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Sustainable Transport Practices In An Urban University. A Case Study Approach

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Abstract

Universities have critical roles in championing sustainable development goals (SDGs) within and around campus in the continuous effort to make the world a better and greener place. Accomplishing the SDGs will rely on advances in sustainable transportation. In recent decades, many universities around the world have begun adopting the sustainable transportation concept through the implementation of various strategies. This research focuses on assessing the current sustainable transport practices implemented in Universiti Teknologi MARA (UiTM), Puncak Alam Campus, Selangor Malaysia. The literature review outlines the current research agenda and most effective strategies for promoting sustainable transportation practices within and around university campuses. After that, the condition of existing facilities and strategies related to sustainable transportation in the UiTM Puncak Alam campus is evaluated using observation methods. The results include recommendations and a framework for administrating, implementing and enhancing a sustainable transportation system thereby increasing the communities' use of sustainable transportation to, from, and within the university campus.

Keywords: Sustainable Development Goals (SDGs), Sustainable Transportation Practices, Sustainable Transportation System, University Campus.

1. Introduction

The exponential increase in environmental degradation and climate change has resulted in the need for a more sustainable society and economy (Akar et al., 2018). Extended that, sustainability is also closely integrated with transportation in promoting ecological balance (Sundram et al, 2017). Transportation's impact on the environment is significantly great as it is a major user of energy and contributor to global warming (Keat et al., 2016). Targeting sustainability should always start with transportation and especially to begin from the university's society such as students, academicians, and staff (Sundram et al, 2021). This is true of the fact that universities as the center of excellence in most countries could easily be the potential for triggering transport sustainability practices across the globe. Sustainable transport is about providing the mobility needs of the population. It emphasizes the important mobility dimensions which are the ease, convenience, affordability, and accessibility of traveling to one's destination with minimal impacts on the environment and others (Brough et al., 2016). These dimensions can be increased with good space design, behavioral change, technological innovations, supportive policies, reward systems, and public engagement and

leadership. Since the key steps to the successful implementation of sustainable transportation should begin with awareness and practices (Abdul & Ho, 2015), this study intends to understand the sustainable transportation practices in a campus environment and propose suggestions for improvement in embracing sustainable transportation practices among stakeholders in a campus environment. This study emphasizes mobility practices taken around the campus area as well as short commutes from home to campus.

2. Literature Review

2.1 Concept, Definitions, and Aims of Sustainable Transportation

The concept of sustainable transportation began to emerge since the Brundtland Report 1992 which focuses on the development that meets the needs of the present without compromising the ability of the future generations to meet their own needs. Ever since, the concepts have evolved and garnered much interest from government agencies, businesses, non-government organizations, and civic groups, resulting in policy initiatives in both the public and private sectors. After decades, scholars and practitioners have provided diverse perspectives on the sustainable development concept. Nonetheless, it is generally accepted that sustainable development demands recognizing and merging three critical aspects; environmental protection, social equity, and economic development. The principle tenet of sustainable transport development views environmental protection as a special kind of economic asset -called natural capital.

In 2015, the United Nations (UN) presented a new evolution in the concept of sustainable development. The 2030 Agenda for Sustainable development charts new pathways to sustainable development agenda generally with the new goalposts of 17 Sustainable Development Goals (SDGs). Accomplishing the SDGs will rely on advances in sustainable transportation. The essence of a new development agenda focuses on people and their quality of life. Sustainable transportation refers to the provision of services and infrastructure for the mobility of people and goods— advancing economic and social development to benefit today's and future generations—in a manner that is safe, affordable, accessible, efficient, and resilient while minimizing carbon and other emissions and environmental impacts (United Nation, 2016).

Since the inception of the new development agenda transport vis-à-vis, SDGs have gained importance. The final report of the Open Working Group (OWG) on SDGs, published on 2015 is acknowledged by many as a breakthrough for the sustainable transport community. The fact that transport-related targets are included in eight out of the seventeen proposed SDGs (Goals 2, 3, 6, 7, 9, 11, 12, 13) illustrates the cross-cutting role that transport has in sustainable development. Sustainable transportation plays a fundamental role by not an end in itself, but rather a means allowing people to access what they need: jobs, markets and goods, social interaction, education, and a full range of other services contributing to healthy and fulfilled lives. Transport is not only a matter of developing transport infrastructure and services, but rather the ease of reaching destinations in terms of proximity, convenience, and safety.

Sustainable transportation is capable of providing substantial benefits such as safety, well-being, comfort, health, economic growth, and social development to communities. At the same time, transportation systems, planning approaches, and practices currently used in many countries harbor pressing concerns and menace sustainability at the global level (Dehghanmongabadi & Hoskara, 2018). Over the years the approach for providing or increasing accessibility is focused on providing mobility based on motorized transport and improving speed. The term improving accessibility is denoted to roads or infrastructure which mainly promotes the use of private vehicles, thus contributing to economic, social, and environmental problems. Due to many adverse consequences of the transportation system, it is widely accepted that urgent paradigm shift in travel modes, policies and behavioral patterns are crucial in mitigating transportation's

externalities and alleviating harmful transport related impacts.

2.2 Previous Studies

Increasingly, tertiary education institutions are taking serious steps to integrate the agenda of sustainable transportation into their development strategies. Previous studies on sustainable transportation on campus can be grouped into two main streams; research into sustainable campus systems and research into user's knowledge and practices of the sustainable campus.

Few local researchers emphasize developing indicators for evaluating sustainable campus systems. (Er & Karudan, 2016; Mahayudin, et al., 2015; Hussin & Kunjumaran, 2015). These researchers highlight the various ways toward sustainable transportation direction in the campus environment. Er and Rewathi, (2016) emphasize the design elements of the public transport infrastructure and improving awareness of sustainability. Mahyudin, et al., (2015) emphasize the university landscape that supports active travel while Hussin and Kunjumaran (2015), point up in participation and cooperation of the university's stakeholders. They further elaborate efforts towards sustainability by introducing environmental excellence in teaching and learning, research, infrastructure development, environmental management, and operations, as well as all matters affecting the campus.

Universities differ in their definition and ideas on ways to implement sustainable transportation efforts. However, universities share the same goals of creating sustainable campus environment by giving attention to ecological challenges, social justice, economic and human's health to minimizing the university's activities impacts on surrounding communities and own members as well as promoting sustainable lifestyle by educating current and next generations according to responsibility of universities to communities and societies. Studies by the local researchers focus into providing concept, aims of, needs for and strategies of sustainable transportation in university campus environment. Yet there are too few studies from local perspective that present empirical understanding into the real implementation strategies and evaluating impacts and practices of sustainable transportation in campus environment.

Gudmundsson, Hall, Marsden, and Zietsman (2015), analyze actual planning and decision making of sustainable strategies in university setting and provide analysis of case studies demonstrate the benefits and limitations of the current approaches to sustainable development in transportation in the United States.

Kaplan (2015), develops an empirical understanding of the current situation in a larger university campus in United States and uncovers ways for more non-motorized traffic be encouraged within and between the campus, and surrounding community. Despite impressive sustainable strategies by the university, his study records generally low existing levels of sustainable transportation among university communities around a campus. There is a particularly low level of bicycling activity. Reasons have to do with time and convenience but also that many respondents do not enjoy bicycle access. His study also points to attitudes and an inventory of campus indicating that existing infrastructure discourages sustainable transportation activity around campus.

Dehghanmongabadi and Hoskara (2018), describes various Travel Demand Management (TDM) Strategies for promoting sustainable transportation within Eastern Mediterranian university. They outline several TDM measures commonly used on university campuses; parking management and utilization, public transportation, carpooling and vanpooling, encouraging the use of bicycles, and providing a pedestrian-friendly campus. Their study records that there are many more barriers to use of active modes of transportation within the East Mediterranean campus than there are motivators. The study concludes with two practical recommendations: those focusing on the quality of physical infrastructure and those suggesting changes in the management structure to create an overarching authority and to provide direction for implementation and use of current and future active modes of transportation inside the university campus.

Several other researchers suggest supporting measures that may be utilized to improve the sustainability of campus transportation system. They highlight alternative and renewable vehicle fuels (Nusrat, Chowdhury, Michela, & Wahiba, 2018), ridesharing, public transport fare subsidy and pass programs (Eom, Iseki, & Warner, 2017) behavioral changes and technologies (Setiono & Yulianto, 2018). These measures give comprehensive foundation on which to address sustainable transportation practices on and around their campuses. In general, the literature on sustainable transportation in university and particularly in a developing country is still scant. Hence, it is timely to conduct a study on sustainable transportation in a university campus in Malaysia.

3. Methodology

Observation is a key data collection technique for conducting research work typically happens in the natural environment and not in a lab or controlled setting. With this research, one can understand how people naturally interact with environment and the challenges they face. It can provide inspiration and ideas for opportunities for improvement and innovation. While it may seem like observation is as simple and uniform as watching and taking notes, there are some subtle differences that can affect the type of data collected. The role an observer plays could improve the reliability and validity of your observations. As such, this study considered having multiple independent researchers observe and code their notes. Using multiple observers with differing perspectives (e.g. students, staff and researcher) helps identify areas of agreement and disagreement and makes the observational data more trustworthy and reliable.

Observation can be a very obtrusive research method, and the ethical aspects of observation research need attention. The focus was more on assessing the current sustainable transport practices implemented in the selected case University campus, which is Universiti Teknologi MARA (UiTM) in Puncak Alam, Selangor, Malaysia. To achieve the following purpose, the study employed three observation technique which are semi structured observation and participative observation. The participants are to be able to recognize and critique some of the methods such as the use of observation checklists, and the use of photographs or videos.

4. Findings

4.1 Shuttle Bus Services

In UiTM Puncak Alam campus, shuttle bus services are regarded as the most efficient transportation system which has valuable impact on the student community's quality of life, opportunity for recreation, education, social and businesses. Furthermore, it is the most popular means of transportation offered by the universities all over the world (Ojo et al., 2015). Most of the students are heavily depending on shuttle bus services (Fig. 1) to commute around the vicinity of campus environment. As such, UiTM Puncak Alam management ensures that the time and quality of services brings total satisfaction to the students. Poor time management and quality of services can cause the students to miss the classes, feel demotivated to wait longer, waste their valuable time and effort. The university transport officers monitor the situation and observe the demand and supply of the buses especially during the peak hours.It should be noted that the students in UiTM Puncak Alam campus has gradually increase in each year. Thus, the university has engaged shuttle bus services from external bus operators. The Bintong bus (Fig. 2) that always schedule to pick up the students is under the contract with UiTM. Usually, the contract buses will operate according to the timetable assigned and the operation hours is from 7am to 7pm.

In addition, Rapid KL also provides services for the students around the campus even though it is an external bus (Fig. 3). However, students need to pay the ride using Touch 'n Go or MyRapid card. For Touch 'n Go card, the students will have to pay RM0.80, while, for MyRapid card from Rapid KL company, the students only need to pay RM0.40 per trip. Students can check the bus route and time in the MyRapid website and Twitter

@AskRapidKL. The fare prices will be displayed in the website according to the estimation of the travel time.

Fig. 1 Universiti Teknologi MARA bus.

Fig. 2 Bintong bus.

Fig. 3 Rapid KL bus.

4.2 Cycling

The uniqueness of the cycling mode compared to mass rapid transit such as buses is that cycling has no fossil fuel usage and is a pollution-free mode of transport (Pucher & Buehler, 2017). Great attention to cycling can improve the social environment on campus as well as spur greater health among the students and staff (Forsyth & Oakes, 2015; Kaplan, 2015). For example, Switzerland is a cycling nation in which more than two-thirds of the population own a bicycle. The Swiss Federal Council in its 'Sustainable Development Strategy 2016-2019' promotes the adoption of non-motorized transport (soft mobility) which includes walking and cycling.

In the UiTM Puncak Alam Campus, some colleges provide bicycle rental services (Fig. 4) for the students to promote cycling in campus. The rental time is around 5.30 pm to 7 pm and the charge are based hourly. Accordingly, UiTM Puncak Alam provided cycling lanes or cycle-path (Fig. 5 and Fig. 6) facilities as part of their responsibility to reduce the effect of greenhouse gasses and created a healthier campus environment.

Fig. 4 The bicycle and cycling services at UiTM.

Fig. 5 The signboard for footpath and cycle-path in UiTM Puncak Alam.

Fig. 6 The foot-path and cycle-path built in UiTM Puncak Alam.

4.3 Walking

Walking activities has received greater attention from the academic communities (Wang et al., 2016; Panter et al., 2016). It plays an important role in improving the quality of life among students specially as the main coping mechanism in managing stress during exam season. In UiTM Puncak Alam campus, the students are encouraged to walk to attend the classes because it is a convenient way for daily exercise. Healthier community leads to increase the productivity in daily life. Walking is not only beneficial for health and environment, but it also gives several advantages such as saving money on transportation cost, savings on parking and time

savings. To further promote safety during walking, the 'foot-path' (Fig. 5 and Fig. 6) is provided by UiTM Puncak Alam. Students from Angsana and Rafflesia college walk to the class using the famous stairs known as "tangga kejayaan" (Fig. 7) since it is connected from the colleges and faculties.

Fig. 7 Famous stairs in UiTM Puncak Alam, also known as "tangga kejayaan".

4.4 Ride sharing

Ride sharing provides the opportunity for users of single-occupancy private automobiles to move away from the need for individual car trips (Akar et al., 2018). It is suggested that two or more people, who share a common source, route, and destination, can use a single automobile (Fig. 8). To reach a sustainable transport system, people may have to drive less and enhance accessibility. People who feel a moral obligation to protect the environmental have a higher intention to share riding as a passenger or a driver, when they are informed that share riding is more sustainable alternative compare to driving alone (Alexandre et al., 2018). Commonly, students in UiTM Puncak Alam optimize share riding basically to commute between colleges and classes even though they are in the different classes. This are very useful for university campuses which are unique and uniform communities. It has many sustainable values such as d intangible benefits such as cost cutting for fuel and parking, opportunities for more social interactions and conservation of energy (Balsas, 2015).

Fig. 8 Share riding.

4.5 Awareness Program

Research on campus sustainability show concern for environmental issues along the sustainable transportation in the university communities, as well as sustainability in waste management programs, greening-campus and greenway corridor, green transportation and green energy among others tend to be the trend (Abdul & Ho, 2015). To achieve the sustainability transportation in UiTM Puncak Alam, the Transport Society organize few green programs to achieve the goal of sustainable campus. On 15th October 2019, the Transport Society or known as TransCLIT organized a program called 'Transport Day' (Fig. 9). On that day, transportation such as buses and cars were prohibited to use certain areas. They recommended the community to use bicycle or walk around the campus. The event highlights the advantages of going car-free to the campus community. Other than the 'No Transport Day; they also organized other programs in order to increase the awareness about sustainable campus.

Fig. 9 The Car Free Day organized by TransCLIT Society UiTM Puncak Alam.

Besides, Universiti Putra Malaysia (UPM) also set up goals to create green and sustainable campus. They also organize the 'No Vehicle Day' on Saturday. They give the students a rebate for bicycle purchase to encourage them to ride bicycles to reduce carbon in campus. They also collaborate with Toyota in the use of electric vehicles for transport just to reduce the carbon emission and to achieve the sustainable campus (Sani, 2019).

Campus walk-ability is an essential part of campus mobility because it helps the users to direct and easy follow the route, linking to the faculties, hostels and other facilities that will enhance their campus experience (Keat et al., 2016). Walking has been shown to improve the physical and mental well-being yet insufficient walking among university students has been increasing. This physical activity can promote to a healthy lifestyle and brings advantages to one's health such as reduce the risk of death, depression and chronic disease (Krzepota et al., 2015). Physical activity has been recommended as an important tool in the prevention and treatment of obesity. Therefore, a regular exercise promotes improvement in the cardiovascular system, assist in the prevention and treatment of chronic disease and is a critical factor in weight loss (Freitas et al., 2015).

The outdoor or physical activities such as Stair-climb Marathon was held in UiTM Puncak Alam. Stair climbing is one of the toughest endurance sport and it is basically a fast and furious climb of the stairs. Stair climbing allows people to get the chance to increase the amount of activity they do by conquering the stairs and have fun in taking part in the event (Suhaimi et al., 2017). This activity brings advantages to the participants in

term of mental and physical health such as (i) Increase the mental strength and physical capability, (ii) prevent illness like stroke or high blood pressure, and (iii) good condition and attractive physical body. The event had positively created the awareness to the community about the importance of healthy lifestyle and at the same time encourage them to live in sustainable environment.

4.6 Physical Amenities

The sustainable design for accessibility is essential in all aspects of physical development. The accessibility of social sustainable for people with disabilities (PWDs) is essential to ensure that they do not feel segregated from the community (Zainol et al., 2019). A disabled people is defined as someone who experienced any limitation or loss physical, mental or sensory or function of the body. The increment in the number of disabled people registered every year leads to the increase number of disabled students (OKU) at the government schools and universities. Due respect to the condition of the students, the facilities provided should be in a good condition and must be user-friendly. In UiTM Puncak Alam, there are common facilities provided for PWDs especially in terms of transportation such as car parks and buses. The parking spaces usually close to a building or entrance (Fig. 10). The parking spaces for the disabled, by handicap parking law, it is typically 30% to 60% wider than regular parking spaces. This is to accommodate the wide opening of car door or for access by wheelchairs.

RapidKL has taken the initiative to provide disabled-friendly public buses (Fig. 11). The floor level of the bus can be lowered and help those with wheelchairs and strollers to board (Othman, 2015). This kind of facilities always help the disabled people in this campus to ride the public transport easily.

Fig. 10 The OKU parking space in UiTM Puncak Alam.

Fig. 11 The space and seat for PWDs in RapidKL bus.

5. Recommendations

5.1 Alternative Renewable Vehicle Fuels

Buses are the main transportation for the residential students who lived in the college to go to the classes or around the campus. The buses are traditional vehicles which use fuel and gas to power the bus. It may contribute to atmospheric and noise pollution in the campus. The main reason for pollution caused by buses is poor vehicle maintenance. Poorly maintained buses lead to extra fuel consumption and emit excessive exhaust fumes. The combustion from fossil fuel engines such as diesel fuel is causing irreparable damage to the environment. Recently, the amount of carbon produced by the earth in atmosphere has been concern and the realization of the low carbon emission required a better understanding about the source, type and quantity of energy use (Abdul & Ho, 2015). In order to achieve the green transportation within the campus, UiTM should introduce the use of electric buses in its campuses. The electric buses can be recharge and the amount usage of diesel also can be reduced. For example, Universiti Teknologi Malaysia (UTM) Skudai, Johor became the first university in Malaysia that exercised the use of electric buses in its campus as part of its environmental conservation efforts (Fig. 12). According to UTM Electric Bus chairman, Professor Dr. Abd Latif Saleh, the bus is a product of joint-venture program between UTM, CMS Consortium Ecotour Sdn Bhd (COMOS), Mara Liner Sdn Bhd and Go Automobile Manufacturing Sdn Bhd (Go Auto). Additionally, he explained the electric bus help save up to 60% of the diesel cost. It uses rechargeable batteries that took only 20 minutes to charge with 88 kilometers per drive. The major factor that accelerates the growth of the electric vehicle (EV) industry at a sustainable level is because of the concern over the environment due to the greenhouse gases emitted by conventional internal combustion engine (ICE) (Bhatti et al., 2016).

Fig. 12 The first electric bus in Malaysia exercised by UTM Skudai, Johor.

1. Bike Sharing Services

In the early 1980s, electric bicycles or E-bikes (Fig. 13) originated in Japan with limited market attractiveness until 2000 due to technological and cost factors. However, with the advancement of technology, the E-Bike has become one of the fastest demands in the transport market with 31 million purchasing power in 2012. Moreover, the E-Bike has been found to have the potential to displace conventional motorized vehicles as it is beneficial in terms of health improvement and safety while being an efficient and convenient form of transportation with zero local air pollution.

According to Elliot and Christopher (2015) with wide varieties of cosmetic design, performances and technologies available such as Bicycle-Style E-Bikes (BSEB) and Scooter Style E-Bikes

(SSEB), function and performance (speed) have become a major distinction. E-bikes are classified as a "semi-motorized" vehicle as it can be run on either by human power or electricity with an average energy consumption of 1.2-1.5 kWh/100km (Ian et al., 2018).

Cost of fuel of E-Bike with less maintenance and speed are found to be significant factors which might encourage students to use the E-Bike, meaning that those who perceive that using the E-Bike can reduce the cost of fuel and incur less maintenance cost are more willing to use E-Bike. Those who believe the E-Bike is faster in terms of short paths as compared to the car are also more willing to use the E-Bike in UiTM Puncak Alam campus.

Fig. 13 Example of E-bike.

2. Eco-friendly Vehicles

As people becoming more conscious about the environment, the automotive industries take the opportunity to innovate environmentally friendly vehicles. Therefore, the automotive industries produce eco-friendly products that will reduce damages towards global environment leading to adoption of green technology including the automotive industries. This innovation of electric vehicle can deliver broader development benefits and reduce the carbon dioxide emission, air pollutant, and increase the penetration of renewables in the long term (Dhar et al., 2017).

There are three major types of eco-friendly cars which are hybrid, electric and bio-diesel cars. The hybrid car is a car that has two engines, gas powered engine and electric. The gas engine is used to power the car while the electric engine used in two situations. Firstly, when the car is in low speed, stop and go mode, the electric engine will take over. Next, when the car is in a quick acceleration, the electric engine will kick in to add some power to the gas engine. Electric cars that used electric engine will never be powerful as the gas engine. It is not high performers in term of aggressive acceleration or high-top speed. Lastly, the bio-diesel car. It has the traditional engine, but it burns a specific form of fuel that is made from bio-matter. It is more eco-friendly compared to the traditional cars. The hybrid vehicle mostly chosen because its running cost and fixed cost are lower than the conventional vehicles (Lebeau et al., 2015).

The hybrid electric technology is able to increase the efficiency of energy consumption of the vehicle during traffic congestion. The Eco Idle is a stop-start feature whereby it makes the engine goes into a partial-deactivation mode when putting a foothold on the brakes. When the Eco Idle is activated, it can provide up to 1 kilometer more on the road. Fuel efficiency has been

improved by increasing the idling stop time, which stops the engine when the brake is pressed and speed drops below a certain level.

In UiTM Puncak Alam campus, the eco-friendly car is popular among the students and staffs. Driving an eco-friendly vehicle is a great way to improve the human health and help the environment. Green vehicles release less harmful chemicals into the air, as it emits low carbon compounds when running (Brough et al., 2016).

Fig. 14 Perodua Myvi with Eco Idle system.

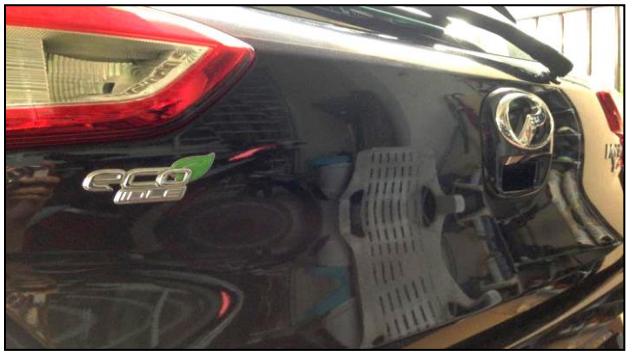

Fig. 15 The Eco Idle logo.

Fig. 16 The Perodua Myvi meter.

The popular car brand among the students is Perodua Myvi. It satisfies Energy Efficient Vehicles (EEV) standards in compliance with Euro 4 regulations. A new 'Eco Idle' system, aerodynamic design and overall technological improvements provide a cleaner and more economical dive (Fig. 14 and Fig. 15). The new EEV engines elevate low noise and vibration levels contribute to a comfortable driving experience (Fig. 16).

3. Active Transportation

The quality of infrastructures and safety must be considered if UiTM Puncak Alam wants to promote walking and cycling among the students. The walking environment should be made safer for pedestrians by well maintained, firm, flat and wide foot-path. The management of UiTM should improve the pedestrian infrastructure by adding the important elements such as covered walkways along the foot-path and cycling path (Fig. 17). It can protect the pedestrians from hot weather or raining. Moreover, UiTM Puncak Alam may improve the pedestrians' infrastructure by adding the street lighting. Street lighting promotes a sense of safety in the campus areas and increase the quality of life by artificially extending the light hours so that any activities can take place.

In addition, UiTM Puncak Alam also need to build the traffic light for the pedestrians. This signal makes it easier for them to cross the road and gives the sign for the cars to stop. Generally, pedestrians have a high potential of sustaining severe injuries or being killed during a collision with a motor vehicle due to the fragility of physical (Jung et al., 2016). They usually distracted by listening to the music, talking on the phone or texting while crossing the road (Mwakalonge et al., 2015). Additionally, in order to reduce the accident from happening especially in the campus, UiTM Puncak Alam should organize public awareness programs, organizational safety information and legislation that concentrated on distracted walking.

Fig. 17 The implementation of covered pedestrian and cycling path in Hong Kong.

Furthermore, the college campuses have few facilities that have been immensely successful at encouraging their students to use bicycle as their primary mode of transportation to class. Thus, UiTM Puncak Alam should provide the specific and designated space only for the cyclist. Currently, both paths are built together but separated using the yellow line only. A separate infrastructure can help in reduce the risk of injury between the cyclist and pedestrians.

The University of California, Santa Barbara is an excellent example of a school that has made a great stride for the infrastructure for cyclist. Their campus contains 10 miles of on-road bicycle routes and 7 miles of separated shared use paths, which feature 7 bicycle roundabouts and 3 underpasses. This infrastructure helps to avoid the roadway conflicts, reduce the number of accidents and the crucial is to encourage students to commute a bicycle (Fig. 18).

Fig. 18 One of the bicycle roundabouts in University of California.

4. Physical Amenities

The efficient operation of the public transport is a key factor for the improvement of living condition in a city. The transportation service performance should be accessed from the passengers' perspective, and it is essential to determine the passengers' satisfaction of the service provided (Rahman et al., 2017). Although there is RapidKL in UiTM Puncak Alam campus that provids disabled-friendly buses, it is commonly full by normal students. Thus,the disabled students are not be able to enter the bus. In suggestion, UiTM Puncak Alam should provide Bionic bus. The Bionic bus is a door-to-door, demand-response services provided with ramp-equipped minibuses. This Bionic bus is already operated in University of Iowa by the Bionic Bus system (Fig. 19). This transportation is specialized for persons with disabilities. All rides are scheduled regardless of the trip purpose. For on-campus rides, the travel time typically in 15 minutes and there is no fare to ride the Bionic bus. All the Bionic vehicles are low-floor, ramp access. While on the bus, the wheelchairs and mobility devices must be secured with a proper restraint. (Parking and Transportation, 2018).

Fig. 19 Bionic bus in University of Iowa.

In current scenario in Malaysia, the disabled people are well treated by the society however sometimes their parking facilities are commonly used by normal people. Thus, there are system that has been proposed called smart parking system by using the Radio Identification (RFID) technology and it is a device that mounted inside the vehicle and aiding infrastructure is developed to allow accredited vehicles and drivers to the restricted areas such as the parking system (Yousaf et al., 2016). The RFID reader will be activated to find any RFID tag once a car entered the parking spot (Fig. 20 and Fig. 21). If the RFID detected is legal, the system will indicate that the parking is deserved to the disabled by blinking the green LED. If the LED will blink red, and the buzzer will sound it indicate that the violations of parking space by the non-disabled (Gining et al., 2018). Therefore, UiTM Puncak Alam should try to improvise, design and develop the disabled parking system as a conceptual guideline of how technology can be applied in order to preserve the disabled rights.

Fig. 20 Visual of car with RFID tag for disabled people/OKU.

Fig. 21 The implementation of RFID system.

Additionally, walking infrastructure should be designed to be effective for the needs of all pedestrians group. Unfortunately, people with disabilities (PWDs) are often ignored in pedestrian facility analysis and design due to lack of data on their walking behavior (Sharifi et al., 2016). The pedestrian path is the essence of the path that is used for foot or wheel for towing disabled independently designed based on the needs of the people to move safely, easily, comfortably and without a hitch (Chenerita et al., 2018). The use of the ramp for the pedestrian is practically for non-existent for all buildings therefore, every difference in floor height will be a major obstacle for the wheelchair users. The presence of the step will break the level of accessibility especially for the wheelchair users (Wibawa & Widiastuti, 2019). The pedestrian crossing in UiTM Puncak Alam campus do not imposed the pedestrian for PWDs and the ramp. Therefore, they need to construct the pedestrian path for the disabled people and propose the installation of the ramp to ease the movement and increase the safety for the PWDs on the road (Fig. 22).

Fig. 22 The ramp for wheelchair user and the stairs for normal person.

5. Cycling Program

Cycling is the effective method to address physical, psychological, and environmental health. It is as an alternative mode of transport and more economical compared to motor vehicle. Cycling can improve the quality of life on campuses. Students in University of California tends to utilize bike as their mode of transportation. College students tend to be physically more fit, have restricted budget, live close to campus and have their own bicycle (Shields et al., 2015). University of California is among the universities that strongly advocate for campus cycling. In order to increase the awareness of sustainable transport, the University of California educates the students on how to choose the appropriate bicycle, theft prevention, appropriate bicycle parking and the advice for the new cyclist.

With respect to encouragement, bike accessibility appears to be a key determinant of behavior. By establishing a partnership between public transport providers and bike share programs could enhance the efficiency of the campus transport system (Wilson et al., 2018). UiTM Puncak Alam campus should help introduce new creative eco-friendly system of transport which is the bike-sharing system which can help the student go to any places. Bicycle lift tramp is another system which could help the student to go uphill without having struggling or problem to ride the bicycle. This system has been used fully by the University of Trondheim in Norway (Fig. 23).

Fig. 23 The bicycle tramp in University of Trondheim.

Other than the bike-sharing program, UiTM Puncak Alam also can organize campaign called Cycling Campaign. The University of Cambridge itself encourage their residents to use their bike at least once a week. Cambridge has always had a large population; however, the 2011 Census shows an increment of 37% of bicycle usage on the road between 2001 and 2011. This campaign has been focusing on cultivating the "cycling culture" at the university and always improve the cycling infrastructure for their residents.

Additionally, the other suggestion for cycling programs in UiTM Puncak Alam is Light Up Your Bike Campaign. This campaign is held by Dublin's Lord Mayor, Paul McAuliffe to encourage people on bikes to 'Light Up', Be Safe, and Be Seen. Dublin Cycling Campaign promoting an awareness campaign to share some advice and helpful lighting-up tips (Place, 2019). It got positive feedbacks from the cyclist and unforgettable experience for them.

Thus, cycling programs such as Bike-sharing Program, Cycling Campaign and Light Up Your Bike Campaign can lead to sustainable environment and transportation in the UiTM Puncak Alam campus. Therefore, they need to implement these programs in order to achieve the sustainable campus in near future.

6. Parking management

To encourage green and sustainability transportation, the university provides several parking systems for the staffs and students since the amount of driving the vehicle is increasing. Thus, to avoid any issues arise such as lack of parking space, they should come out with the idea to develop extra parking spaces for the students. In years, the number of student increase and the number of cars also increase. Currently, students park their car at Padang Casuarina or the parking spaces beside the Fakulti Sains Kesihatan (FSK) 234 (Fig. 24 and Fig. 25). In addition, the parking spaces for staff are near to each faculty. UiTM Puncak Alam provided a single level parking garage at the Fakulti Sains Kesihatan (FSK) 7, parking spaces on the side of the streets, and around the faculties. However, the lack of parking spaces still become an issue among the students and staffs.

Fig. 24 Students parking at Padang Casuarina.

Fig. 25 Students parking near to FSK 234.

To improve the parking system, UiTM Puncak Alam campus should start the university parking building project. For example, in Chulalongkorn University, they constructed car park buildings at four corners of the campus as shown in Fig. 26. People can commute from the car park buildings to various campus locations as well as popular attractions around the university. The car park buildings have solved the lack of parking spaces and reduced the traffic congestion in the campus (Pinthong et al., 2018).

UiTM can develop a low cost Smart Parking Sensor Network. Smart Parking where sensors will connect with the remote devices over internet and share information using the designated tools (Jog et al., 2015). Since in UiTM Puncak Alam campus there are lack of parking spaces, this technology can be applied in solving the parking problems to a great extent. The main goal for the smart parking solution is enable both drivers and parking managers in optimizing the parking capacity (Jog et al., 2015).

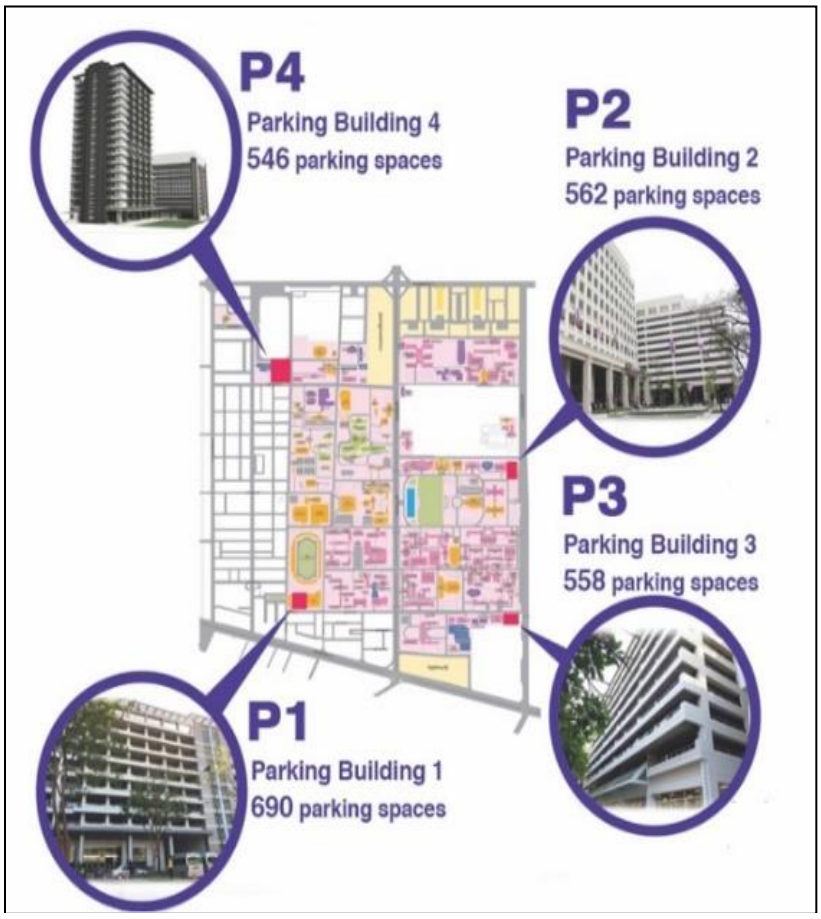

Fig. 26 The parking building system in Chulalongkorn University.

Besides, UiTM Puncak Alam campus should build automated parking system. It will help to reduce the movement of the cars to easy enter and exit the parking lot. However, the parking fees should not be priced too expensive as it is for UiTM Puncak Alam campus community. To reduce the amount of the cars in the campus, this strategy can be implemented. Additionally, the carbon emissions release by the cars also can be reduced, plus leads to a healthy environment and sustainable campus.

Conclusions

This study sheds light on the use of sustainable transport modes for students in UiTM Puncak Alam campus. Encouraging sustainable transport among students has become an important movement among the students. There have been numerous studies focused on current active transportation modes used within universities such as shuttle buses, cycling, walking, share riding, footpath and cycle-path. Moreover, the study also creates awareness among stakeholders about environmental sustainability which eventually will help to increase modal split between private vehicle / motorized and public transport / non-motorized. (Kent at el, 2015). In addition, improving the public transport service may have a significant impact, especially when considering the wide coverage of campus areas and the objective of reducing private transport which normally causing traffic congestion, air pollution and accidents (Balsas, 2015). Finally, this paper is a useful reference for future researchers who are interested in undertaking new case studies for enhancing the level of sustainability in transportation sector in other university campuses.

References

1. Abdul, A. & Ho, C. S. (2015). "Realizing Low Carbon Emission in the University Campus towards Energy Sustainability." Open Journal of Energy Efficiency, Vol. 04(02), pp. 15–27.

2. Akar, G., Fischer, N. & Namgung, M. (2013), "Bicycling choice and gender case study: the Ohio state university", International Journal of Sustainable Transportation, Vol. 7 No. 5, 347-365.

3. Akar G., Yujin P. & Na C. (2018). "Who is Interested in Carpooling and Why: The Importance of Individual Characteristics, Role Preferences and Carpool Markets", SAGE Journals, Vol. 2 pp. 6-72.

4. Alexandre, B., Shaheen, S., Cohen, & Adam. (2018) "The Benefit of Car Pooling", eScholarship.

5. Armstrong, B, Davison, G, de Vos Malan J, Gleeson, B & Godfrey B (2015). "Delivering sustainable urban mobility, report for the Australian Council of Learned Academies, Australian Council of Learned Academies, Melbourne", The National Academies of Science Engineering Medicine.

6. Asadul, H., Amelia, C., Tunazzina, S. (2017). Environmental sustainability practices in South Asian university campuses: an exploratory study on Bangladeshi universities. Environment, Development and Sustainability 19:6, 2163-2180.

7. Atkins, P., Marson, R., & Brann B. (2015). State of Australian cities 2014–15: progress in Australian regions, Australian Government Department of Infrastructure and Regional Development, Canberra.

8. Balsas, C. (2015), "Sustainable transportation planning, a new academic specialization in the USA", International Journal of Transportation Science and Technology, Vol. 4 No. 1, pp. 1-16.

9. Bhatti, A. R., Salam, Z., Abdul Aziz, M. J., & Yee, K. P. (2016). "A Comprehensive Overview of Electric Vehicle Charging using Renewable Energy." International Journal of Power Electronics and Drive System, Vol. 7(1), pp. 114–123.

10. Brough, A. R., Wilkie, J. E. B., Ma, J., Isaac, M. S., & Gal, D. (2016). "Is Eco-Friendly Unmanly? The Green-Feminine Stereotype and Its Effect on Sustainable Consumption." Journal of Consumer Research, Vol. 43(4), pp. 567–582.

11. Cattaneo, M., Mattia, C., Malighetti, P., Paolo, M., Chiara, M., Stefano, P. (2018). Students' mobility attitudes and sustainable transport mode choice. International Journal of Sustainability in Higher Education 19:5, 942-962.

12. Chenerita, A., Anjasmara, N., & Nugroho, A. (2018). "The Road Access Service (Pedestrian Ways) For Disabled." Advances in Transportation and Logistics Research, Vol. 1, pp. 1–5.

13. Dhar, S., Pathak, M., & Shukla, P. R. (2017). "Electric vehicles and Indias low carbon passenger transport: a long-term co-benefits assessment." Journal of Cleaner Production, Vol. 146, pp. 139–148.

14. Dehghanmongabadi, A & Hoşkara, Ş,. (2018). Challenges of Promoting Sustainable Mobility on University Campuses: The Case of Eastern Mediterranean University. Sustainability.10, pp. 4842

15. Eom, H.., Iseki, H., Warner, C. (2017). University Transport Demand Management: Travel Options Toward Better Sustainable Campus Environment. 10.13140/RG.2.2.30734.00324.

16. Er, A.C., & Karudan, R. (2018). Promoting campus sustainability: a conceptual framework for the assessment of campus sustainability. Conference Proceeding

17. Forsyth, A., & Oakes, J. M. (2015). "Cycling, the Built Environment, and Health: Result of a Midwestern Study." Journal International Journal of Sustainable Transportation, Vol. 9(1), pp. 49–58.

18. Freitas B.G., L. A., S.Ferreira, S. dos, Freitas R. Q., B. Januario, R. S., Alves, R. C., Silva, A. C., Da Silva, S. G. (n.d.). "Effect of Self-Selected and Imposed-Intensity Walking Programs on Fat Oxidation in Obese Women." Journal of Exercise Physiology, Vol. 18(1), pp. 62–69.

19. Gianneti, B., Luis, V., Nora E. Munguia, M.W., Andrea G. Z., Sara, P.V., & Bernd, D. (2015). "Sustainable transportation strategies for decoupling road vehicle transport and carbon dioxide emissions", Emerald Insight.

20. Gining, R. A. J. M., Fauzi, S. S. M., Hadi, A. F. A., Razak, M. Z. A., & Jamaluddin, M. N. F. (2018). "Design and Development of Disabled Parking System for Smart City." Journal of Physics: Conference Series, Vol. 1019, pp. 1–7.

21. Gudmundsson, H., & Hall, Ralph & Marsden, G. & Zietsman, J. (2015). Sustainable Transportation: Indicators, Frameworks, and Performance Management. 10.1007/978-3-662-46924-8.

22. Hussin, R., & Kunjuraman, V. (2015). Exploring strategies for sustainable 'ecocampus': The experience of Universiti Malaysia Sabah. Malaysian Journal of Society and Space.

23. Ian Vince McLoughlin, I. Komang, N., Leong, H. K., Quang, H. N., Bharath, S., & Wei Zeng, C. Y. (2018). "Campus Mobility for the Future: The Electric Bicycle", Journal of Transportation Technologies, Vol. 2 pp. 1-2.

24. Jog, Y., Sajeev, A., Vidwans, S., & Mallick, C. (2015). "Understanding Smart and Automated Parking Technology. "International Journal of u- and e-Service, Science and Technology, Vol. 8(2), pp. 251–262.

25. Jung, S., Qin, X., & Oh, C. (2016). "Improving strategic policies for pedestrian safety enhancement using classification tree modeling." Transportation Research Part A: Policy and Practice, Vol. 85, pp. 53–64.

26. Kaplan, D. H. (2015). "Transportation sustainability on a university campus." International Journal of Sustainability in Higher Education, Vol. 16(2), pp. 173–186.

27. Keat, L. K., Yaacob, N. M., & Hashim, N. R. (2016). "Campus Walkability in Malaysian Public Universities: A Case-Study of Universiti Malaya." Planning Malaysia Journal, Vol. 14(5), pp. 101–114.

28. Kelarestaghi, Kaveh, B., Alireza, E., Kevin P., & Heaslip. (2019). Cycling usage and frequency determinants in college campuses. Cities 90, 216-228.

29. Kent, J., & Robyn, D. (2015). "Practice and public–private partnerships in sustainable transport governance: The case of car sharing in Sydney, Australia", Science Direct, Vol 40, pp. 58-64.

30. Kim Daniel H. (2016). "Introduction of System Thinking", Pegasus Communication Inc.

31. Krzepota, J., Biernat, E., & Florkiewicz, B. (n.d.). "The Relationship Between Levels of Physical Activity and Quality of Life Among Students of The University of The Third Age." Central European Journal of Public Health, Vol. 23, pp. 335–339.

32. Lebeau, P., Cauwer, C. D., Mierlo, J. V., Macharis, C., Verbeke, W., & Coosemans, T. (2015). "Conventional, Hybrid, or Electric Vehicles: Which Technology for an Urban Distribution Centre?" The Scientific World Journal, Vol. 2015, pp. 1–11.

33. Low, S.T., Abdul Hakim, M., Weng, W. C. (2012) "Proposed implementation strategies for energy sustainability on a Malaysian university campus", Business Strategy Series, Vol. 13 Issue: 5, 208-214.

34. Mahayudin, R., & Yazid, M., & Mohd Yunos, M. Y., & Azree, Md & Othuman, M., Md Azree & Mohd tahir, O. (2015). Developing a Sustainable Campus Landscape Criteria: An Evaluation Universiti Pendidikan Sultan Idris as a Green Campus. Advances in Environmental Biology. 9.

35. Mohammadreza, A. K., Frank, M., Hoda, D. (2015). Socio-environmental performance of transportation systems. Management of Environmental Quality: An International Journal 26:6, 826-851.

36. Muhieldeen, M.W., Adam, N.M., Salleh, E., Tang, S.H. and Kwong, Q.J. (2008), ''Student behavior that leads to energy abuse at a teaching institution in Malaysia'', paper presented at the International Seminar in Sustainable Environment & Architecture (9th ISESEE 2008: Humanity and Technology), Uitm Shah Alam.

37. Mwakalonge, J., Siuhi, S., & White, J. (2015). "Distracted walking: Examining the extent to pedestrian safety problems." Journal of Traffic and Transportation Engineering (English Edition), Vol. 2(5), pp. 327–337.

38. Namgung, H. J. (2019). The influence of attitudes on university bicycle commuting: Considering bicycling experience levels. International Journal of Sustainable Transportation 13:5, 363-377.

39. Nandarani, M., & Harold, A. (2016). Using energy profiles to identify university energy reduction opportunities. International Journal of Sustainability in Higher Education **17**:2, 188-207.

40. Nir, B., Nurit C. (2018). Changing trip behavior in a higher education institution: The role of parking fees. International Journal of Sustainable Transportation 19, 1-10.

41. Nusrat, C., Chowdhury, Akram, H., Michela, L., & Wahiba, Y. (2018). "Optimization of Solar Energy System for the Electric Vehicle at University Campus in Dhaka, Bangladesh," Energies, MDPI, Open Access Journal, vol. 11(9), pages 1-10, September.

42. Ojo, T. K., Amoako, S. R., & Agyeman, W. (2015). "Students' satisfaction of campus shuttling bus services: A Qualbus Approach." Management Research and Practice, Vol. 7(1), pp. 68–79.

43. Othman, S. S. (2015, March 13). "Disabled - friendly Malaysia: Improve transport facilities for this group." Disabled - Friendly Malaysia: Improve Transport Facilities for This Group. Retrieved from https://www.nst.com.my/news/2015/09/disabled-friendly-malaysia-improve-transport-facilities-group

44. Panter, J., Heinen, E., Mackett, R., & Ogilvie, D. (2016). "Impact of New Transport Infrastructure on Walking, Cycling and Physical Activity." American Journal of Preventive Medicine, Vol. 50(2), pp. 45–53.

45. Parking and Transportation. (2018, June). Retrieved December 4, 2019, from https://transportation.uiowa.edu/bionic-bus-passenger-guide.

46. Pinthong, J., Limsuwan, K., & Stitmannaithum, B. (2018). "Green Transportation System to Promote Sustainable Lifestyle in Chulalongkorn University." E3s Web of Conferences, Vol. 48, pp. 1–3.

47. Place, C. (2019, November 29). "Light Up Your Bike - AGAIN!!" Retrieved December 7, 2019, from https://www.dublincycling.com/events/light-your-bike-again.

48. Pucher, J., & Buehler, R. (2017). "Cycling towards a more sustainable transport future." Journal Transport Reviews, Vol. 37(6), pp. 689–694.

49. Rahman, F., Chowdhury, T. D., Haque, T., Rahman, R., & Islam, A. (2017). "Identifying Existing Bus Service Condition and Analyzing Customer Satisfaction of Bus Service in Dhaka City." Journal of Transportation Technologies, Vol. 07(02), pp. 107–122.

50. Sani, R. (2019, January 30). "Greening the campus." New Straits Times. Retrieved from https://www.nst.com.my/education/2019/01/455787/greening-campus

51. Selima, S., Hyojin, K., Nastaran, P., & Firoozeh, K. (2018). Geographical Assessment of Low-Carbon Transportation Modes: A Case Study from a Commuter University. Sustainability 10:8, 26-46.

52. Setiono, & Yulianto, Budi. (2018). Application of android-based parking violations reporting system to support green campus program. MATEC Web of Conferences. 195.04016.10.1051/matecconf/201819504016.

53. Sharifi, M. S., Stuart, D., Christensen, K., & Chen, A. (2016). "Time Headway Modeling and Capacity Analysis of Pedestrian Facilities Involving Individuals with Disabilities." Transportation Research Record: Journal of the Transportation Research Board, Vol. 2553(1), pp. 41–51.

54. Shields, M. M., Thomas, K. H., Paschal, A. undefined, Tucker, M. undefined, Leeper, J. undefined, & Usdan, S. undefined. (2017). "Promoting Campus Cycling for Outdoor Recreation and Transportation: Investigating Factors Influencing Student Bicycle Usage on a Large, Southeastern University from an Ecological Perspective." Journal of Outdoor Recreation, Education, and Leadership, Vol. 9(1), pp. 98–112.

55. Sundram V.P.K., Atika, S.B. and Akmal, A.O (2017), "Green Supply Chain Management Practices in Malaysia Manufacturing Industry", International Journal of Supply Chain Management, Vol.6 No.2, 89-95.

56. Sundram, V.P.K., Hashim, N., Shariff, S.H., Pujati, A. & Ardiansari, A. (2021). "Sustainable transportation on university campus: A case at UiTM Selangor, Puncak Alam Campus, Malaysia and Universitas Negeri Semarang, Indonesia". Asian Journal of University Education. Vol. 17, No. 2, 262-272.

57. Suhaimi, M. Z., M. Tohid, U., Kinson, A. F., Johari, N., A. Rahman, F. Z., & Mahdzar, M. (2017). "Effects of Stair-Climb Marathon on Participants: A Case Study of Step-Up Event." Journal of Academia UiTM Negeri Sembilan, Vol. 5, pp. 105–117.

58. Wibawa, B. A., & Widiastuti, K. (2019). "Obstacles of Accessibility for the Disabled People in the Campus 1 UPGRIS." Journal of Architectural Design and Urbanism, Vol. 1(2), pp. 34–43.

59. Wilson, O., Vairo, N., Bopp, M., Sims, D., Dutt, K., & Pinkos, B. (2018). "Best practices for promoting cycling amongst university students and employees." Journal of Transport & Health, Vol. 9, pp. 234–243.

60. Yousaf, K., Durairajah, V., & Gobee, S. (n.d.). "Smart Parking System Using Vision System for Disable Drivers (OKU)." ARPN Journal of Engineering and Applied Sciences, Vol. 11, pp. 3362–3365.

61. Zainol, H. M., Isa, H. R. M., Sakip, S. undefined, & Azmi, A. undefined. (2019). "Social Sustainable Accessibility for Disabled Person through Sustainable Development Goals in Malaysia." Asian Journal of Quality of Life, Vol. 4(16), pp. 47–57.