# INTERMODAL AND MULTIMODAL CONSIDERATIONS AND DEVELOPMENTS

**Michael D. Meyer**
*School of Civil and Environmental Engineering, Georgia Institute of Technology, USA*

**Keywords:** Transportation mode, intermodal transportation, multimodal transportation planning, terminals, freight transportation, transportation systems integration

## Contents



UNESCO – EOLSS SAMPLE CHAPTERS

## Summary

The transportation system consists of many different modal networks that provide mobility and accessibility to transportation system users. In many countries of the world, the road network is the primary means of transporting people and goods; whereas in others, the pedestrian/bicycle network, the urban transit network, the inland and coastal water network, the rail network and the aviation network provide important means of transportation. Many trips, however, require the traveler to use more than one mode of transportation. A multimodal perspective of a transportation system is thus one where multiple modes of transportation are available to the user of the transportation system. Locations where the different modal networks interconnect are called intermodal terminals or transfer points, which if not designed and managed effectively, can become major bottlenecks in transportation system performance. Intermodalism or intermodality has also been viewed from a public policy perspective as a means of encouraging travelers or freight movers to use a combination of modes for a trip that collectively reduce fuel consumption and pollutant emissions, and that meet other policy objectives such as reducing traffic congestion.

## 1. Introduction

A "modal' perspective has been a dominant theme of transportation planning and investment for many years. This perspective is based on the view that the technology or means of transportation, often referred to as a transportation mode, is the basic component of a transportation system. Passenger transportation modes include human-powered transportation such as walking or bicycling, personal automobiles and motorcycles; bus, rail and ferry transit services; and for longer distance travel, intercity bus, rail, ferry, and air service. Freight transportation modes are very similar in that many use the same infrastructure as the passenger transportation system. Thus, for example, freight can be moved by human-powered transportation including walking and bicycling; motor trucks and mopeds; and for longer distance travel, intercity bus, rail, barge, ship and air services.

Most travelers and freight movements, however, do not use solely one mode of transportation to reach a destination. The trip often consists of many different modes, each serving a different trip function and having different characteristics. Thus, for example, from a total trip perspective, a typical urban commuter in a large city might walk to a bus route, take a bus to a station where he transfers (by walking) to a subway; the subway takes the commuter to a downtown location where he walks through the subway station and along a sidewalk network to his work location. This trip consists of three modes of transportation—walking, bus and subway. Although the traveler views this trip as simply leaving home and going to work, and often does not distinguish between which agency or operator has responsibility for which part of the trip, in most cases, the different components of this traveler's trip are the responsibility of different organizations. This modal orientation of transportation investment and institutional structure represents a challenge to many urban areas that want the best and most cost effective improvements to the transportation system, regardless of where the funds come from or who has what responsibility.

A major purpose of transportation investment is to improve traveler mobility and accessibility to land. This can be achieved through a variety of means, with many choices available to the user of the transportation system. In recent years, transportation policy in many countries has focused on developing such a broader systems perspective on transportation. Multimodal transportation planning represents this perspective in that it considers all of the transportation modes that are found in an urban or regional transportation system.

A multimodal transportation system is one where many different modes are provided and where trips that include transfers from one mode to another can occur in a coordinated way. The locations where different transportation modes connect to allow travelers or goods to transfer, such as the subway station in the above example, are known as intermodal terminals. Intermodal terminals are very important components of a transportation system in that they can become critical bottlenecks in system performance if not designed or operated correctly. Intermodalism or intermodality has also been defined at a much broader policy level to include the either the substitution of one mode for another, or the complementary use of different modes for the trip. The containerization of freight, one of the major trends in freight movement worldwide over the past 20 years, is a good example. Intermodal freight transportation is based on the concept of containers being transported over long distances by using different modes. For example, the container could travel via truck to an intermodal terminal where it (and possibly the truck itself) is transferred to a rail or barge service, which transports the

UNESCO – EOLSS SAMPLE CHAPTERS

container over a long distance. At the destination, the container is transferred back to a truck for ultimate delivery.

Multimodal and intermodal considerations will likely play a more important role in the planning for, and investment in, future urban and regional transportation systems. These considerations are important because they focus investment decisions on what is necessary to provide the most efficient transportation system performance. In addition, public policies that focus on minimizing the negative environmental impacts associated with the use of the transportation system, or which emphasize the positive economic development impact of transportation investment, must adopt this much broader perspective in order to better link the performance of the transportation system to these goals.

## 2. Transportation Modes

A transportation system consists of many different modes or means of transporting people and goods. The modes of transportation available today for urban transportation are common to most metropolitan areas, although they exhibit different performance characteristics and can be applied in different ways to serve different purposes. The mode of transportation is important for several reasons. Most importantly, transportation mode reflects the level of performance needed or desired by the traveler. Thus, most travelers wanting to be at a destination 200 kilometers distant within three hours would not likely choose a human-powered mode to reach the destination. The various combinations of transportation modes in a typical urban transportation system represent the different levels of system capability to satisfy trip-making demands. Some travelers will choose a mode that will be fast, but which might not be the most direct; others might choose a slower mode, but one that delivers the travelers very close to the destination. Figure 1 shows the typical modes of transportation that are found in today's urban areas. Note in this figure that the mode is classified by the combination of its typical speed and the level of accessibility it provides to destinations. Also note that telecommunications in this characterization is considered a mode of transportation. Telecommunication technologies, in some applications, allow an individual to accomplish a task, even though that individual never has to leave their home or work place. Because this ability can be considered a replacement for an actual trip, many planners and engineers thus view this as a mode of transportation.

The mode of transportation also has important implications to the cost of travel, not only to the traveler, but also to those agencies that provide the infrastructure. Thus, most transit bus services use the road system that has been provided mainly in urban areas to serve motor vehicles (although many cities such as Houston, Texas and Ottawa, Ontario have provided separate roadways for express bus services). A rapid rail transit service, however, will require a costly separate infrastructure with its own power and operational control system. In this case, the more sophisticated and higher capacity/higher speed mode is also more costly.

Another important characteristic of the mode of transportation is that each mode has different impacts on the natural environment. For passenger travel, human-powered transportation (walking, bicycles, rickshaws, etc) have the least impact on the

UNESCO – EOLSS SAMPLE CHAPTERS

environment, whereas most engineers and scientists would agree that the motor vehicle has the greatest impact. Not only does the motor vehicle consume significant amounts of petroleum-based fuel, the pollutants emitted from the engine and metallic contaminants from the battery and other vehicle components lead to serious concerns about degradation of an urban area's air and water resources. In the freight sector, the motor truck is generally considered to have a greater environmental impact than rail or water transport. In many countries, and especially in Europe, public policy aims at encouraging shippers to use the more environmentally-sensitive rail and water transportation modes versus the motor truck.

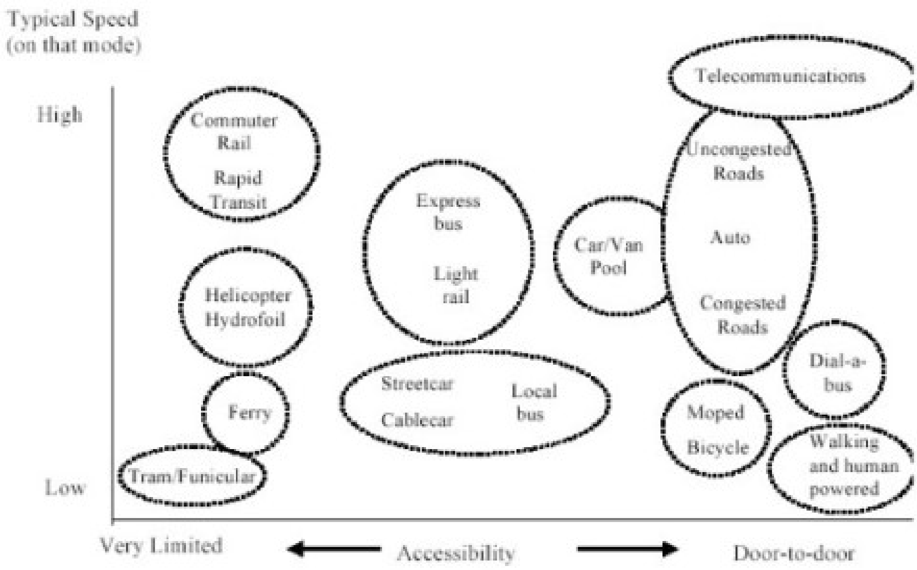


Figure 1: Typical urban transportation modes

Transportation modal networks are also considered to have important and different influences on the way in which urban areas develop and evolve over time. It is generally accepted by planners and researchers that the motor vehicle and the corresponding road network, for use by both the personal automobile and the truck, have been a predominant factor in the dispersal of economic activities in the typical urban area of today. Also known as urban sprawl, it is unlikely that these characteristics of urban form could have occurred without the near ubiquitous accessibility afforded by the motor vehicle. In urban areas of higher population density, such as New York City, London, Tokyo and the megacities of Latin America, Asia, and Africa, the reliance on mass transit networks have allowed such densities to occur. Even in many of these cities, however, the introduction of the motor vehicle has caused tremendous population growth on the urban fringes where mass transit services are difficult to provide. And in many developing countries, building freeway networks has become an important component of government policy, often at the expense of the transit system.

Finally, the mode of transportation is important from an organizational and system management perspective. Many transportation agencies and government funding programs are organized along modal lines. Many states or provinces have agencies responsible for the road network, having very little responsibility for other parts of the transportation system. Funding for this network, most prominently coming from gas taxes, is often restricted in its use to only improvements on the road network. In urban areas, special authorities have been created to provide transit services, develop and manage ports or airports, and to build special facilities such as tollways that are similarly based on funds that are restricted to that modal use.

For freight transportation, the responsibility for providing modal networks varies by country. In many countries, the infrastructure for freight transportation is solely the responsibility of private operators or owners. The rail network in the United States, for example, is almost entirely provided by the railroads. In other countries, the rail network is a government responsibility. In Europe, many countries, encouraged by the European Union, are adopting a policy of separating the ownership of the rail infrastructure from the organizations who use or operate on this infrastructure in order to foster greater competition. Truck and ship terminals are often the responsibility of private companies, yet the road and river channels used by shipping companies are often provided for and maintained by government agencies.

The different institutional responsibilities for funding and operating transportation modal networks can create significant challenges to transportation planners and officials as they consider the most cost effective investments to improve the performance of the transportation system. In many countries, metropolitan or regional planning agencies have been created by national and state/provincial governments to coordinate this decision making process. However, adopting a multimodal perspective on transportation system investment often runs into institutional barriers that reflect the history of how the transportation agencies responsible for different parts of the system are organized and funded.

-
-
-

TO ACCESS ALL THE **13 PAGES** OF THIS CHAPTER,
Visit: http://www.eolss.net/Eolss-sampleAllChapter.aspx

**Bibliography**

Banister, D. (1994) Transport Planning, Falmouth, Cornwall, E&FH SPON (A text that looks at transport planning in the USA and Europe).

Brotchie, J., Newton, P. Hall, P. and Dickey, J. (eds) (1999) East West Perspectives on 21$^{st}$ Century Urban Development, Aldershot, Ashgate (Collection of articles comparing the development of Asian and western cities; limited attention given to transportation investment).

Meyer, M. and Miller, E. (2001) Urban Transportation Planning: A Decision Oriented Approach, (2$^{nd}$ edition), New York, McGraw-Hill (An up-to-date text that examines transportation planning from a system perspective with many examples, mainly from the USA)

Miller, G. (1999) Intermodal Freight Transportation, 4$^{th}$ edition, Washington D.C: Eno Foundation (A comprehensive reference on intermodal freight transportation)

UNESCO – EOLSS SAMPLE CHAPTERS

Pharoah, T. and Apel, D. (1995) Transport Concepts in European Cities, Aldershot, Ashgate (A text based on case studies of 10 European cities).

Transportation Research Board (2000) Refocusing Transportation Planning for the 21st Century, Conference Proceedings 20, Washington D.C., National Academy Press (Proceedings of a national conference in the USA that examined transportation planning for the 21st century).

**Biographical Sketch**

**Dr. Michael D. Meyer** is a Professor of Civil and Environmental Engineering, and former Chair of the School of Civil and Environmental Engineering at the Georgia Institute of Technology. From 1983 to 1988, Dr. Meyer was Director of Transportation Planning and Development for Massachusetts where he was responsible for statewide planning, project development, traffic engineering, and transportation research. Prior to this, he was a professor in the Department of Civil Engineering at M.I.T.

Dr. Meyer has written over 140 technical articles and has authored or co-authored numerous texts on transportation planning and policy, including a college textbook for McGraw Hill entitled *Urban Transportation Planning: A Decision Oriented Approach* . He was the author of *Transportation Congestion and Mobility: A Toolbox for Transportation Officials* , a book sponsored by the Institute of Transportation Engineers and the Federal Highway Administration that focuses on transportation actions that can be implemented to enhance mobility. He is an active member of numerous professional organizations, and has chaired committees relating to transportation planning, public transportation, environmental impact analysis, transportation policy, transportation education, and intermodal transportation.

Dr. Meyer is the recipient of numerous awards including the 2000 *Theodore M. Matson Memorial* Award in recognition of outstanding contributions in the field of transportation engineering; the 1995 *Pyke Johnson Award* of the Transportation Research Board for best paper in planning and administration delivered at the TRB Annual Meeting; and the 1988 *Harland Bartholomew Award* of the American Society of Civil Engineers for contribution to the enhancement of the role of the civil engineer in urban planning and development. He was recently appointed to the Executive Committee of the Transportation Research Board.

Dr. Meyer has a B.S. degree in Civil Engineering from the University of Wisconsin, an M.S. degree in Civil Engineering from Northwestern University and a Ph.D. degree in Civil Engineering from M.I.T. He is a registered professional engineer in the State of Georgia .

UNESCO – EOLSS
SAMPLE CHAPTERS