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

PNEUMATIC MAILBOX SYSTEM (PMS) FOR HIGH-RISE BUILDING

Shazlinda Atirah Nordin[1], Raja Nurulhaiza Raja Nhari[1*]

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

athirah@gmail.com, *rajanurulhaiza@uitm.edu.my

ABSTRACT

The fluctuating nature of package shipments makes it difficult for structures to anticipate residents' package locker requirements. Possible causes include the lack of locker capacity in high-rise buildings and the impracticality of contemporary courier services in high-rise buildings due to door-to-door delivery, which wastes time and money-making multiple efforts at delivery. In Malaysia, package management is currently full of outdated practices and inconveniences. The goal of this design idea is to facilitate and upgrade courier services in high-rise buildings. The objective of this research is to develop Pneumatic Mailbox System design ideas, to assembly the simulation from improvised design of the Pneumatic Mailbox System, to demonstrate the performance of Pneumatic Mailbox System and to demonstrate entrepreneurial skill in proposing Pneumatic Mailbox System simulation which can be marketable. The data collection for this research was qualitative research which consisted of a document review, literature review, design thinking method, and 3D simulation. The Pneumatic Mailbox System comprises seven (7) components and materials. The Pneumatic Mailbox System exhibits the capability to be implemented on both pre-existing and newly constructed buildings owing to its minimal maintenance demands during installation. Several recommendations for the future endeavours of fellow researchers are to enhance the capabilities of the Pneumatic Mailbox System, to develop a functional prototype of Pneumatic Mailbox System and others.

Keywords: *Courier services, High-rise building, Malaysia, Package, Pneumatic Mailbox System*

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

INTRODUCTION

Mechanical transportation such as elevators is an important facility in the structure of high-rise buildings that exceed 4 floors to facilitate the resident to move to other floors. The elevator system's efficiency and effectiveness affect its life cycle cost and user safety. Incorrect elevator system maintenance can create corroded and fractured steel wire rope, which can cause accidents (Siti et al., 2018). Damage to the elevator in the building may disrupt the routines of the people who live there. Maintenance must be performed consistently to guarantee that the elevator is in good working order and to prevent any damage to the elevator. The application of any modern technology is guaranteed to be fraught with difficulties and obstacles. The occurrence of the problem might be attributed to several different circumstances. The proliferation of technology, as seen in the phenomena of online shopping that is prevalent in today's society, brings up a number of concerns for people. Impractical deliveries, such as those made door-to-door delivery which use a mechanical transportation system like an elevator or those made delivery packages at locker on the ground floor can result in a number of contributing factors to the problem.

The fluctuating nature of package shipments makes it difficult for structures to anticipate residents package locker requirements. No apartment complex can afford to accommodate the constant installation of extra lockers to accommodate cyclical changes in storage needs (Fox, 2022). Problems with package delivery included packages being misplaced or never arriving, incorrect addresses being given, and lockers being overflowing with packages (Sangani, 2022). This can result in large amounts of packages piling up in lockers or lobbies of high-rise buildings, as well as disturbing other residents and affecting the cleanliness of the building. After the nationwide outbreak of covid-19, some high-rise buildings instituted policies prohibiting couriers from making deliveries straight to residents' homes in an effort to stop the spread of the virus. No delivery people from a courier company are permitted to enter the apartments of a tiered residential complex (Bailand, 2021).

In order to ensure the solution is beneficial to everyone concerned, several issues were investigated and examined before it was implemented. The problem comes when the courier services wish to deliver the package to the customers, but the customers are not present to receive the package. Consequently, the courier services are unable to deliver the package (Turská & Madleňáková, 2019). Possible causes include the lack of locker capacity in high-rise buildings and the impracticality of contemporary courier services in high-rise buildings due to door-to-door delivery, which wastes time and money-making multiple efforts at delivery. From the customer's side, there are also problems, like missing or broken items in the package, couriers have to deal with unhappy customers or replace stolen packages. Therefore, the goal of this design ideas is to facilitate and upgrade courier services, as well as to provide a solution for problems that arise with courier services in high-risebuildings.

The 2030 Agenda for Sustainable Development Goals presents a worldwide framework for the present and future dignity, peace, and prosperity of people and the planet, the SDGs that are related to the Pneumatic Mailbox System are SDG 7: Affordable and clean energy, SDG 9: Industry, innovation and infrastructure and SDG 11: Sustainable cities and communities. In order to contribute to a more sustainable environment, the innovation project uses a solar energy system to power the device. Both global warming and carbon footprints can be mitigated, thanks to this innovation which eliminates the need for direct electricity consumption. Aside from that, the innovation project makes use of materials that are safe for the environment and components that are resistant to rust in order to meet the criteria for a green product. When these components are incorporated into innovation projects, the environment has the potential to become better and safer.

LITERATURE REVIEW

Previous research on Pneumatic Mail System (PMS)

In 1893, Philadelphia became the destination of the world's first mail delivery system using pneumatic tubes. In 1897, the first pneumatic in New York City was developed. The average speed of the mail in each tube was 30.5 miles per hour, and it could hold 400 to 600 letters. Pneumatic tubes extended for a total of 27 miles, linking 23 different post offices. This network reached all the way along the east and west sides of Manhattan, from Bowling Green and Wall Street to Manhattanville and East Harlem in the north (Young, 2021).

The canisters or carriers that carried the letters would leave the Post Office every 10 minutes and fly underneath the city streets, through a well-greased tube at 30 miles an hour. Even in a heavy snowstorm, a message from Times Square could be delivered to the General Post Office in three minutes (Farman, 2018). The utilization of air pressure by Pneumatic Tube Systems allows for the movement of cylinder-shaped carriers from one end of a tube to the other (Vukolov, 2019). The tubes' interior diameter was eight and one-eighth inches, and they were fabricated from cast iron (Budds, 2018). Assuming a double-tube setup, this diameter could carry 200,000 letters each hour.

The 95,000 carriers were cylindrical steel tubes that looked like artillery projectiles or torpedoes (Budds, 2018). The dimensions of the carrier were 24 inches in length, 8 inches in width, and 21 pounds in total mass. Doors on both ends are locked securely using a cam mechanism. If the end doors were not secured, the carrier could not be loaded into the sending unit and sent down the tube. Power plants with electric motor-driven positive rotary blowers and reciprocating air compressors maintained a pressure of 3-8 psi. Although the carriers were capable of speeds of up to 100 mph, they were limited to 30 MP due to the numerous twists (*Chicago, the Great Central*

Market, 1905). Figure 1 show the pneumatic tubes were placed in the basement facilities of post offices.

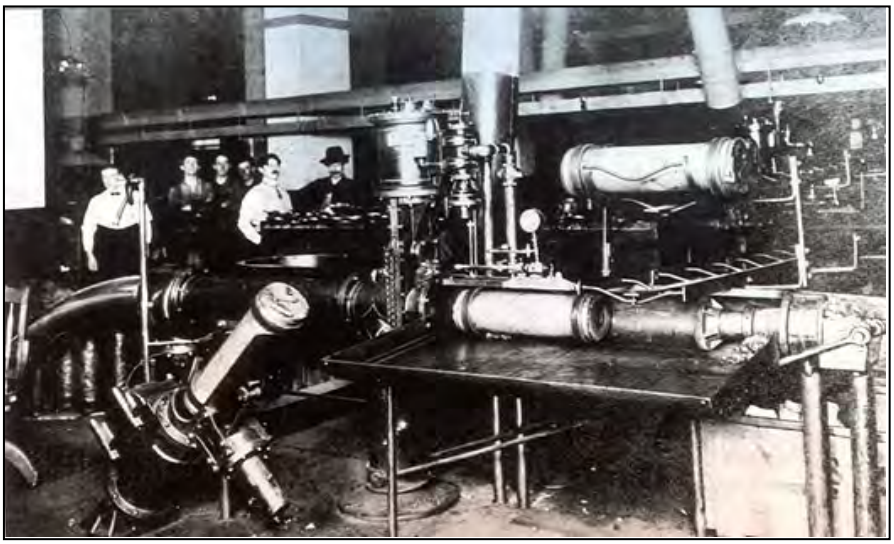

Figure 1: Pneumatic tubes were placed in the basement facilities of postoffices

Current system management issues on courier service in Malaysia

In Malaysia, package management is currently full of outdated practices and inconveniences, as there is no evidence of innovation in the application of the technology used for courier services in any of the country's high-rise buildings. Residents of high-rise buildings frequently use package lockers to facilitate courier delivery. Locker capacity may be inadequate if there are many packages delivered. Package lockers are included as a last delivery option because it give customers control over the delivery process, from choosing the date and time to the speed and destination of the courier to the outcome of the delivery (Keen et al., 2022).

Current system management issues on courier service worldwide

In New York, the number of packages that are delivered to Murray Hill's New York Tower increases to between 400 and 500 on a daily basis. New York Tower has an online communication system that scans incoming packages and notifies the residents to pick up packages at the building reception; however, during this year, the system might become backed up (Zimmer, 2016). The building is contemplating hiring seasonal workers to assist with the receipt and organization of all the goods, and it may expand its package room to accommodate the boxes in the future (Zimmer, 2016).

In a country like Korea and Iran have used a door-to-door delivery system for high-rise buildings. It has been 50 years since Iran used the door-to-door delivery system,

but it still cannot provide a smooth and stable service for all cities in the country (Bahrami et al., 2016). The fast expansion of courier services has caused some significant obstacles since about 60% of all citizens live in high-rise residential buildings (Yoo & Park, 2013). Door-to-door delivery can waste time and energy because the package courier must use an elevator to carry packages that are typically heavier than people (Yoo & Park, 2013). The elevator system accounts for 5-15% of a building's overall energy use on average (Al-Sharif et al., 2004)

The Internet of Things (IoT) is a revolutionary concept that brings together various intelligent frameworks, framework components, intelligent devices, and sensors (Kumar et al., 2019). In Singapore, using smart mailbox has been one of the most innovative and promising solutions for last-mile courier service providers in several Asian countries (Tsai & Tiwasing, 2021). The first to try out a smart mailbox systemare residents of Block 202 Clementi Avenue 6. Residents will no longer need to checkin regularly to see if packages or letters have come because residents will be notified immediately by phone (Tay, 2020). As an alternative without using a key to open the mailbox, residents can use the Sing Post application to generate a Quick Response code that can be scanned to access the mailbox. Mailbox delivery notifications, viewing the number of things waiting for pickup, and granting access to others to get packages or letters on the user's behalf are all features available through the app (Tay, 2020).

Significance of Pneumatic Tube System/Pneumatic Mailbox System

Industries such as the chemical, pharmaceutical, and food sectors all make extensive use of Pneumatic Tube System (Levy, 2001). A Pneumatic Tube System has the benefit over other methods in transporting a bulk particle material because the pipeline can be routed in a variety of ways (Levy, 2001) . The enclosed nature of the conveying and the simplicity of the pipeline privilege that may be routed through the facility have led to its widespread adoption, even though the running costs of such systems can be higher than those of many mechanical conveyors (Knight et al., 2002). Furthermore, several new uses and challenges for the product were considered.

A Pneumatic Tube System moves bulk items slowly through a tiny pipeline. It's simple to maintain. It reduces waste and operator risk. The pneumatically propelled pipe transfers materials in an environmentally and worker-safe environment. Utilizing a system that is pneumatic comes with a great deal of benefits. When moving things from one place to another, a Pneumatic Tube System saves time. In addition, installing and adapting a Pneumatic Tube System is simple. It handles various materials without structural support. It can also handle abrasive and friable materials due to its low material-to-air ratio. Since Pneumatic Tube System can cover more than one level, it is easier to move things up and down floors, which can be hard on the human when done by hand.

The innovation of the Pneumatic Tube System to the PMS had achieve SDG 9, which is industry innovation and infrastructure. Foster economic growth and human flourishing by investing in infrastructure that is both locally and globally accessible, cheap, sustainable, and resilient. Increase the industrial sector's contribution to employment and GDP in line with national circumstances by 2030 and increase it by double in the least developed countries. This should include increased resource-use efficiency as well as greater adoption of environmentally friendly technologies and manufacturing processes.

The subsequent step is the implementation of the Pneumatic Tube System, which makes management more effective, efficient, and methodical in areas in which it has already attained its objectives under SDG 11. Making cities safe and sustainable entails providing safe and cheap housing as well as improving slum communities. It also entails investing in public transportation, establishing green public areas, and promoting participatory and inclusive urban planning and management.

The relationship between previous and current study that leads to PMS innovation

An innovative courier services system has been developed, which leverages the pre-existing infrastructure of elevators to facilitate the loading and automated transportation of packages to specifically assigned floors. PMS is an innovative mailbox solution that employs a pneumatic system to effectively address the demands of modern technology. Research has been conducted on issues related to mechanical transportation because one of the benefits of PMS is the reduction of its usage in high-rise buildings. Several previous research have yieldeddiverse findings pertaining to the management of courier services in high-rise buildingin Malaysia and worldwide. Furthermore, the research results indicate that a range ofinterventions have been implemented on mailboxes, both historical and contemporary. These interventions include the adoption of gravity mailboxes, mailboxes with Internet of Things (IoT) technology, and pneumatic mail systems employing pneumatic tube networks. Thus, research served as a catalyst for the development of a PMS innovation, specifically the implementation of a Pneumatic Tube System.

This research introduces a novel approach to tackle the growing need for home delivery by proposing a new courier service system and evaluating its benefits and viability compared to current elevator systems. One additional limitation of this research is the authors' heavy reliance on the data, which may not accurately represent the customary trends in elevator utilisation within the Asian context. In light of this matter, future researchers should incorporate data pertaining to the utilisation of elevator in the Asian region. This study presents a novel proposal for a courier service system tailored to residential buildings, in light of the evolving lifestyles observed in contemporary society.

Research Methodology

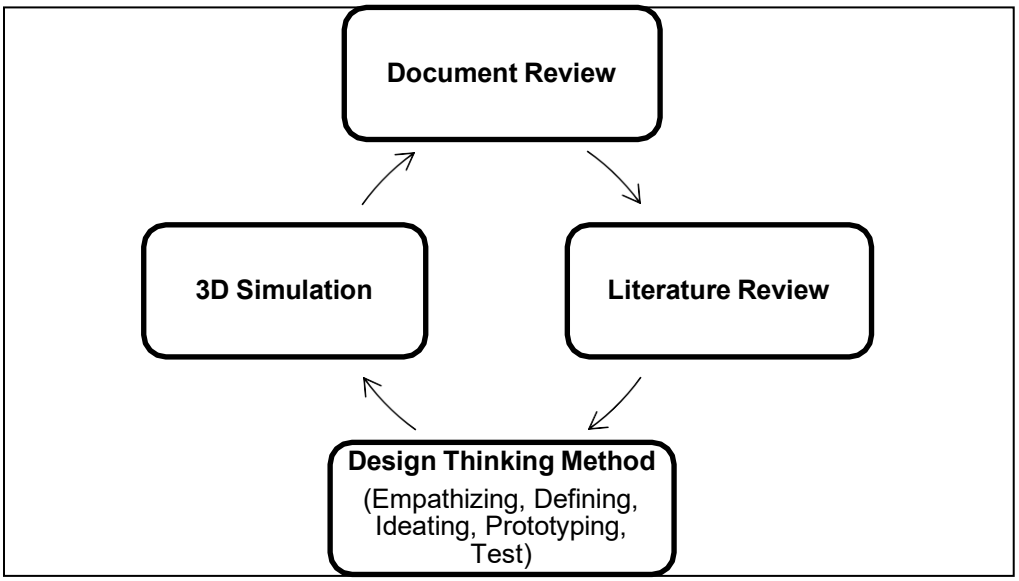

Figure 2: Flow of research methodology

The data collection used was qualitative research. First, is document review, the data was acquired by downloading a brochure of the company's existing products, which then led to the development of innovative concept Pneumatic Tube System. Next is a literature review. Context is brought to the theoretical argumentation and empirical analysis by offering an overview of prior research.

Thirdly is the design thinking method, Pneumatic Mailbox System was achieved using design thinking techniques, empathizing, defining, ideating, prototyping, and testing. Empathizing is learning about the audience. It is essential to a human-centered design process like design thinking because it enables user to form worldviews and obtain a thorough understanding of user's requirements (Dam, 2022). Next is defining. Defining is sharpen the key question, ideate if brainstorm and create solutions. These stages are an important part of the design process because it helps designers come up with designers' point of view (POV), which is a clear statement of the problem that designers want to solve. Third is ideating. In this stage, designers should be ready to produce ideas after having understood the demands of users in the previous stage (the empathize stage), and after having examined the observations of designers in the previous stage (the define stage), in order to build a user's-centric problem statement. Next stage is prototyping. Prototyping is building a representation; prototypes are simple experimental models of proposed solutions. Its purpose is to test or verify ideas, design assumptions, and other part of its conceptualization in a quick and cost-effective manner so the designers involved may make improvements or alter products (Dam, 2022) but this stage has changed to three-dimensional (3D) simulation because it is difficult to realize Pneumatic Mailbox

System in the form of a prototype. The last stage is testing. Testing is test ideas that allows designers to identify and evaluate whether the product has any flaws or defects in the manufacturing design or the product lacks functionality. Instead of doing tests as recommended by design thinking, this project uses simulation as a digital prototype to make it easier for designers to describe the function and flow of the product in the form of illustrations.

Lastly is 3D simulation. The information was gathered by using SketchUp Pro 2022 Software to do the simulation video and collecting data. The various components of the Pneumatic Mailbox System were visually represented and designed using SketchUp Pro 2022 software. This 3D modelling tool was utilised to construct a virtual representation of the Pneumatic Mailbox System, enabling the visualisation of the innovation concept prior to its physical realisation as a prototype. SketchUp Pro 2022 is equipped with extensions that facilitate the generation of animated representations of three-dimensional (3D) designs. One of the software extensions employed to generate animations for the innovation concept is LibFredo6 13.6. This extension facilitates the manipulation of objects, enabling the object to transition between different destination and generate motion.

It is important to consider the study's limitations before interpreting the findings. As a result, this research is restricted to look at Pneumatic Mailbox System in construction for usage in high-rise buildings. There is a limit on the number of packages that can be transferred using PMS; not all packages can be managed using PMS; the PMS System can only be used for packages that weigh less than 5 kilograms. This research is only concerned with the theoretical and feasibility stages of improvising the currently available technology for pneumatic systems. Because of the impossibility of obtaining a pneumatic system and simulation are used as an alternative to visualize the idea of the innovation concept, there was consequently no prototype that was tested and analysed. This is because the research is only at the feasibility stage. The next stage of this innovation research needs advanced technology to produce a system. Additionally, the lack of prior research on related topic limits this study, making it difficult for researchers to pinpoint pertinent issues.

RESULT AND FINDINGS

Components and Materials of Pneumatic Mailbox System (PMS)

The Pneumatic Mailbox System comprises seven (7) components and materials as shown in Table 1. The first component is a blower with dimensions of width is 488 millimetres, and length is 725 millimeters, a pneumatic blower is a kind of motor or pump that uses force to move air into the blower and expels it out through the blower's outlet. The volume of moving air provides the push that moves the package forward or backward at speeds of 6.0 to 8.0 seconds. Next, is diverter transfer withdimensions of width 560 millimetres and height is 900 millimetres. The diverters

transfer performs the function of a switching station, which enables carrier to reach its destinations through the shortest and most direct route possible, which is determined by the diverters. Third is dispatch tubes with a size of 165 millimetres to 200 millimetres. The tube materials used for Pneumatic Mailbox System are Poly Vinyl Chloride, Poly Vinyl Chloride Clear Tube and Stainless Steel. Fourth, transfer and receiving station with dimensions of width is 1124 millimetres and height is 1838 millimetres. This station is used to transfer and receive packages. Fifth, carrier for a package with a radius of 79 millimetres and has a length of 350 millimetres and is capable of loading packages less than 5 kilograms. Carriers are used to insert packages to facilitate the movement of packages inside the dispatch tube. Sixth, is solar energy with dimensions of width 3690 millimetres, and length is 6052 millimetres. Pneumatic Mailbox System uses solar panels as a renewable energy source in place of traditional power plants. The last components are locker with dimensions of width 946 millimetres and height is 1838 millimetres. Lockers serve as storage spaces for packages that are delivered to a designated destination when the recipient is unable to collect the package in a timely manner. Packages can be received and securely stored until the recipient returns home.

Table 1: Components and Materials of a Pneumatic Mailbox System

Components and Materials	Descriptions
1. Blower	The blower creates pressure and flow in the Pneumatic Mailbox System. The direction in which the carrier moves is determined by the vacuum or pressure.
2. Diverter Transfer	Pneumatic Mailbox System is developed with two ways divert valve. These diverts may switch between lines transporting a dilute or dense and preventing contamination.
3. Dispatch Tubes	Dispatch tubes are able to curve and bend in order to convey the package. The tube materials that used for Pneumatic Mailbox System are Poly Vinyl Chloride, Poly Vinyl Chloride Clear Tube and Stainless Steel.
4. Transfer and Receiving Station	This station is equipped with a technologically advanced interface equipped with an Artificial Intelligence of Things (AIoT) system which is a combination of Artificial Intelligence (AI) technologies and the Internet of Things (IoT) infrastructure. This transfer area is also equipped with security features such as fire alarm, theft alarm and arrival alarm.
5. Carrier for package	The carrier is equipped with a Quick Response code security system to make it easier for the recipient to access the package carrier and Radio-Frequency

	Identification to track the carrier when it moves inside the tube.
6. Solar energy	Pneumatic Mailbox System makes use of solar power in order to cut down on building monthly electricity bills. Pneumatic Mailbox System solar panels are Passivated Emitter and Rear-Cell (PERC) solar panels.
7. Locker	Lockers are constructed using stainless steel and glass and are equipped with advanced technology and security systems.

Simulation and Assembling Method of the Pneumatic Mailbox System (PMS)

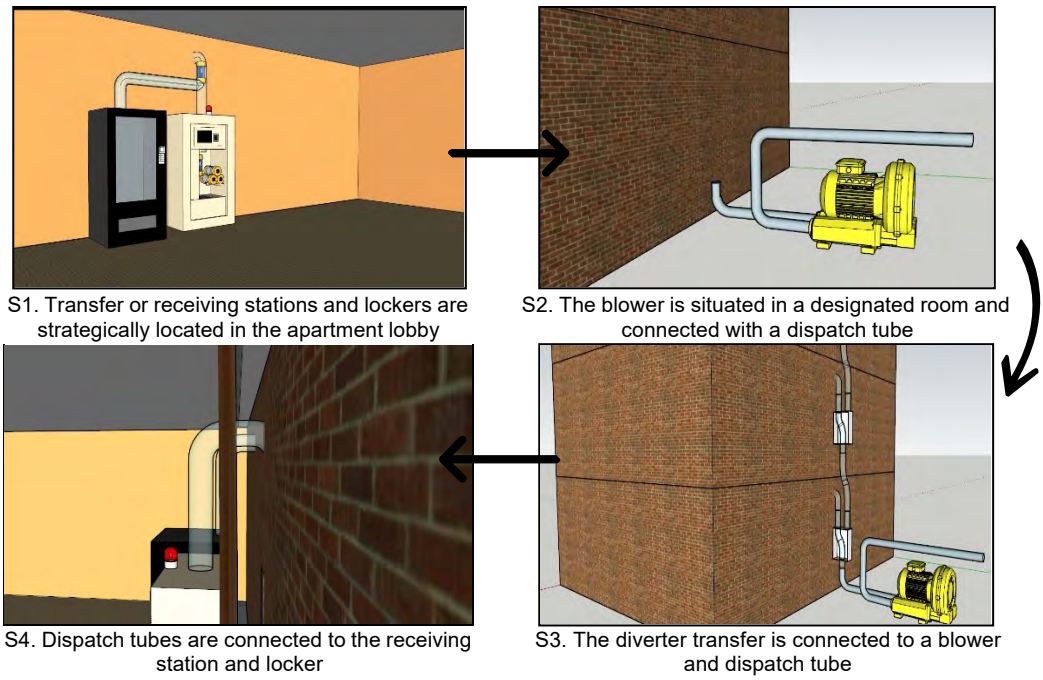

Figure 3: Simulation and Assembling method of the Pneumatic Mailbox System

Figure 3 shows the simulation and assembling method of the Pneumatic Mailbox System in the apartment. In the apartment building, transfer or receiving stations and lockers are strategically located in the apartment lobby on every floor (S1). Additionally, the dispatch tube system is connected to stations and lockers are housed in a designated room for Pneumatic Mailbox System. The blower is situated on the ground floor of the building (S2). A blower serves as a power unit within a system, generating both positive and negative air flow in order to facilitate the transportation of the carrier. To maintain a continuous supply of fresh and filtered air from the external environment, an open tube is connected to a blower. Subsequently,

a dispatch tube measuring between 165 mm and 200 mm in dimension is connected to the blower and diverter transfer mechanism (S3). The diverter transfer is equipped with a dispatch tube that has the capability to establish a connection between two dispatch tubes that are linked to the diverter transfer. This mechanism is employed to facilitate the transition of the carrier route to alternative dispatch tubes. Afterward, the remaining dispatch tubes are connected to the receiving station or locker (S4). The Pneumatic Mailbox System has the flexibility to be installed on either existing or new construction buildings due to its low maintenance requirements during installation.

Operation Process of the Pneumatic Mailbox System (PMS)

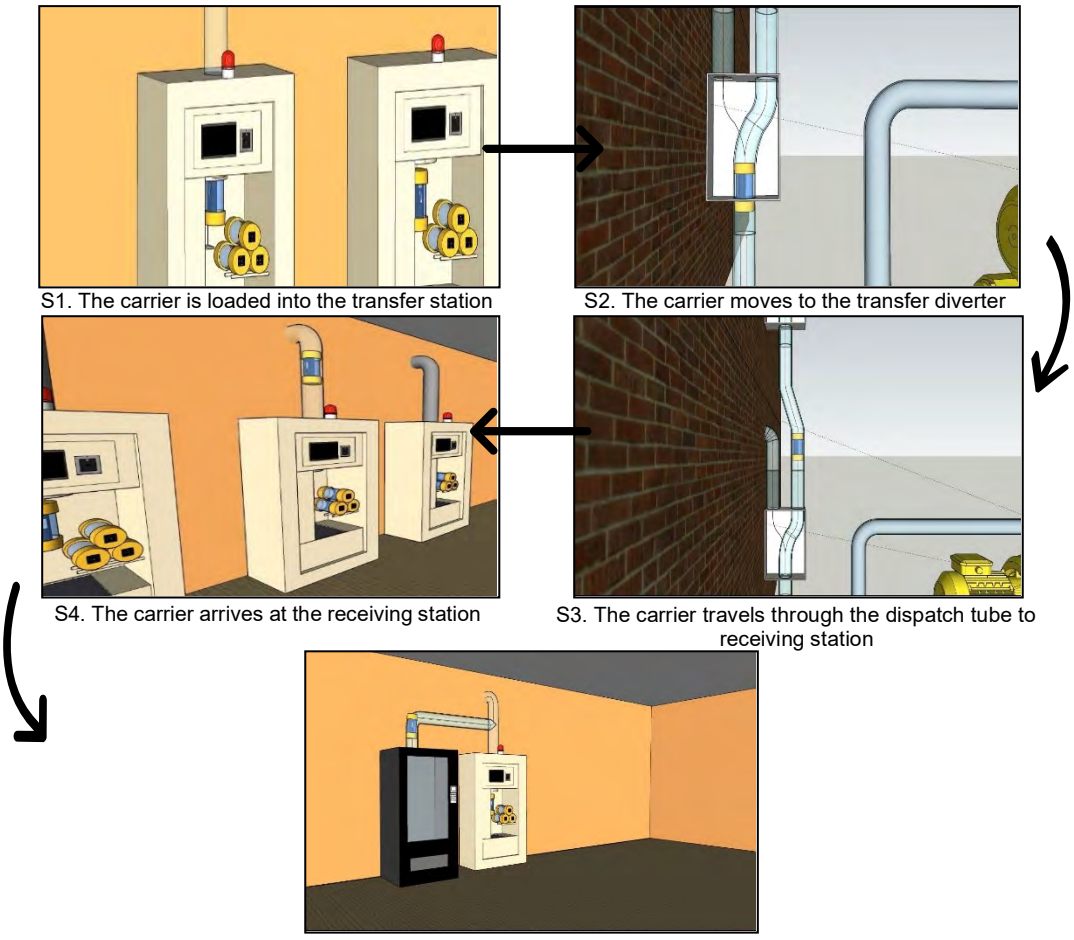

Figure 4: Simulation Operation Process of the Pneumatic Mailbox System

Figure 4 shows the simulation operation process of the Pneumatic Mailbox System in the apartment. The design idea of Pneumatic Mailbox System for residential area for this innovation project was improvised from existing innovation products and

various innovation techniques approaches. This product is created for a type of high-rise building. Basically, this system is a combination of Pneumatic Tube Systems techniques, Internet of Things technology and solar panel. The Pneumatic Mailbox System was improvised by making the innovation of transfer and receiving station which completed with an alarm system, identifier, password, and Quick Response code, as well as an alphanumeric keypad. The lower-level station can transmit packages, whereas the upper-level station can only receive packages. Each zone of stations is serviced by its own blower.

The package is loaded into the carrier. As an additional layer of protection, the courier specifies the destination to which the package will be delivered and enters the recipient's contact information. The carrier is loaded into the transfer station (S1). The carrier is positioned in the dispatch tube. Carrier travel through a system of tube that link the various stations and zones. The carrier moves to the transfer diverter (S2). Interzone buffers or storage pipelines act as intermediate stops for carrier route from one zone to another. The diverter functions as a tube connection, opening a route between stations for the blower to transport the carrier along. During a transaction, a carrier is transferred from its origination point to its destination. Interzone transactions occur when the source and destination stations are in different zones or the same zone.

To get to its destination, the carrier travels through the dispatch tube to the receiving station by utilizing the air that is supplied by the blower (S3). Each zone's blower in a conventional dispatch tube can only affect a single carrier at a time. As soon as the carrier arrives at its destination (S4), the arriving sensor will have its light turned on. A Quick Response code will also be displayed on the recipient phone, and the recipient will receive a notification when the package has been delivered to the destination. If the recipient cannot pick up the package because the recipient is not at home, the recipient may select another day to pick up the package at the locker. The package will be kept in the locker (S5), and the recipient will be able to retrieve it at the time that was specified. Each recipient will be provided with a Quick Response code to access the carrier system in order for their package to be picked up. If this is not done, the recipient will not be able to open the carrier for the package.

Discussion on Marketability of Pneumatic Mailbox System (PMS)

Marketing can be defined as the management tasks and decisions that are made to take advantage of opportunities and avoid threats in a changing environment. This is done by developing and delivering a market offering that meets customer needs in a way that helps the business, the customer, and society to reach their goals (Cronje et al., 2004). A product's marketability can be used as a metric to gauge how easily and profitably the product can be sold to customers. The viability of a proposed new product can be evaluated by first determining its target demographic and then formulating a strategy for reaching out to that demographic through marketing. When

it comes to reaching business goals and coming up with new marketing ideas, the marketability of a company's products and the business strategy behind those products are key instruments. By developing a marketing strategy for the company, it will make the business more focused and provide a clearer path for the company's vision and mission. In addition, it promotes brand awareness, which in turn increases the likelihood that customers will purchase and repurchase the company product or service. Through effective marketing methods, it is certain that it will be able to make a profit for the company and that its sales figures will increase.

The complexity of purchasing, the nature and size of customer, economic and technical selection criteria, buying to specific requirements, risks, derived demand, reciprocal buying, and negotiations all influence the purchasing procedure (Alruthia, 2020). The identification of the target market is predicated on the idea that seller must determine what needs to be fulfilled in order for customer to be interested in the product (Kampamba, 2015). The 4P's (product, price, place (distribution), and promotional activities) can be integrated into this ratio, and the marketing mix can enhance the level of customer satisfaction (Thabit & Raewf, 2018). Every company strives to create a blend of the 4P's that may fully delight customers while still attaining its objectives. This mix, which varies from firm to company based on resources and marketing objectives, is therefore created with the demands of the target market in mind (Komari et al., 2020). The determination of the market price ofrisk is solely contingent upon the overall anticipated end-of-period wealth, thereby remaining impervious to the level of marketability (Stapleton & Subrahmanyam, 1979).

Pneumatic Mailbox System is a technological advancement derived from Pneumatic Tube System. The marketability of Pneumatic Tube System can be associated with the marketability of Pneumatic Mailbox System, which has been extensively utilized in various sectors such as medical and healthcare, commercial, industrial, and others. The market is growing as a result of rigorous research and development in Pneumatic Tube System, as well as the increasing rate at which top industries adopt solutions that are both economical and effective. Additionally, an increase in the adoption of automated solutions in pharmacies and laboratories is helping to augment the market revenue growth because the system helps to improve productivity, boost data quality, and minimize cycle time. This is contributing to the overall growth of the market. The proliferation of industrial enterprises that make use of Pneumatic Tube System contributes to increases in productivity, product quality, and other aspects, which in turn drives the expansion of the market for Pneumatic Tube System. During the epidemic, hospitals also struggled with a lack of staff, which ultimately necessitated the immediate implementation of the Pneumatic Tube System. The fact that an investment in a Pneumatic Tube System does not require a significant sum of money also contributes to the rise in demand.

As a result, this demonstrates that it is reasonable to predict that Pneumatic Mailbox System marketing will also be successful taking into consideration the fact that Pneumatic Tube System has been used in a variety of different industries. This is made possible as a result of the improvement of Pneumatic Tube System innovation to Pneumatic Mailbox System, which makes the use of Pneumatic Tube System more widespread in the sector. Pneumatic Mailbox System application in high-rise buildings as a package and letter delivery system can make the daily life of users easier in addition to maximizing the use of mechanical transportation such as elevators in order to maximize the potential for damage to elevators. Furthermore, the Pneumatic Mailbox System exhibits the capability to be implemented on both pre-existing and newly constructed buildings owing to its minimal maintenance demands during installation, rendering it a convenient system for building installation. The utilization of air pressure provided by the blower system in the Pneumatic Mailbox System facilitates maintenance procedures and contributes to cost reduction.

More importantly, the utilization of solar energy as an alternative energy source has the potential to contribute to the reduction of electricity consumption in high-rise buildings. The utilization of renewable energy sources for energy and heat production is characterized by the absence of greenhouse gas emissions, thereby mitigating environmental pollution, and ensuring the preservation of finite fossil resources for future use. This innovation of Pneumatic Mailbox System has the potential to be utilized by diverse demographic groups across various age ranges and sectors, including both governmental and private entities. Additionally, it has the potential to be implemented in various settings such as offices, banks, post offices, and another relevant environment.

Conclusion and Recommendations

In conclusion, it can be posited that the implementation of PMS innovation has the potential to yield numerous benefits in the realm of user' everyday existence. The utilization of this innovation is characterized by its environmentally sustainable nature and user-friendly design, rendering it suitable for users of all ages and genders. The utilization of anti-corrosion materials and environmentally sustainable green technology in the manufacturing process of PMS has the potential to mitigate pollution levels. The utilization of elevators in high-rise buildings can potentially contribute to environmental pollution due to the reliance on hydraulic elevators, which necessitate the use of oil for optimal operational performance. If this oil infiltrates water sources, it has the potential to pose a significant environmental risk. Hence, the presence of PMS has the potential to decrease the reliance on elevators in high-rise buildings. The anticipated outcome of utilizing PMS is projected to yield superior outcomes compared to the current PTS product. PMS represents a pioneering advancement in the realm of package transportation in high-rise buildings, complemented by the incorporation of diverse Internet of Things (IoT) technologies such as QR codes and RFID, aligning with the advancements of the Fourth Industry

Revolution (IR 4.0). Thus, the implementation of the PMS has the potential to enhance the environmental sustainability, cleanliness, and management efficiency of courier services in high-rise buildings in Malaysia. Several recommendations for the future endeavours of fellow researchers are as follows:

- Enhance the capabilities of the PMS to accommodate larger packages, with a maximum weight limit of 20 kilograms.
- Develop a functional prototype of PMS to facilitate comprehension of its operational procedures.
- Future research endeavours should strive to circumvent the issue of carrier obstruction by minimising the incorporation of excessive bends in the design of PMS tubing.
- Since pneumatic blowers generate a lot of noise in comparison to other power transmission methods, it is suggested that future researchers develop quieter blowers to prevent noise pollution.
- Subsequent researcher may augment the existing body of literature pertaining to issues encountered in the realm of courier services.

ACKNOWLEDGEMENT

Praise be to Allah, the Most Compassionate, the Most Gracious. The author would like to thank to her family, lecturers, friends, and Universiti Teknologi MARA for providing the supports for this study.

REFERENCES

Alruthia, M. (2020). *The Importance of Marketing Strategies*.

Al-Sharif, L., Peters, R., & Smith, R. (2004). Elevator Energy Simulation Model. *Peters Research*, *14*, p.12.

Bahrami, F., Safari, H., Tavakkoli-Moghaddam, R., & Yazdi, M. (2016). On modeling door-to-door parcel delivery services in Iran. *Iranian Journal of Management Studies*, *9*, 883–906. https://doi.org/10.22059/ijms.2017.59944

Bailand, V. N. a/p. (2021, June 18). 'No direct deliveries to high-rise units.' *The Star*. https://www.thestar.com.my/metro/metro-news/2021/06/18/no-direct-deliveries-to-high-rise-units

Budds, D. (2018, April 12). *How pneumatic systems have captivated New York for over 100 years*. Curbed NY. https://ny.curbed.com/2018/4/12/17226296/new-york-infrastructure-pneumatic-tubes-hyperloop

Chicago, the Great Central Market: A magazine of business. (1905). Chicago : Chicago Commercial Association. http://archive.org/details/chicagogreatcent321906chic

Cronje, G. J. de J., Toit, G. S. D., Badenhorst, J. A., & Motlatla, M. D. C. (2004). *Introduction to Business Management*. Oxford University Press.

Dam, R. F. (2022). *The 5 Stages in the Design Thinking Process*. The Interaction Design Foundation. https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process

Farman, J. (2018). Invisible and Instantaneous: Geographies of Media Infrastructure from Pneumatic Tubes to Fiber Optics. *Media Theory*, *2 (1)*, 134–154.

Fox, H. (2022). *Challenges of Modern Apartment Delivery Management*. https://www.swiftlane.com/blog/apartment-delivery-management-challenges/

Kampamba, J. (2015). An Analysis of the Potential Target Market through the Application of the STP Principle/Model. *Mediterranean Journal of Social Sciences*, *6*, 324–340. https://doi.org/10.5901/mjss.2015.v6n4s3p324

Keen, C. C., Liang, C. H., & Sham, R. (2022). The effectiveness of parcel locker that affects the delivery options among online shoppers in Kuala Lumpur, Malaysia. *International Journal of Logistics Systems and Management*, *41*(4). https://trid.trb.org/view/1991520

Knight, E. A., Ansell, R. O., & McGlinchey, D. (2002). Benefits of On-Site Measurement on Pneumatic Conveying System Performance. *Measurement and Control*, *35*(8), 234–237. https://doi.org/10.1177/002029400203500803

Komari, A., Indrasari, L., Pariyanto, A., & Santoso, H. (2020). *The Effect of Marketing Mix 4P Towards Marketing Product Performance Of Tenun Ikat Small Industry In Bandar Kediri*. *volume 473*, 805–809. https://doi.org/10.2991/assehr.k.201014.173

Kumar, S., Tiwari, P., & Zymbler, M. (2019). Internet of Things is a revolutionary approach for future technology enhancement: A review. *Journal of Big Data*, *6*(1), 111. https://doi.org/10.1186/s40537-019-0268-2

Levy, A. (2001). The influence of a bend on the flow characteristics in pneumatic conveying systems. In A. Levy & H. Kalman (Eds.), *Handbook of Powder Technology* (Vol. 10, pp. 403–409). Elsevier Science B.V. https://doi.org/10.1016/S0167-3785(01)80042-7

Sangani, S. (2022, January 13). *Off-campus apartments face package delivery issues with Amazon*. https://www.thedp.com/article/2022/01/off-campus- housing-package-delivery-issues-amazon

Siti, N. A., Asmone, A. S., & Chew, M. Y. L. (2018). An assessment of maintainability of elevator system to improve facilities management knowledge-base. *IOP Conference Series: Earth and Environmental Science*, *117*, 012025. https://doi.org/10.1088/1755-1315/117/1/012025

Stapleton, R., & Subrahmanyam, M. (1979). Marketability of Assets and the Price of Risk. *Journal of Financial and Quantitative Analysis*, *14*, 1–10. https://doi.org/10.2307/2330652

Tay, T. F. (2020, December 3). Smart letterboxes to be trialled at two Clementi Housing Board blocks. *The Straits Times*. https://www.straitstimes.com/singapore/consumer/smart-letterboxes-to-be-trialled-at-two-clementi-housing-board-blocks

Thabit, T. H., & Raewf, M. B. (2018). The Evaluation of Marketing Mix Elements: A Case Study. *International Journal of Social Sciences & Educational Studies*, *4*(4). https://doi.org/10.23918/ijsses.v4i4p100

Tsai, Y.-T., & Tiwasing, P. (2021). Customers' intention to adopt smart lockers in last-mile delivery service: A multi-theory perspective. *Journal of Retailing and Consumer Services*, *61*, 102514. https://doi.org/10.1016/j.jretconser.2021.102514

Turská, S., & Madleňáková, L. (2019). Concept of Smart Postal Mailbox. *Transportation Research Procedia*, *40*, 1199–1207. https://doi.org/10.1016/j.trpro.2019.07.167

Vukolov, A. (2019). Forgotten Facility: The Pneumatic Tube Mail System in Russian State Library: Proceedings of the 7th European Conference on Mechanism Science. In *Mechanisms and Machine Science* (pp. 147–154). https://doi.org/10.1007/978-3-319-98020-1_17

Yoo, O. H., & Park, J. (2013). The Elevator-Integrated Delivery System for High-Rise Residential Buildings. *Journal of Asian Architecture and Building Engineering*, *12*(1), 149–156. https://doi.org/10.3130/jaabe.12.149

Young, M. (2021, January 21). *The Pneumatic Tube Mail System in New York City*. Untapped New York. https://untappedcities.com/2021/01/21/pneumatic-tube-mail-nyc/

Zimmer, A. (2016, December 6). How Buildings Are Tackling the Problem of Package Pile-Up. *DNAinfo New York*. https://www.dnainfo.com/new-york/20161206/murray-hill/package-rooms-apartment-doorman-delivery-nyc

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