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Research Article

Investigating the environment impact of using a cycling, pedestrians' friendly network on campus

Architect. Shahenda Osama Mahmoud # and Prof. Dr. Ayman Hassan Mahmoud^

#Architecture Department, Higher Institute of Engineering El-Shorouk Academy, Egypt.
^Architecture Department, Faculty of Engineering– Cairo University, Egypt.

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Abstract

Using sustainable mobility systems and practices on university campuses has a variety of advantages, which can be classified as environmental, economic, social, or educational, depending on the primary purpose and goal of higher education institutions. Reduced air and noise pollution, reduced traffic on campus and in the surrounding environment, reduced use of non-renewable resources, and meaningful uses of land on campus are some of the environmental benefits of attaining sustainable mobility on university campuses. One of the most obvious detrimental consequences of colleges on environmental values, economic equality, and quality of life inside campus communities as well as adjacent towns is the everyday flow of vehicles to campuses. As a result, transportation is one of the most important challenges on today's university campuses, as well as in the neighboring communities.

Keywords: *Sustainable campuses; Cycling; network; pedestrian; Sustainable Transport*

1. Introduction

Today's development processes are accompanied by rapid economic expansion, environmental degradation, poor human health conditions, and social segregation. The rapid economic expansion is associated with the expansion of industrial and commercial areas, poor environmental standards, poor living conditions, and the use of material and energy resources. Global environmental and human health issues are more likely to occur as a result of these development processes, which also raise their hazards. The need for sustainability in all facets of human life is driven by these dangers (Weiland, U. (2006)).

The United Nations Conference on Human Environment in Stockholm issued the first reference to sustainability on a global scale in 1972. To address the issue between the environment and development processes, the World Commission on Environment and Development produced a widely read study in 1987 that defined sustainability. The Brundtland Report defined sustainable development as "development that satisfies the demands of the present without impairing the ability of future generations to satisfy their own needs." The Brundtland Report was approved by the UN General Assembly, and many nations throughout the world have adopted it as a political strategy.

*Corresponding author's ORCID ID: 0000-0000-0000-0000
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Furthermore, a sustainable development was described as "increasing the quality of human existence while living within the carrying capacity of the eco system" at the UNCED in Rio de Janeiro in 1992. It is widely acknowledged that to achieve sustainability, it is necessary to recognize and integrate the three key spheres of environmental preservation, social justice, and economic growth. In other words, economic growth based on social justice and wise use of natural resources is the hallmark of sustainability (Harris, J.M. (2003)).

2. Definitions and goals of sustainable campus

University campuses are like "little cities" because to their population, size, difficulties, and range of activities, making campus sustainability a worldwide concern. There are now several definitions of a sustainable campus, based on the three key areas of sustainable development and university development policies. Some people think that a sustainable campus can only be developed if all national and international declarations about environmental protection, green building, etc. are followed.

According to Shriberg (2002) in his Ph.D. thesis, The Pennsylvania State University's concept of a sustainable university, which was included in an Indicator Report issued in 2000, may be the finest description of a sustainable university since it combines goals and a vision. According to The

Pennsylvania State University's Indicator Report, a sustainable university is one that:

1) A university whose long-term prospect for continuing to exist is good; specifically, such a university behaves in ways that sustains the integrity and biodiversity of the local and planetary ecosystems upon which all life depends.
2) A university whose core values include respect for the biota and natural processes, mindfulness of place, living within planetary limits, accounting for full costs, and civic responsibility.
3) The kind of university that Pennsylvania State is striving to become.

Besides, a sustainable university is defined by L. Velazquez et al and L. Cole who are two theorists that these definitions presented a wide perspective on definition of sustainable campus. L. Velazquez et al (2006) defined a sustainable university campus as:

A higher educational institution, as a whole or as a part, that addresses, involves and promotes, on a regional or a global level, the minimization of negative environmental, economic, societal, and health effects generated in the use of their resources to fulfill its functions of teaching, research, outreach and partnership, and stewardship in ways to help society make the transition to sustainable lifestyles.

Moreover, L. Cole (2003) mentioned sustainable campus as: The one that acts upon its local and global responsibilities to protect and enhance the health and well-being of humans and ecosystems as well as he added that it actively engages the knowledge of the university community to address the ecological and social challenges that we face now and in the future.

Due to the definitions given above and the direct and indirect effects of higher education on local, regional, national, and international values regarding economic factors, environmental protection, and social equality, the theories will base their arguments on the notion that the main objectives of sustainable campuses are creating healthy campus environments by paying attention to ecological challenges, social justice, economic factors, and human health to minimize (Alshuwaikhat, H.M, and Abubakar, I. (2008)

3. Need for sustainability on campus

Universities are an example of higher education institutions whose fundamental duty is to prepare its students for life by enhancing their awareness, abilities, knowledge, and values. Therefore, via their research operations in numerous fields, university campuses have the capacity to both educate the next generation of decision-makers and to provide solutions to the biggest global difficulties now being faced today and tomorrow's problems. Universities have always been places where the present and next generations may learn about and explore the cosmos. These institutes of higher learning have a special freedom to advance new ideas, produce new information, and make social commentary.

University campuses are educational districts that include open spaces, buildings, and other physical components that are part of educational milieus. In this sense, the campus of a university may serve as a laboratory where students study big problems and progress real answers by focusing on their own institute and actions. There has been an increase in the demand for sustainability on college and university campuses from those who support sustainability in higher education.

In conclusion, it is crucial to promote sustainability in all facets of university campus settings due to the statements as well as the significance and role of universities in local and global societies. Thus, the need for sustainability on university campuses can be broken down into four categories based on the three main pillars of sustainable development, the effects of university campuses on society, including the social, environmental, and economic effects, as well as the educational role of universities in communities.

According to the three main pillars of sustainable development, ***the need for sustainability in university campuses can be divided into four categories:***
- The need of sustainability in university campuses due to social and cultural effects of campus environments.
- The need of sustainability in university campuses due to environmental effects of campus environments.
- The need of sustainability in university campuses due to economic effects of campus environments.
- The need of sustainability in university campuses due to educational effects of campus environments.

3.1 Social and cultural effects of campus environments

Higher education environments have helped their local communities progress socially and culturally. Because universities provide a significant contribution to the growth of the global community, the application of sustainability on university campuses has many positive implications on societies and their culture. Advancing sustainability in higher education institutions will serve as a key catalyst for advancing sustainability in society.

3.2 Environmental effects of campus environments

Higher education environments have helped their local communities progress socially and culturally. Therefore, university campuses are unique locations with distinct social and cultural responsibilities to the surrounding area and subsequently to society. The society has given higher education institutions a specific charter, according to Cortese (1999). In return for their contribution to the health and welfare of society via the development and spread of information and values, higher education institutions in the United

States are granted academic independence and a tax-free status. Additionally, proponents of sustainability emphasize that schools and universities "owe it to society to progress toward sustainability."

Since universities make a significant contribution to the creation of the global society as well as the production and training of culture and new values among societies with regard to teaching, research activities, services, operations, and public notification toward sustainability, it follows that the application of sustainability in university campuses has many positive effects on societies and their culture. As a result, higher education institutions should serve as both centers for guiding society toward sustainability and for developing sustainable development patterns that would be well-matched with society. Advancing sustainability in higher education institutions will serve as a key catalyst for advancing sustainability in society. Since universities and other institutions of higher learning are important hubs for teaching, learning, and research that have a significant impact on present and future leaders through their students and graduates as well as being leverage points that reflect and influence community perspectives.

3.3 Economic effects of campus environments

Through research, training, and the creation of new information, skills, and projects, university campuses are formed as educational and research hubs that significantly contribute to economic growth and development, life quality, and economic fairness in communities. In addition, university campuses are significant economic players that directly affect the local economies of the places they are located in by engaging in procurement operations, providing services, maintaining their facilities, spending money on commodities, and hiring staff and teachers. Additionally, through supporting their research and pedagogical operations, higher education institutions play a significant part in developing enterprises and putting technology to the test. However, because to their extensive use of resources, goods, and services including electricity, water, transportation, and paper, as well as their production of trash, these educational environments are also among the largest users of these things. Therefore, college campuses have a significant influence on the local economy. To better identify and manage the whole cost of all daily operations and activities, as well as to limit the consumption of resources and the production of trash, universities must implement sustainability in every area of campus settings.

3.4 Educational effects of campus environments

The world's largest educational communities are found on university campuses. In addition, universities play a variety of functions in their local communities, such as conducting research, imparting information, skills, and technology, and preparing their graduates to be productive and responsible citizens. As a result, higher education institutions now have the chance to use their campuses as a sustainable teaching tool by incorporating sustainability into all areas of campus surroundings. Additionally, students have several opportunities to learn about, get experience with, and put sustainable living into practice while pursuing their education, which they may then apply to their everyday lives once they graduate. On the other hand, a sustainable campus develops a learning environment that can enhance both formal and informal learning. Furthermore, academic research and teaching on university campuses must priorities sustainability. Therefore, the requirement for sustainability in every area of university campuses is crucial to enhancing academic achievement.

As a result, existing university campuses may require further growth. Therefore, it is imperative that the sustainability concept be applied to every aspect of university campuses until those environments are healthy, have a successful economy thanks to resource conservation, waste reduction, and effective environmental management, and promote equity and social justice in their operations. Furthermore, Cortese (1999) suggested that sustainability be integrated into the core responsibilities of universities, including their procedures for teaching, learning, and research. However, activities on a sustainable university campus have no adverse consequences on the surrounding ecosystems or the communities of living things. Finally, sustainable university campuses support local, national, and worldwide societies in securing a bright future for the social, economic, and environmental spheres.

4. Sustainability components in campus environment

Certainly, environmental, economic, and social sectors are interested in the topic of sustainability. Therefore, the development of sustainability components in many areas of these three key pillars in university campus settings is crucial for creating sustainable university campuses. There are several approaches to fostering sustainability on college campuses, all of which depend on the plans put in place by the institutions to make their campus settings more sustainable. Consequently, as a result of several studies, the following essential factors are crucial for attaining sustainable campuses and developing sustainability on university campuses:

1.Management of Campus Site Design and Planning
2.Management of Campus Transportation
3.Management of Campus Energy
4.Campus Water Management
5.Waste Management on Campus
6.Campus Material Management Use
7.Curriculum Management
8.Health Management
9.Management Governance

4.1. Site design and planning management in campus

The basic goal of a university campus is to bring together various individuals with their intellectual backgrounds and views in a learning environment to provide opportunities for social and scholarly interchange. In addition, the physical attributes and calibre of this learning environment are crucial, therefore campus site design and planning play a vital role and directly affect the effectiveness of university campus environments. Since campus site design and planning is a significant part of the land-use planning process in academic settings, it involves a general evaluation of the site, determining the locations of physical elements on the site, and setting up facilities and activities.

Buildings, public open spaces, green spaces, playfields, roadways, parking lots for cars, pedestrian walkways and sidewalks, bike lanes and parking lots, furniture, lighting, signs, infrastructure, and utilities are some of the most important and effective physical features on university campuses. Therefore, if a university campus wants to have a successful campus site design and planning that create a sustainable environment to meet the various needs of an educational institution toward achieving the main goal of educational campuses and also to have a beneficial campus site design and planning that be patronage for reducing use of land and negative impacts on the environment, it is crucial to pay attention to all physical elements in campus site design and planning management (Richardson, G.R.A., and Lynes, J.K. (2007).

4.2 Social and education management in campus

Curriculum, wellness, and governance management are three key components of social and educational management that are essential to establishing sustainability on university campuses. These components are briefly discussed in the sections that follow.

4.2.a. Curriculum Management

University curriculum selections are not subject to any kind of global standard. To give students studying sustainability principles a practical and factual framework, every university should offer prerequisite courses in all disciplines. It is crucial to have sustainability majors and programs to create possibilities for in-depth research. In the end, university campuses offer the chance to educate students, employees, visitors, and members of the community through their activities.

4.2.b. Health Management

The concept of sustainability suggests a clear connection between environmental and human health. Therefore, a sustainable campus is thought to provide a healthy and supportive educational environment that improves individual and communal wellbeing.

Additionally, offering meaningful work that is matched with a healthy work environment and chances for relaxation and leisure is an essential component of the academic program at universities. However, many institutions are beginning to evaluate the health issues that affect both students and faculty members and are connected to stress, diet, meditation practices, and physical condition. Therefore, a healthy university campus is a thriving learning environment that encourages healthy lifestyle choices among students and faculty.

4.2.c. Management Governance

The part of management that decides on all elements of activities on university campuses and has an impact on all aspects of university campuses is known as governance in campus environments. There is no precise definition of sustainable governance at universities, and the governance concerns at higher education institutions are more complex. Additionally, governance on university campuses offers an exact control over the mission, finances, performance, and policies of the institution as well as a sense of harmony between the mission, strategies, and curriculum. Governance so directly influences the caliber of colleges.

Consequently, the university's objective, master plan, and development strategy should all include sustainable governance.

4.3 Environmental and Economic management in campus

Energy, water, waste, and use of material management are the primary and fundamental components in environmental and economic management on university campuses that contribute to achieving sustainability in university campus environments. These components are briefly explained in the sections that follow.

4.3.a. Management of Campus Energy

University regulations should place a high priority on energy management because campus energy usage is comparable to that of a small city. The greatest strategy to save energy and achieve zero-carbon energy consumption is to maximise the use of renewable energy sources, also known as clean energy sources, such wind, solar, hydropower, and geothermal energy.

4.3.b. Campus Water Management

The primary objective of campus water management is to decrease water use. This may be done by collecting rainwater and storm water as well as reusing wastewater for things like watering watery plants, irrigation, and cooling towers.

Additionally, effective landscape design using native plants and grasses, irrigation system design, and educational initiatives are all useful ways to persuade the campus community to protect the environment's water resources.

4.3.c. Waste Management on Campus

The growth of solid wastes on university campuses throughout the world is one of the biggest obstacles standing in the way of their environmental stewardship obligations. Waste of all types, including paper, cans, plastic, glass, and others, is produced by the operations and activities on university campuses. An effective waste management system should be set up to reduce the amount of garbage produced on campus, reuse waste to conserve resources, and provide a healthy campus environment.

4.3.d. Campus Material Management Use

The usage of materials on university campuses is governed by biological, cultural, and spatial contexts. Therefore, using locally produced and environmentally friendly products has several advantages, including lower transportation costs, less energy use, and less negative environmental effects. Additionally, selecting appropriate construction materials is crucial in campus building design strategies since the manufacturing of these materials has an impact on the environment's quality and the depletion of its resources.

Additionally, the primary goals of campus material management are to limit the use of nonrenewable resources, employ recycled materials in campus construction projects, and regulate the use of materials through instructional programs on campus.

5. Physical Characteristics of a Long-Term Campus Landscape

The physical part of the campus examines the urban design features that improve the college's sustainability in the future. This chapter's sustainability is primarily concerned with the lifespan and robustness of the physical services provided by the campus. The physical element is regarded as a necessary foundation for achieving higher levels such as ecological, individual, and societal goals. This component is dependent on the original selections and designs to think about while crafting the first plans This chapter discusses the following topics: Connectivity, edges and gates, varied circulations, spaces, and facilities all exist on campus.

5.1 Campus Landscape Connectivity and Permeability

There are three degrees of advantages to the quality of connectedness between urban spaces:

To begin with, in terms of the ecosystem, connectedness serves as a link between flora and fauna corridors (biodiversity). It also allows air masses to flow about.

Second, using the same notion, connection aids in the simple and safe mobility of users. Finally, the presence of connectedness allows for effective linking between places, the construction of a strong urban fabric, and the provision of a feeling of orientation while travelling between different areas from an urban perspective.

"Connectivity (or permeability) in a transportation network refers to the density of relationships and their directness. Many short links, multiple junctions, and few dead ends characterize a highly permeable network. Travel distances reduce as connection improves, and route alternatives expand, allowing for more direct transit between destinations, as well as a more available and reliable transportation system (National Heart Foundation of Australia, 2014, p. 1)

Some of the connection definitions have been clarified:

1- link: is a section of road or walkway that connects two nodes. A roadway that runs between two junctions or from a dead end to one.
2- Node: A genuine node or a dangling node is the terminal of a connection.
3- A connection's endpoint is where it connects to other links is referred to as a real node. A point of convergence.
4-Dangle node: A link's terminus with no additional connections. A road that ends in a dead-end or cul-de-sac is known as a dead-end or cul-de-sac.
5- Circuit A finite, finite path that starts and ends at a single node

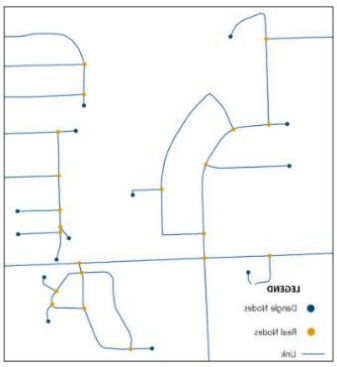

Fig.1 Clarification of different connectivity definitions (Tresidder, 2005)

5.2 Gateways and campus edges

There are two types of universities: self-contained universities that are bordered by fence, gates, or buildings, and completely integrated institutions that periodically interact with streets and buildings.

The uniformity of the gateway's design: materials, colors, and shapes would give the gate a better value. The presence of the university's emblem, as well as the usage of this gate, make it obvious that users are welcome to connect with the campus.

5.3 Circulations on the university campus

On campus, there are 2 major circulation routes: pedestrian and vehicle. Pedestrian circulation should be prioritized on campus, whether they are connected or segregated, because walking is the principal means of transportation. If the two are mixed, pedestrian paths should not be used as a driveway extension. The provision of safe, efficient, and comfortable pedestrian pathways, it is vital to get a well, accessible, and easy vehicular network.

5.3.a. Pedestrian routes and walkways:

These guidelines can be adjusted to suit various climates and situations (Dober, R. P. (2000).

Paths are used to link various buildings and locations on campus.

These walkways serve as place-making elements, shaping the campus's appearance and structure. Paths should be proportional to the number of people who will use them to go from point A to point B without encountering any barriers.

5.3.b. Breezeways:

Breezeways or arcades are a manner of distributing pedestrian paths and providing a range of movement alternatives.

Fig.2 potential Locations for Breezeways in UNB Fredericton Campus. (Source: UNB Fredericton Campus Plan)

5.3. c. Cycling on campus

On campus, cycling is a particularly clean and healthful mode of transportation. This field needs to be given more encouragement. When constructing paths, it should be rated as the second most important factor after pedestrian circulation. There should be special lanes and signage accessible. Cycle racks should be placed at strategic areas such as main entrances, building entrances, and open space perimeters.

5.3.d. Circulation in the vehicle

Campus highways are necessary parts of the campus environment, but they should not be allowed to take over. They're best when they're the shortest, linking several locations with few intersections and pedestrian circulation for safety.

5.4 The intersection of criterion for efficient circulation systems

5.4.A. Some guidelines for vehicle circulation

Depending on the site, there may be many drop-off areas: main gates, tower entrances, and service areas.

The development of locations such as enclosures and internal rooms where servicing and emergencies vehicles can be parked.

In regard to recycling bins, workshops, and labs on campus, efficient parking spaces should be provided for garbage or service vehicles.

When maneuvering across campus, not only cars but also buses and other vehicles should be able to pass.

The availability of internal linkages between parking areas to minimize congestion on highway routes when looking for parking places.

5.4.B. Separation of the pedestrian and vehicular networks

There are two ways to create a segregated pedestrian network: one is to use a distinct material to indicate the pedestrian path in a shared roadway, the other option is to slow down traffic by using an abrasive material. Second, if greater physical separation is required, walled benches, ornate railings, barricades, or bushes may be used to offer both physical and aesthetic isolation (Queen's University 2013, June 16).

On some universities, the problem of walking and car networks colliding is managed by building a well-designed perimeter road that serves autos and connects to major critical locations, while the campus core is solely for pedestrian usage (National Heart Foundation of Australia, 2014, p. 5).

University of Guelph (university in Ontario, Canada): Another hierarchy of campus entrance roads is demonstrated in this scenario.

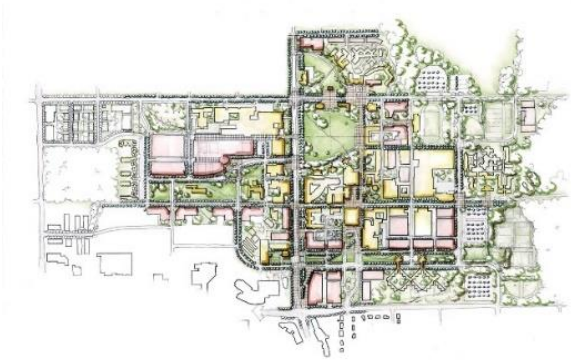

Fig.3 University of Guelph Map (Source: University of Guelph Campus Master Plan - Urban Strategies).

The primary road is forming a ring that is connected to parking lots, followed by minor roads that connect to campus buildings and interior pedestrian pathways that may accommodate service and emergency vehicles. A link between the vehicle and pedestrian circulations is simpler to build on small campuses (Dober, R. P. (2000).

Ruhr Bochum University: The campus is connected by pedestrian pathways from the exterior highways to the subterranean parking spots. Since the college is located in an industrial region, the designer had the exterior roadways run through areas with a high density of vegetation.

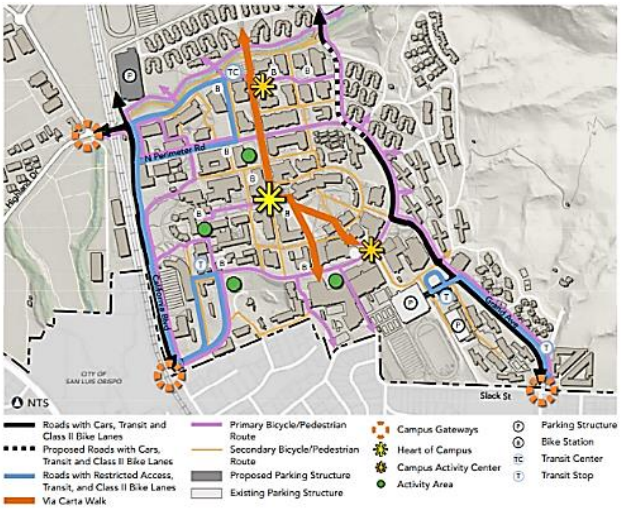

Fig.4 Circulation Master plan of Ruhr Bochum University

5.4.C. Connections between vehicle and pedestrian circulation are excellent.

Smaller streets are provided to allow for slower vehicles and a better pedestrian environment.

-Promoting the use of pedestrian networks by limiting the use of interior auto routes by offering fewer vehicular connections and encouraging the use of peripheral vehicle routes, which is beneficial for university campuses.
- The supply of parking on city streets, as well as the shortening of highways, may obstruct car traffic.
When there are crowded pedestrian areas, thick roundabouts are an unsuitable option.

5.4.D.A well-designed roadway that meets the demands of many users.

Pedestrians, bikers, and transit riders should be treated equally to motorists on the roadways. By constructing roads that are both fantastic public places and sustainable transit networks, the quality of life on campus will increase.

Fig.5 A sample showing Walkway intersection with walkway (WIW), street (WIS) and open space (WIO), in the new campus of Sulaimani University

6. Spaces

A university campus is more than just a collection of buildings that serve educational purposes; it is also a combination of places and structures. These areas are just as important as the buildings in terms of enhancing the campus's sustainability, personality, and appearance.

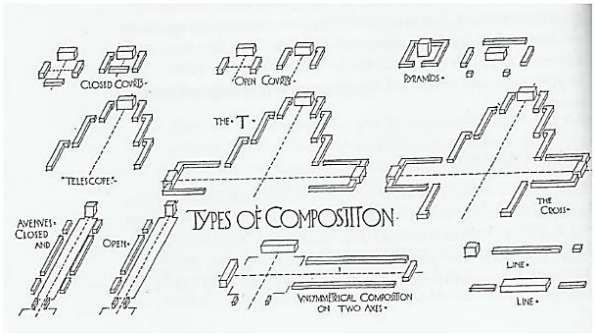

Fig.6 Different types of space organization

Space organization, according to (Githens), may be divided into 10 types. Closed and open high court, pyramids, telescopes, the T, the cross, closed and open avenues, asymmetry on two dimensions, and way.

Rather of taking space, buildings should create it. The following requirements should be met by these newly developed places:

• Providing a place which is used within the limits of the campus rather than developing areas on the outside or in land-use dead zones.
• Interrelated with the campus's larger structure, resulting in functional, accessible, and usable places that interact with neighboring structures.

Fig.7 Sproul Plaza in University of California, Berkeley (University of California Berkeley, 2019)

7. The Importance of Sustainable Transportation on University Campuses

In recent years, the population of university campuses throughout the world has expanded. As a result, most of these educational environments have decided to move toward sustainability to reduce their negative effects on society, the economy, and the environment, as well as to expand their educational role in communities and thus create a sustainable model for other communities and societies.

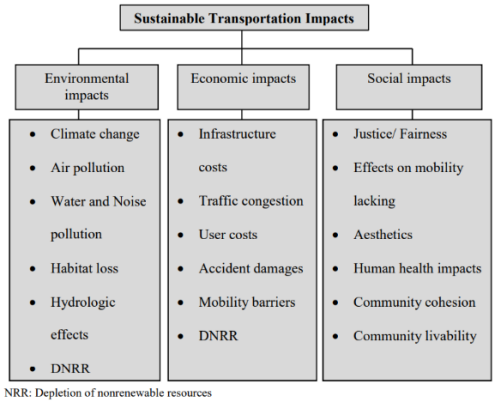

Fig.8 Impacts of Sustainable Transportation

Indicators of sustainable transportation may also be classified into three categories based on these three areas of sustainable transportation impacts:(Litman, T.A. (2008b).

1. Environmental indicators for transportation
2. Social indicators for transportation
3. Economic metrics for transportation.

Table1: Transportation Indicators (Based on Haghshenas and Vaziri, 2012)

Transportation environmental indicators	**Transportation social indicators**	**Transportation economic indicators**
Pollution of the air Consumption of energy Type of renewable energy Vehicles that are efficient Land consumption and noise pollution Management of the environment	Safety Satisfaction Access Transport for disabled Equity Citizen participation in transport decision Security	Local government cost and benefit. Consumer direct cost and benefit. Consumer indirect cost and benefit. Transport price. Commercial transport.

The following are some guidelines to keep in mind while choosing indicators for sustainable transportation. These principles are (Litman, T.A. (2008b)).

1. *Comprehensive***:** Indicators should account for a wide range of economic, social, and environmental implications, as well as different modes of transportation (both personal and freight).
2. *Data quality:* To ensure that information is reliable and consistent, data gathering processes should meet high standards.
3. *Comparable:* Data gathering should be consistent across jurisdictions, time periods, and demographic groups so that the results may be compared.
4. *Simple to understand:* Indicators should be relevant to decision-makers and easily understood by the public.
5. *Accessible and transparent:* All stakeholders should have access to indicators (and the data on which they are based) and analytical data.
6. *Effortless to gather:* The set of indications should be easy to collect.
7. *Net Impacts:* Indicators must differentiate between net (total) impacts and impacts that shift to other locations and time periods.
8. *Performance objectives:* Choose indicators which may be used to create actionable performance goals.

7.1 Transportation Demand Management (TDM)

Transportation Demand Management (TDM) is the most extensively employed method in university campus contexts, and it includes a variety of planning and management measures. U-Pass, parking management, boosting bicycle usage, and developing a pedestrian-friendly campus are all part of this concept and its present methods on university campuses.

7.1.1 Parking Management

Parking is an important component of several types of transportation networks, as well as the most prevalent difficulty on university campuses. Parking facility issues can be classified as supply or management issues.

7.1.1.a. Parking restriction and supply

Two of the most essential TDM methods are parking supply and parking limitation. In densely populated regions like university campuses

7.1.1.b. Parking pricing

The alternative strategy is parking pricing, in which automobile owners pay to use parking facilities.

7.1.1.c. Parking Location

It makes a difference where parking lots are located on university campuses. Because commuters cannot easily park in front of buildings if parking facilities are in the central or peripheral areas, both initiatives promote commuters to save time and obtain direct access to

buildings by using alternate means of transportation like walking, bicycling, and public transportation.

Fig.9 Bicycle Parking

7.1.1.2. Public Transport Pass Strategy (U-Pass)

In university campus environment, TDM techniques' most important and popular component is U-Pass program. Furthermore, on university campuses, the U-Pass program encourages all members to commute using public transportation and active modes of transportation rather than private autos.

In general, the U-Pass method can improve access to university campuses for academic staff, administrative employees, and students. This progresses in terms of university campus accessibility.

1- Making driving a more inexpensive option.
2- Managing parking requests to improve access for persons who must drive.
3- Improving the quality of public transportation and reducing traffic congestion.
4- Reducing public transportation travel rates.
5- Increasing the frequency and length of service for public transportation.

7.1.1.3. Carpool Program

Carpooling is a well-known TDM tactic that encourages owners of single-occupancy personal vehicles to shift demand away from personal automobile journeys. This technique entails two or more commuters sharing a same source, route, and destination in an automobile.

7.1.1.4 Promoting bicycling and creating a pedestrian-friendly campus.

In communities, particularly on university campuses, walking and cycling are the ideal forms of transportation to replace automotive journeys. Because the motorist walks from the parking lot, the biker walks from the bike station, and the public transportation user walks from the bus station, all commuters are pedestrians on their way to campus. There are several specific techniques for encouraging bicycling and building a pedestrian-friendly campus, including the following:

1- Increase the number of bikes lines.
2- Improve sidewalks and pedestrian pathways.
3- Always maintain a high level of safety
4- Improve lighting quality.
5- Create unique shortcuts to improve road and route connectivity and direct linkages.
6- Vehicle restrictions, speed reductions, and traffic calming
7- Maintaining the built environment and public open areas in good shape
8- Make nice semi-open gaps to keep the sun and rain out.
9- Provide shade components along the paths based on climatic conditions.
10- Strategies for law enforcement and encouragement
11- Bicycle stations that are both convenient and safe
12- Immaculately kept facilities.

Fig.10 Promoting Bicycle Use and Creating a Pedestrian Friendly Campus

Conclusions

It is crucial to apply sustainability measures in all facets of human societies due to the world's population expansion, rising hazards to environmental quality, and human health conditions. hence, the University campuses are the finest setting for spreading sustainability concepts. Besides, University campuses are important teaching and improvement sites for sustainability techniques and raise knowledge of sustainability among the general public. As a result, it is crucial to integrate sustainability in many areas of university campus environments, including planning, transportation, water usage, waste management, energy use, material use, wellness, curriculum, and governance. Additionally, each university campus has its own policies and programs that must be followed to achieve sustainability.

As a result, a sustainable campus will serve as a "living laboratory" for current and future cohorts of its own students, members of the community, and guests so they can learn from and gain valuable experiences from living in a sustainable environment and apply them to their real and everyday lives.

In the end, this dissertation focuses on sustainability in the transportation sector, which is essential to sustainability on college campuses. As a result, there will be extensive discussion of sustainable mobility on university campuses in the chapter that follows.

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