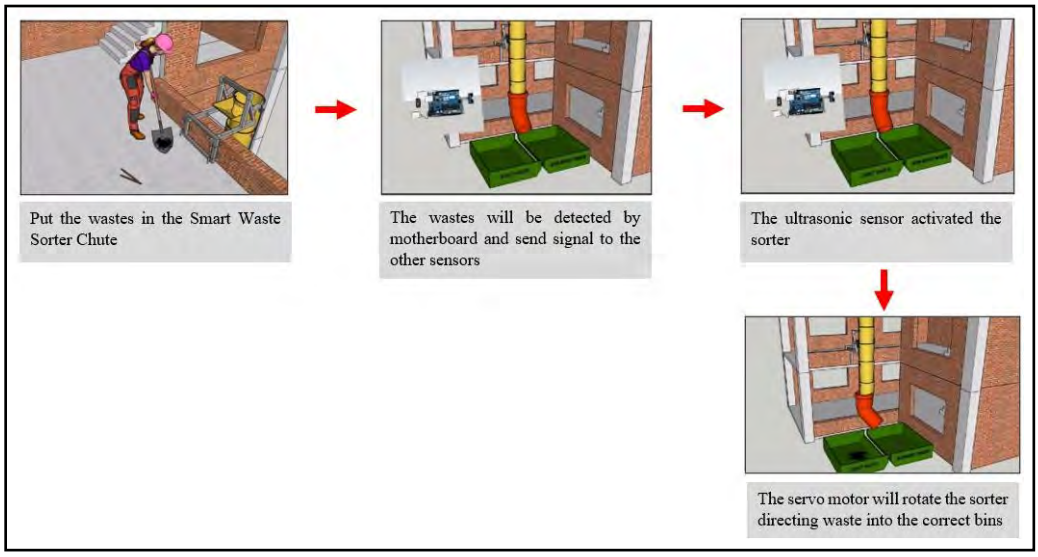
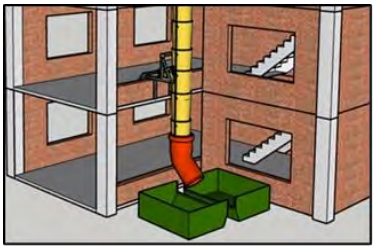


Figure 7: Simulation on Operational Procedure of Smart Waste Sorter Chute

Comparison Between Previous Chute and Smart Waste Sorter Chute

There are a few comparisons in term of features and performance of the existing waste chute and smart waste sorter chute. All of the comparison are as table 1 below

Table 1 : Feature of performance between Standard Chute and Smart Waste SorterChute

Feature	Standard Chute	Smart Waste Sorter Chute
		
Waste Sorting	Manually	Automatically with sensors
Efficiency	Not efficient	More efficient

Environmental Impact	May harmful	Less harmful
Cost	Less expensive	More expensive

- Waste Sorting

  Waste sorting is an important procedure that involves classifying various waste products into groups by manually or automatically. The objectives of this approach are to maximise resource recovery and reduce the negative effects of waste disposal on the environments. Identification, separation, and collection of inert waste and non-inert waste kinds are steps in the waste sorting process. The contractor or employees will supply the trucks or bins with labels for the different waste classifications.

- Efficiency

  Efficiency in a smart debris chute requires simplifying the waste disposal procedure in order to save resources, time, and labour. Waste flowing through the chute continuously and without interruption to minimise clogging or blockages. The debris chute's size and capacity also affect how effectively it works. A smart debris chute should be able to hold enough waste to handle the level of waste that is expected to be produced during construction. With the ability to endure the weight and impact of the waste being disposed of, a smart debris chute should be strong and long-lasting. Additionally, it should be simple assembled and disassembled to minimise time consuming and effective application.

- Environmental Impact

  Smart Waste Sorter Chute seeks increasing productivity while minimising the harmful environmental effects of waste disposal. The reduction of noise and air pollution is one part of the environmental impact performance. Standard chutes frequently produce noise and pollution emissions when moving and processing waste. This innovation chute lowering noise pollution and air pollutants. The entire environmental impact of waste removal is reduced by offering an instant and effective disposal route. Additionally, using a smart debris chute assists in preventing waste from spreading and harming the environment.

- Cost

  When assessing a smart waste chute's efficiency in waste management operations, its cost performance is a crucial aspect to take into account. The cost of a smart debris chute takes into account a number of elements connected to its

design, installation, use, and maintenance. The cost may around the range RM 5000 to RM 10 000 as the cost depends on the chute's size, capacity, material quality, any additional features, and any cutting-edge technology included in the design. Additionally, the costs also count features like automated mechanisms and sensors that improve functionality and efficiency

Marketability Potential of Smart Waste Sorter Chute

A Smart Waste Sorter Chute is an innovative product made to increase the effectiveness and sustainable of waste disposal in high-rise buildings and construction sites. It combines a number of technical features to automate managing waste and decrease manual labour. This innovative device promotes productivity while reducing potential hazards by combining innovative technology with traditional waste chutes.

Smart Waste Sorter Chute may suitable for firms or organisation which seeking for eco-friendly waste management solutions as the importance of sustainability develops. The organisations that looking for innovation, and city planners looking to improve urban infrastructure because of its seamless integration into current construction processes and its significant impact on safety, efficiency, and environmental responsibility. This product encourages disposal and waste sorting, which is in line with these sustainability objectives. Adopting the smart waste chute gives organisations a clear benefit over rivals, which makes it appealing to organisations that desire to stay ahead in a field that continues to evolve quickly while keeping a focus on environmentally operations and employee wellbeing.

CONCLUSION

Effective management of waste generate during construction becomes essential for the global sustainability agenda since it contributes significant amounts of waste to landfills. In order to better understand the way innovative technology can significantly reduce waste generation, increase resource efficiency, and encourage sustainable practises in the construction industry, this research project examines new techniques of disposal waste consisting of waste sorting methods and product simulation. According to the product development and operation, Smart Waste Sorter Chute indicates an important step forward for effective and sustainable waste management techniques which bring advantages for both the construction industry and the environment. The smart chute use sensors, information processing, and automation to optimise waste disposal procedures. These chutes will be directing waste to the appropriate bins by automatically detecting, and sorting waste materials such as inert and non-inert waste category. This simplifies the waste management procedure, limits the amount of mixed waste that must be disposal or transport and lowers the possibility of contamination.

ACKNOWLEDGEMENT

Alhamdulillah, first and foremost, I am thankful to Allah SWT for his blessing giving me opportunity, strength and ability to complete this Innovation Project II (BCT654) in my last year of degree despite the fact I had a lot of difficulties while working on this project. I would like to express my appreciation to my supervisor, Dr. Hasni Suryani Mat Hasan, as well as the lecturer who were involved, Dr. Asmat Ismail, for the support and guidance while I completed my research project, which was a mentally and physically challenging for me. I would want to convey my gratitude to my parents andfamily, who have never stopped providing me their encouragement and dedication in order to lift my spirits not just while accomplishing this project but throughout my whole studies to seeing I succeed in life.

REFERENCES

Al-Janabi, I., Al-Kubaisi, M. A., & Weli, S. S. (2021). *High Rise Buildings: Design, Analysis, and Safety: An Overview*. *8*, 1–13. https://doi.org/10.15377/2409-9821.2021.08.1

Arockiam JeyaSundar, P. G. S., Ali, A., Guo, di, & Zhang, Z. (2020). 6—Waste treatment approaches for environmental sustainability. In P. Chowdhary, A. Raj, D. Verma, & Y. Akhter (Eds.), *Microorganisms for Sustainable Environment and Health* (pp. 119–135). Elsevier. https://doi.org/10.1016/B978-0-12-819001-2.00006-1

Aznar-Sánchez, J. A., García-Gómez, J. J., Velasco-Muñoz, J. F., & Carretero-Gómez, A. (2018). Mining Waste and Its Sustainable Management: Advances in Worldwide Research. *Minerals*, *8*(7), Article 7. https://doi.org/10.3390/min8070284

Daniels, M., & Priefer, R. (2020). Medical Waste Proper Disposal and Techniques—A Review of Multiple Devices. *Medical Research Archives*, *8*(12). https://doi.org/10.18103/mra.v8i12.2266

Duque-Acevedo, M., Belmonte-Ureña, L. J., Cortés-García, F. J., & Camacho- Ferre, F. (2020). Agricultural waste: Review of the evolution, approaches and perspectives on alternative uses. *Global Ecology and Conservation*, *22*, e00902.

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

Hossain, N., Bhuiyan, M. A., Pramanik, B. K., Nizamuddin, S., & Griffin, G. (2020). Waste materials for wastewater treatment and waste adsorbents for biofueland cement supplement applications: A critical review. *Journal of Cleaner Production*, *255*, 120261. https://doi.org/10.1016/j.jclepro.2020.120261

Lachimpadi, S. K., Pereira, J. J., Taha, M. R., & Mokhtar, M. (2012). Construction waste minimisation comparing conventional and precast construction (Mixed System and IBS) methods in high-rise buildings: A Malaysia case study. *Resources, Conservation and Recycling*, *68*, 96–103. https://doi.org/10.1016/j.resconrec.2012.08.011

Martins, J., Haider, S. A., Pereira, J., Mata, N. N., & Abreu, A. (2022). *Innovation Management on Waste Biorefineries* (pp. 915–932). https://doi.org/10.1007/978-3-031-06562-0_36

Mohammed, M., Shafiq, N., Abdallah, N. A. W., Ayoub, M., & Haruna, A. (2020). A review on achieving sustainable construction waste management through application of 3R (reduction, reuse, recycling): A lifecycle approach. *IOP Conference Series: Earth and Environmental Science*, *476*(1), 012010. https://doi.org/10.1088/1755-1315/476/1/012010

Millati, R., Cahyono, R. B., Ariyanto, T., Azzahrani, I. N., Putri, R. U., & Taherzadeh, M. J. (2019). Chapter 1 - Agricultural, Industrial, Municipal, and Forest Wastes: An Overview. In M. J. Taherzadeh, K. Bolton, J. Wong, & A. Pandey (Eds.), *Sustainable Resource Recovery and Zero Waste Approaches* (pp. 1–22). Elsevier. https://doi.org/10.1016/B978-0-444-64200-4.00001-3

Tayebi-Khorami, M., Edraki, M., Corder, G., & Golev, A. (2019). Re-Thinking Mining Waste through an Integrative Approach Led by Circular Economy Aspirations. *Minerals*, *9*(5), Article 5. https://doi.org/10.3390/min9050286

Umar, U. A., Shafiq, N., Malakahmad, A., Nuruddin, M. F., & Khamidi, M. F. (2017). A review on adoption of novel techniques in construction waste management and policy. *Journal of Material Cycles and Waste Management*, *19*(4), 1361–1373. https://doi.org/10.1007/s10163-016-0534-8

Westerman, P. W., & Bicudo, J. R. (2005). Management considerations for organic waste use in agriculture. *Bioresource Technology*, *96*(2), 215–221. https://doi.org/10.1016/j.biortech.2004.05.011

Pejabat Perpustakaan
Librarian Office

Universiti Teknologi MARA
Cawangan Perak
Kampus Seri Iskandar
32610 Bandar Baru Seri Iskandar,
Perak Darul Ridzuan, MALAYSIA
Tel: (+605) 374 2093/2453 Faks: (+605) 374 2299

UNIVERSITI TEKNOLOGI MARA

Surat kami : 700-KPK (PRP.UP.1/20/1)
Tarikh : 20 Januari 2023

UNIVERSITI TEKNOLOGI MARA PERAK
TERIMA
25 JAN 2023
Tindakan
Universiti Teknologi MARA Perak
PEJABAT REKTOR

Prof. Madya Dr. Nur Hisham Ibrahim
Rektor
Universiti Teknologi MARA
Cawangan Perak

Tuan,

PERMOHONAN KELULUSAN MEMUAT NAIK PENERBITAN UiTM CAWANGAN PERAK MELALUI REPOSITORI INSTITUSI UiTM (IR)

Perkara di atas adalah dirujuk.

2. Adalah dimaklumkan bahawa pihak kami ingin memohon kelulusan tuan untuk mengimbas (*digitize*) dan memuat naik semua jenis penerbitan di bawah UiTM Cawangan Perak melalui Repositori Institusi UiTM, PTAR.

3. Tujuan permohonan ini adalah bagi membolehkan akses yang lebih meluas oleh pengguna perpustakaan terhadap semua maklumat yang terkandung di dalam penerbitan melalui laman Web PTAR UiTM Cawangan Perak.

Kelulusan daripada pihak tuan dalam perkara ini amat dihargai.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menjalankan amanah,

SITI BASRIYAH SHAIK BAHARUDIN
Timbalan Ketua Pustakawan

nar

Setuju.

27.1.2023

PROF. MADYA DR. NUR HISHAM IBRAHIM
REKTOR
UNIVERSITI TEKNOLOGI MARA
CAWANGAN PERAK
KAMPUS SERI ISKANDAR