Chapter 1
Introduction

1.1 The Nature of the Problem

Congestion in transportation facilities—walkways, stairways, roads, busways, railways, etc.—happens when demand for their use exceeds their capacity.

Travelers tend to complain about traffic congestion because it adds to their travel time and takes away from the time they can dedicate to other activities. Truck drivers complain because it reduces their productivity and increases their operating costs. Transit service providers complain about roadway traffic congestion because it increases the number of buses and drivers needed to provide the service. Congestion increases business costs, air pollutant emissions and fuel consumed.

Congestion also can influence investment decisions, and therefore it becomes a major economic concern. It influences where people live, work and how they travel. Therefore reducing congestion benefits a wide constituency.

Traffic congestion has been a fact of city life from ancient times when movement was by walking and animal-drawn coaches to today's cities that rely on various means of mechanized travel. It is a byproduct of economic activities that grow faster than the growth in transportation infrastructure.

Traffic congestion is now found in cities throughout the world. It continues to increase as the cities' population and motorization grow and as travel growth outpaces investments in roads and public transportation. The beginning of congestion is generally perceived by drivers when their trip time increases by approximately 0.4–0.5 min/mile, and they become acutely aware of congestion when it increases by 0.8–1.0 min/mile.

Traffic congestion may also be the hallmark of a vibrant economy: a city without a traffic congestion problem is likely to experience an economic recession, or a declining population. But where congestion is too pervasive and trip time reliability is a problem, the city may become a less desirable attraction for economic growth.

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People who live a large metropolitan area are concerned about traffic congestion because it affects most of their daily activities—arriving on time to work or at a business meeting, to meet a friend, catching a plane, etc.

Below are examples of different traffic congestion experiences and the type of responses that each engenders:

- If you have moved your young family in the suburbs where you could afford the house and your commute has become longer and more stressful, you will favor the construction of more road capacity, or an affordable, faster transit service.
- If you can afford to buy or rent in the central city, roadway traffic congestion may not bother you too much, but crowded buses or trains, or station platforms will. If you live in the city, therefore, you would favor improving transit service and bicycle routes for your mobility needs.
- If you are an urban economist, you are concerned with marginal cost pricing and are likely to favor reducing traffic demand through congestion pricing. You will be supported by environmentalists and those living near congested roadways because less motor vehicle traffic improves air quality. But congestion pricing is likely to be opposed by suburban commuters because it will increase their commuting cost—upsetting the cost balance of their housing and commuting that they were counting on when they decided on the housing location choice. In addition, low-income commuters will tend to oppose congestion pricing preferring "free" roads that require waiting on traffic queues to toll roads that reduce congested travel.
- If you are an environmental advocate you will support higher land density developments such as "smart growth" because you want to reduce the growth of vehicle miles of travel (VMT). But if you are a developer, you are concerned about the demand for high density housing in suburban areas.
- Transportation planners and environmental groups advocate more transit capacity to encourage travelers to use transit service and they are typically joined by economists in promoting the idea of using revenues from congestion pricing to finance transit improvements.
- If you are a traffic engineer, you will seek to reduce traffic congestion by removing capacity bottlenecks through capacity expansion, and you will favor the application of advanced technologies to improve the efficiency of the road network.

These examples show that the sources and perspectives of traffic congestion are many and diverse. In these examples there is no single overall solution to the congestion problem that meets every situation because the contexts are different. And where these contexts do not overlap it is usually impossible to find a solution strategy that satisfies every need.

1.2 Why this Book

This book has been prepared to fill the need for a clear and comprehensive look at the many dimensions of traffic congestion. It defines and describes congestion, explains its causes, describes its consequences, and identifies ways to provide congestion relief.

Traffic congestion has been extensively explored for many years in various articles and books. But these documents have usually treated congestion from specific perspectives (person travel or goods movement) or discipline (e.g., traffic engineering, transit operations, economics, land use planning and zoning).

In fact, there is no lack of interest or knowledge to reduce or manage urban traffic congestion to meet one's expectations. However, to implement solutions to the traffic congestion problem that are acceptable requires agreement among the diverse stakeholders involved. But these diverse stakeholders—including the various disciplines—are unlikely to find convergence on what needs to be done about the growing traffic congestion problem without a shared language and common objectives.

Although they may all use the same words—congestion, mobility, accessibility—in debating the congestion issue, they do not necessarily share the same meaning that these words convey. To discuss and debate the congestion problem in a public forum it is necessary to use definitions and metrics that allow for clear and unambiguous exchange of ideas among interest groups. Traffic congestion solution strategies need to be described in terms that impacted stakeholders find relevant to their daily lives.

This book, therefore, has been prepared in response to the many needs for a comprehensive, clear, and objective look at the many dimensions and impacts of traffic congestion in metropolitan areas.

The book gives practitioners and researchers, local elected officials, and community leaders, information on urban traffic congestion—its causes, characteristics and consequences—they can use to create a framework that allows diverse interest groups to debate the issue of traffic congestion by using the joint platform of mobility and accessibility. To develop rational policies for managing the urban traffic congestion problem, a focus on mobility and accessibility is needed. Not just mobility as traffic engineers are inclined to favor; and not only accessibility, as "smart growth" advocates favor.

The book lays the foundations for achieving a common understanding among the various stakeholders and disciplines and presents simple quantitative methods for estimating the effects of congestion on mobility, accessibility, travel time reliability, and other quality of life indicators.

Building on this understanding the book presents a rational analysis framework that a city, suburb, or a metropolitan area can use when managing growing traffic congestion problems. Thus the book is useful not only to transportation students and transportation professionals, but also to urban planners, and transportation policy analysts and policy makers.

In summary, the book focuses on four key objectives:

1. To understand and address the factors that contribute to traffic congestion,
2. To understand the issues involved in quantifying urban traffic congestion,
3. To assess the impacts of congestion on urban and suburban mobility, access to activities, network productivity, and environmental quality, and,
4. To provide congestion relief strategies that increase traffic efficiency and increase the use of alternative modes of transportation.

Each of these objectives is examined from a concise multi-disciplinary perspective using illustrations and techniques that provide for a broad, yet clear, understanding of traffic congestion and its impacts, and that will describe adaptation and mitigation strategies that are likely to provide congestion relief.

1.3 Overview of the Book

The book is organized into 24 chapters grouped into four parts:

1. Part I—Background (Chaps. 1–3):

In addition to this chapter Part I includes Chap. 2, "How Transportation Technology has Shaped Urban Travel Patterns," and Chap. 3, "Historical Perspective of Urban Traffic Congestion." Chapter 2 examines urban development and traffic congestion from historical and contemporary viewpoints. It shows how technology, transportation technology in particular, has extended urbanized areas and traffic congestion. The chapter shows that urban traffic congestion is not only a current phenomenon, but has existed in cities since ancient times. Chapter 3 shows how growth in population, employment, motorization and vehicle miles since World War II has contributed to the spread of congestion from the city center to the entire metropolitan area.

2. Part II—Traffic Congestion Characteristics, Causes, and Consequences (Chaps. 4–13):

Chapter 4 describes the underlying causes of traffic congestion. They include the concentration of travel demand in time and space (Chap. 5); the effect of growth in population employment and car use, population density, and the lag between roadway capacity growth and travel growth (Chap. 6); and the effect of bottlenecks (Chap. 7). Chapter 8 describes the criteria and metrics used to describe and quantify congestion; and Chaps. 9–13 address the impacts of congestion on trip time and reliability, mobility, accessibility, traffic productivity, transportation costs, and quality of life issues.

3. Part III—Congestion Relief Strategies (Chaps. 14–23):

Chapter 14 provides an overview of possible adaptive and mitigation strategies for managing congestion. The chapter provides a framework for the various

capacity expansion and demand mitigation strategies for managing nonrecurring congestion (Chap. 15) and recurring congestion (Chaps. 16–23). Capacity-oriented (adaptive) strategies (Chaps. 16–17) aim at increasing roadway capacity to keep up with traffic demand. Traffic reduction (mitigation) strategies focus on reducing the use of automobile travel (VMT) by relying on changes in travel behavior motivated by pricing, regulatory, or employer-based strategies (Chaps. 18–23). While some capacity oriented strategies are relatively easy to implement (for example removing a physical bottleneck or improving the timing and coordination of traffic signals), strategies aimed at reducing automobile use (VMT) require behavioral changes. Modifying travel behavior of individuals by restricting their travel choices for the larger societal good is more difficult to implement.

4. Part IV—Conclusions

This concluding chapter summarizes the book's key points, sets forth suggested congestion relief strategies for typical problem locations, and provides a future outlook to the congestion problem in light of expected changes in socio-demographics, and in transportation technology.

1.4 Who Can Benefit from this Book

This book is intended for a wide audience. It will be especially useful to transportation students, practitioners and researchers. But it will also be helpful to urban planners, policy analysts, and transportation policy makers by providing a broad discussion of the issues framing the traffic congestion problem.

Transportation students will benefit from an integrated understanding of the core issues framing the traffic congestion problem, as opposed from what they can get from books that focus on specific aspects of the congestion problem.

Transportation practitioners are provided with a quick reference framework to evaluate the contextual impacts of individual projects.

Transportation policy analysts will benefit from a better understanding of the factors influencing transportation performance.

Policy makers and the general public will benefit from the book because it is organized to cover topics the public cares about, and because it provides knowledge tools needed to better understand and evaluate alternative solution strategies.