TRANSPORTATION AND URBAN SUSTAINABILITY

Lal C. Wadhwa
Civil and Environmental Engineering, James Cook University, Australia

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Summary

Of all dimensions of urban sustainability, nothing has more profound impact on the quality, vitality and sustainability of a city than its transportation system. It allows the pursuit of human activity patterns and economic thrust in the life of a city. Without it, cities simply cannot function in the modern world. It is, therefore, unrealistic to believe that urban sustainability can be attained without sustainable urban transportation.

However, transportation is responsible for significant consumption of non-renewable resources and is a contributor to unsustainable levels of greenhouse gas emissions and adverse health impacts. The private motorcar, especially when solo driven, has been identified as the major cause of transportation woes—congestion, depletion of scarce resources, emissions, accidents etc.—and is largely responsible for leading our transportation systems towards unsustainability. The use of the private car is entrenched in our lifestyles, values and attitudes and it will be extremely difficult to achieve a major shift in people's aspirations and expectations. Yet without such a shift, it is unrealistic to expect that significant progress towards sustainability will be achieved, and herein lies the dilemma.

There are no simple solutions to achieving sustainable transportation. This paper presents short- and long-term strategies, including those which represent deliberate attempts to covertly influence human behavior through shift in values and attitudes. These cover a range of technological, economic, regulatory and planning alternatives. It is realized that technological solutions alone will not deliver sustainable transportation and it is essential that all key elements of transportation systems are targeted.

1. Introduction

Urban sustainability is achieved when all urban systems are sustainable. These systems include:

- land-use
- transportation
- communications
- power
- water supply
- wastewater management
- solid waste disposal
- security
- industry and employment
- education.

However, nothing has more profound impact on urban sustainability, than a city's transportation system. Without it, people would not be able to get to work or to educational institutions, industry could not function, security systems would collapse, etc. In fact, human activity patterns would be severely impacted and the city would become unsustainable. It is, therefore, premised that transportation systems are fundamental to our cities and that sustainable transportation is a pre-requisite to urban sustainability.

Urban transportation systems are responsible for severe environmental impacts that lead an urban area towards unsustainability. The current trends in urban transportation in most of the advanced societies in the world are unsustainable. This is evidenced from increasing delays and congestion, emissions of greenhouse gases, adverse health effects of deteriorating air quality, accidents and fatalities, rapid depletion of scarce and non-renewable fossil resources, just to name a few problems.

The world is facing the daunting task of making urban transportation systems sustainable. The stakes are so high that the protection of life on our planet is threatened if current trends are allowed to continue. With the objective of moving the existing transportation systems towards sustainability, this paper provides an inventory of strategies developed from the technological, economic, planning, regulatory and management perspectives. These strategies and their effectiveness are discussed in this paper and are based on the data and experiences from Australia, and North America.

2. Objectives and Vision

Achieving sustainable transportation is a fundamental requirement for urban sustainability. Therefore, the key objective is to direct transportation system decisions and investments that should expand and not limit the economic, ecological and social choices available to future generations. However, in moving towards sustainability, we must maintain the following supplementary but vitally important objectives:

2.1. Economic Objective

- Maintain competitiveness and economic growth; reduce costs

Striving to achieve sustainability simply by reducing the amount of travel is not a valid solution. Maintaining competitiveness and ensuring economic growth must not be compromised. The total cost of transportation should be minimized by reducing fatalities and injuries, minimizing congestion, and by optimal utilization of transportation infrastructure and other resources. The economic objective remains uncompromisable in our desire to achieve sustainability. This is a challenging objective.

2.2. Environmental Objective

- Maintain and improve the quality of urban environment

The single greatest threat to the sustainability of transportation systems comes from vehicle emissions that contribute to greenhouse gases, cause deterioration in air quality, and impair human health, accounting for community costs running into billions of dollars. The objective is to develop and use non-polluting energy resources and move towards zero-emission vehicles. Other environmental impacts such as noise pollution, water pollution, loss of biodiversity, and other ecosystem impacts must be controlled. The environmental objective is so vital that it is sometimes taken as the sole criteria of sustainability.

2.3. Social Objective

- Maintain and enhance mobility, accessibility, and equity; fair distribution of costs and benefits

Another objective that will contribute to sustainable transportation includes equity considerations. The system must provide for widest participation of all stakeholders, enhance mobility and accessibility and ensure fair distribution of the costs and benefits of the system to the entire community.

3. Current Trends in Transportation Systems

A review of the current transportation trends in Australia and North America points towards an unsustainable transportation future. Growth in the total transportation task (passenger and freight) has been characterized by high rates of growth in modes that are comparatively more energy-intensive in the performance of their task. Urban public transport modes are generally declining in their contribution to the total transportation task.

In Australia,

1. Passenger vehicle-kilometers have roughly doubled over the past 20 years while road freight ton-kilometers have almost tripled. The growth has been stronger in urban areas.
2. Congestion in six major Australian cities cost the community $12.75 billion in 1995. This figure is projected to increase to a whopping $30 billion by 2015.
3. The transportation sector consumed 1202 PJ of energy in 1997-98 and the amount is estimated to increase to 1572 PJ by 2014-15.
4. The share of petroleum in transportation energy use is 98.7%. It is expected to remain high at over 96.5% over the next 15 years.
5. Domestic transportation greenhouse gas emissions have continued to increase and are dominated by the road modes. The emissions have increased from 61 million tons (in CO_2 equivalent) in 1991 to 72 million tonnes in 1997.
6. Road accidents alone result in over 1700 deaths each year and the cost to the community is estimated at over $8 billion.

In the United States,

1. The passenger and freight transportation task continues to grow with over 2.39 trillion passenger kilometers in 1997.
2. Over 40 000 persons are killed each year in road accidents.
3. The US transportation sector remains almost entirely dependent on petroleum as an energy resource and more than 50% of petroleum used in the United States must now be imported. The US petroleum use is currently 12 million barrels per day for transportation and has been rising.
4. The emission of CO_2 from the transportation sector in 1998 was about 1800 million tons.

5. Congestion is on the increase costing the community $34 billion a year in just the top ten congested urban areas in USA. An average driver wastes 76 hours and 330 liters of fuel in congestion. In the top ten congested cities, congestion costs range between $700 and $1090 per driver per year.

There is a genuine and growing concern that the trends in fuel consumption, almost total reliance on fossil fuels, greenhouse gas emissions, effect on air quality and public health, congestion, and fatalities in the transportation sector are unsustainable, and destined towards the disintegration of the urban transportation systems.

4. Elements of Transportation Systems

The key elements of urban transportation systems are the vehicles and fuel, infrastructure and traffic flow, and, most importantly, the road users and drivers. These are shown in Figure 1.

4.1. Vehicles and Fuel

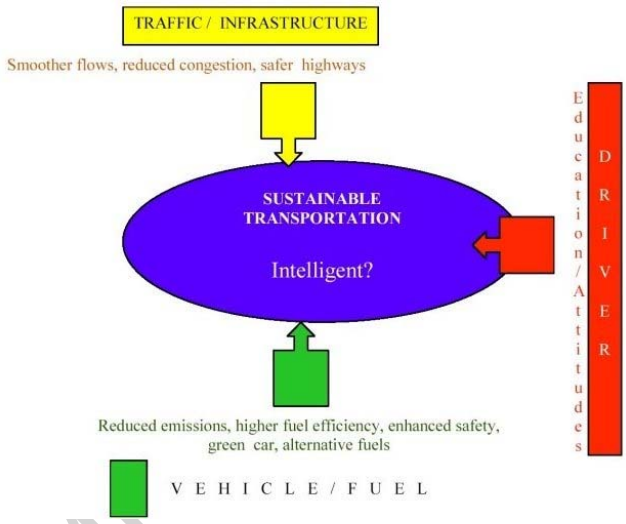

Figure 1. Major elements of transportation systems

The polluting nature of fossil fuel and current vehicle technology is largely responsible for making our transportation systems unsustainable. In addition to the deteriorating impact on the urban environment and public health, the current practices are depleting non-renewable fossil fuels at an unacceptable rate. Although great strides have been made in reducing vehicle emissions, the dependence on fossil fuels has not diminished in spite of almost thirty years of research and development. It is premised that there is a significant potential in switching to alternative energy sources and in producing green cars (with zero emission levels). Fuel efficiency must be increased and it has been estimated that it is possible to make vehicles that are 5-20 times more fuel-efficient than present cars. The transportation sector will have to switch to non-depleting, non-polluting energy sources if it is to be sustainable. Technological advances, pricing and regulatory measures can make significant contributions towards increasing fuel efficiency.

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Biographical Sketch

Dr. Lal Wadhwa is the Head of Civil and Environmental Engineering at James Cook University in Australia. He holds undergraduate qualifications in Science and Civil Engineering and a Master and Doctorate in Systems Engineering and Management. He has thirty years of teaching experience in Australia, USA, Canada, Thailand and India. He has authored almost 100 research papers and edited/authored seven books.

Dr. Wadhwa's research interests are in the areas of highway safety, sustainable transportation, engineering management and modeling and simulation. He is the coordinator of the Master of Engineering Management program at James Cook University. He is a Fellow of the Institution of Engineers, Australia and a Member of the Institute of Transportation Engineers, USA.