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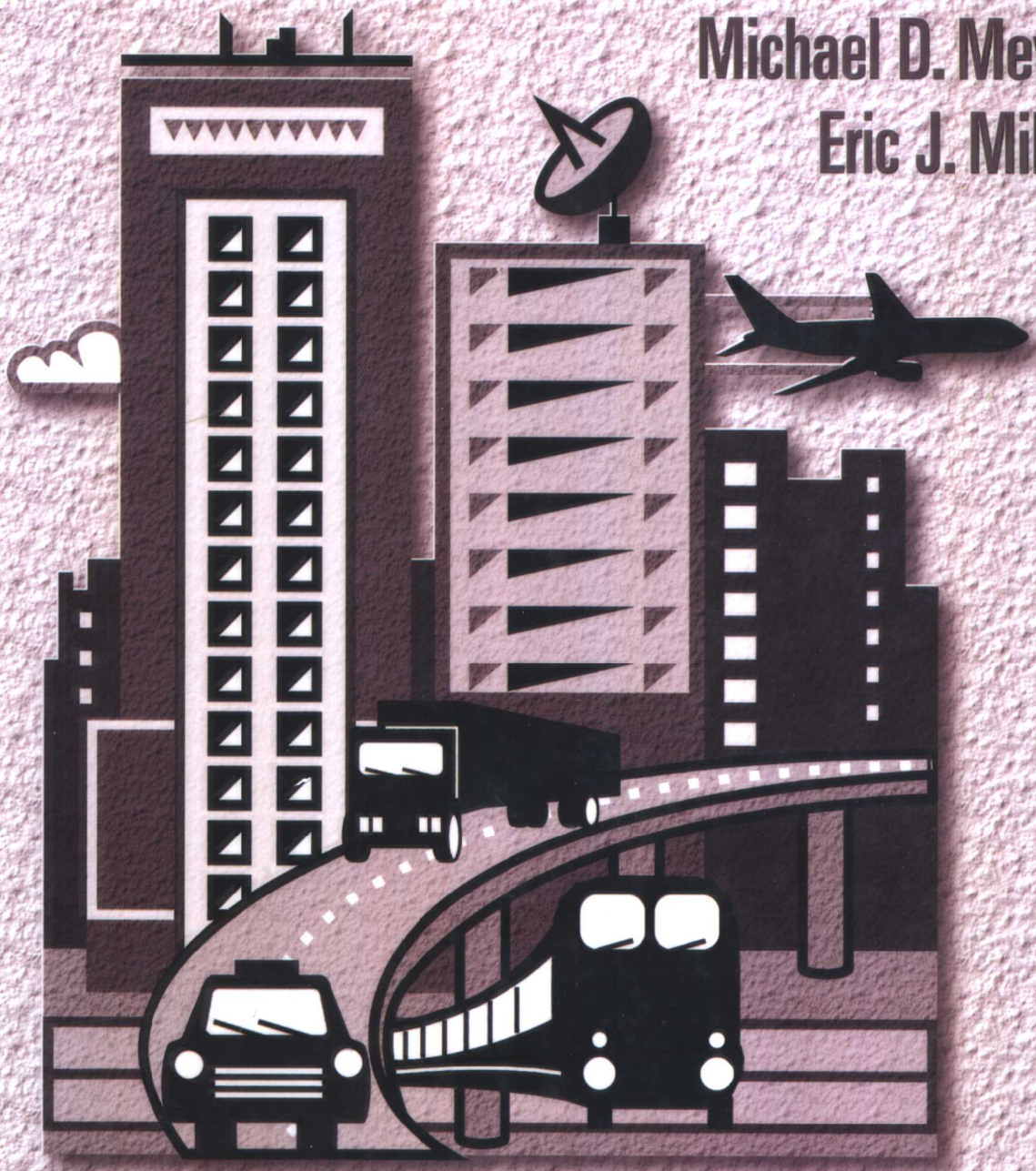

Urban Transportation Planning

Second Edition

URBAN TRANSPORTATION PLANNING

A Decision-Oriented Approach

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PREFACE

When we wrote the first edition of *Urban Transportation Planning: A Decision-Oriented Approach* in the early 1980s, the world was a very different place. Oil embargoes during the previous years had created heightened awareness of the precarious dependence of western economies on foreign sources of energy. Not surprisingly, energy contingency planning and the fuel-saving benefits of proposed transportation actions were prominently discussed in the book. The technology of transportation was viewed primarily as a given, and in many ways did not factor into the strategies for dealing with transportation problems. Land use was a critical input into travel demand modeling, but very few examples were available of how land-use policies could be used to influence transportation system performance. Formal environmental impact analysis had been born a mere 10 years prior to the book's publication, and thus the transportation profession was still defining/creating/ inventing ways for this to occur in a meaningful way.

It is symptomatic of the study of transportation and of the excitement that it holds for countless transportation professionals that much has changed since the book's first publication. In fact, our intent for this second edition was to provide a simple update of the material, while leaving the basic structure the same. As we began, we quickly learned that this approach could not be followed. Too much had changed. The incredible revolution in computing (e.g., the first edition's draft manuscript had been produced with an electric typewriter) and its ever increasing sophistication and availability have changed forever how transportation planning will be conducted. Terms such as GIS, GPS, IT, Internet, virtual reality, and e-commerce were unknown, at least outside of the science fiction literature. And today's students must know as much about the technology of transportation system operation as they do about the physical characteristics of transportation facilities. This new edition has incorporated this new context into an understanding of how transportation systems serve society.

The basic theme of the book, that the major purpose of transportation planning is to inform decision making, remains as the defining theme of this edition. This concept has, if anything, been reinforced over the past 15 years. The institutional framework for decision making has repeatedly been pointed to as one of the key characteristics influencing the effectiveness of planning. It has also been described as one of the important constraints limiting innovation and change. Given its central role in our description of transportation planning, decision making and its linkage to planning remains as one of the most important sections (Chapter 2) in this edition. The material has been updated to include legislation, regulations, and other contextual factors that influence the substance and form of transportation planning.

Several concepts not found in the first edition have been incorporated into this version. In most cases, they reflect the changes that have occurred over the past 15 years. However, in other cases, they represent ideas or principles that we strongly believe will characterize transportation planning over the next two decades, even

though they are not widely recognized as such by most transportation professionals. These concepts include,

Metropolitan focus—The first edition discussed transportation planning in the context of *urban* areas. In this edition, we refer to transportation planning as it should occur in *metropolitan* areas. Most major cities of the world, and certainly those of North America, have evolved into regional concentrations of population and economic activity that, without a map showing jurisdictional boundaries, would be indistinguishable from one part of the region to another. Central cities, although still important as centers of business, government, and culture, have become just one part of a much larger metropolitan region. Many of the challenges of transportation planning now relate to travel and connections from one part of the region to another, bypassing the central city completely. Institutional structures have been established at the metropolitan level to guide transportation planning; modeling approaches have been expanded and enhanced to reflect this much broader context for planning; and the role of a metropolitan economy in the context of a global market has become an important focus of planning activities. Planning at the metropolitan level will be the focus of much of transportation planning in the future.

Systems perspective—Transportation has been thought of as a system for many years. However, this edition adds a new dimension to this "systems" perspective. The transportation system itself exists within and interacts with other much larger systems. This has important implications for problem definition, scale of analysis, methods and tools that can deal with these broader issues, and implementation strategies that transcend traditional institutional boundaries. Chapter 3 presents new material on the characteristics of a system and how these characteristics relate to transportation systems planning.

Linkage to development and land use—The first edition treated land use primarily as an important input to the technical planning process. Much has happened over the past 15 years. Many public officials have aggressively pursued public policies that have linked growth and transportation investment. Growth management, "smart" growth, and sustainable development have become important policy contexts in many jurisdictions for transportation investment decisions. This edition provides additional material on the important policy relationship between transportation systems and metropolitan development.

Linkage to environmental quality and ecosystem health—One of the trends identified in the first edition has continued to become more important over the past two decades and will likely be even more important in the future. A systems perspective leads to the observation that human activity will most likely have negative impacts on the natural environment. These impacts have been considered at higher scales of analysis, for example, regional air quality; watersheds; and, ultimately, global climate change. Incorporating environmental considerations at this level into transportation systems planning will be increasingly common in future years. We have laid the groundwork for this concept in this edition.

Linkage to community quality of life—The concept of a "community" and the "quality of life" experienced by its citizens has become more popular in recent years. This concern has led to new urban design principles (which in some cases are

nothing more than urban design as it occurred 100 years ago), more attention given to the incidence of benefits and costs on different groups in society, and much stronger consideration to community impact analysis. This edition discusses the tools and techniques that can be used to establish a strong linkage between community quality of life and transportation system performance.

System performance orientation—Society has become more sensitive to the quality of service provided by schools, enforcement agencies, health organizations, and businesses. Citizens are asking for more accountability of public investment and continual monitoring of performance to identify opportunities for improvement. Transportation has not been immune from this trend. Many transportation agencies have developed measures of system performance that can be used to monitor the condition of the system and the quality of service being provided to the public. This edition adopts a performance-based planning approach to transportation planning. Chapter 2 describes how performance measures can be incorporated into the planning review.

Evolution in transportation system technology—The past decade has seen a significant addition to the toolbox of strategies that can be considered by transportation planners and decision makers. The application of advanced electronics, sensors, and network feedback technologies has made transportation system operation much more sophisticated. Intelligent transportation systems (ITS) technologies are now being considered, and many have been implemented, in most major metropolitan areas in North America and around the world. The vehicle itself will likely become much "smarter" in coming years with automated guidance and navigation capabilities, collision warning systems, self-monitoring diagnostics, and network connections to a central information management system becoming commonplace. The transportation planning process must consider such technologies, not only from the perspective of their impact on travel behavior, but also from the perspective of their relative costs and benefits as compared to traditional strategies.

Revolution in computer technology—Perhaps the most significant change that has occurred since the first edition relates to the rapid advances in computing power and the pervasiveness of computer use. Transportation planning very much relies on computer-based analysis, database management, and electronic presentation of results. The power of the computer now permits the simulation of individual travel behavior in the transportation system, changes in metropolitan development patterns, and the optimization of network operations. It seems likely that further advances in computing will add even greater capability to tomorrow's planners.

Adopting an implementation perspective—The first edition portrayed the planning process as including the implementation phase of plans and programs. Planning needed to incorporate in its approach concern for the feasibility of implementing strategies and actions. This edition continues this emphasis but adds a stronger focus on financial feasibility. Almost every conceivable action that results from a transportation planning process will require resources. For many years, transportation plans did not reflect closely the availability of these resources. In the United States, this came to an end in 1991 when the U.S. Congress required transportation plans and programs to be financially constrained; that is, they should reflect the level of resources that can reasonably be expected to be available over the plan or

program time frame. This has led to increased emphasis on prioritization and on nontraditional sources of funding, both of which are covered in Chapter 9.

The first edition has been used in college courses around the world. As far as we can determine, many of this generation's transportation professionals have been exposed to the concepts in the first edition . . . and survived! We hesitated, therefore, in changing the structure of the book. However, we felt that the logic of information flow from one chapter to the next could be improved, and so we have made some changes from the first edition.

Chapter 1 introduces transportation to the reader and describes the significant changes that have occurred over the past 15 years. The relationship between transportation system performance and other systems, such as the economy or the environment, are highlighted. The evolution of the planning process toward greater environmental and community sensitivity is a basic point of departure for subsequent coverage of transportation planning.

Chapter 2, which was formerly Chapter 3, establishes the linkage between the transportation planning process and decision making. Different models of decision making are presented and their respective implications on planning discussed. The chapter ends by presenting a framework for transportation systems planning that incorporates many new concepts such as performance measures.

Chapter 3 is a new chapter that introduces the concept of systems as it pertains to transportation. Eight characteristics of systems are presented and their application in transportation planning highlighted. The chapter also describes the characteristics of urban travel that influence the substance and form of transportation planning.

Chapter 4 is the same chapter as in the first edition, only updated to reflect modern approaches to data collection and database management. The important influence of technology in these activities is noted, with special attention given to geographic information systems (GIS) and computer-based survey methodology. The role of performance measures and the concomitant need for data is a new addition to this chapter.

Chapter 5 introduces demand modeling. The reader should note that, unlike the first edition and other transportation texts, demand modeling is presented before the introduction of land-use modeling. Because land-use modeling is usually shown on process charts as occurring prior to demand modeling, textbooks have covered this material first. However, we have found in teaching our courses that if land use is presented first, we spend a great deal of time discussing its use in demand modeling and are thus required to present material on demand modeling. We have therefore reversed the order of presentation.

Chapter 6 begins by discussing the theory underlying urban development and how land-use models represent the evolution of changing metropolitan form over time. The chapter reviews several land-use models that are used throughout the world and critiques their use.

Chapter 7 provides an overview of transportation system performance and how this performance can be modeled. Known as transportation supply, system performance can be analyzed from the perspective of individual vehicle/person movement to network flows. The analysis of highway, transit, pedestrian, and bicycle facilities and

services is described. A range of analysis tools, from simple heuristics to network simulation models, provides the reader with a sense of the many different types of tools that can be used to examine the performance of transportation systems.

Chapter 8 shows how the results of analysis can be synthesized into an evaluation framework for presentation to decision makers. In addition, evaluation includes the comparative evaluation of different alternatives, using such techniques as benefit–cost or cost-effectiveness methods. The assessment of impacts after project implementation, so-called ex post evaluation, is also discussed.

Chapter 9 describes different methods for establishing priorities among different projects, for developing a transportation investment program, and of identifying alternative financing strategies. The chapter also covers financial analysis and the relationship between system plans and programs. Characteristics of successful project implementation and of new institutional arrangements are presented.

The flow of information reflected in this structure of the book represents our latest thinking on the important issues associated with urban transportation planning and how they should be presented. This thinking has been greatly influenced by many individuals whom we have worked with and learned from. We are particularly grateful to the following individuals who took the time to provide feedback on earlier drafts of this book: Professors Adjo Amekudzi, Ralph Gakenheimer, Randy Guensler, Les Hoel, Tom Horan, John Leonard, Buzz Paaswell, Pete Parsonson, John Pucher, Ron Rice, Craig Roberts, Mike Rodgers, Ted Russell, Scott Rutherford, Richard Soberman, Gerry Steuart, Simon Washington, and Billy Williams; the following transportation professionals: Wayne Berman, Tom Brahms, Dan Brand, Sarah Campbell, Ann Canby, Janet D'Ignazio, Tom Deen, Don Emerson, Frank Francois, Randy Halvorsen, Kevin Heanue, Wayne Kober, Ken Kruckemeyer, Keith Lawton, Liz Levin, Ysella Llort, Steve Lockwood, Lance Neumann, Neil Pedersen, Alan Pisarski, John Poorman, Chuck Purvis, George Schoener, Jim Scott, Jim Shrouds, Robert Skinner, Jim Smedley, and Rich Steinmann; and the following students, Murtaza Haider, Dan Melcher, Matt Thornton, Elias Veith and Jean Wolf. Special thanks go to Dr. Lisa Rosenstein, who worked long hours making this manuscript readable, and to Lee Wilder and Lillie Brantley for making sure the work was done on time.

Finally, we would not be where we are today without the loving support of our family. To our wives, Heidi and Nancy, we can only express our gratitude and thanks for your endless support. One of the significant changes that did occur since the first edition was the addition of new family members. Given that this book is about the future, we dedicate this work to our next generation—Katie, Eric, Nathan, and Scott.

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CONTENTS

chapter

1

Urban Transportation Planning: Definition and Context

1.0 INTRODUCTION

A metropolitan area's economic and social health depends to a large extent on the performance of its transportation system. Not only does the transportation system provide opportunities for the mobility of people and goods, but over the long term it influences patterns of growth and the level of economic activity through the accessibility it provides to land. In addition, it provides connections to other metropolitan areas, to the nation, and to the world. In recent years, changes to the urban transportation system have also been treated by many public officials as a means of meeting an assortment of national and community objectives. Such changes have been motivated in some cases by the desire to improve air quality, to enhance the viability of economic activity centers, to provide services to those needing mobility (e.g., low-income households, persons with disabilities, and the elderly), and to promote more sustainable community development. Planning for the development or maintenance of the urban transportation system is thus an important activity, both for promoting the efficient movement of people and goods in a metropolitan area and for providing a strong supportive role in attaining other community objectives.

The approach toward urban transportation planning presented in this book is very different from a transportation planning process that envisions a comprehensive and complete "plan" as the final product of the process. Rather, this approach recognizes that, to be effective, planning must be an integral and ongoing part of the *decision-making* process. The *product* of planning can be any form of communication with decision makers that provides useful information for understanding problems facing a metropolitan area, identifying alternative actions, selecting the best alternative, and developing successful implementation strategies.

This is not to say that plans are unimportant. Plans tell the public what kind of a system they can look forward to in the future and provide some sense of satisfaction that today's problems are being addressed. Plans establish the context within which subarea and project studies can be performed. Plans can anticipate where future development will occur (or through strategic investment, influence where this development should occur) and thus protect right-of-way for future transportation infrastructure. With funding constraints, plans tell a region what it can afford, and what it cannot, so that additional resources can be pursued where necessary. So, although the transportation plan is just one way of informing the decision-making

process, it is an important part of defining a vision for the future and of establishing strategic transportation investment and system operations directions for the metropolitan area.

The first section of this chapter presents a definition of transportation planning that reflects the decision orientation of the process. The next section discusses a multimodal perspective on transportation planning that has responded to the changing context of planning, which is discussed in the final section.

1.1 A DEFINITION OF URBAN TRANSPORTATION PLANNING

There are many transportation planning processes underway in a metropolitan area at any given time, each defined at a different level of complexity and purpose. For example, while transit planners examine alternative service configurations, traffic engineers identify congestion-reducing alternatives for the highway network; regional planners look at urban development patterns and the provision of public services; individual employers consider alternative employee transportation programs; and social service agencies examine transportation options to improve delivery of their services to targeted population groups such as the elderly and disabled. With different groups and organizations (and thus different types of decisions) concurrently involved in planning activities, the requirements of these planning efforts will vary in important ways. However, the primary purpose of the planning effort is the same in each case—to generate information useful to decision makers for the specific types of decisions they are facing. Given that so many agencies and groups are involved with metropolitan-level transportation decision making, a regional perspective is needed on how these activities fit together. This is a major purpose of transportation planning.

The definition of urban transportation planning used in this book will focus on this basic purpose and on the following propositions suggested by Boulding [1974].

1. *The world moves into the future as a result of decisions (or the lack of decisions), not as a result of plans.* Planning can be effective only if it provides useful information to those who must make decisions. It must not only provide information that is desired by decision makers, but also provide information that is needed to understand fully the short- and long-term consequences of alternative choices.

2. *All decisions involve the evaluation of alternative images of the future and the selection of the most highly valued of feasible alternatives.* Decision making involves two major elements: an agenda consisting of alternative images of the future with some conception of the relationship between present action and future societal directions, and a valuation scheme that outlines preferences for the characteristics of likely decision outcomes. In the case of urban transportation, this valuation scheme is often intricately tied to societal values and goals as expressed in the political decision-making process.

3. *Evaluations and decisions are influenced by the degree of uncertainty associated with expected consequences.* Decisions regarding future actions are based on