UNIVERSITY OF MARYLAND
CENTER FOR RESEARCH & INNOVATION

UNDERSTANDING URBAN TRANSPORTATION SYSTEMS

An Action Guide for City Leaders

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Introduction

The many economic, social and environmental problems worldwide are also primarily urban problems: cities are where the people are. This leads to a logical prescription: cities should deal with these problems in an integrated way, with coordination across geography, issues, disciplines and agencies. The terms “quality of life” and “livability” are now commonly used not just in environmental and land-use planning, but also in planning for economic development and infrastructure.

A key piece of that infrastructure is the urban surface transportation system.1 Despite huge public and private investments, urban congestion is worsening, and most transit is not attracting enough riders to pay even a third of its operating cost, much less its capital cost. Adding more transportation capacity — either highway or transit — does not always reduce congestion, and the benefits of policies that reduce motor-vehicle trips (and, thus, emissions that contribute to global climate change) is politically difficult and technically debated.

This guide limits its discussion of urban transportation issues to its biggest and most debated component: urban surface transportation.2 Its purpose is to provide a broad overview of the causes of urban transportation problems, and of the implications for finding good solutions. It addresses five big issues:

- The role of the public sector in urban surface transportation;
- Characteristics of the existing urban transportation system;
- How the urban transportation system is likely to change in the future;
- Characteristics of the process through which transportation policy is made; and
- Actions city leaders might take.

1 If public and private expenditures on infrastructure are a measure of importance, then transportation is the most important single element of the physical infrastructure in urban areas.

2 This guide uses the shorthand “transportation system” to mean the facilities (e.g., roads and rails), programs and policies that the public sector contributes to the design, development and operation of urban surface transportation. This refers to roads and pathways for motor vehicles, bikes, and pedestrians; all types of intra-city transit; but not seaports or airports.
The Role of the Public Sector in Urban Surface Transportation

Without transportation systems, cities would never have developed. Once laid down, transportation systems stay — they are the bones that support a complex social and economic fabric. Transportation technology allowed people to get to places with natural advantages for population concentrations. It allows modern cities to exploit the advantages of concentration to more efficiently provide better goods and services, and to trade those goods and services with other places, which in turn allow for economic specialization and efficiencies.

Economically and socially vibrant urban areas cannot exist without a system for moving people, goods and services. The health of cities, and their ability to generate income and wealth for their inhabitants, is improved if the transportation system is efficient, and if its construction and operation considers its impacts on citizens, land use, the environment and economic development.

Urban transportation systems should be especially important to local elected officials because (1) they are mainly built, owned and operated by the public sector, and (2) decisions by individual travelers will not consider many important impacts of their travel unless public policy does something to require it. Public investments and policies for transportation have big effects, and getting them right is important. Getting them right means making them:

- **Efficient.** Efficiency means “bang for the buck”: a high ratio of benefits for costs. The cost of a transportation investment can be measured in dollars.\(^3\) Benefits may be desired effects like safe and quick trips or positive effects on economic development, or the reduction of undesired effects, like air pollution or sprawling land-use patterns.
- **Fair.** One can measure the distribution of benefits and costs, but whether such a distribution is viewed as “fair” depends on one’s perspective: it is a value judgment. A typical standard applied to public policy decisions is that people should benefit in proportion to the contributions they make and pay in proportion to the costs they impose. Public policy relieves the burden on some populations based on merit or need (e.g., based on age or income). But no general principle can definitively resolve the dozens of different arguments about fairness that accompany significant transportation investments or policies.

Making any system efficient and fair (in other words, making it work well) starts with an understanding of causes and effects — of the key characteristics of the existing urban transportation system and factors that are likely to cause it to change in the future.

\(^3\) More precisely, it is the present discounted value of the estimated lifecycle costs of the planning, design, construction, operation, maintenance and decommissioning of transportation facilities.
Characteristics of the Existing Urban Transportation System

The system is complex.

Complexity exists at every level in the system. Just understanding how traffic behaves at the intersection of two highways is complicated enough. Now expand this view to the whole system: the corridors around those highways, other modes of travel, the full metropolitan highway network, the effects of transportation on other areas of concern (e.g., land use, the environment) and the distribution of all those effects across locations and groups now and in the future.

Travelers understand the system and make reasonable choices.

How the transportation system in a city performs depends both on public investment and policy, and on millions of decisions made daily by consumer-travelers about whether, where, how and when to travel. Understanding how people make travel choices is key to understanding urban transportation problems and potential solutions.

- **Travelers aim for value.** Most urban trips do not occur because people enjoy the travel. They occur because people want to enjoy the benefits of being in different places, engaging in different activities and having choices available to get the best value. In that sense, travel is a means to other ends: the real consumer demand is for jobs (the better the transportation, the greater the opportunities and potential economic rewards), shopping (more choices and lower prices), entertainment, recreation, education, social interaction and so on.

- **Travelers consider the benefits.** The main benefits that travelers consider are safety, speed, reliability, convenience and comfort. Other characteristics can be more important to some travelers than others: for example, environmental sensitivity.

- **Travelers consider the costs.** The main costs that dominate travelers’ decision-making are the ones that affect them directly: out-of-pocket costs for vehicles, fuel, maintenance, parking, tolls and travel time. Some travelers may also give some consideration to costs to society (e.g., the costs of vehicle emissions, which contribute to health hazards and to greenhouse gases).

Thus, the congestion we observe in urban areas is not the result of uninformed decisions. It is, to a close approximation, the best that travelers can do, given the benefits and costs they personally expect from trips and the value they place on those benefits and costs.

**Individual travel decisions may not lead to optimal system performance.**

Travelers make decisions they think are in their best interest, and they have a lot of travel experience to help them with those choices. Travelers try to optimize their outcomes in the context of the benefits and costs that they personally incur. Some of the costs of their travel are not ones that they have to pay directly (what economists refer to as *externalities*); for example:
• **Congestion costs to others.** People consider the costs to them of driving at congested places and times, but they do not consider the costs they impose on hundreds of other travelers. Collectively, those external costs add up to considerably larger costs.

• **Environmental and other costs.** The impacts of any single driver’s tailpipe emissions are mainly impacts on others. Transportation projects can affect water quality directly, and can indirectly affect many aspects of urban living through their impacts on land development and attendant public facilities and services.

### Pricing is part of the problem and the solution.

Congestion means high amounts of something in the same place at the same time. Some congestion in urban areas is good: it means that people see value in engaging in urban activities. But a lot of people trying to get to the same places at the same time means traffic congestion.

The typical market solution to too much demand at peak times is to increase prices at those times (e.g., for electricity or plane flights) or offer alternatives at different times (e.g., movie matinees). When available supply is not rationed with higher prices, other mechanisms are used (e.g., a lottery or standing in line), or people do without. But for the urban highway system, when a lot of travelers want to use limited capacity at the same time, they are allowed to try. The result is that they sit in line (congestion), and that congestion is expensive to both individuals and the larger economy, because it burns extra fuel and valuable time.

Every aspect of urban transportation can be priced. People pay directly for vehicles, fuel, transit fares and parking. If prices increase — because of market forces or public policy — their consumption (use) will decrease. Cities can directly or indirectly affect those prices with their policies. Directly, they can build new freeways or lanes (reducing, at least temporarily, the amount and costs of congestion), increase the cost of on- and off-street parking downtown or tax fuel purchases. Indirectly, adding capacity might reduce travel time (which reduces the cost of travel), or a new emissions regulation can increase the cost of vehicles.

An example of using pricing to address surface transportation is road pricing (also called congestion pricing). Drivers pay for much of the road system through fuel taxes, but such payments give them no signals or incentives to reduce their travel on congested facilities during peak periods (the *where* and *when* of travel that is central to congestion). Simple versions of such systems now operate in California and Virginia. A few interstates have an extra lane that is a toll lane, and the toll varies by time of day or, better, by amount of congestion. Drivers choose: stay in free congested lanes and go slow, or pay for a toll lane and move fast. Road pricing rations scarce highway capacity more efficiently by charging higher prices where and when congestion occurs.

The pricing problem helps explain why the statement “we can’t build our way out of congestion” is true. As long as drivers do not pay more when they use congested facilities they will collectively over-use those facilities and they will be congested.

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Road Pricing: Drivers choose to stay in free congested lanes and go slow, or pay for a toll lane and move fast.
Public policy should and will change.

Several factors make changes in public policy both desirable and likely:

- **Diminishing returns to investment.** In the United States, the surface transportation system (primarily, the road system) is mainly built. Almost all of the important links are in place. In that situation it is likely that (1) the benefits per dollar of new capacity will decline, and (2) the per unit real costs of adding that capacity will be higher, because (a) construction costs are higher, (b) requirements for highway projects are greater (e.g., more environmental protection, safety features, access for alternative modes) and (c) more construction is taking place in developed areas, where land, disruption and relocation costs are high.

- **Funding scarcity.** The U.S. is currently in one of its worst recessions, and recovery will take a number of years. People’s willingness to pay taxes and trust government to build and operate facilities has declined. Past federal, state and local government practices on both the revenue side (how they charge for transport facilities and services) and the expenditure side (e.g., failing to fully invest in efficient lifecycle maintenance so that limited funds can be used for new capacity) solve short-run budget dilemmas by pushing evermore expensive maintenance problems into the future. Pressure for new highway and transit system components is high. In short, securing funds is more difficult, and the need for funding is as great as it ever was.

- **Increased knowledge about and value placed on the impacts of transportation projects.** Twenty years ago, only a small number of scientists and interest groups were talking about greenhouse gas emissions and climate change. Now it is a topic of global debate and action. As people’s understanding of direction and magnitude of these effects increases, so do the values they place on public policy choices. Those values are also influenced by economic circumstances, which may also change substantially.
How the Urban Transportation System is Likely to Change in the Future

Change will not be absolute or quick, but here are some likely directions for change over the next 20 years.

The demand for urban transportation will grow and change.

Most analysts expect the U.S. population and economy to grow in the long run. In-migration will continue to cause growth in metropolitan areas, even as some current metropolitan residents exit for smaller cities, which will also grow. Some metropolitan areas will grow geographically (suburbanize); others already have such large boundaries that their development will have a larger component of infill (urbanize). All will get more polycentric (the central city downtown will still be important, but its share of metropolitan employment will probably decrease).

In that context, there will certainly be a public voice for more transportation facilities in urban areas. But, for reasons discussed earlier, the composition of those facilities may change. Highways will continue to receive the largest share of total transportation funding (though a greater share of highway money will go to maintenance), but their relative share will probably decrease as more money goes to transit, bicycle and pedestrian facilities. More attention will be given to surface-transportation connections (commuter rail) between metropolitan cities in “mega-regions.”

Transportation demand will change with advances in telecommunications and logistics.

People will be more able to do work from home. Internet purchase will consolidate shopping trips by individual consumers into deliveries to multiple consumers by service trucks. Those and related communications advances will reduce the need for travel. But many other factors (e.g., growth of population, incomes and economic activity) will encourage more travel. The net effect is likely to be growth in all measures of transportation usage unless there are big changes in market conditions (e.g., the price of fuel) or public policy (e.g., larger gas taxes, more tolling).

Urban transportation policy and investment will continue to become more diversified.

Though roads will continue to have the biggest budget, there will be changes in the way governments spend transportation money, which will change how local governments set goals and plan their communities to meet these goals. Local governments should place increased attention on the following issues:

Changes in urban transportation policy and investment place increased attention on:

- Funding;
- Maintenance;
- Demand management;
- Access and connectivity;
- Alternative modes
- Effect on public objectives; and
- Performance measurement.
1. Funding
Securing funding for urban transportation projects will continue to be a challenge, probably an increasing one, because of:

- The increasing backlog of maintenance and deferred modernization;
- The inability of federal and state Highway Trust Funds (funded by fuel taxes) to keep up with revenue requirements;
- Potential slower economic growth, and ongoing difficulties in convincing travelers and policymakers to increase the fees and taxes for transportation; and
- Reliance on public-private partnerships will not make enough difference in the cost of construction, operation, and maintenance to overcome these funding problems.4

2. Maintenance, and getting more from what we have
The funding pinch will hit new projects the hardest. Cities will be pressed by the public and interest groups to make do with less revenue — to work smarter and more efficiently — by:

- Making what they have last longer. For all modes, there will be a shift in the percentage of investment from new capacity toward maintenance.
- Making what they have deliver more mobility or access. Cities will pay more attention to operational improvements on existing facilities and, in collaboration with state and federal transportation departments, new technologies (Intelligent Transportation Systems). Technologies exist that could substantially increase the throughput of vehicles for any lane mile, but getting them implemented in any significant way will take time.

3. Demand management
Local leaders must place more attention on pricing and other types of policies that change the incentives that people have to be traveling in a certain place at a certain time, because of diminishing returns to new capacity, and because any such capacity will be used inefficiently if it is not properly priced. Road pricing might start as the priced use of high-occupancy-vehicle lanes (existing ones, or ones to be built). Changing parking pricing can also approximate some of the benefits of road pricing. Expect calls for regulatory policies to decrease single-occupant automobile trips (e.g., commute-trip reduction ordinances), based on desires to reduce both congestion and emissions.5

4. Access and connectivity
Most transportation planners now stress that transportation decision-making is more about what travelers can get to (access) than about how fast they can move (mobility). In practice, the two are interdependent; travelers care about what they can get to in a given amount of time. Nonetheless, attention placed on access increases the desirability of density in urban centers and more investment in alternative modes that facilitate shorter trips.6 Connectivity can provide both access and mobility by creating

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4 Because of their potential to improve construction and operational efficiency, and to infuse capital into the system, efforts to craft public-private partnerships will continue and grow.

5 Be careful of these policies if they are based solely on assumption that car travel is bad and needs to be reduced. The technical rationale should be that external costs are not being counted and that the transportation system can be used more efficiently if policies directly or indirectly cause travelers to respond to prices that are more in line with true costs.

6 Though the distinction between access and mobility is commonly made in the literature of transportation planning, it is not a clean one. It is hard to separate access from some notion of travel time (mobility): the number of activities one can get to in, say, 20 minutes is a function both of their proximity and the speed of travel.
routes that shorten distances and travel times between origins and destinations, an advantage especially important for increasing trips on alternative modes.

5. Alternative modes: transit, bike, and walk

Highways and streets will remain the workhorse for urban transportation in all metropolitan areas and will continue to get the biggest share of revenue, but they will incrementally get a smaller share of total transportation budget. That change will mean relatively larger increases in funding for alternative modes of travel.

Alternative modes will be a growing share of all trips in most urban areas, but they will remain a relatively small share of all trips in all but the biggest metropolitan areas. Growth of metropolitan areas is likely to result in greater trip density in their centers of activity. Unless pricing policies are adopted, more highway congestion in metropolitan areas is likely. Improvements in alternative modes of travel will not, without pricing, be able to stop the increase in congestion and in travel time per trip.

6. Performance measurement

The idea is not a new one, but it gets increased attention when funding is tight. The basic question is: of the transportation investment options before us, which options provide (1) the most benefits relative to costs, and (2) the best distribution of net benefits (social equity). These measures will certainly address the performance of the transportation system (safety, speed, access, reliability and so on) and will increasingly address the effects of transportation facilities and programs on other non-transportation objectives. While local leaders should have the primary role in judging which transportation projects and programs work for them, expect new top-down requirements for performance measurement and slow changes in current state and local systems for evaluating and selecting transportation investments.

7. Transportation’s effects on other public objectives

Transportation is a means to an end: a way of getting to places that have activities that matter to people. Citizens everywhere want to achieve many goals at the same time. Cities should be striving for policies that efficiently and fairly improve quality of life and livability, now and in the future (which means they should also want sustainability).

Good transportation can contribute to that quality of life, of course, but so can economic prosperity, health, education, urban design, a clean environment and so on. Within transportation planning, effects on these attributes are often viewed as “secondary” to the primary effects on transportation performance. But those attributes are primary in their own right: viewed from their perspective, transportation is a secondary consideration. The National League of Cities and its members share this larger view: transportation is part of what makes cities livable, but it is an intermediate goal of urban policies aimed at creating more livable urban areas, where livability is multi-dimensional.
Many of these goals are wrapped into the principles of “smart growth,” whose key ideas include a greater emphasis on the relationships between land use and transportation, and supporting land-use patterns that are more likely to yield lower auto trip rates, lower energy consumption and reduced greenhouse gas emissions. Recent federal policy (in U.S. Departments of Housing and Urban Development, Transportation, and the Environmental Protection Agency) embraces the ideas of smart growth, livability, sustainability and multidisciplinary regional planning. Among the concepts gaining support in transportation planning is “complete streets”: the idea that streets have multiple uses that go beyond the transport of people and goods in motor vehicles, including not only transportation by alternative modes, but also social interaction, utility rights of way and more.
The basic objective is easily stated: invest in transportation projects and programs that make urban areas better (more livable), and do so in ways that are efficient (cost effective) and fair. But there is no limit to the variations and problems, as different cities pursue that objective in different ways.

**Reasonable people will disagree.**

There is general consensus about the need for sustainable investment, a strong economy, environmental quality and equity, but beyond this consensus there is disagreement about core values, methods, theory and data.

Debates that derive from core values — as all debates about the economy, the environment, equity, and the role of government do — will never result in unanimous agreement; even consensus will not be possible on many issues. When policymakers consider (as they should) the other public objectives that transportation affects (e.g., those related to economic development, environmental quality and social justice), a conclusion that there is some unique and clearly superior policy direction seems unsupportable. Consider:

- Not only do people disagree strongly about whether investment in transit is efficient relative to investments in highways; supporters of transit disagree about whether urban rail projects are efficient relative to investments in buses. Data and purported facts support both sides of the argument.

- Not everyone agrees that congestion is always bad, and that we would be better off if people drove less. Congestion may be an indication and inevitable companion of healthy places: people want to be there. And since travel is a measure of how easy it is for people to get to places (relative the value they place on being in those places) more vehicle-miles traveled might be a measure of how well the transportation system is operating.

- While there is a growing consensus that public investment should be sustainable, and that sustainability has economic, environmental and social aspects, the agreement dissipates as the debate gets into the details of specific investments. Groups that advocate for economic or environmental interests will marshal data and theory in support of their positions.

- Though everyone acknowledges the importance of cost-effective lifecycle maintenance, there is disagreement about whether priority should be placed on investing in building new capacity or on maintaining what exists.

Technical analysis can provide reasonably reliable answers to some questions about urban transportation planning: if price goes up, use will decline; if capacity is added, use will increase; if light rail or bike lanes are built, ridership is likely to shift from other modes within some estimated bounds. Even here, however, there will be disagreement, and the disagreement about technical issues increases as one tries to address the interactions among potential effects. Moreover, the physical sciences cannot answer...
many transportation questions; rather, these answers rely on economics and value. Just within the pur-
view of transportation, people have multiple and conflicting objectives and values.

That is true in general, and true in its specifics. Different communities have different situations and 
may differ in how they value the attributes and impacts of transportation projects. Transportation plan-
ing is starting to acknowledge this point by calling for “context-sensitive design”: in other words, “it 
depends.”

These arguments support a conclusion that a technical analysis or a “black-box” model will never be able 
to find a single, best solution to any complicated urban transportation problem. That is not to say that 
technical evaluation, including performance measurement, cannot help — it certainly can. But even 
with well-conceived and well-calibrated performance measures, those multiple measurements cannot 
combine themselves into a single, overarching measure of net benefits. Models cannot do that unless 
someone determines how to value the multiple performance measures, and the technicians building 
those models usually have no special data or authority for setting those values.

A model cannot give an unambiguous answer about how 
to proceed unless values are quantified. Any attempts at 
such quantification will be suggestive, but not definitive. Decisions about big issues for land use, transportation, economic development and the environment in urban areas will always require discussion, compromise and incremental adjustment.

Working toward agreement is more productive when it is 
tied to a clear framework.

Though there is no universally accepted best solution to any significant urban transportation problem, 
some solutions are better than others. A public discussion about the pros and cons of alternative solu-
tions will be more intelligible and productive if it is tied to a clear framework. A framework provides 
logical places for all the analysis and performance measures that a transportation evaluation might 
generate.

This guide suggests that such a frame-
work have placeholders not only for 
differ aspects of the performance of the 
transportation system (e.g., safety, speed, 
reliability, construction and operating 
costs), but also for the many aspects of different systems that the transportation system can affect. That 
framework can have different forms, but any framework would address questions about:

- What? What are local objectives (economic, sustainability, mobility, access, etc.)? What are the market and policy factors, including transportation projects and programs, that affect those objectives (what are causes and effects)?
- How? Given the objectives and causal chains, how should local governments prioritize projects to meet those objectives? How will they measure success? How does the public get involved?

“A framework provides logical places for all the analysis and performance measures that a transportation evaluation might generate.”
• Where? Where do certain projects and policies work best? Where will funding come from: federal, state or local sources; public-private partnerships?
• Who? Who gets the benefits? Who pays the costs? Who are the players that help inform decision-making process?

Measurement can and often does have an impact on decisions and outcomes. Just the decision to measure something can be a signal that it will be important in the final weighting of outcomes.

Public decision-makers are critical.

For all the above reasons, technicians can offer decision-aiding techniques, not decision-making techniques. Policymakers are an essential part of the solution. They are elected or appointed to work on behalf of a diverse citizenry. They have to condense all the information that technicians are generating into something that is consistent with well-accepted principles and facts, and gives different weights — often based on their judgments — to different facts and hypotheses. They have to defend and amend those judgments based on their assessment of the arguments of other elected and appointed officials (in cities, counties, metropolitan planning organizations, state and federal agencies, the legislature), community groups and the public at large.
The summary answer is “Consider aligning the process for selecting surface transportation investments with technical and political realities described in this guide.” That would mean:

- Acknowledge the complexity of the urban transportation system and its connections with and impacts on other aspects of urban livability.

- Require a framework for evaluation that acknowledges this system complexity: one that address not just new facilities, but maintenance of existing ones; not just roads and cars, but other modes of travel; not just transportation performance, but impacts on other factors that contribute to urban livability; not just short-run impacts, but long-run ones.

- Encourage technical analysis that evaluates tradeoffs among alternatives in intuitively sensible ways. Measures of performance that relate to goals related to categories of desired outcomes (e.g., transportation performance, economic development, environmental quality, social services and amenities, social justice) will help, but they are only inputs to a political discussion about potential impacts and tradeoffs. No technical model is going to provide a unique and acceptable answer that can be adopted without such discussion.

- Pay more attention to differences among reasonable alternatives, and worry less about getting the absolute impacts right.

- Though a jurisdiction may not be ready for full-scale road pricing, a simple and important question that transportation evaluation can address is: What might users of the facility be willing to pay for its use (if, hypothetically, we were to charge for that use), and how does the collective amount they might pay compare to the present value of the lifecycle costs of the facility? That simple analysis gets the discussion focused on the right questions: (1) If travels don't find the value (the benefits) of a project great enough to be willing to pay for it, then why are we building it? and (2) Even if no project has an estimate of potential user benefits or payments that are greater than lifecycle costs, which ones come closest to covering those costs? Consistent with discussion elsewhere in this guide, answers to this question, by itself, are not sufficient for project selection: other criteria may suggest selecting a project that is not the top performer here. But answering these questions in a consistent way, even approximately, across transportation investment and program options under consideration, would improve discussion and decision making.
About This Publication

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The National League of Cities is the nation’s oldest and largest organization devoted to strengthening and promoting cities as centers of opportunity, leadership and governance. NLC is a resource and advocate for more 1,600 member cities and the 49 state municipal leagues, representing 19,000 cities and towns and more than 218 million Americans.

Through its Center for Research and Innovation, NLC provides research and analysis on key topics and trends important to cities, creative solutions to improve the quality of life in communities, inspiration and ideas for local officials to use in tackling tough issues, and opportunities for city leaders to connect with peers, share experiences and learn about innovative approaches in cities.