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Challenges of Promoting Sustainable Mobility on University Campuses: The Case of Eastern Mediterranean University

Abolfazl Dehghanmongabadi [1,*] and Şebnem Hoşkara [1,2]

[1] Department of Architecture, Faculty of Architecture, Eastern Mediterranean University, North Cyprus, 99450 Famagusta, Mersin 10, Turkey; sebnem.hoskara@emu.edu.tr or sebnem.hoskara@utsa.edu

[2] Urban and Regional Planning Program, Department of Architecture, College of Architecture, Construction and Planning, the University of Texas at San Antonio, San Antonio, TX 78207, USA

* Correspondence: abolfazl.dehghan@emu.edu.tr; Tel.: +90-533-886-1449

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Abstract: Universities have the extraordinary ability to generate awareness regarding all aspects of sustainability in communities. To be successful, they must first adopt and model sustainable concepts within their own campuses. Transportation is one of the most affective sectors on the level of sustainability on university campuses. In recent decades, numerous universities around the world have begun encouraging usage of active modes of transportation through various strategies. This research has a multi-faceted approach to researching proven strategies, sampling local conditions, and making context-driven recommendations. The literature review outlines the most effective strategies related to Transportation Demand Management (TDM) for promoting usage of active modes of transportation inside university campuses. After that, the condition of existing facilities and strategies as well as commuters' propensities related to active modes of transportation in the Eastern Mediterranean University (EMU) campus are evaluated using both qualitative and quantitative methods. The results include a set of recommendations and a framework for administrating, implementing, and enhancing a sustainable transportation system thereby increasing the commuter's use of sustainable active modes of transportation to, from, and within the university campus.

Keywords: sustainability; transportation; sustainable modes of transportation; university campus; EMU

1. Introduction

Amid the range of its modes, transportation is capable of providing the basic requirements of safety, well-being, comfort, health, economic growth, and social development to communities in varying degrees. Some modes do so more efficiently than others but all modes increase mobility and access to services, resources, other people, opportunities, and markets [1–5]. Unfortunately, the transportation systems and planning approaches currently used in developing and developed countries harbor pressing concerns and menace sustainability at the global level [3,5]. Due to the ramifications of poor transportation systems, it is widely accepted that urgent changes in travel modes, policies, and behaviors are crucial for mitigating transportation's externalities and reducing negative transport-related impacts [3,6,7]. Based on the concept of sustainable development, sustainable transportation emerged from the transportation sector to address these issues [3,6,8].

Universities are unique communities with rapidly-expanding populations in need of transportation options; simultaneously they are capable of engendering an educational milieu for sustainability [9–12]. As a result of increased university attendance, the number of commuters to and from university campuses has likewise increased. Disproportionately, the majority of these commuters use private

automobiles [13]. The dependency on private automobiles is directly related to the lack of appropriate infrastructures and strategies for shared other modes of transportation [14].

This level of automobile usage directly and indirectly impacts the quality of the environment in university campuses and their surrounding neighborhoods. Spatial impacts include congestion; poor- or inaccessibility; occupation of land area for parking; air and noise pollution; energy consumption; and deterioration of visual and natural conditions. In addition to these environmental impacts, there are also many tangible and intangible social impacts such as declining health of staff, students, and neighbors; disturbance of work, study, living, and teaching environments; reduced personal safety and increased number of accidents; waste of time during periods of traffic congestion; and growth of mental health problems [14–16]. These are all externalities of unsustainable transportation systems. Fortunately, awareness about their negative impacts has greatly increased along with special attempts by university planners to supply sustainable transportation options [9,13,17]. Consideration of concerns related to the transportation sector is a first step in moving towards achieving sustainability on university campuses.

The aim of this research is to promote active modes of transportation for commuting to and from as well as transiting within university campuses in response to the challenges of enhancing sustainability in the transportation sector. In order to achieve this aim, the objectives are:

1. Outline and argue for the benefits of sustainable transportation within university campuses;
2. Identify successful strategies for promoting the use of active modes of transportation;
3. Isolate challenges related to existing active modes of transportation inside the Eastern Mediterranean University (EMU) campus;
4. Collect input from university staff and students to ascertain and explain recommendations that increase the use of active modes of transportation inside university campuses; and
5. Provide a planning framework towards achieving sustainable transportation on university campuses.

The following research questions helped form the aim and its objectives:

1. What are the ways of enhancing usage levels of active modes of transportation inside university campuses?
2. What are the determinative steps that must be considered to achieve an efficient, sustainable transportation sector within university campuses?

2. Literature Review

Over recent years, the population of universities has increased throughout the world and a considerable number of institutions have moved toward becoming more sustainable in order to reduce their own negative impacts on the environment, economy, and society [18,19]. These educational institutions, with an interest in developing their role in society, aim to be sustainable models for other communities [12]. Unwittingly, one of their weakest points in modelling sustainability is the daily movement of their populations by automobiles to and from, and within the campus [18,20,21]. Transportation issues are, therefore, one of the biggest challenges within university campuses and their surrounding communities [22]. For these reasons, numerous universities have started to plan a shift in their transportation sectors away from the use of private automobiles and towards the use of sustainable modes of transportation [18,22,23].

Promoting sustainable modes of transportation for university campuses has many environmental, social, and economic benefits, but the educational benefits of this effort are most profound since internally they have a duty to educate and foster the next generation of decision makers [19,23] and externally they have a duty to spread the most progressive knowledge into general usage. In view of this influential position, they should act as a laboratory for testing new ideas and strategies related to active modes of transportation [9,12,13,21]. Besides, transportation strategies which are introduced in university campuses are often transferred to and promoted in other parts of the community when

students, having studied and lived in the campus environment, carry what they learned both inside and outside the classroom to the rest of the world. For both students and staff, opportunities to learn about and become familiar with sustainable transportation systems and strategies influence their attitudes and behaviors in the future [24].

Since promoting a multimodal and efficient transportation system within university campuses will be the main tool for altering the transit attitudes and behaviors of graduates for eventual transfer of strategies into their communities and daily life [25–27], there is an indispensable need for inclusion of Transportation Demand Management (TDM) strategies in comprehensive transportation system plans for university campuses. TDM appeared as a package in a series of executive strategies to solve problems related to the transportation sector. TDM encourages strategies for better management to promote more effective and environmentally-conscious attitudes about transportation. It is defined as the art of changing transportation behavior [28]. TDM strategies have numerous benefits such as diminished consumption of energy resources, preservation of natural resources and the environment, efficient use of land, decreased traffic accidents and congestion, a decline in pollution, increased transport options, and overall improvement in livability and social equity [28,29]. TDM strategies must also provide a balance between travel choice and the motivation to decrease trips using private cars [23]. The following sections describe several TDM strategies 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 [22,30].

(A) Parking Management and Utilization

In contemporary life, issues related to parking are one of the greatest common problems faced by users and planners of university campuses. Issues related to parking facilities can be divided into two different categories: supply and management [23,31]. Management approaches play a crucial role in the solution of the parking problem and they need not only supply solutions, but also support and provide more strategies which move toward a more efficient use of existing parking capacity.

Management approaches are also essential to a parking supply program [26,32]. Effective parking management within TDM has a significant influence, leading to declines in requests for parking spaces and decreases in parking costs on university campuses [22,31]. Additionally, good parking management offers social, environmental, and economic benefits meaning, for example, increasing livability, supporting social equity, improving service efficiency and quality, decreasing land use, increasing walkability, and saving costs [20,28,31]. Three proven approaches to parking management within university campuses are described as follows [23,26,30].

One of the most effective strategies within densely populated areas such as university campuses is parking supply and restriction. This strategy has a direct effect on travel behavior and the total number of automobiles with access to the campus [23,33]. When parking supply within the campus does not meet the demand, users adapt to using parking outside the campus or choose alternate modes of transportation for their commutes [34]. In most cases, the supply of fewer parking areas within university campuses encourages commuters to use sustainable modes of transportation such as walking, cycling, and public transportation [22,23].

Pricing of parking spots is another approach within university campuses that deters use because it means private car owners must pay fees to use parking areas. Universities that charge both staff and students for usage of parking facilities have better coverage of the costs of parking supply and management as well as reductions in demand for parking and increased usage of sustainable modes of transportation by commuters [23,26,34].

Inside university campuses, the location of parking areas can play a key role in the number of private car users; if parking areas are located only in the central or peripheral areas of the campus, commuters are denied the opportunity of convenience parking close to buildings and their destinations [23]. In weighing their options, this strategy encourages car users—especially ambivalent commuters—to choose sustainable modes of transportation to save their time and potentially gain

more direct access to their destination. Besides reducing private car usage, strategic parking locations can save transportation costs for both the commuters and the universities [22,33].

(B) Carpooling and Vanpooling Program

One of the more recognized TDM strategies is the carpool and vanpool program, which provides the opportunity for users of single-occupancy private automobiles to move away from the need for individual car trips. This strategy suggests that two or more people, who share a common source, route, and destination, can use a single automobile [35]. This strategy usually involves people who live and work in the same and/or nearby neighborhoods [22,36]. Joint users of this strategy have a responsibility to share the costs of fuel and parking. This strategy is the most common mode used for trips that are not well supported by public transportation. The carpool program is most useful in small towns and rural areas and when people are commuting from peripheral areas where there are less public transportation services. This system can also be very useful for university campuses which are unique and uniform communities [22]. It has many tangible and intangible benefits such as cost cutting for fuel and parking, time saving, opportunities for more social interactions, reductions in stress, reduction in congestion and emissions, the conservation of energy, and support of a healthier future [22,35].

(C) Public Transportation Strategy (U-Pass Program)

Public transportation strategies like the U-Pass Program are one of the most popular of the TDM strategies for university campuses. The U-Pass Program's main goal is to encourage all participants to use public transportation modes (buses, trains, or light rail) and/or active transportation modes (bicycles, walking, etc.) rather than commuting by private cars [27,37]; it does so by subsidizing the costs of public transportation and increasing accessibility for more potential users. The U-Pass strategy has been effective and successful in terms of increasing the number of public transportation users and decreasing the demand for parking facilities on university campuses [33,38]. According to American University Officials, the top five reasons to apply the U-Pass Program are: declines in parking demand and traffic; improved access to housing and the university campus by all members; decreased costs of travel and student education; increased transportation justice, and enhanced usage levels of sustainable, active modes of transportation [37,38].

In addition, the U-Pass program has several advantages for universities such as Supports universities in achieving their environmental responsibilities; Diminishes the demand for parking areas, hence universities have more land to use for educational goals and Reduces parking spaces and traffic impact on surrounding areas [22,33,38].

Importantly, for university–community relations, U-Pass programs offer many benefits to the surrounding community like reducing motorized vehicle trips, enhancing physical activity, reducing traffic, and minimizing air and noise pollution [22,38]. There are several affective factors in the process of promoting use of public transportation that they have influence on the quality of services such as quality of shelters, number and location of shelters, lighting, seating elements, route/schedule information, signage, and timing [18,20–23].

An example of a U-Pass Program was created by the University of British Columbia (UBC)—the third largest university in Canada and one of the major traffic generators in the Vancouver region [22]. In September 1997, UBC established, "the Trip Reduction, Research, Education, and Knowledge (TREK) program center [27]." The main aim of TREK was to identify convenient and cost-effective approaches for commuting to and from the university campus without the use of private cars. While UBC's daytime population increased 51 percent during the 16 years between 1997 till 2013, TREK continued to follow the guidelines of TDM, focusing on the increase and improvement of effective transit services and transportation alternatives for university students and staff. The growing numbers of transit riders to and from the UBC campus was supported by increases in parking costs, a reduction in the supply of parking spaces, and transit fare discounts leading to further reductions in parking demand and traffic

congestion [27]. According to a UBC Transportation Status Report from 2013, the U-Pass program was successful; there had been a significant increase in transit ridership and a decrease in private vehicle traffic. The main challenge TREK implementation faced was the increased demand for bus services, which demonstrated that UBC community members were very keen to join the program [22,27].

(D) Promoting Bicycle Use and Creating a Pedestrian Friendly Campus

The best modes of transportation to substitute for private car trips, particularly within university campuses, are walking and cycling [22,39,40] because these modes preserve independent choice of route and schedule. Walking is potentially the easiest adaptation because during any other mode of transit to university campuses, all commuters also become pedestrians to reach their final destination from parking place for drivers, bike station for cyclists, and bus or train station for users of public transportation. Already, because walking is an inseparable mode and an intrinsic part of all modes of transportation with suitable pedestrian accommodations at least partially in place, a university's promotion of this mode will be more cost efficient and spatially feasible. For promoting walking among university's members, various affective factors must be considered that the main of them are related to the quality of infrastructures and safety. These main factors include continuity of pedestrian paths, quality of pavements, safety along sidewalks, lighting, safety at interaction points, pedestrian signage, width of pedestrian paths, disabled-users' accessibility, quality of crosswalks, and shading element [22,34,41,42]. Similarly, the promotion of cycling needs motivator factors such as safe and separate bike lines, well-defined network among bike lines, appropriate lighting, signage and shading, safe and well-designed bicycle stations and racks, showering facilities, and repair and accessory facilities [22,36,42–46]. Bicycle infrastructure can be low-cost and accommodated spatially on university campuses by initially employing on-street striping and placing simple bike racks near high-traffic nodes. Still, convincing commuters to walk or cycle over longer distances and consume more time may require more complex pairings of TDM strategies with pedestrian and bicycle amenities. Pairing these modes with public transportation by providing well-defined walking and cycling facilities has been shown to be effective for longer travel; numerous researchers noted that commuters to university campuses use public transport more when such facilities are conveniently provided [22,32,40]. Planners' utilization of TDM guidelines for pedestrian- and bicycle-friendly campuses is a widely-used means of enhancing usage levels of active modes of transportation at university campuses [22].

In this respect, this study by focusing on the strategies and their main factors in Table 1 assesses the quality of service related to existing active modes of transportation in the case study.

Table 1. Transportation Demand Management (TDM) strategies commonly used on university campuses and effective factors.

Strategies	Factors	References
Parking Management and Utilization • Parking supply and restriction • Pricing of parking spots • Location of parking areas	-	[23,26,30]
Carpooling and Vanpooling	-	[22,35,36]
Public Transportation	• Quality of shelters • Number and location of shelters • Lighting and seating elements • Route/schedule information • Signage and timing	[18,20–23]

Table 1. *Cont.*

Strategies	Factors	References
Promoting Bicycle Use	• Safe and separate bike lines • Well defined network among bike lines • Appropriate lighting, signage, and shading • Safe and well-designed bicycle stations and racks • Showering facilities • Repair and accessory facilities	[22,36,42–46]
Creating a Pedestrian Friendly Campus	• Continuity of pedestrian paths • Quality of pavements and safety along sidewalks • Lighting and pedestrian signage • Safety at interaction points width of pedestrian paths • Disabled-users accessibility • Quality of crosswalks and shading element	[22,34,41,42]

3. Materials and Methods

The frame of this research is based on the case study method. Material for the case study was gathered from the study-area profile with a questionnaire survey and interviews reflecting the aim, objectives, and questions [47,48]. Four techniques made it possible to gather the necessary information: literature review, semi-structured key informant interviews, photo-elicitation, and questionnaire survey. After that, "Statistical Package for the Social Sciences (SPSS) Statistics software" was employed to analyze the collected data. To assure the quality of the research, the triangulation method was used to collect sufficiently diverse data sets increasing the dependability of the conclusions drawn from this research. Via these complementary methods, the necessary information for recognizing the determinative factors was obtained. The determinative factors influence achievement of a sustainable transportation system based on promoting active modes of transportation within university campuses.

(a) Literature Review

The literature reviewed in this study consists of choosing sources for investigation, and comparing related works of others to develop answers to the main research questions. The review covered indexed journal articles (SCI and SSCI), books, published conference papers, and published research works (theses). The key words and phrases used to search the literature include "sustainable transportation", "university campuses", and "TDM Strategy". The literature review pursued answers to the research questions of this study and particularly subjects to incorporate into the semi-structured interviews.

(b) Semi-Structured Interviews

Semi-structured interviews are normally planned around a set of predefined open-ended questions plus additional questions that may be employed during the dialogue between interviewer and interviewee(s). Here, five questions were the focus of individual interviews with six Eastern Mediterranean University (EMU) staff members: an Environmental Affairs Administration staff member, the Campus Services coordinator, the Rector's office coordinator, the director of the Security Unit, the director of the Transportation Services Unit, and the director of the Traffic Education and Research Center. Group interviews employed the same five questions with ten professors who have expertise in the fields of urban design, transportation, architecture, and civil engineering. Questions were geared toward gaining a comprehensive understanding of university strategies and plans as well as individual perceptions of existing and potential future conditions of active commuting within and to or from the EMU campus. The five main questions are presented in the following:

- Is there any future plan to decrease commuting to the campus by private car?
- Is there any program to improve the quality of services related to active modes of transportation inside the campus? How do you see the quality of services?

- Is there any program to encouraging carpooling and vanpooling among students and staff?
- Is there a Campus Planning Unit in the University?
- How are the decisions about any development in campus being taken?

During each interview, the personal suggestions of the interviewees on related topics based on their expertise have also been asked. Although the same questions were asked to all groups, during the interviews with the professors, the discussions have been deeper about the future of planning and transportation modes within EMU campus.

(c) Photo Elicitation

Photo elicitation is a method that uses photos, videos, and other forms of visual symbols and provides the opportunity for researchers to elicit comments from participants based on what they observe in the imagery [49,50]. In the context of this study, photos and maps were shown to participants to assist them in expressing their awareness of elements of or concerns, issues, and opportunities for active transport within EMU campus. This method helped respondents to focus on and improve the communication of important details to the interviewer [49,50]. The presented map of EMU delineated districts, building distribution, streets within the campus, and boundary lines of the campus. Photographs, as presented to the participants, displayed features of motor vehicle streets, pedestrian pathways and sidewalks, junctions, street design features, bicycle lanes, transit facilities, and parking areas. By using this imagery, richer awareness and clearer interpretation of respondents' viewpoints about existing conditions were possible. All these photos used in the interview were taken by the authors.

(d) Questionnaire survey

A questionnaire survey was conducted with the aim of obtaining feedback from EMU students, faculty and staff regarding their dominant modes of transportation and their feelings about the current infrastructure and commuting environment of the EMU campus. Feedback from these groups, the target users, is indispensable in making certain that their needs and concerns are addressed in the future planning, strategies, and policies. The four-section questionnaire survey focused on active modes of transportation and their relevant facilities at the EMU campus. Section 1 consisted of eleven general questions, for instance, gender, age group, level of study, and location of living. Section 2 asked each respondent to select different modes of transportation for commuting within and to or from the campus. Section 3 focused on the quality of infrastructure and service related to active modes of transportation with 26 rating scale questions associated with walking, cycling, and public transport. Finally, at the end of the questionnaire survey, participants were asked to list their personal expectations and suggestions with four open-ended questions (Appendix A). This questionnaire survey was completed in the spring academic semester of 2018. Participants were selected to represent all of the 39 academic departments to adequately represent every part of the campus; 15 students and five staff members were selected randomly from each department to fill-in the questionnaire survey resulting in the sample size of 585 students and 195 staff members. Although the questionnaire survey included, in its first section, general but detailed questions about the users such as their gender, age groups, and education level, the authors have decided to limit the demographic perspectives of the users within the scope of this paper, with the belief that, these would not serve directly for the main purpose of the research presented here. Table 2 shows a summary of the demographic profiles of the respondents.

Table 2. The demographic profile of the respondents (Sample size 780). EMU: Eastern Mediterranean University.

Characteristic		Staff		Students	
		N	Sample (%)	N	Sample (%)
Gender					
1	Female	101	51.8	275	47
2	Male	94	48.2	310	53
Age group					
1	Under 25 years	-	-	378	64.6
2	26–35 years	24	12.3	207	35.4
3	36–45 years	65	33.3	-	-
4	46–60 years	100	51.3	-	-
5	61 and above	6	3.1	-	-
Location of living					
1	Area 1 (< 1 Km from the EMU campus)	0	0	396	67.7
2	Area 2 (1 < 5 Km from the EMU campus)	92	47.17	167	28.5
3	Area 3 (> 5 Km from the EMU campus)	103	52.83	22	3.8

4. Introducing and Assessing EMU Campus' Existing Quality of Services and Strategies Related to Active Modes of Transportation

Eastern Mediterranean University (EMU), established in 1979, is the largest employer in Famagusta, North Cyprus, with a daily population of approximately 20,000 students and 1100 faculty and staff members. Famagusta is located on the east coast of the Mediterranean island and has a population of approximately 55,000. As such, one third of the population of Famagusta is somehow connected to EMU.

The area of the campus, which is divided into the adjacent though segregated north and south sections, is around 2200 acres. The northern section is primary in terms of the density of the buildings and facilities while the southern section houses fewer buildings and facilities but has undeveloped land for future development and campus expansion. The campus is approximately five kilometers from the historic city center (the Walled City) but is well-connected by continuous development along two arterial roads, Salamis Road and Lefkosa Road (Figure 1).

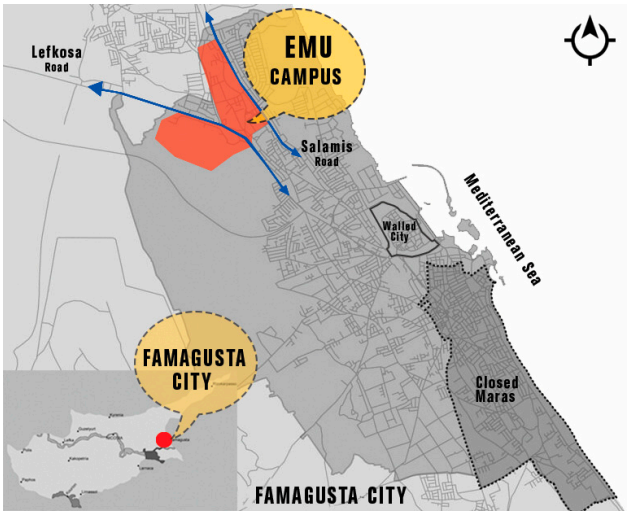


Figure 1. The Location of Eastern Mediterranean University Campus in Famagusta (Source: Authors).

EMU's social, economic, and spatial relationships with Famagusta shape its desire to adopt sustainability into its transportation sector and facilitate accessibility while helping to cultivate the interactions and conditions that make its campus a vibrant place of intellectual exchange and

innovation. Existing transportation system for EMU and Famagusta city is planned more around automobiles than active modes. Within the scope of this research, an assessment of the existing situation of the transportation sector and related strategies at EMU campus was conducted. The assessment sought to identify and understand existing weaknesses, strengths, and opportunities of integration and implementation of sustainable transportation for the campus. At EMU, existing strategies and facilities related to active modes of transportation include parking controls, walking, cycling, and public transportation within the campus while the provision of carpooling and vanpooling elements are considered.

5. Results

There are four transportation modes that EMU's students and staff utilize for commuting to, from, and inside the campus: walking, cycling, public buses, and personal automobiles. The levels of commuting by each mode among students and staff are based on results of the questionnaire survey and presented in Table 3.

Table 3. Commuting Patterns of EMU's Students and Staff.

Modes	Commuter Category	Commute between Campus and City	Commuting inside Campus
Pedestrian	Staff	1%	60%
	Students	47%	80%
Bicycle	Staff	0%	0%
	Students	8%	5%
Public Transport	Staff	2%	0%
	Students	29%	7%
Private Cars	Staff	97%	40%
	Students	16%	8%

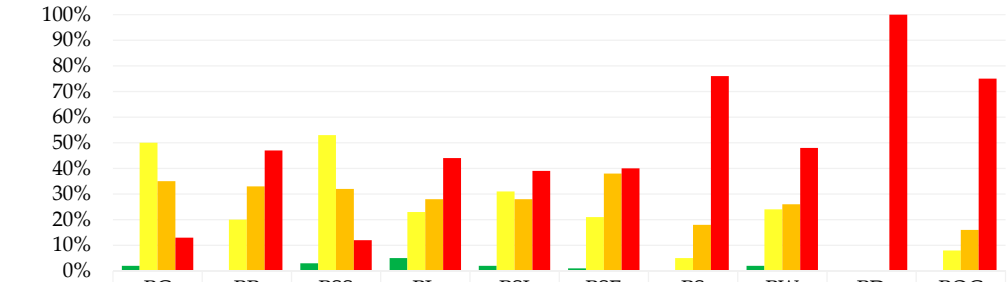
Percentages show that most EMU students commute to the campus from the city and transit inside the campus by walking. According to the questionnaire survey, most students live in on-campus dormitories or in nearby (within five kilometers) residential districts. On the other hand, most staff commute to campus by private car; they mostly live in suburban areas without sufficient public transport and travel more than five kilometers to reach the university.

5.1. Quality of Services Related to Existing Sustainable Modes of Transportation

To assess the quality of services of existing active modes of transportation within the EMU campus, each mode was evaluated. From the questionnaire survey and interviews of EMU's students and staff, their perspectives of the physical conditions of infrastructure and facilities related to the active modes of transportation are compiled and described in the following sections.

5.1.1. Quality of Services Related to Pedestrians

The level of users' satisfaction related to quality of physical components and the general existing situation of facilities related to pedestrians inside EMU campus include continuity of pedestrian paths (PC), quality of pavements (PP), safety along sidewalks (PSS), lighting (PL), safety at interaction points (PSI), pedestrian signage (PS), width of pedestrian paths (PW), disabled-users accessibility (PD), quality of crosswalks (PQC), and shading element (PSE) were evaluated and are summarized in Figure 2.



	PC	PP	PSS	PL	PSI	PSE	PS	PW	PD	PQC
Excelent	2%	0%	3%	5%	2%	1%	0%	2%	0%	0%
Good	50%	20%	53%	23%	31%	21%	5%	24%	0%	8%
Fair	35%	33%	32%	28%	28%	38%	18%	26%	0%	16%
Poor	13%	47%	12%	44%	39%	40%	76%	48%	100%	75%

Figure 2. Quality of facilities and services related to pedestrian inside EMU campus (Source: Authors). Pedestrian paths (PC), quality of pavements (PP), safety along sidewalks (PSS), lighting (PL), safety at interaction points (PSI), pedestrian signage (PS), width of pedestrian paths (PW), disabled-users accessibility (PD), quality of crosswalks (PQC), and shading element (PSE).

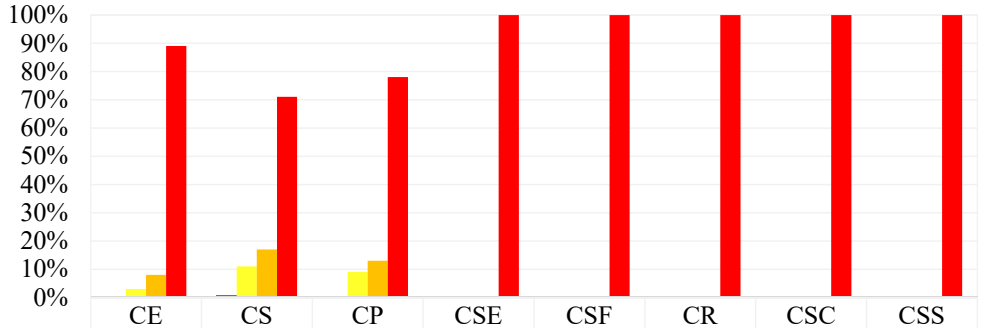
According to the results, continuity and safety along pedestrian paths are mentioned by respondents as the only motivating factors that encourage commuting by walking. Meanwhile the quality of the pavement, lighting, shading elements, pedestrian signage, width of pedestrian paths, accessibility by disable users, and crosswalk quality along the pedestrian paths are declared by responders to be barriers that directly affect efficiency of walking on the campus. Figure 3 includes four pictures is showing the quality of payments, shading elements and width of pedestrian paths inside the EMU campus. These pictures are taken from different places inside the campus.

Figure 3. Quality of payments, shading elements and width of pedestrian paths: **P1** Quality of payments along pedestrian paths within EMU Campus; **P2**–**P3** Trees being the only elements providing shade for pedestrians along the sidewalks; **P4**—Insufficient width of pedestrian paths along the main axis (Source: Authors).

5.1.2. Quality of Services Related to Cycling

The level of users' satisfaction related to the quality of existing facilities for cycling include bike lane efficiency (CE), safety along bike-share lanes (CS), bicycle parking and racks (CP), shading elements (CSE), showering facilities (CSF), repair and accessory facilities (CR), safety of bike stations (CSS), and signage for cyclists (CSC). These were observed and are summarized in Figure 4.

Based on findings of the questionnaire survey and visual analysis carried out on the site, there are no appropriate motivating factors to encourage cycling among EMU commuters. Besides the fact that bike lanes are considered to be inappropriately-shared space on vehicular roads, bicycle parking and racks is efficiently located around campus and their conditions are not always suitable for use. There is also a lack of security for bike stations, shading elements, signage for cyclists, showering facilities, and ancillary services. Figure 5 includes 6 pictures in which quality of bike lanes and stations are represented.



	CE	CS	CP	CSE	CSF	CR	CSC	CSS
Excelent	0%	1%	0%	0%	0%	0%	0%	0%
Good	3%	11%	9%	0%	0%	0%	0%	0%
Fair	8%	17%	13%	0%	0%	0%	0%	0%
Poor	89%	71%	78%	100%	100%	100%	100%	100%

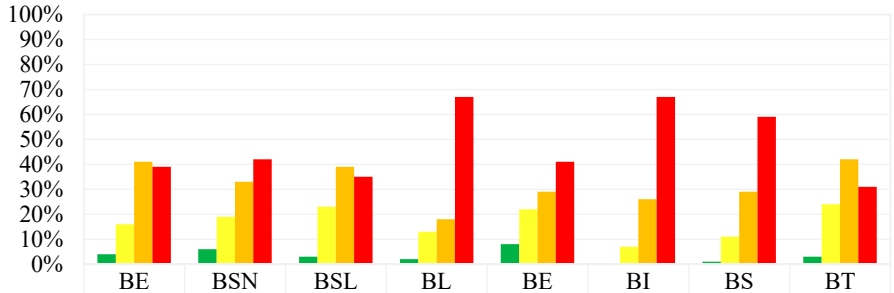
Figure 4. Quality of facilities and services related to cycling (Source: Authors). Bike lane efficiency (CE), safety along bike-share lanes (CS), bicycle parking and racks (CP), shading elements (CSE), showering facilities (CSF), repair and accessory facilities (CR), safety of bike stations (CSS), and signage for cyclists (CSC).

Figure 5. Quality of bike lanes and stations: **P1**–**P2**–**P3** Insufficient and unsafe bike lanes only partially painted with no appropriate separation from motorized vehicles; **P4**–**P5**–**P6** Bike stations and racks lacking of quality and safety within EMU Campus (Source: Authors).

5.1.3. Quality of Services Related to Public Transportation

The quality of the public transportation system on the EMU campus was evaluated for only the bus services provided by the university. EMU bus service is free of charge to students and staff and is the only heavy public transportation service in Famagusta. Assessment depended on efficiency of bus services (BE), quality of bus shelters by focusing on number of shelters on the campus (BSN) and location of shelters (BSL), quality of lighting (BL), quality of seating elements (BE), existence of route/schedule information (BI), bus signage (BS), and bus timing (BT) (Figure 6).

Results revealed that there is an overall lack of quality related to the bus service provided by EMU. Figure 7 includes 5 pictures illustrating the quality of buses and bus shelters inside EMU campus.



	BE	BSN	BSL	BL	BE	BI	BS	BT
Excelent	4%	6%	3%	2%	8%	0%	1%	3%
Good	16%	19%	23%	13%	22%	7%	11%	24%
Fair	41%	33%	39%	18%	29%	26%	29%	42%
Poor	39%	42%	35%	67%	41%	67%	59%	31%

Figure 6. Quality of facilities and services related to public transportation (Source: Authors). Bus services (BE), quality of bus shelters by focusing on number of shelters on the campus (BSN) and location of shelters (BSL), quality of lighting (BL), quality of seating elements (BE), existence of route/schedule information (BI), bus signage (BS), and bus timing (BT).

Figure 7. Quality of facilities related to bus service: **P1**–**P2** Low quality bus stop shelters lacking of aesthetics within EMU Campus; **P3**–**P4** Bus-stops with no shelters, no route/schedule information and seating discouraging users to use public transportation; **P5** Quality of buses within EMU Campus (Source: Authors).

Many respondents indicated that the bus service covers all destinations inside Famagusta, but that there is a lack of service for commuters who live in the suburbs. Mainly, most of the staff members living in the suburban areas do not have the opportunity to use or evaluate the services of this public transportation system.

5.2. Management Strategies Related to Transportation Context of EMU

According to the interviews conducted to understand the university's strategies and future plans in respect to the transportation sector, generally, and specifically in relation to active modes of transportation, there are no efficient and clear strategies or plans for the campus' transportation system. As explained by interviewees, decisions regarding campus transportation were made on an as-needed basis; there is no designated committee or administrative unit to investigate and make final decisions concerning campus transportation, nor to define transportation strategies.

However, there is one authority, the Security Department, responsible for decisions or proposals related to vehicular traffic and car parking areas on the campus, and another authority,

the Transportation Services Unit, manages bus transportation. The Security Department is also responsible for the maintenance and security of the car parking areas and general commuting to and from university. Besides, there are no efficient and clear strategies regards parking management and utilization. Whereas the Transportation Services Unit controls all dimensions of the bus transportation services provided to students and staff by the university.

Without decision-making authority or administrative control over campus transportation, there is also the Traffic Education and Research Center within the academic body of the university. This center was established in 1998 by the University Board of Executives with the following mission components:

- Assist the foreign EMU students and academic and administrative staff in adapting to the traffic rules and regulations of the Turkish Republic of Northern Cyprus (TRNC) by offering educational seminars.
- Conduct research and organize symposiums, congress, and conferences on traffic problems.
- Increase the awareness of people living in North Cyprus about the importance of traffic.
- Establish links with organizations working on traffic safety both in North Cyprus and abroad.

Related to the strategies for carpooling and vanpooling, the results show EMU does not have any control over or supportive strategies related to encouraging carpooling among students or staff. However, several professors are privately arranging and using carpooling for commuting to and from the campus without interference of the university management system. As for vanpooling, the Transportation Services Unit mentioned that the university does organize vanpooling for lecturers who come from other cities such as Lefkosa and Kyrenia. Despite this, there are no strong supportive strategies for this service and this service is not always provided by EMU.

During the process of this research, Urban Research and Development Center (URDC) of EMU, which was assigned by the Rectorate in November 2015 to prepare the Campus Master Plan of EMU has also conducted a broader questionnaire survey for the overall campus. The research and analysis conducted by the Campus Master Plan team, coordinated by one of the authors of this paper, also corresponds with the findings of this research which indicate that, EMU does not have an adequate transportation management body nor a sustainable traffic and transportation plan; the future of the physical development of the campus, including its traffic and transportation development strategies is still unknown. Lack of planning, until recently, can be regarded as the basic problem of the transportation system for the EMU campus. Although there is an attempt to plan the future of the Campus, the unplanned development attempts seem to continue, until the Master Plan gains a legal status.

6. Discussion and Recommendations

Based on results of the questionnaire survey, behavior observations, site surveys, and interviews, the existing motivators and barriers related to use of the active modes of transportation at EMU campus have been clarified and summarized in Table 4.

The table shows that there are many more barriers to use of active modes of transportation within the EMU campus than there are motivators. Therefore, this study, based on existing conditions and the opinions of students, faculty, and staff, provides a set of recommendations by also examining some good university practices of sustainable transportation policy, strategy, and plan establishments mainly included in the European Platform on Sustainable Urban Mobility Plans (SUMPs) under the Urban Mobility Observatory. The authors believe that, this set of recommendations may also be generalized or adopted for other cases based on their specific characteristics, which should be identified through a thorough analysis.

These recommendations are divided into two groups: 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.

Table 4. Existing motivators and barriers factors of using active modes of transportation at EMU campus based on opinions of students and staff.

	Motivators	Barriers
Pedestrian	■ Safety along pedestrian paths ■ Continuity along pedestrian paths and sidewalks	■ Suitable pavements ■ Appropriate width for pedestrian paths ■ Main/legible pedestrian path ■ Suitable shading elements ■ Safety in interaction points ■ Appropriate crosswalks ■ Appropriate lighting at night ■ Signs along pedestrian routes ■ Appropriate accessibility and facilities for disable users ■ Pedestrian zone to provide a safer area for pedestrians
Cycling	**No Motivators**	■ Appropriate and safe bike lanes and bike stations ■ Safety in interaction points ■ Appropriate lighting at night ■ Ancillary services
Public Transportation	■ Existence of free bus services	■ Appropriate bus stations ■ Appropriate timing ■ Number of bus stations along the campus ■ Facilities related to bus shelters include lighting, seating elements, route/schedule information
Management strategies	**No Motivators**	■ Lack of plan for future development ■ Control and maintenance on existing facilities ■ Strategies to encourage the use of sustainable modes of transportation ■ Lack of expert committee to get appropriate decisions

Creating a successful sustainable transportation network for university campuses is achievable through the formation of a comprehensive and efficient university management structure. University transportation management has direct influence over and the ability to provide a successful and comprehensive sustainable transportation network with appropriate strategies for the university campus. Utilizing the following indispensable phases, this process will enhance the level of sustainability in the transportation sector of university campuses.

- Provide a sustainable master plan (SMP) for the university campus., since having a master plan by considering all aspects of sustainability is main way, which a university expresses its vision for future development and utilization of campus environment.
- Create a stable, sustainable transportation committee (STC) that has control and will make decisions about all aspects of transportation on the university campus, as well as undertake consistent efforts to promote sustainable transportation strategies by focusing on shifting to sustainable modes of transportation.
- Design a University Sustainable Transportation Master Plan (U-STMP) and University Sustainable Urban Mobility Plan (U-SUMP) corresponding with a general sustainable master plan along with strategies and policies confirmed by the STC.
- Increase the level of collaboration between the STC and local organizations, especially the municipality, to make decisions promoting successful sustainable transportation strategies between the university campus and the city to encouragement of active transportation.

- Increase the level of collaboration between the university administration, STC, and governmental agencies in order to establish a price-control mechanism for public transportation modes and connect the university's efforts to city's projects in order to increase the efficiency of both.
- Develop representation of students and staff within the STC to make better decisions and provide efficient strategies that meet their needs.
- Provide a series of educational programs focusing on enhancing knowledge of students and staff about environmental, social, cultural and economic benefits of commuting by sustainable modes of transportation.

To enhance the quality of services related to active modes of transportation, the most recent version of existing standards must be considered and applied. Accordingly, development of a Sustainable Urban Mobility Plan (SUMP) which is a strategic plan aimed to provide high-quality and sustainable mobility and transport to, through and within an area, as a recent guideline in European Union is considered within recommendations. Thus, the actions listed in Table 5 are recommended for university campuses, both for EMU campus and other university campuses with no transportation policy and plans, to improve the quality of services related to active modes of transportation. The study of sustainable mobility and transportation in some European examples of university campuses indicates that, although a number of actions have been taken on the issue, which have resulted in positive improvements with in the concerned campuses (such as, a bike sharing scheme at the Aristotle University in Thessaloniki, Greece; public bicycles in the university campus of Poznan in Poland; promotion of public transport by providing information and a tax-saver commuter ticket in Cork, Ireland, etc.); none of these actions covers a comprehensive approach for improving the quality of services related to active modes of transportation. Therefore, the authors suggest that the recommendations presented above and in Table 5 should be organized within the framework of a University Sustainable Transportation Master Plan (U-STMP) and University Sustainable Urban Mobility Plan (U-SUMP) specifically prepared for the concerned university.

Active modes of transportation work most efficiently when there is strong collaboration between all modes. Convenient connections and legible access in the physical infrastructure of active modes play a crucial role in providing and encouraging use of an effectual sustainable transportation system. The following framework clarifies the general process that a university can consider when developing an efficient and sustainable transportation sector (Figure 8).

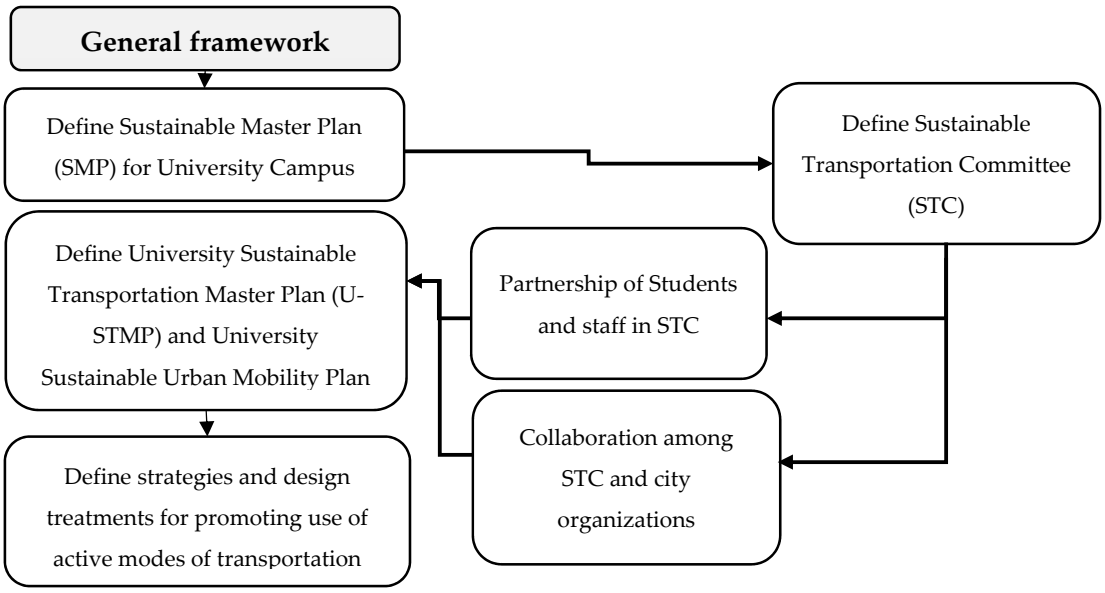


Figure 8. A general framework towards achieving an efficient, sustainable transportation sector in university campuses (Source: Authors).

Table 5. Recommendations for university campuses to improve the quality of services related to active modes of transportation under University Sustainable Transportation Master Plan (U-STMP) and University Sustainable Urban Mobility Plan (U-SUMP).

	Measures	
Pedestrian Enhancements	■ **Pedestrian areas & paths**	■ Provide pedestrian paths of appropriate width for pedestrian volumes throughout the campus; ■ Provide appropriate pedestrian-scale lighting along pedestrian paths and at intersections to increase visibility and safety; ■ Make available suitable signals and signage to help pedestrians find their way easily and safely between origins and destinations.
	■ **Enhance pedestrian crossings**	■ Design appropriate crosswalks and techniques to alert other users where pedestrians are crossing; ■ Design appropriate corner radii at intersections to balance the needs of all users and maximize the safety of pedestrians. Small-radii curbs benefit pedestrians by slowing down speeds of turning vehicle, decreasing the crossing distance, and increasing the size of waiting areas.
	■ **Design suitable curb extensions**	■ Extending the sidewalks into the street space at intersections or mid-street crossings. Curb extensions benefit pedestrians by reducing distance of pedestrian crossing, providing space for pedestrian to queue before crossing the streets, increasing visibility of pedestrians; and reducing speed and calming traffic of vehicles.
	■ **Enhance safety**	■ Design treatments such as widen sidewalks for pedestrians and provide enough space that is capable of supplying utilities and amenities for example benches, trash cans, and signs; ■ Use flashing yellow lights and different pavement textures in intersections to alert motorists to the presence of pedestrians; ■ Increase shading elements as well as archways and canopies along pedestrian ways to protect pedestrians from extreme sun exposure and precipitation; ■ Define a main pedestrian path through the campus that does not have any conflicts with motorized traffic; and ■ Define a major pedestrian-only zone in the central part of campus to provide a safe area for pedestrians.
	■ **Increase accessibility for disabled people**	■ Consider disabled users by creating appropriate pavements, signage, and curb ramps.
Cycling Enhancements	■ **Cycling lanes**	■ Design appropriate separated bike lanes or provide marked shared lanes by using clear signage to alert drivers to the presence of bicyclists; ■ Include attractive scenery around bike lanes and distance them from vehicular traffic and noise and air pollution wherever possible.
	■ **Cycling amenities**	■ Design appropriate bike stations and placing them in accessible and suitable locations; ■ Provide suitable signage and maps to show direct routes for bicyclists; install suitable lighting and shading along bike lanes; ■ Provide ancillary bike services such as shower facilities, repair and accessory shops, and storage for student and staff bicycles during the summers.
	■ **Cycling strategies**	■ Develop strategies for bike sharing among students and staff to encourage them to commute by bicycle or at least move around campus by bicycle; ■ Develop strategies to increase integration of cycling with public transport.

Table 5. *Cont.*

Measures		
Public Transportation Enhancements	■ **Public transport amenities**	■ Design public transportation shelters/stops to have harmony with the campus environment and be more comfortable and safe for users by providing suitable lighting, seating elements, and clear schedule information; ■ Increase the number of public transportation stations throughout the campus and select locations for shelters offering a good access to pedestrians and bicyclists infrastructure.
	■ **Public transport timing** ■ **Public transportation strategies**	■ Pay special attention to the timing of public transportation to comfort and encourage users. ■ Providing mobility packs, including information about public transport services to inform students and staff that it has a strong influence on university users' transport behavior.

7. Conclusions

Encouraging sustainable commuting in university has become an important movement around the world. There have been several studies focused on transportation modes used by commuters to, from, and within universities in addition to studies on the affective factors on commuters' propensity to use active modes of transportation. This research reviewed existing literature and studied data collected through a real case study to set out a process of encouraging university commuters to use active modes of transportation. Encouragement is possible through the supply of convenient, comfortable, and well-designed physical infrastructure and facilities. Considering the transportation context of the infrastructure and facilities is a first step toward success but it is not sufficient.

An authoritative transportation management structure to define appropriate strategies based on existing conditions and user demands is necessary to plan and provide higher quality, more coordinated, more sustainable, and better utilized campus transportation services. Moreover, implementing strategies to limit use of private automobiles and to support existing users of active modes of transportation will encourage more commuters to shift to active modes of transportation. Furthermore, employing transportation-education strategies through workshops and seminars expands awareness and knowledge of the advantages of commuting by active modes of transportation.

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 on other university campuses. The results are provided in a framework that can guide researchers as well as the leadership and decision-makers of universities towards developing plans and strategies that encourage university populations to use active modes of transportation. Besides, for future studies, through the other findings of this research, the influences of demographic factors (e.g., gender, age, location of living, and education level) on improving level of sustainability in transportation sector through encouraging use of active modes of transportation must be thoroughly investigated and considered.

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Appendix A. Sample of Questionnaire

Appendix A.1. Personal Information

1- Gender: ☐ Male ☐ Female
2- What is your age group? ☐ Under 25 years ☐ 26 to 35 ☐ 36 to 45 ☐ 46 to 60 ☐ 61 and above
3- Country:
4- Nationality:
5- Are you a ☐ Student ☐ Staff
6- Which faculty/department are you studying at or a member of?
7- What is your field of study? (If you are a student)
8- What is your highest degree or level of study? (If you are a student) ☐ Undergraduate student ☐ Graduate student
9- How long have you been studying or working at the EMU? ☐ Less than 1 year ☐ 1 to 2 year ☐ 3 to 4 year ☐ More than 4 years
10- Where do you live? ☐ Area 1 (<1 Km from the EMU campus) ☐ Area 2 (1 < 5 Km from the EMU campus) ☐ Area 3 (>5 Km from the EMU campus)
11- What kinds of accommodation are you living in? ☐ Dormitory ☐ Shared flat ☐ Apartment ☐ Villa ☐ Other . . . . (Please specify)

Appendix A.2. Modes of Transportation for Commuting within and from/to the Campus

1- What kind of transportation modes do you usually use for commuting to or from the campus? ☐ Private car ☐ Public transportation ☐ Bicycle ☐ Walking
2- What kind of transportation modes do you usually use to move from one place to another within the campus? ☐ Private car ☐ Public transportation ☐ Bicycle ☐ Walking

Appendix A.3. The Quality of Infrastructure and Service Related to Active Modes of Transportation inside EMU Campus

Appendix A.3.1. Quality of Services Related to Pedestrians

1- How do you see the continuity among pedestrian paths inside the campus? ☐ Poor ☐ Fair ☐ Good ☐ Excellent
2- What do you think about the condition and quality of pedestrian paths' pavements? ☐ Poor ☐ Fair ☐ Good ☐ Excellent
3- What do you think about safety along the pedestrian paths? ☐ Poor ☐ Fair ☐ Good ☐ Excellent
4- What do you think about quality of lighting along pedestrian paths at nights? ☐ Poor ☐ Fair ☐ Good ☐ Excellent
5- How do you see the safety in interaction points between pedestrians and vehicles inside the campus? ☐ Poor ☐ Fair ☐ Good ☐ Excellent
6- How do you see the quality of pedestrian signage? ☐ Poor ☐ Fair ☐ Good ☐ Excellent
7- What do you think about the width of pedestrian paths? ☐ Poor ☐ Fair ☐ Good ☐ Excellent
8- What do you think about the quality of services for accessibility of disabled users? ☐ Poor ☐ Fair ☐ Good ☐ Excellent
9- How do you see the quality of crosswalks along the campus? ☐ Poor ☐ Fair ☐ Good ☐ Excellent
10- How do you see the quality of shadings elements along the pedestrian paths? ☐ Poor ☐ Fair ☐ Good ☐ Excellent

Appendix A.3.2. Quality of Services Related to Cycling

1. How do you see the bike lane efficiency inside the EMU campus? ☐ Poor ☐ Fair ☐ Good ☐ Excellent
2. What do you think about safety along bike-share lanes? ☐ Poor ☐ Fair ☐ Good ☐ Excellent
3. What do you think about quality of bicycle parking and racks? ☐ Poor ☐ Fair ☐ Good ☐ Excellent
4. What do you think about the quality of shading elements along the bike lanes? ☐ Poor ☐ Fair ☐ Good ☐ Excellent
5. What do you think about the quality of showering facilities? ☐ Poor ☐ Fair ☐ Good ☐ Excellent
6. What do you think about quality of repair and accessory facilities? ☐ Poor ☐ Fair ☐ Good ☐ Excellent
7. What do you think about safety of bike parking and racks? ☐ Poor ☐ Fair ☐ Good ☐ Excellent
8. How do you see the quality of signage for cyclists? ☐ Poor ☐ Fair ☐ Good ☐ Excellent

Appendix A.3.3. Quality of Services Related to Public Transportation

1. What do you think about efficiency of bus services? ☐ Poor ☐ Fair ☐ Good ☐ Excellent
2. What do you think about quality of bus shelters by focusing on number of shelters on the campus? ☐ Poor ☐ Fair ☐ Good ☐ Excellent
3. What do you think about quality of bus shelters by focusing on location of shelters? ☐ Poor ☐ Fair ☐ Good ☐ Excellent
4. What do you think about quality of lighting inside bus shelters? ☐ Poor ☐ Fair ☐ Good ☐ Excellent
5. What do you think about quality of seating elements inside bus shelters? ☐ Poor ☐ Fair ☐ Good ☐ Excellent
6. How do you see the existence of route/schedule information? ☐ Poor ☐ Fair ☐ Good ☐ Excellent
7. What do you think about quality of bus signage? ☐ Poor ☐ Fair ☐ Good ☐ Excellent
8. What do you think about the bus timing? ☐ Poor ☐ Fair ☐ Good ☐ Excellent

Appendix A.4. Personal Expectations and Suggestions

1- What is your expectation and suggestion for improving the service quality of pedestrian facilities?
2- What is your expectation and suggestion for improving the service quality of cycling facilities?
3- What is your expectation and suggestion for improving the quality of bus service?
4- Which type of active modes of transportation do you prefer to use if all facilities about it be in a good condition?

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