Ways to Activate Urban Transport to Achieve Urban Sustainability

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Abstract. The past few decades have witnessed a significant increase in the number of cars at the expense of public transport, as a result of the economic development in cities, which was accompanied by the possibility of buying a private car on the one hand and the expansion and spread of the city on the other hand. Although public transportation is so important, it cannot be the only alternative in transportation. The research idea referred to achieving urban sustainability by increasing accessibility opportunities through activating the role of public transport and reducing the use of private cars to a minimum. Urban sustainability can be achieved in several ways, and the research assumes that one of these ways lies in activating the role of public transport in cities. The research tries to shed light on the role of direct public transportation in urban development. The research relied on its methodology on the statistical indicators and evidence contained in international scientific studies in this field. The research confirmed his hypothesis that transport has a very positive impact on achieving urban sustainability. Therefore, the role of public transport must be activated and opportunities for its success must be provided.

1. Introduction

Due to the importance of public transport, many countries undertake the process of planning and managing public transport through the transport ministries or their affiliated bodies, which are concerned with studying the country's needs in terms of transport networks and systems in all their forms and stages. There is a need to prepare various plans that include transport projects within the public development plan projects, because if public transport is not comfortable and appropriate, the negative repercussions for that will appear clearly and quickly in all joints of the city, which made many countries of the world make investments to support public transport. But transportation planners currently realize that road construction cannot be scaled up close to expectations of an increase in traffic, as it requires significant costs. There are factors that increase the effectiveness of public transportation, which relate to the shape of the city, as the compact city encourages public transportation, where the population and jobs are concentrated [1]. Therefore, public transport must be developed and citizens encouraged to leave private cars to reduce traffic congestion. However, public transportation cannot serve all parts of the city or provide door-to-door services for residents like private transportation.
The daily business trip is one of the most important causes of congestion, so the number of private cars must be reduced and compensated for by efficient and modern public transport, and the need to regulate the relationship between work sites and housing sites in the suburbs and distribute services in the city in a balanced manner to facilitate their users and provide job opportunities. Sustainable urban development proposes the idea of activating economic development by increasing accessibility opportunities to reduce movement and flow through activating the role of public transport and reducing the use of private cars to a minimum, by raising the cost of transportation for the user to reflect the full social and environmental costs of trips. This would ensure economic development. As well as controlling environmental pollution, as shown in Table (1).

### Table 1: impact of transport on sustainability [2].

| Environmental          | Social                        | Economical                |
|------------------------|-------------------------------|----------------------------|
| 1. Water and air pollution | 1. Effects of injustice        | 1. Traffic jam             |
| 2. Habitat loss for biota | 2. Harmful to move            | 2. Contraindications to movement |
| 3. Depletion of non-renewable resources | 3. Impact on human health | 3. Accident damage          |
| 4. Depletion of non-renewable resources | 4. Household inadequacy | 4. Cost services           |
|                        | 5. Aesthetic effects          | 5. Cost the consumer       |
|                        | 6. Social interactions        | 6. Depletion of non-renewable resources |

2. **The impact of public transportation on sustainable urban development**

Much international literature has divided the benefits that public transportation provides to society into three parts, the first is the benefits resulting from avoiding the use of private cars, which are economic, social and environmental savings, and the second is the benefits of movement in the city, and the third part is the returns that the government reaps in the form of taxes through economic development provided by the public transport structure, noting that the third part has not been addressed, as it is outside the framework of the research objectives currently.

#### 2.1. Benefits of avoiding the private car

Most societies now have advanced car transportation systems, but the increasing dependence on cars has created many problems, many of which can be solved by public transport. Public transportation is more efficient in dense urban areas where cars pose the greatest problems. Therefore, when all impacts are considered, the best way to improve the means of the transportation system is to activate public transportation [3].

#### 2.2. Benefits of giving up direct car use

Changing travel patterns from private cars to public transportation results in savings in vehicle consumption costs. The size of these savings depends on factors such as the distance the car travels per day and the decrease in vehicle ownership [4]. This transfer to public transportation saves fuel and oils. In addition, depreciation and parking are partly variable costs, because driving cars increases the frequency of repair and replacement vehicle parts, reduces the value of the car upon resale, and increases the risk of accidents, traffic and parking costs.

#### 2.3. Benefits of avoiding driving

What is meant here to avoid driving is extra trips in passenger cars. They also include taxi trips. Many car drivers spend a great deal of time driving to get children to school or leisure activities, family members to their jobs, and social visits. Such trips can be ineffective, especially if they require drivers to have an empty return trip, so a single trip requires twice the distance covered. Driving can be an unwanted burden when it interferes with other important activities. Public transport service allows drivers to avoid unwanted trips.
2.4. Reducing crowding
Traffic congestion is one of the big problems that cities face. Traffic congestion leads to increased delays, stress, vehicle operating costs and pollution. Congestion increases with every additional vehicle on the road. Urban streets have limited capacity, and traffic congestion occurs when the size of vehicles exceeds the road capacity limits. Reducing traffic congestion from 90% to 85% of the maximum can reduce road delay capacity by 20% or more [5]. The volume of traffic grows so that delay due to congestion is not encouraging any additional trips during the peak period. Road expansions will not solve the problem because roads often fill again as a result of latent demand, and to reduce total delays and congestion, public transport can be in the case of improving service, such as giving priority to public transport or allocating special lanes for public transport to solve the problem of prime time, and it is possible to switch from driving cars to public transport .Public transport can also be an effective tool to reduce congestion, as one bus can replace 45 private cars, Figure (1), this figure shows how three buses can replace 145 private cars that caused congestion on an entire street

2.5. Parking cost savings
These benefits can appear in the form of cost savings for the user when the parking spaces are priced, reducing congestion in parking spaces, and thus increasing the comfort of car drivers, as well as reducing budgets spent on parking spaces. Reducing the demand for cars can also provide indirect benefits by reducing the area of land needed for parking facilities, and reducing the demand for parking with the passage of time provides economic benefits by avoiding an increase in supply or allowing the occupancy of services for other uses and providing social, environmental and aesthetic benefits by reducing the land allocated to services parking [7].

2.6. Traffic safety
Public transport is safer than other modes of transport, especially private cars, which reduces the number of injuries, and as a result, health care costs associated with travel, and public transport on trips is safer than accidents, as the death rate of public transport passengers is about 0.1( one in ten) compared to private car passengers, cars are a major cause of premature death in all Western countries[8], so as the occupancy rate of public transport increases, the average costs of accidents tend to decrease with the increase in vehicle occupancy. The World Health Organization (WHO) considers traffic that will be one of the worst risks facing health in urban areas, and it is expected that traffic accidents in 2020 will be the third cause of death in the world [9]. As in Figure (2)
Figure 2: shows the killing incidents per 10,000 people for selected countries in the Middle East for the year 1996

2.7. Health effects
Public transport users walk on average about three times as much as those who depend on private cars, and achieving approximately 22 minutes per day of moderate physical activity is essential for health [10]. An increase of one percent in the number of public transport passengers adversely affects certain diseases, such as obesity by 0.4%, high blood pressure by 0.3%, high cholesterol by 1.3%, the incidence of heart attacks by 1%, this decrease is a result of increased physical activity.

2.8. Road costs
It includes the costs of road construction and maintenance and the costs of various traffic services such as planning, police, emergency services and lighting. These costs depend on the car’s weights, sizes and speed. Faster vehicles require more road space and urban areas suffer from major congestion problems and higher land values, so any reduction, even if only minor, in traffic volume will result in significant savings.

Many studies have been conducted in the economics of transportation which attempted to investigate the share of costs imposed by different types of vehicles on the roads [11]. It is noted that most of these studies only look at direct road construction, maintenance costs, services and sometimes highway patrols. Overhead costs are not reflected in transportation budgets and are generally ignored, such as opportunity costs for road planning, traffic, local police, emergency services, and street lighting.

2.9. Energy conservation and emission reduction
Public transport policies can be considered one of the means that reduce air pollution in cities by reducing the number of motorized trips, and thus reducing fuel consumption and reducing pollution [12]. Urban public transportation uses less energy and produces less carbon dioxide, volatile organic compounds and nitrogen oxides emissions per passenger mile compared to a private car [13].

2.10. Noise reduction
Noise pollution is a more local phenomenon than air pollution, and is one of the most important problems that cities face, this noise increases near the main traffic lane. Diesel-based transportation is noisier than a personal car, but when comparing the noise caused by the number of cars avoided by the public transport vehicle, the noise is less, and modern public transport that uses electricity and applied in developed countries, it does not cause noise.

3. Traffic benefits from public transportation
Public transport provides transportation benefits that no one else can do, as it provides personal trips to groups who are deprived of private transportation (residents who cannot drive due to financial,
economic or social restrictions). Public transport generally serves a relatively small portion of vehicle trips in many societies, but the trips they serve tend to be of high value to users and society. Public transportation also provides the primary means of transportation by assisting residents to access important activities such as medical services, education and employment. This service is very important for passengers who have moderate to severe disabilities that limit their ability to move, and are often unable to use other travel options, such as cycling, walking or traditional taxis because users have limited alternatives [14], the benefits of public transportation far exceed its costs.

3.1. User benefits (passengers)
They result from improved comfort, speed and convenience, or to financial savings for passengers using transportation even without those improvements. For example, if a general transportation priority is to increase speed, then existing users benefit from the travel time savings. Likewise, improving buses and safety in public transport centres, reducing prices and other types of improvements contribute to providing benefits to existing users of public transport. The benefits are direct and provide them with easy access to services and activities, including medical services, and economic benefits from education, work, etc. By providing more shopping options, you can achieve financial savings. Public transportation can also be achieved by improving access to education and employment and increasing people's economic job opportunities. Residents who live close to the public transport service have more annual employment rates than those who lack such proximity to public transport [15]. Likewise, a large part of students depends on public transportation to commute to schools and colleges, so activating public transport services can increase productivity in the future. Increased usage of such groups will provide direct benefits to users and increase overall productivity.

3.2. Support public services
Public transportation can support the activities of government institutions and reduce their costs, because some people are unable to access administrative, medical and other services without relying on public transport services. Therefore, public transport services help reduce dependence on social welfare and unemployment and ease of access to public transportation can affect the ability of elderly and disabled people who cannot drive, and can reduce care costs [16]. As a result, part of the support for public transport may be offset by savings in government budgets by contributing to economic growth and national prosperity, particularly by providing an efficient service for industrial, commercial and agricultural activities.

3.3. Social benefits
Public transportation helps achieve equity goals in society because it increases economic and social opportunities for people who suffer from hardship, whether economically, materially or socially, and helps to achieve equality goals, such as helping physically or economically deprived population groups to obtain public services, education and job opportunities. Relatively speaking, public transportation helps to reduce the degree of disadvantaged groups of people who do not drive compared to motorists. It is also necessary for communication and social interaction.

3.4. Provide options (diversify transportation options)
Public transport services offer options even if they are not currently used, but they can be used in critical situations, whether on a personal level or on a community scale [17], for example when the car breaks down or car traffic congests, passengers do not want to link to the private car and this is similar to lifeboats for ship passengers It must be present even when not in use.
Public transportation reduces the costs of traffic congestion, road facilities, parking lots, accidents and pollution emissions. These benefits depend on reducing the quantity and quality of traffic, for example the provision of public transport services. Additional benefits if car trips between urban areas are reduced at peak times, and not on off-peak times or rural trips, because traffic at peak time between urban areas tends to crowding.
Public transportation and its improvements affect the city’s traffic, therefore, the application of various types of improvements in public transport have their repercussions on traffic, such as improving
mobility and improving the suitability of public transport, some of which are effective in attracting car drivers and limiting travel in private cars. Table No. (2) summarizes the impact of traffic on various types of improvements in public transport, thus providing many benefits.

| The type of improvement in public transportation | Improve service quality | Increase fit | Increased mobility | Reducing car trips |
|------------------------------------------------|------------------------|--------------|--------------------|-------------------|
| Extra tracks. Expand coverage, increase service, frequency and working hours, reduce wages, and make special discounts | ✓                      |              |                    |                   |
| Reducing wages and making special discounts |                        | ✓            |                    |                   |
| More exclusive mobility services |                        |              | ✓                  |                   |
| Passenger travel programs that encourage alternative modes of transportation |                        |              |                    | ✓                 |
| Public transportation priority programs in motion |                        |              |                    | ✓                 |
| Improving comfort by providing comfortable seats and strollers |                        |              |                    | ✓                 |
| Implementing the development of land use that supports public transportation |                        |              |                    | ✓                 |
| Improving pedestrian and cycle conditions, which improve access to public transport stations |                        |              | ✓                  |                   |
| Improve passenger information and promotion programs |                        |              |                    | ✓                 |
| Security improvement |                        |              |                    | ✓                 |
| Directed services, such as express passenger buses, and special events. |                        |              |                    | ✓                 |
| Park and ride services |                        |              |                    | ✓                 |

4. Activating the demand for public transport

The swap between transportation costs and real estate prices is no longer an adequate mechanism for organizing and controlling the city-wide because the costs of transportation and the use of private cars have decreased greatly and many segments have become able to own it as a result of the high standard of living as well as the expansion of road networks for cars [19]. Therefore, it was necessary to find new mechanisms to reduce the use of the private car, the most important of which is the activation of public transport.

The choice of the mode of transport is a function of many factors, part of which is related to the trip, such as the purpose of the trip, the characteristics of the alternative mode of transport, the time of the trip, the cost and the comfort, and the part related to the passenger such as access to the car, age and income, and part related to the transportation system.

There are many public policies aimed at enhancing the demand for public transport by simply enhancing reliability and improving the quality of service through many different means on the demand for trips, such as the geography of the region, economy, population characteristics, quality of service and price. The table below summarizes the routes through which public transportation can increase.
The effects of travel that encourage public transportation can be evaluated by comparing the overall costs (travel time and additional expenses per trip) for public transport and cars to calculate the competitiveness ratio of public transport, and the higher this percentage, public transport is relatively less attractive compared to driving cars [20]. To increase the contribution of public transport and increase the number of passengers, there are many internal and external policies that can affect that, as follows

4.1. Internal factors to activate the demand for public transport.

Among the most prominent factors that can improve the level of service for public transport are improving the percentage of served areas, increasing working hours, frequency and wages, and providing comfort and safety, Table (3) [21].

| The factor          | Using the factor to increase public transportation passenger and benefit                                                                 |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Convenience the information | Increase the coverage, comfort and frequency of public transport  
Provide information on where, when and how to use public transportation |
| price the speed    | Keep wages low and make special discounts, such as travel permits  
Providing express travel services and giving priority to public transport |
| accessibility     | Develop more accessible land use patterns and more diversified transportation systems  
Providing park and ride services, and public transport services for major transport terminals. |
| integration       | Providing park and ride services, and public transport services for major transport terminals.  
Provide adequate public transport vehicles for transport so that it is not crowded |
| Comforts           | Treating public transport vehicles, facilities and services are safe  
Ensure that public transport vehicles, facilities and services are safe |
| The safety reputation | Ensure that public transport vehicles, facilities and services are safe  
Treating public transport passengers with respect, offering public transport as a desirable option for trips |

4.1.1. Prices change. The overall average flexibility of public transport passenger’s items of fares is between (-0.44) to (-0.34), this means that every 1% increase in fare reduces passengers between 0.34 to 0.44%, although this varies according to different geographical, demographic and service factors. Large cities tend to be less flexible than smaller cities, and rush hour travel is less flexible than off-peak hours [22].

4.1.2. Quality of service. The quality of the service can be improved by creating special parking spaces in which private cars cannot stop, which leads to the speed of climbing and descending into public transport, as well as reducing the distances between public transport stops to reduce the total distance that the passenger travels from home and to the work site. It can also increase the number of entrances and exits for means of transportation to reduce waiting time. A self-help system can be implemented in ticketing at stations to reduce congestion in ticketing on the bus or at the station. The general average flexibility of public transport for passengers in relation to the quality of service is (0.5%), and this means that every increase of (1.0%) in the frequency of service or distances travelled or the increase in operating hours for public transport increases the percentage of passengers (0.5%), although this varies according to for various factors such as the type of nature of the geographical area and the demographic [23].

4.1.3. The type of public transportation. In countries with a diversity of public transport, there is a wide debate about the differences in demand between buses and railways for public transport. Rail services are more comfortable and desirable than buses, and this contributes to attracting more passengers. However, the bus network can reach more destinations and provide more coverage, and it
can be comprehensive and direct across the region, and this leads to attracting more passengers to transporters. The demand for the quality of public transportation varies according to the quality of services and income.

4.1.4. Giving priority to public transport. One of the ways to give priority to public transport is to create special lanes for its lanes that are not used by other modes of transport, and thus are not affected by congestion that occurs in the streets or to give priority to public transport traffic at intersections, as more than half of the time for public transport trips is lost at intersections. In Zurich, priorities have been applied since the mid-seventies of the last century, and more than 90% of the intersections are equipped with sensors that give priority to public transport. In Greater London, there is a traffic control system that responds to public transport demand, known as BUSCOOT, which gives priority at intersections of public transport lines [24].

4.1.5. Comfort, Safety, Convenience. Personal comfort, safety, and convenience are essential for retaining a large number of public transport passengers [25], and the means include equipping cars with amenities such as comfortable seats, mobile phone sockets, and easily providing information about public transport services. It is also necessary for transportation vehicles, stations and waiting areas to appear attractively and to afforestation areas surrounding plants to provide additional features of services that enhance the user's comfort and enjoyment. A safer environment should also be provided in public transport stations from personal attacks or terrorist attacks by developing an appropriate design to facilitate monitoring and control, and to facilitate the evacuation process in the event of an emergency, as well as the use of construction materials that do not cause significant damage when disasters occur[26] .

4.2. Activating the demand for public transport by reducing the use of the private car. On the other hand, there are several policies through which the use of private cars can be reduced to support public transportation. Most of the policies lie in increasing the high cost of owning and operating private cars. This corresponds to an increase in investments and subsidies in public transport by increasing government subsidies and investments and by expanding public transport infrastructure [27] . Policies for restricting the private car could be in gasoline prices, imposing high taxes, adding registration fees, licensing fees, and other government fees, as well as vehicle insurance, maintenance, and financing costs in general. So that the choice of public transportation is inevitable.

4.2.1. High taxes on private cars. Most countries impose a one-time tax on sales and annual vehicle registration fees. These fees usually amount to between 1 to 10 percent of the car's selling price or market value, and registration fees tend to be higher in Denmark, as value-added taxes are imposed, which is equivalent to as much as 180% of the purchase price of a new car (taxes and fees in Norway, Austria, and Germany range from 15 to 50 percent of the purchase price of the car)[28], so it is noted that countries that impose heavy taxes on private cars, such as Denmark, Switzerland, and Norway, have the lowest car ownership rates in Western Europe. However, the income effect must also be taken into account when comparing car ownership rates in different countries.

4.2.2. Fuel taxes. Taxes are imposed on auto fuel, thus increasing its price and reducing the use of private cars as the primary response by motorists to fuel economy. We see that the reactions are through reducing trips, increasing the use of mass transportation, and changing work sites[29] .

4.2.3. Parking restriction. Some analysts believe that this factor may be the most important factor affecting public transportation riders. The scarcity of land and local restrictions on sidewalk parking for a long time resulted in higher parking costs in the central business districts of cities. These costs depend on the size of the city and the value of the land[30]. High local parking taxes raise parking costs, reduce passenger driving, and encourage the use of public transportation.

4.2.4. Road Fees and Driving Restrictions. These restrictions consist in preventing private cars from reaching specific locations or times. Such as city centers and limited access to public transportation. During the late eighties of the last century, Italian cities (such as Florence and Milan) prevented...
private cars from reaching the city center during working hours during the day. Road use can be reduced by imposing road fees. Road pricing is a material and regulatory approach to reducing demand for automobile traffic in the United States, as well as using fees to increase resources to finance highway infrastructure public transport or alternative means of transport.

5. Conclusion
There is an expected increase in the use of cars around the world during the coming years, and cars will cause very large emissions, and they can have important effects on global weather patterns and air quality, to deal with these problems, fuel consumption must be reduced to reduce emissions by providing a viable alternative instead of using private cars.

To make a greater contribution to public transport, there should be integrated transport policies, not only in promoting public transport, but by restricting the use of private cars.

Public transport can effectively enhance urban sustainability in many ways, public transport is the most effective and efficient means of transporting people within cities and towns of private cars.

When considering all costs, a variety of factors are related to sustainability, public transport is more efficient than cars, and requires less land to move around.

Public transport is more energy-efficient than cars, because it requires less energy to move a person compared to a private car, so public transport is "cleaner environmentally" than cars, and there is a direct relationship between public transport efficiency and energy use, as it uses less energy to travel. Population in addition to that the production of pollutants and greenhouse gases are in smaller quantities per person. Therefore, the research recommends that public transport should be the main part, if not the dominant part of the urban transportation system.

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