Transit-Oriented Development: Developing a Strategy to Measure Success

DETAILS

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TRANSIT-ORIENTED DEVELOPMENT: DEVELOPING A STRATEGY TO MEASURE SUCCESS

This digest summarizes key findings from NCHRP Project 20-65(5), "Transit-Oriented Development: Developing a Strategy to Measure Success," conducted by John L. Renne and Jan S. Wells of the Alan M. Voorhees Transportation Center, Edward J. Bloustein School of Planning and Public Policy, Rutgers University.

CONTENTS

SUMMARY

This digest offers a strategy to systematically evaluate the potential success of transit-oriented development. The digest identifies and evaluates various indicators of the impacts of transit-oriented development, provides the results of a survey of transit-oriented development indicators, and identifies ten indicators that can be used to systematically monitor and measure impacts.

Over the past decade, transit-oriented development (TOD) has gained in popularity as a planning tool to promote smart growth. Many articles, books, reports, and plans have discussed the potential benefits of TOD, which vary broadly. But except for studies focusing on transit ridership and land value near stations, little empirical research has been conducted to holistically measure the outcomes of TOD. This study builds on a number of recent projects—namely, work at Rutgers University dealing with the New Jersey Transit Village Initiative and the recently published *TCRP Report 102: Transit Oriented Development in the United States: Experiences, Challenges, and Prospects* (Cervero et al., 2004).

This digest summarizes research conducted to determine the wide range of outcomes and benefits of TOD. The digest also look at who is evaluating TOD across the United States, what are the most useful indicators, how difficult it is to collect data, and how often progress should be monitored. It concludes with suggestions for developing a strategy to monitor the success of TOD.

In looking across the United States to determine what indicators exist, 56 benefits/indicators were identified and categorized into five groups: travel behavior, economic, environmental, built environment, and social diversity/quality. A survey was then conducted of transportation professionals from state departments of transportation, metropolitan planning organizations, county and local governments, and transit agencies concerning the usefulness of each indicator, the difficulty in obtaining the data for each indicator, and the frequency with which each indicator should be monitored.

Based on this research, the most useful indicators are transit ridership, density, quality of streetscape, quantity of mixed-use structures, pedestrian activity and safety, increase in property value and tax revenue, public perception, number of mode connections at the transit station, and parking. While data collection is relatively easy for

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some of these indicators, it is more difficult for some of the others; a strategy suggested in the last section of this digest is setting aside government funds to monitor TOD progress. For virtually every indicator, with a few exceptions, data collection needs to occur only yearly or less frequently.

In the future, unless objective measures can be established to examine both the positive and negative outcomes of TOD, the excitement about TOD may be overshadowed by unintended effects. Government policy must continually be reexamined to produce sustainable outcomes; and, without indicators for TOD, we cannot truly measure success. This digest's suggestions are meant to begin a new dialogue that rates TOD not just on transit ridership and land value changes but also on an integrated set of measures. The digest is not a last word but rather a starting point for governments, transit agencies, researchers, and communities to begin to understand how to make TOD work for the good of the public.

INTRODUCTION

Across the United States, sprawling developments are consuming land, congesting roads and highways, and leading to a host of other economic, environmental, and social problems. In policy efforts to mitigate these problems, smart growth has emerged. In *Making Smart Growth Work*, Porter states,

> Smart growth calls for building communities that are more hospitable, productive, and fiscally and environmentally responsible than most of the communities that have been developed in the last century. . . . [It] seeks to identify a common ground where developers, environmentalists, public officials, citizens, and others can all find acceptable ways to accommodate growth. (Porter, 2002, 1)

Porter describes six key principles of smart growth:

1. Compact, multiuse development;
2. Open-space conservation;
3. Expanded mobility;
4. Enhanced livability;
5. Efficient management and expansion of infrastructure; and
6. Infill, redevelopment, and adaptive reuse in built-up areas (p. 1).

TOD has recently become a popular tool to promote smart growth. As shown in the recently published *TCRP Report 102: Transit-Oriented Development in the United States: Experiences, Challenges, and Prospects* (Cervero et al., 2004), there are many and somewhat varying definitions of TOD. One definition, which has been adopted by the State of California, does a good job of capturing the essence of TOD:

> Moderate to higher density development, located within an easy walk [approximately ½ mile] of a major transit stop, generally with a mix of residential, employment and shopping opportunities designed for pedestrians without excluding the auto. TOD can be new construction or redevelopment of one or more buildings whose design and orientation facilitate transit use. (California Department of Transportation, 2002, 3)

TODs have been hailed as a model for integrating land use with transportation in the interest of smart growth (Calthorpe, 1993; Cervero, 1998; Newman and Kenworthy, 1999; Renne and Newman, 2002; Renne and Wells, 2004). According to Cervero et al., "TOD has gained currency in the United States as a means of promoting smart growth, injecting vitality into declining inner-city settings, and expanding lifestyle choices" (2004, 3). *The New Transit Town: Best Practices in Transit-Oriented Development* (Dittmar and Ohland, 2004) states that TOD is an essential part of the healthy growth and development of regional economies.

FIGURE 1 Oakland, California: the compact, mixed-use, community-based Fruitvale Village—which includes a health clinic, child care center, senior center, library, bicycle storage facility, parking deck, and affordable housing—is an exemplary model of TOD.

While there have been many claims for the various benefits of TOD, few studies have looked holistically at the outcomes of TOD to measure its success. As Cervero et al. state, "Relatively little empirical research has been conducted documenting the economic benefits of TOD beyond studies showing developments near rail stations boost ridership and increase land values" (2004, 453). Across the United States, various people and organizations are encouraging TOD, not only because it may lead to higher levels of transit ridership but also because it is believed to encourage economic development, environmental conservation, and increased social diversity not only in the community but also across the region. These holistic goals are summarized in the Ahwahnee Principles, which were introduced in 1991 as the guidelines for new urbanism development (Newman and Kenworthy, 1999). Since the early 1990s, the movement for new urbanism and the push for TOD across the United States have been somewhat intertwined. While not all new urbanist projects are TODs, most TODs seek to promote the basic concepts of new urbanism.

This digest describes an effort to develop a systematic approach to measuring the various outcomes of TOD. First, it explains the expectations of planners and policymakers involved with TOD. Then it discusses the best indicators for measuring success. Finally, it presents the conclusions from the study and suggests a strategy for evaluating the success of TODs.

Research Objective

The objective of this research project is to develop a strategy to measure the success and outcomes of TODs. This work builds upon other recent projects related to TOD, and it suggests an approach to monitor and analyze TOD impacts and benefits systematically.

The next section provides background on indicators of TOD success; it reviews previous work and identifies who is currently evaluating TOD across the United States. The section after that presents a review of TOD benefits and indicators based on the perceptions and measurements of success expressed by representatives of various state agencies, municipalities, metropolitan planning organizations (MPOs), local redevelopment agencies, and transit agencies. These indicators were gleaned from an extensive review of websites, printed material, and follow-up phone calls. In essence, indicators were identified and then categorized according to five groups: economic, environmental, social diversity/quality, built environment, and travel behavior.

The next section presents the results of a web-based survey of transportation professionals that sought to assess three factors concerning TOD indicators:

1. the perceived usefulness of each indicator;
2. the feasibility of collecting each indicator; and
3. the preferred frequency of collection.

Finally, the last section describes a core measurement tool or checklist of 10 indicators and suggests strategies for implementation.

BACKGROUND ON INDICATORS OF TOD SUCCESS

A survey of scholarly and professional sources is presented here to begin developing a list of indicators to measure the success of TOD. This work builds upon *TCRP Report 102: Transit-Oriented Development in the United States: Experiences, Challenges, and Prospects* (Cervero et al., 2004). Although the research presented here looks generally across the United States, information has been gathered from those places with a record of promot-

FIGURE 2 South Orange, New Jersey: infill housing, streetscape improvements, and commercial upgrading are common characteristics of TODs across the United States. This photograph shows a revitalized train station, which includes a number of service retail establishments built below the train platform. South Orange is one of the 14 designated Transit Villages in New Jersey.

ing TOD. The TCRP project provided a good starting point because it includes responses to a stakeholder survey on TOD from 90 transit agencies from across the country as well as 23 municipalities, 8 redevelopment agencies, 24 MPOs, and 10 state departments of transportation (DOTs). These governments and agencies were used to identify any and all possible indicators that could be used to measure the success of TOD.

This study also benefited from recent projects in California and New Jersey to better understand TOD. In 2002, the California Department of Transportation (Caltrans) published a TOD report called the *Statewide Transit-Oriented Development Study: Factors for Success in California* (California Department of Transportation, 2002). In New Jersey, the Alan M. Voorhees Transportation Center recently conducted an evaluation of the New Jersey Transit Village Initiative for the New Jersey DOT (NJDOT). As a result of this evaluation, a number of reports that look at various aspects of TOD in New Jersey have been published; they are available online at http://policy.rutgers.edu/vtc/tod/tod_projects.htm. Both the New Jersey and California studies outline various strategies for promoting TOD within their states.

TOD Indicators: Background

TCRP Report 102: Transit-Oriented Development in the United States: Experiences, Challenges, and Prospects

The topic of TOD impacts is dealt with in part three of *TCRP Report 102* (chapters 7, 8, and 9), which finds that little has been done to measure impacts of TOD other than looking at transit ridership and effects on land value. "The literature is replete with platitudes that have been heaped upon the TOD concept; however, relatively few serious studies have been carried out that assign benefits to TOD in any quantitative or monetary sense" (Cervero et al., 2004, 119).

Chapter 7 of *TCRP Report 102* makes an important distinction concerning whether benefits are redistributive or generative. The study notes that redistributive benefits relate mostly to financial and pecuniary transfers. An example of a redistributive benefit is when higher sales tax revenue in a TOD community is offset by lower tax revenue in a non-TOD community. Conversely, "generative impacts represent net efficiency gains that stem from improved resource allocations and accordingly are economic (versus financial) in nature" (p. 121).

TCRP Report 102 presents a table of "Classes and Recipients of TOD Benefits" (shown here as Table 1), which portrays benefits as primary or secondary/collateral, as well as public sector or private sector. Some benefits, such as increased affordable housing, accrue to both public and private sectors, but each is categorized into only one area. The authors of the TCRP report caution that the benefits shown in Table 1 cannot be summed to determine the total benefits, "because there is a fair degree of overlap amongst them. To do so would be double-counting" (p. 121).

It should also be noted that some outcomes are not just related to TOD but would be applicable to any program that promotes smart growth. This is an important point that reverberates throughout this study: TOD is a tool within the overall smart growth agenda and is not distinct from smart growth. We believe that, if done properly, TOD helps an area achieve each of the six key principles of smart growth set out by Porter (2002), as described in the introduction.

The TCRP report also includes a survey of TOD stakeholders to determine the impact of TOD (the results are shown in Figure 3). Respondents were asked to rate the importance of TOD toward achieving various benefits on a 1 (lowest) to 7 (highest) scale. As some may expect, respondents from transit agencies rate increased transit ridership and increased political support for transit as the most important benefit of TOD. Strikingly, respondents from MPOs gave TOD a lower rating for relieving traffic congestion and reducing sprawl than did other stakeholders, perhaps because regional planners at MPOs see minimal overall impact of a few TODs in a region of sprawl and increasing traffic congestion. Even if TODs do help to reduce traffic and sprawl, the pace of low-density, automobile-dependent development in many regions is most likely outpacing any gains made in TODs. Because virtually no MPO across the United States has regulatory power, a lack of regional coordination of land use and transportation planning makes their perceived effectiveness of TOD limited. In contrast, redevelopment agencies, as local stakeholders, rated relief in traffic congestion and improvement of neighborhood quality the highest outcome of TOD.

Chapter 8 of the TCRP report summarizes many studies in recent years that look at the effectiveness of TOD on transit ridership:

> If there is any single benefit of TOD that all sides agree is beneficial to society as a whole, it is increased ridership. . . . While the chief environmental benefit of TOD comes from coaxing mo-

TABLE 1 Classes and Recipients of TOD Benefits

	Primary recipient of benefit	
Class of benefit	**Public sector**	**Private sector**
Primary	1. Increase ridership and farebox revenues 2. Provide joint development opportunities 3. Revitalize neighborhoods 4. Economic development	5. Increase land values, rents, and real estate performance 6. Increase affordable housing opportunities
Secondary/Collateral	A. Less traffic congestion and VMT-related costs, like pollution and fuel consumption (1)	G. Increase retail sales (1, 2)
	B. Increase property and sales tax revenues (5)	H. Increase access to labor pools (A, 6)
	C. Reduce sprawl/conserve open space (1, 3, 6)	I. Reduced parking costs (C, 2)
	D. Reduce road expenditures and other infrastructure outlays (1)	J. Increased physical activity (C, E, F)
	E. Reduce crime (3, 4)	
	F. Increased social capital and public involvement (3, 4)	

NOTE: VMT = vehicle miles traveled. Values in parentheses represent the source of the secondary/collateral benefit.
SOURCE: Cervero et al., 2004, 120, Table 7.1.

> torists over to mass transit, a secondary benefit is the inducement of more walk and bicycle access trips to and from transit. (p. 139)

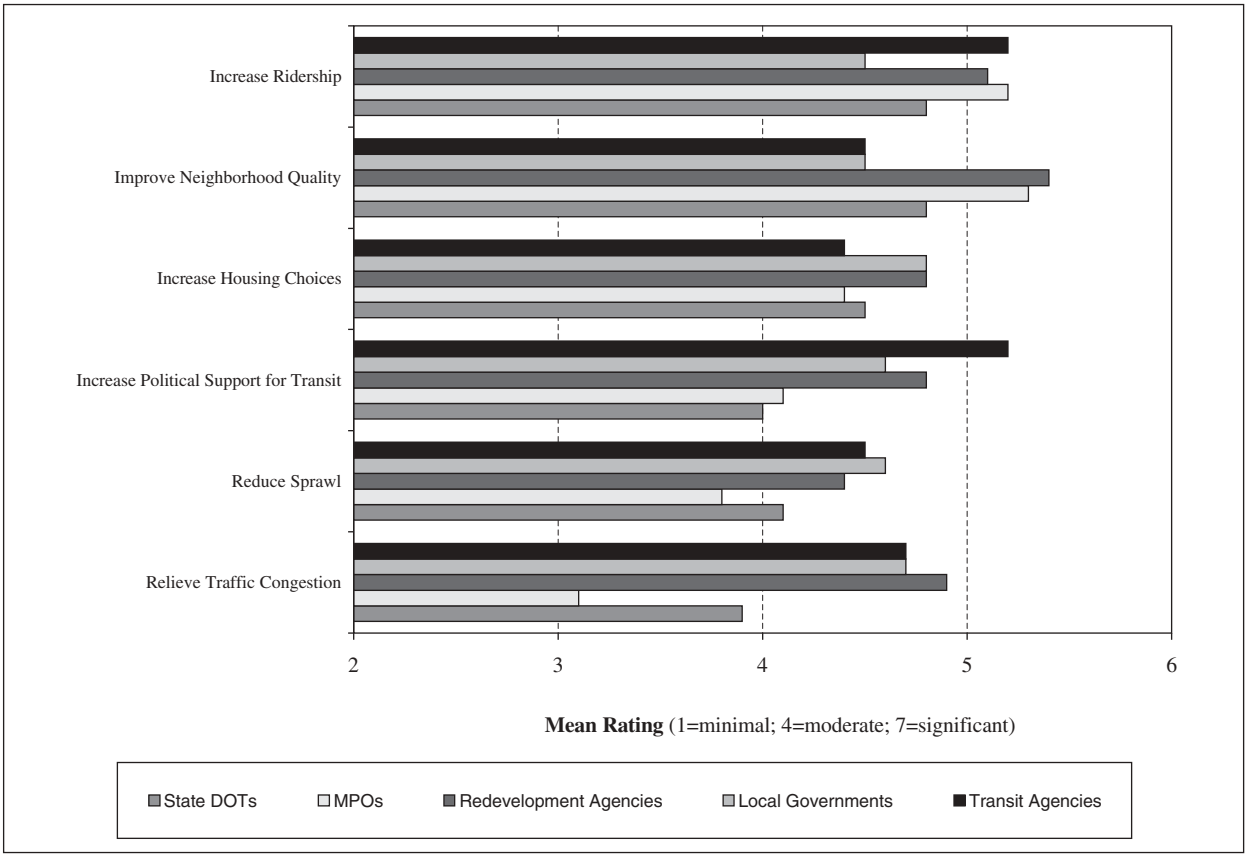
The authors go on to state that various studies report that certain conditions must exist for transit ridership to increase. The "3D's: Density, Diversity, and Design" are significant, and in the San Francisco Bay Area, a study of 129 rail stations showed a strong positive link between residential density, numbers of retail and service jobs (land use diversity), and city block patterns (urban design) with transit use (p. 154).

Chapter 9 of the TCRP report looks at studies of TOD and real estate impacts, the majority of which show a positive relationship between transit stations and increased land value. According to Cervero et al. (2004), this relationship generally holds true for residential developments, including condominiums and rental units, as well as office, retail, and other commercial uses. However, the authors note that the payoffs are not automatic and are often contingent upon a healthy local real estate market with a strong demand for housing as well as citizen concern about worsening traffic conditions. Other important factors in success are prodevelopment policies, such as density bonuses and mixed-use zoning, and the general perception of safety within the neighborhoods. In summary, TOD is not a panacea for failing neighborhoods; but to be successful, it must accompany the same real estate principles that make neighborhoods, transit-based or not, successful—vitality, investment, and a sense of place.

Evaluating TOD in California and New Jersey

Two states, California and New Jersey, have recently released reports on TOD. This section describes how these reports address the topic of evaluating TOD outcomes.

California. In 2002, the report *Statewide Transit-Oriented Development Study: Factors for Success in California* was released by the Caltrans (California



Source: Cervero et al., 2004, 134, Figure 7.1.

FIGURE 3 Rating of impact of TOD in achieving benefits based on experiences in stakeholder's community.

Department of Transportation, 2002); it is available online at http://www.dot.ca.gov/hq/MassTrans/tod.htm. This report focuses primarily upon the ingredients of a good TOD. The objectives of the study were as follows:

> Define [TOD] and its successful components; describe the benefits of TOD; examine the status of implementation of TOD throughout the U.S. and in California; identify the major barriers and impediments to the wider implementation of TOD; identify what is working well, as well as the need for additional resources to overcome barriers; and, finally, develop a set of strategies and activities that the state of California may implement to help facilitate the broader implementation of TOD. (California Department of Transportation, 2002, 2)

The study claims that TOD can lead to social benefits—such as affordable housing, economic development, enhanced safety, and environmental benefits—as well as reduce infrastructure capital and operating costs for government "by up to 25% through compact and infill development" (California Department of Transportation, 2002, 27). While the report uses recent research to support its claims, it does not prescribe a specific methodology for collecting indicators to assess the outcomes or successes of TOD.

The Technical Appendix to the California report sets forth a methodology for estimating the energy conservation and climate change benefits of TOD, which are based on savings in gasoline use by TOD residents. The appendix also provides detailed profiles of TODs in California, which include discussions of how the TOD has led to a better land use mix, more residential density, employment, transit ridership, transit service, and improved station aesthetic design, as well as whether or not the TOD has created a destination or attraction. The report does not specif-

ically recommend ways in which TODs could be systematically evaluated. It states that one of the barriers to implementing TOD is the need for better data:

> The lack of evidence documenting a track record of TOD as a successful development product is an obstacle in convincing stakeholders and bankers about the benefits of projects. And, the lack of accurate or up-to-date information on the potential benefits of TOD in shifting travel from the automobile to transit and nonmotorized modes in local analysis tools (such as traffic models) has become a serious impediment to the broader implementation of TOD, infill development, and affordable housing that meets market demand.
>
> New or revised transportation analytical tools and data are needed to enable local and regional agencies to more accurately project the transportation performance of proposed TOD projects, as is required by [the California Environmental Quality Act] and local development planning and approval processes. (California Department of Transportation, 2002, 143–44)

New Jersey. The New Jersey Transit Village Initiative is a state-based program to promote TOD in New Jersey that is led by the NJDOT and made up of multiple state agencies.[1] Individual places are selected as Transit Villages and receive special treatment from the state in the goal of promoting smart growth. These municipalities must apply to the Transit Village Task Force (made up of representatives from each of the state agencies) and demonstrate through experience and planning that they support the principles of the Transit Village Initiative, including compact development, transit-supportive land uses, and a high-quality pedestrian environment; a complete list of Transit Village requirements is available online at http://www.state.nj.us/transportation/community/village/criteria.shtm). Wells and Renne (2004) conclude in a recent article that the Initiative's intra-agency cooperation at the state level and the intergovernmental cooperation between the state and local government is an effective model for government, especially for the purpose of promoting smart growth. They state that this resembles European-style planning, which yields more pedestrian-friendly and transit-focused cities, similar to what Ewing observes in a classic article about the debate over compact development: "My answer to sprawl is active planning of the type practiced everywhere except the United States (and beginning to appear here out of necessity)" (Ewing, 1997, 118).

In a recent evaluation of the New Jersey Transit Village Initiative, led by the Alan M. Voorhees Transportation Center (VTC) at Rutgers University, a report titled *Transit Villages in New Jersey: Recommendations for Assessment and Accountability* (Wells and Renne, 2003) sets forth recommendations for evaluating the progress of Transit Villages. The report recommends an annual accounting and record keeping by both municipalities and state agencies (including NJ Transit) to monitor economic activity, environmental activity, transportation activity, and community perception, as well as institutional and legal actions (e.g., a change in zoning). It is recommended that data be collected within a half-mile of the transit station on a regular basis to monitor the impacts. Table 2 shows the indicators that were recommended for collection.

Subsequently, VTC began implementing the proposed recommended tool. However, the disparity of resources among the Villages soon became a problem. Many did not have the staff to gather and provide the information needed or did not have information in an electronic form. In conjunction with NJDOT, the indicators were refined to those that could be gathered with reasonable effort (see Table 3). Using local tax maps, blocks within the Transit Village were listed. Using building permit data retrieved electronically from the New Jersey Department of Community Affairs, the amount of investment dollars for new and rehabilitation construction and additional housing units created in the Transit Village could be determined. These investment dollars could then be compared with public funds that the municipality had received.[2] Other indicators, such as the total number of businesses or number of automobile-dependent establishments in the Transit Village, are proposed to

[1] The New Jersey Transit Village Initiative comprises the NJDOT; NJ Transit; NJ Department of Environmental Protection; NJ Redevelopment Authority; NJ Department of Community Affairs, including the Office of Smart Growth and Main Street New Jersey; NJ Economic Development Authority; NJ Housing and Mortgage and Finance Agency; NJ Commerce and Economic Growth Commission; and NJ Council on the Arts.

[2] The descriptions of these efforts are contained in *Implementation of the Assessment Tool, New Jersey Transit Village Initiative,* available online at (http://policy.rutgers.edu/vtc/tod/documents/NJ%20Transit%Villages_economic%20activity.pdf) .

TABLE 2 Recommended Indicators to Evaluate TOD as Part of the Evaluation of the New Jersey Transit Village Initiative

Economic activity	Environmental and transportation activity	Institutional changes	Community perception

Public Investment
• Municipal funds
• State funds
  ◦ Grants
  ◦ Loans
• Federal funds
  ◦ Grants
  ◦ Loans
• Tax abatements
• Total public investment (calculated from indicators above)
 	
Private Investment, Commercial
• New or substantially rehabilitated retail/office space[a]
• Estimated private investment[b]
• Estimated new property taxes generated[c]
 	
Private Investment, Residential
• New or substantially rehabilitated housing units[a]
• Estimated private investment[b]
• Estimated new property taxes generated[c]
• Number of new studios/ one bedroom
• Number of new two bedrooms
• Number of new three or more bedrooms
• Number of new units for sale
• Number of new units for rent
• Number of new subsidized units for rent and for sale (with income limits)
	Pedestrian
	• Length of improved streetscape
	• Number of improved intersections/street crossings for pedestrian safety
	• Length of façade improvement
	• Pedestrian activity counts
	
	Parking
	• Number of new spaces for shoppers only
	• Number of new spaces for commuters only
	• Number of spaces that are shared
	• Number of new bicycle racks or lockers provided
	
	Traffic Flow
	• Number of new shuttle or jitney services provided to and from the transit station
	• Number of traffic control or flow improvements
	
	Land Use
	• Amount of brownfield properties remediated under a [Department of Environmental Protection] approved plan
	• Number/size of vacant buildings rehabilitated or replaced
	• Number/amount of underutilized/vacant lots reclaimed for construction or green/recreation space
	• Number of new or improved park areas
		• New TOD ordinances
		• New TOD or smart growth designations
			Residential Survey
			• How would you rate your town/neighborhood as a place to live?
			• Do you feel the downtown (or transit station area) is more or less attractive now compared to (number) years ago?
			• Is it more or less pleasant to walk around the downtown (or transit station area) now compared to (number) years ago?
			• Does the downtown (or transit station area) seem more or less safe now compared to (number) years ago?
			• Does the downtown (or transit station area) offer better or worse shopping now compared to (number) years ago?
			• Does the downtown (or transit station area) offer more or less restaurant options now compared to (number) years ago?
			• Does the downtown (or transit station area) offer more or less entertainment options now compared to (number) years ago?

[a] Based on Certificate of Occupancy issued by the municipal building department.
[b] Based on building permit data.
[c] Based on assessed value times tax rate less previous ratable.
SOURCE: Wells and Renne, 2003, 7–12.

TABLE 3 Final List of Indicators to Monitor the Progress of the New Jersey Transit Village Initiative

Indicator	Data source	How often the data will be collected	Who will collect the data
Net Increase in Dwelling Units	Building Permit Data	Yearly	NJ Department of Community Affairs (DCA)
Total Construction Activity	Building Permit Data	Yearly	DCA
Residential Construction Activity	Building Permit Data	Yearly	DCA
Affordable Housing Units Created	Building Permit Data	Yearly	DCA
Nonresidential Construction Activity	Building Permit Data	Yearly	DCA
Total Businesses in Transit Village	Town/Transit Village Application	Yearly	Municipality Annual Report
Number of Automobile-Dependent Establishments	Town/Transit Village Application	Yearly	Municipality Annual Report
Number of Transit-Supportive Shops	Town/Transit Village Application	Yearly	Municipality Annual Report
Parking Spaces	Town/Transit Village Application	Yearly	Municipality Annual Report
Acres of Brownfields Reclaimed	Town	Yearly	Municipality Annual Report
Transit Ridership Counts	NJ Transit	Yearly or as available	NJ Transit
Pedestrian Activity Counts	Town/DOT	Every 1–2 years	Town/DOT
Public Perception	Survey Results	Every 2–4 years	DOT
Public Investment	Town	Yearly	Municipality Annual Report
Other Infrastructure or Transportation Improvements	Town	Yearly	Municipality Annual Report

SOURCE: Wells and Renne, 2004, 2.

come from an annual report that the municipality would submit to the state as a requirement of being a Transit Village. This annual reporting process is not currently in place, although it is being considered by NJDOT.

Other Literature in Evaluating TOD

As Nelson, Niles, and Hibshoosh report in *A New Planning Template for Transit-Oriented Development* (2001), TOD exists mainly as a vision for the future, and it is unclear if the benefits will exceed the costs. They report that studies on TOD feasibility and applicability do not solidify the argument that the restructuring of an urban environment can actually be done. The problem with this analysis is its limited scope, focusing success solely on nonwork travel. Their goal was to "improve the planning methodology for TOD by bringing into sharp focus the dynamics of the retail marketplace and nonwork travel demand" (p. 1). In their analysis of nonwork travel, such as trips for shopping, entertainment, and recreational travel, they report "the limited experience of TOD's effect on travel and land use patterns" (p. 7). Due to the limited number of TODs, even in regions that have been embracing the concept, it is hardly reasonable to evaluate the success of TODs based solely on the retail marketplace and nonwork travel at this early stage. Boarnet and Crane, while also somewhat skeptical of TOD's impact on nonwork travel, come to a similar conclusion in their book, *Travel by Design: The Influence of Urban Form on Travel* (2001).

A main goal of TOD is to create more benefits than costs on both a regional and local scale. Indeed, as Dunphy (1995) suggests, in order for a TOD to make a meaningful difference in development pat-

terns, it must reflect upon the region and not exclusively the area within a quarter-mile of the local station. To achieve this, the response of developers, consumers, and taxpayers to the TOD concept is crucial. Nelson, Niles, and Hibshoosh (2001) compiled a table of 16 planning elements that will determine the success of TOD at a regional as well as a local scale (shown in Table 4). They assert that the regional level impact of TOD is only a vision in the minds of planners and cannot be measured from any current experience. Over the past few years (since Nelson, Niles, and Hibshoosh's work was published), numerous articles have appeared in major newspapers, such as the *New York Times, Los Angeles Times, Chicago Tribune,* and *San Francisco Chronicle*, on a growing market for compact, mixed-use, urban infill development, especially near transit. *Urban Land*, a monthly publication of the Urban Land Institute, has featured a number of successful TODs across the United States in several of its recent issues. Reconnecting America, a nonprofit organization supporting smart growth, recently spun off a new Center for Transit-Oriented Development. This center has been working with a growing number of communities across the country that are becoming more serious about TOD. It also released a book called *The New Transit Town: Best Practices in Transit-Oriented Development* (Dittmar and Ohland, 2004) that serves as a guidebook for better understanding TOD.

Conclusion

Public investment in infrastructure is too often made without fully understanding the outcomes. This not only holds true for highways, which encourage automobile-dependent land uses, but also for poorly planned transit systems that do little to encourage sustainability. For example, sometimes new rail systems are planned with little thought about the land uses at the stations. This lack of coordination between land use and transportation planning can lead to disappointing results. Part of the reason that poor decisions are made over and over again is because few planners and policymakers evaluate the failures or successes of similar projects before embarking on new ones. A lack of empirical data about the outcomes of TODs may lead to similar problems. For example, though many new TODs across the United States appear to be economically successful, there are little data available to explain the full range of their impacts. If luxury apartments and town houses are the only type of residential product available, the TOD may not be helping poor and working-class families that most need transit. If, however, the only choice is between more expensive housing or living with vacant, derelict land, then the results need to be evaluated within the context of the options. Without measuring the outcomes of TODs, mistakes in investment strategies will continue to be repeated. However, success may be a matter of viewpoint.

TABLE 4 Factors Determining the Success of TOD

Factor	Station area success	Regional success
Number and siting of TODs (station area)		X
Transit quality		X
Transit technology		X
Street pattern	X	X
Station-area parking	X	X
Employment and housing density	X	X
Commercial mix	X	X
Retail siting criteria		X
Regional market structure		X
Consumer activity patterns		X
Travel behavior/trip chaining		X
Zoning flexibility/land assembly	X	X
Resident reactions	X	X
Housing type preference/lifestyle & life stage		X
Self-selection in residential choice	X	X
Government policies		X

SOURCE: Nelson, Niles, and Hibshoosh, 2001, 18–19.

REVIEW OF TOD BENEFITS AND INDICATORS

In pursuing the goal of developing a strategy to measure the success of TOD, this section presents the results of this study of what governments and agencies across the United States suggest are the benefits of TOD. The same DOTs, MPOs, transit agencies, municipalities, and redevelopment agencies studied in *TCRP Report 102* (Cervero et al., 2004) were asked to identify the benefits they foresee from TOD.

Research Methods

TCRP Report 102 presents the results of a survey of governments and agencies from across the United States about various aspects of TOD, such as the definition of a TOD, the existence of a formal program to promote TOD, sources of funding, tools used to promote TOD, the location of existing TODs, level of involvement of the agency, and impediments to development. One element not covered in the report is how to measure the outcomes or benefits of TOD. The survey conducted for *TCRP Report 102* included this question related to benefits: "Based on your agency's experience, how important is TOD toward: increasing transit ridership, increasing political support for transit, relieving traffic congestion, reducing sprawl, increasing housing choices, and improving neighborhood quality" (Cervero et al., 2004, A-18). While the responses to this question provide a better understanding of the relative importance of each aspect of success, the question itself only begins to address the full range of benefits from TOD. As mentioned in the section that provided background on indicators of TOD success, *TCRP Report 102* identifies various classes and recipients of TOD benefits, but it does not identify who across the United States is collecting data that show whether these and other benefits are actually being realized.

FIGURE 4 Orenco, near Portland, Oregon, is a model community in coordinating land use planning and promoting walking and bicycling as part of successful TODs with its new light rail system.

In order to determine if the individual governments and agencies that responded to the TCRP survey identify important benefits or outcomes to TOD, a two-part strategy was implemented. First, Internet websites hosted by these agencies were searched to determine if they report benefits associated with TOD. Second, agencies without websites were contacted to determine if they had any written material describing outcomes. In total, 96 agencies were analyzed, including 25 transit agencies, 4 commuter rail agencies, 24 cities and counties, 8 redevelopment agencies, 25 MPOs, and 10 state DOTs; they are listed in Appendix A. As a result of this research, 56 indicators were identified. These indicators were then categorized into five groups:

- Travel behavior—parking and traffic flow
- Economic—public and private investment
- Environmental—air quality and energy use
- Built environment—design quality, pedestrian friendliness, and land use
- Social—diversity, safety, and affordability

Tables 5 through 9 present information collected for each of these groups of indicators, specifically the category of the indicator, the nature of the indicator, the standard of measurement, and the names of agencies using the indicator. It is important to remember that the agencies listed in tables may not actually collect the data for these indicators to measure the progress of TOD; rather the agencies, in varying degrees, report that these indicators demonstrate benefits of TOD.

Findings

As shown in Figure 5, the most commonly noted benefits/indicators of TOD, in descending frequency, are as follows:

(*text continued on page 14*)

TABLE 5 Travel Behavior Benefits/Indicators

Category	Benefit/Indicator	Measure	Sources
Parking	Number of parking spaces for shoppers only	Number	NJ Transit Village Evaluation[a]
	Number of parking spaces for commuters only	Number	NJDOT; Salt Lake City; NJ Transit Village Evaluation
	Number of parking spaces that are shared	Number	NJ Transit Village Evaluation; Northeast Illinois Commuter Railroad Corporation (METRA)
	Number of parking garages	Number	Puget Sound Regional Council; METRA
	Number of bicycle racks or lockers provided	Number	Puget Sound Regional Council; NJ Transit; Northeastern Illinois Planning Commission; METRA; NJ Transit Village Evaluation
Traffic Flow	Transit ridership	Number	NJ Transit; Los Angeles County Metropolitan Transportation Authority; Port Authority of Allegheny County; Metropolitan Atlanta Rapid Transit Authority; TRI-MET; BART; Santa Clara Valley Transportation Authority; Niagara Frontier Transportation Authority; Seattle Dept. of Transportation; Office of Planning, Washington, D.C.; Portland, Ore., Office of Transportation; San Mateo, Calif.; Mountain View, Calif. Community Development; Contra Costa County, Calif., Redevelopment Agency; Delaware Valley Regional Planning Commission (DVRPC); Atlanta Regional Planning Commission; Indianapolis MPO; Mid-Ohio Regional Planning Commission; Caltrans; NJDOT; Ore. DOT; Miami-Dade Transit Agency; Conn. Department of Transportation; Baltimore Department of City Planning; Salt Lake City; Capital District Transportation Committee, Albany, N.Y.; East-West Gateway Council of Governments; METRA; NJ Transit Village Evaluation
	Number of shuttle or jitney services provided to and from the transit station	Number	NJ Transit Village Evaluation; METRA
	Vehicle miles traveled (VMT) for residents/employees	Miles	Washington Metropolitan Area Transit Agency (WMATA); TRI-MET; North San Diego County Transit District; Seattle Dept. of Transportation; Sacramento; San Diego; San Mateo; Mid-Ohio Regional Planning Commission; Caltrans; Oregon DOT; Conn. Department of Transportation; Capital District Transportation Committee, Albany, N.Y.; East-West Gateway Council of Governments
	Number of single-occupancy-vehicle trips for residents/employees	Number	Seattle Dept. of Transportation; Indianapolis MPO; Greater Buffalo–Niagara Regional Transportation Council
	Bicycle activity counts	Number	San Diego
	Number of traffic control or flow improvements (including traffic calming devices)	Number	Metropolitan Atlanta Rapid Transit Authority; Northern Virginia Transportation Commission; Portland, Ore., Office of Transportation; Portland Metro; NJ Transit Village Evaluation
	Amount of bicycle lanes	Miles/feet	NJ Transit; Southeastern Pennsylvania Transportation Authority; Northeastern Illinois Planning Commission; METRA
	Pedestrian activity counts	Number	Santa Clara Valley Transportation Authority; Port Authority of Allegheny County

[a] The New Jersey Transit Village Evaluation was conducted by VTC on behalf of NJDOT, and the other participating state agencies including NJ Transit (see "Background on Indicators of TOD Success" for a summary of the evaluation of the New Jersey Transit Village Initiative).

TABLE 6 Economic Benefits/Indicators

Category	Benefit/Indicator	Measure	Sources
Public Investment	**Municipal Funds**	Dollars	NJ Transit Village Evaluation
	State funds (detail by source):		
	—Grants	Dollars	NJ Transit Village Evaluation
	—Loans	Dollars	NJ Transit Village Evaluation
	Federal funds (detail by source)		
	—Grants	Dollars	NJ Transit Village Evaluation
	—Loans	Dollars	NJ Transit Village Evaluation
	Tax abatements given	Dollars	NJ Transit Village Evaluation
	Total public investment	Dollars	NJ Transit Village Evaluation; METRA
Private Investment	**Commercial**		
	New or substantially rehabilitated retail/office space	Square footage	TRI-MET; BART; Office of Planning, Washington, D.C.; Boston Redevelopment Authority (BRA); DVRPC; Atlanta Regional Planning Commission; Greater Cleveland Regional Transit Authority; Miami-Dade Transit Agency; Colo. DOT; Baltimore Dept. of City Planning; Englewood, Colo.; Salt Lake City; Sacramento Economic Development Department; Capital District Transportation Committee, Albany, N.Y.; METRA; NJ Transit Village Evaluation
	Number of convenience retail establishments (e.g., dry cleaning, video rental)	Number	METRA
	Estimated private investment	Dollars	NJ Transit Village Evaluation; METRA
	Estimated new property taxes generated	Dollars	Niagara Frontier Transportation Authority; NJ Transit Village Evaluation
	Housing		
	New or substantially rehabilitated housing units	Number of units	TRI-MET; BART; Office of Planning, Washington, D.C.; BRA; DVRPC; Atlanta Regional Planning Commission; Miami-Dade Transit Agency; Baltimore Department of City Planning; Englewood, Colo.; Salt Lake City; Capital District Transportation Committee, Albany, N.Y.; NJ Transit Village Evaluation
	Minor housing improvements	Dollars	NJ Transit Village Evaluation
	Estimated private investment	Dollars	NJ Transit Village Evaluation
	Estimated new property taxes generated	Dollars	NJ Transit Village Evaluation; Englewood, Colo.
	Estimated increase in property value	Dollars	TRI-MET; DART; Contra Costa County Redevelopment Authority; Seattle; Englewood, Colo.; Salt Lake City; NJ Transit Village Evaluation

(*continued on next page*)

TABLE 6 (Continued)

Category	Benefit/Indicator	Measure	Sources
Private Investment *(continued)*	**Configuration**		
	Studio/one bedroom	Number of units	NJ Transit Village Evaluation
	Two bedrooms	Number of units	NJ Transit Village Evaluation
	Three or more bedrooms	Number of units	NJ Transit Village Evaluation
	Tenure		
	For sale	Number of units	NJ Transit Village Evaluation
	For rent	Number of units	NJ Transit Village Evaluation
	Subsidized units (with income income limits)	Number of units	NJ Transit Village Evaluation
	For sale	Number of units	NJ Transit Village Evaluation
	For rent	Number of units	NJ Transit Village Evaluation

TABLE 7 Environmental Benefits/Indicators

Category	Benefit/Indicator	Measure	Sources
Air Quality	Amount of air pollution (NO_x, CO_2, PM)	Air Pollution Index (API) reports	San Francisco Municipal Railway; North San Diego County Transit District; Sacramento; San Diego; Mountain View, Calif., Community Development; Portland Metro; Mid-Ohio Regional Planning Commission; Caltrans; Oregon DOT; Baltimore Department of City Planning; Englewood, Colo.; East-West Gateway Council of Governments
Energy Use	Consumer gasoline consumption	Gallons	Caltrans

- Mixed use,
- Transit ridership,
- Density,
- New or rehabilitated office/retail space,
- Pedestrian orientation/human scale,
- Vehicle miles traveled,
- Air quality,
- New or rehabilitated housing,
- Number of new or improved park areas,
- Increase in property value,
- Household diversity,
- Number of bicycle racks or lockers,
- Number of traffic control improvements (including traffic calming),
- Affordable housing, and
- Amount of bicycle lanes.

The next stage of the research for this project was to conduct a national, web-based survey of transportation professionals, asking them to specify the indicators' usefulness, the ease or difficulty in gathering the data, the frequency of data collection, and whether the agency actually collected such data. The results are described in the section on the survey of TOD indicators.

SURVEY OF TOD INDICATORS

The review of TOD benefits and indicators in the previous section provided a list of indicators/benefits that are considered by various agencies nationwide to

TABLE 8 Built Environment Benefits/Indicators

Category	Benefit/Indicator	Measure	Sources
Design Quality	Presence of pedestrian-orientation/human scale	Subjective/width and height proportions	NJ Transit; Columbus Planning Division; Seattle; Charlotte Planning Division; Northeastern Illinois Planning Commission; Mountain View, Calif., Community Development; Salt Lake City Redevelopment Agency; BRA; North Central Texas Council of Governments; Greater Buffalo–Niagara Regional Transportation Council; Salt Lake City; Redwood City, Calif., Redevelopment Agency; East-West Gateway Council of Governments; METRA
Pedestrian Friendliness	Length of improved streetscape	Feet	NJ Transit Village Evaluation
	Number of improved intersections/street crossings for pedestrian safety	Number	NJ Transit Village Evaluation; METRA
	Length of façade improvement	Feet	NJ Transit Village Evaluation
	Amount of brownfield properties remediated under a DEP-approved plan	Acreage	NJ Transit Village Evaluation
	Number/size of vacant buildings rehabilitated or replaced	Number/square feet	NJ Transit Village Evaluation
	Number/amount of underutilized vacant lots reclaimed for construction or green/recreation space	Number/acreage	North San Diego County Transit District; NJ Transit Village Evaluation
	Number of new or improved park areas	Number	Southeastern Pennsylvania Transportation Authority; DART; Northern Virginia Transportation Commission; Mid-Ohio Regional Planning Commission; Caltrans; METRA; NJ Transit Village Evaluation
Land Use	Number of mixed-use structures	Number/square footage	NJ Transit; LA County Metropolitan Transportation Authority; Southeastern Pennsylvania Transportation Authority; WMATA; DART; Santa Clara Valley Transportation Authority; Niagara Frontier Transportation Authority; Sacramento Regional Transit District; Peninsula Corridor Joint Powers Board; Seattle DOT; Office of Planning, Washington, D.C.; Sacramento; Columbus Planning Division; Seattle; Charlotte Planning Department; San Mateo, Calif.; Northeastern Illinois Planning Commission;

(*continued on next page*)

TABLE 8 (Continued)

Category	Benefit/Indicator	Measure	Sources
Land Use (continued)			Mountain View, Calif., Community Development; La Mesa, Calif., Community Redevelopment Agency; BRA; DVRPC; Atlanta Regional Planning Commission; San Diego's Regional Planning Agency; Portland Metro; Southeast Michigan Council of Governments; Puget Sound Regional Council; North Central Texas Council of Governments; Indianapolis MPO; Greater Buffalo–Niagara Regional Transportation Council; NJDOT; Ore. DOT; Englewood, Colo.; Redwood City, Calif., Redevelopment Agency; East-West Gateway Council of Governments; METRA

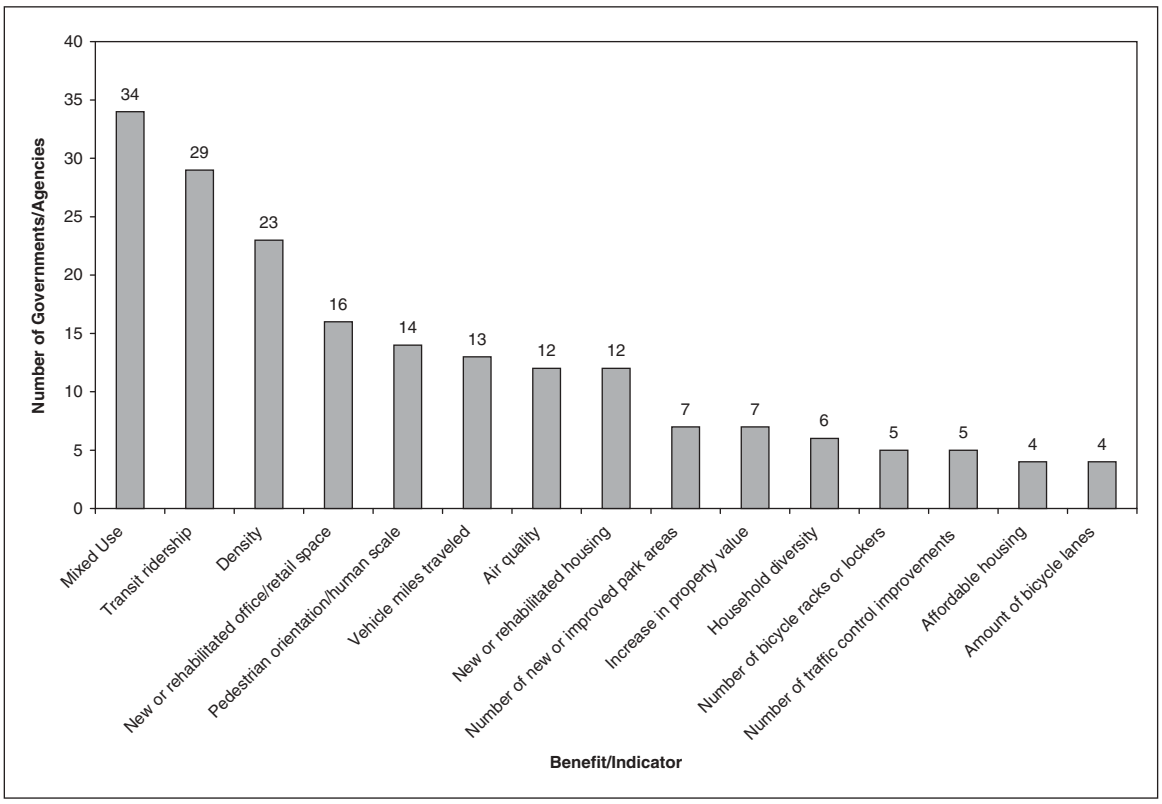
represent TOD. It did not, however, uncover whether each agency actually collects and monitors the progress of TOD. Furthermore, it did not seek to explain which indicators were considered most important (other than by finding which benefits are most frequently reported, as shown in Figure 5). These and other questions were the subject of a national web-based survey that was conducted in June 2004 as part of this research project.

Research Methods

This survey sought to learn about TOD indicators from professionals who work directly with TOD. It targeted individuals working at state, county, and municipal governments; metropolitan planning organizations; and transit agencies. Geographically, the research concentrated on a few regions in the United States that have had significant experience with TOD:

TABLE 9 Social Diversity/Quality Benefits/Indicators

Category	Benefit/Indicator	Measure	Sources
Social	Amount of crime	Crime rate	WMATA; BART; Caltrans
	New cultural/artistic institutions or establishments	Number	Sacramento Regional Transit District; DART; NJDOT
	Number of neighborhood associations	Number	Northern Virginia Transportation Commission
	Public perception (administered survey)	Percentage in favor	Mountain View, Calif., Community Development Dept.
	Household diversity	Age/household income	Sacramento; San Diego; Columbus Planning Division; Mountain View, Calif., Community Development Dept.; Ore. DOT; METRA
	Increase in household disposable income	Dollars	Mid-Ohio Regional Planning Commission; Caltrans; Ore. DOT
	Number of affordable housing units	Units per acre	Portland Development Commission; Salt Lake City Redevelopment Agency; BRA; Miami-Dade Transit Agency



Source: Review of Internet sites and printed material of government transportation entities, Alan M. Voorhees Transportation Center, Rutgers University, 2004.

FIGURE 5 Most frequently cited benefits/indicators of TOD.

FIGURE 6 Englewood, Colorado: Growing regions are turning to TOD as a way to promote smart growth, curb sprawl, and provide alternatives to the automobile. This example in Englewood, a Denver suburb, is particularly important because a compact, mixed-use TOD—including the city hall and a public space—was built along a new light rail line on the site of a vacant suburban mall.

Chicago; Northern California; Southern California; New Jersey; Portland, Oregon; and Washington, D.C. Approximately 60 professionals who have been working directly with TOD in these regions at various agencies were contacted by telephone and email numerous times and asked to complete an anonymous online questionnaire.[3] (Appendix B includes a copy of the questionnaire and complete results from the survey). The response rate was 50%, with the respondents representing 30 governments and agencies from across the United States. Figure 7 shows the distribution of responses by region of the country and employer. Considering that not many places are involved with TOD across the country and that very few have thought about monitoring its progress, the

[3] The questionnaire was hosted by the John J. Heldrich Center for Workforce Development (a sister institute to the Alan M. Voorhees Transportation Center at the Edward J. Bloustein School of Planning and Public Policy at Rutgers University in New Brunswick, New Jersey).

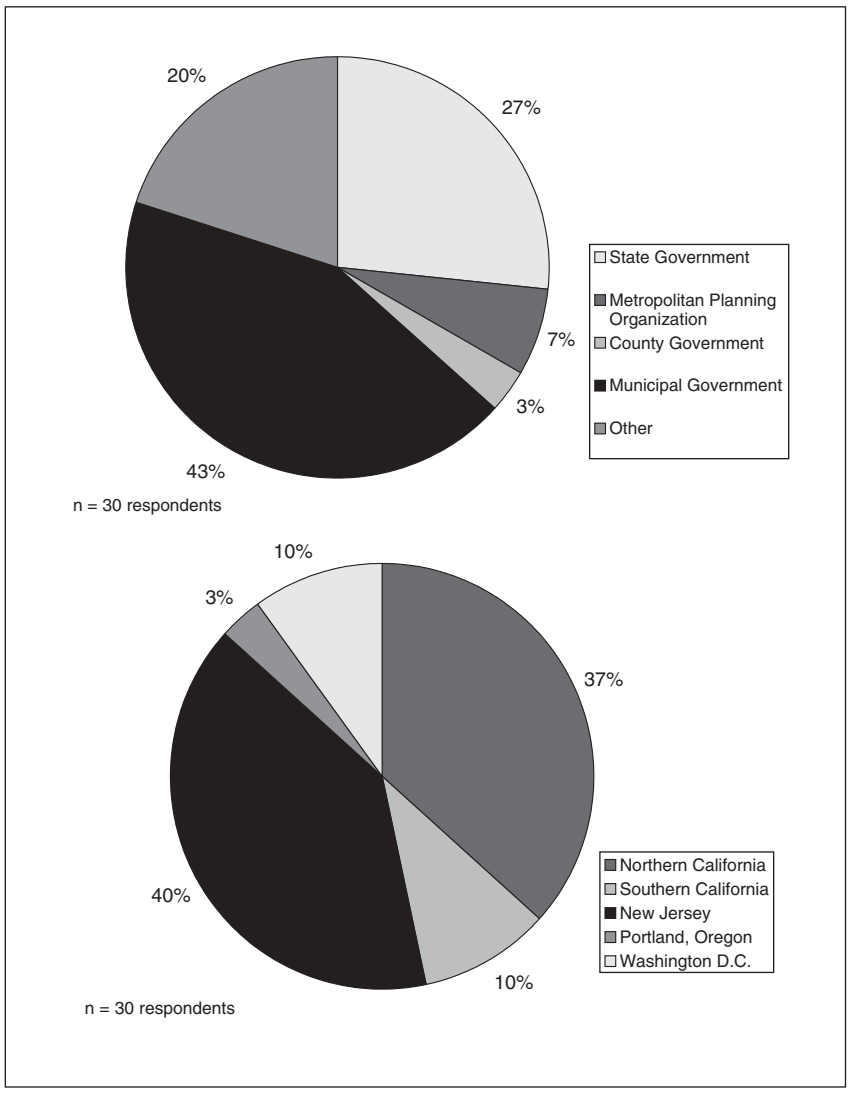


FIGURE 7 Distribution of survey respondents by region and employer.

responses to this survey provide good insights from across the country and across levels of government, although a random sample design was not used.

Findings

In the survey, professionals were given a randomized list of TOD success indicators (as described in the previous section) and asked to rate their usefulness and the difficulty of obtaining data. Respondents were also asked for additional information, such as the frequency with which data should be gathered and whether important indicators were not listed on the survey. More specifically, the survey collected information on the following factors:

1. The usefulness of each indicator: very useful, somewhat useful, not very useful, or not useful at all.[4]
2. The difficulty of obtaining data for each indicator: very easy, somewhat easy, somewhat difficult, or very difficult.
3. The frequency with which data should be collected for each indicator: 4 times per year, 3 times per year, 2 times per year, once a year, or less than once a year.
4. The number of indicators for which data are actually collected and the percentage available in electronic format or online.

[4] The same indicators were rated for factors 1, 2, and 3.

5. Whether there were any important indicators not listed on the survey and what they were.
6. The three to five most and least important indicators for measuring the success of TOD.
7. Contact information for respondents willing to discuss these issues further by phone.

Most Useful Indicators

Table 10 lists the indicators that were considered most useful for monitoring the progress of TOD. As shown, the most important indicators are the qualitative rating of streetscape and pedestrian activity counts, followed by the number of transit boardings. While much of the literature in TOD focuses on transit ridership, these findings suggest that equally important is the quality of the built environment and the number of people walking along the streets. Therefore, a transit station with a poor urban fabric and few pedestrians, but lots of commuter parking and high levels of transit ridership, would not rate highly as a successful TOD.

Another interesting finding is that in the list of most useful indicators in Table 10, all the categories of TOD benefits (travel behavior, economic, built environment, and social diversity/quality) except environmental are represented. Gasoline consumption of TOD residents was the highest ranking environmental indicator, with only 30% of respondents rating it as "very useful." The low ratings for environmental indicators are most likely due to the research design of the study. Because this survey generally targeted transportation planners working with TOD on a regular basis and not EPA professionals, it probably underrepresents those concerned with the environmental effects of TOD. The suggestions given in the last section of this digest speak to this shortfall in environmental perspective. However, it should be pointed out that the FHWA/FTA encourages TOD as a way to promote clean air with funding through the Congestion Mitigation Air Quality program (CMAQ). In Portland, Oregon, CMAQ funds have been used for TOD dating back to 1994.

TABLE 10 Indicators rated very useful for TOD by at least 50% of the respondents

Indicator	Percentage of respondents who rated the indicator as 'Very Useful'	Category
Qualitative rating of streetscape (i.e., pedestrian orientation/human scale)	77	Built environment
Pedestrian activity counts	77	Travel behavior
Number of transit boardings[a]	**70**	**Travel behavior**
Population/housing density	67	Built environment
Estimated increase in property value	63	Economic
Public perception (administered survey)	63	Social diversity/quality
Number of bus, ferry, shuttle, or jitney services connecting to transit station	**63**	**Travel behavior**
Number/square feet of mixed-use structures	**60**	**Built environment**
Number of improved intersections/street crossings for pedestrian safety	**60**	**Built environment**
Estimated amount of private investment	57	Economic
Number of parking spaces for residents	53	Travel behavior
Number of shared parking spaces	53	Travel behavior
Number of convenience/service retail establishments (i.e., dry cleaners, video rental)	**53**	**Economic**
Employment density (i.e., number of jobs per acre/square mile)	53	Economic/built environment
Estimated amount of private investment by type of land use	52	Economic

[a] Indicators in bold were also identified as being very easy to collect (see Table 11).

Ease of Collection

While it is important to know what the most useful indicators are, it is also important to know how easy or difficult it is to collect data for each indicator. Table 11 depicts the perceived easiest indicators to compile. Indicators listed in both Table 10 (very useful) and Table 11 (very easy to collect) are shown in bold. Note that only 5 out of the 13 very useful indicators are considered among the 22 that are very easy to collect:

1. Number of transit boardings;
2. Number of bus, ferry, shuttle, or jitney services connecting to the transit station;
3. Number/square feet of mixed-use structures;
4. Number of improved intersections/street crossings for pedestrian safety; and
5. The number of convenience/service retail establishments.

It should be observed that environmental indicators were also not found on the easiest list, again most likely because transportation professionals do not directly address environmental outcomes. The conclusion that we draw from comparing Table 10 and Table 11, which is supported by experience related to the Transit Village Initiative in New Jersey, is that the data for the most useful in-

TABLE 11 Indicators of TOD rated very easy to collect by at least 50% of the respondents

Indicator	Percentage of respondents rating indicator as 'Very Easy' to Collect	Category
Number of bus, ferry, shuttle or jitney services connecting to transit station[a]	**79**	**Travel behavior**
Number of bicycle racks or lockers	72	Travel behavior
New or improved cultural/artistic institutions or establishments	71	Social diversity/quality
Mileage of bicycle lanes	71	Travel behavior
Amount of improved public park area/public space	68	Built environment
Number of subsidized housing units	64	Economic
Number of neighborhood institutions (i.e., local clubs or organizations)	64	Social diversity/quality
Number/amount of underutilized lots reclaimed for construction or green/recreation space	63	Built environment
Number of parking spaces for commuters	62	Travel behavior
Number of traffic flow improvements (i.e., traffic-calming devices)	61	Travel behavior
Number/acreage of brownfield properties remediated	61	Built environment
Number of affordable housings units	61	Social diversity/quality
Number of transit boardings	**61**	**Travel behavior**
Number of improved intersections/street crossings for pedestrian safety	**59**	**Built environment**
Number/size of vacant buildings rehabilitated or replaced	57	Built environment
Estimated amount of new property taxes generated	57	Economic
Amount of crime	57	Social diversity/quality
Number of convenience/service retail establishments (i.e., dry cleaning, video rental)	**57**	**Economic**
Length of facade improvement	57	Built environment
Number/square feet of mixed-use structures	**54**	**Built environment**
Length of improved streetscape	54	Built environment
Number of substantially rehabilitated housing units	50	Economic

[a] Those indicators in bold are also shown on Table 10 as being very useful.

dicators of TOD success are going to require special efforts to compile. This challenge is addressed in the suggestions given in the last section of this digest.

Frequency

The next series of questions in the survey asked about the frequency of data collection. The vast majority of indicators, with a few exceptions, needed to be collected only once a year or less often according to 95% of the respondents. Because data collection can be costly, this is good news. The only exception was transit ridership, which more than 50% of the respondents said should be collected more than once a year. Because transit agencies usually track ridership closely and on a regular basis, the collection of these data should not be difficult.

Collection Efforts

Figure 8 shows the results of the next question in the survey: how many indicators are being monitored. The results indicate that almost three-quarters of the responding agencies track 10 or fewer indicators; and, nearly half (49%) collect five or fewer indicators listed in the survey. This suggests that the majority of agencies are not monitoring TOD progress with any depth and deliberation.

Electronic/Online Sources of Information

The survey asked whether indicator data were available either in electronic format or online. The results were not informative, and in retrospect the question probably should have been worded to pinpoint exactly what measures were available in this format rather than what percentage were. Of the 22 respondents who indicated that they collected data, 15 indicated that 50% or less of the information was in electronic form and 12 said that no data were available online. More investigation is needed on best practices for specific measures, given local governmental and agency capacities.

Other Indicators

Concerning important indicators that were not listed in the survey, suggestions included land use mix, rate of automobile ownership, presence of car sharing programs, and the existence of transit fare incentive programs. Although these indicators might be added to future surveys, listed indicators could substitute for the proposed indicator in many cases—for example, VMT or resident parking capacity could substitute for car ownership and car sharing and transit ridership could be used in place of fare incentive programs. Data on car ownership and mode split

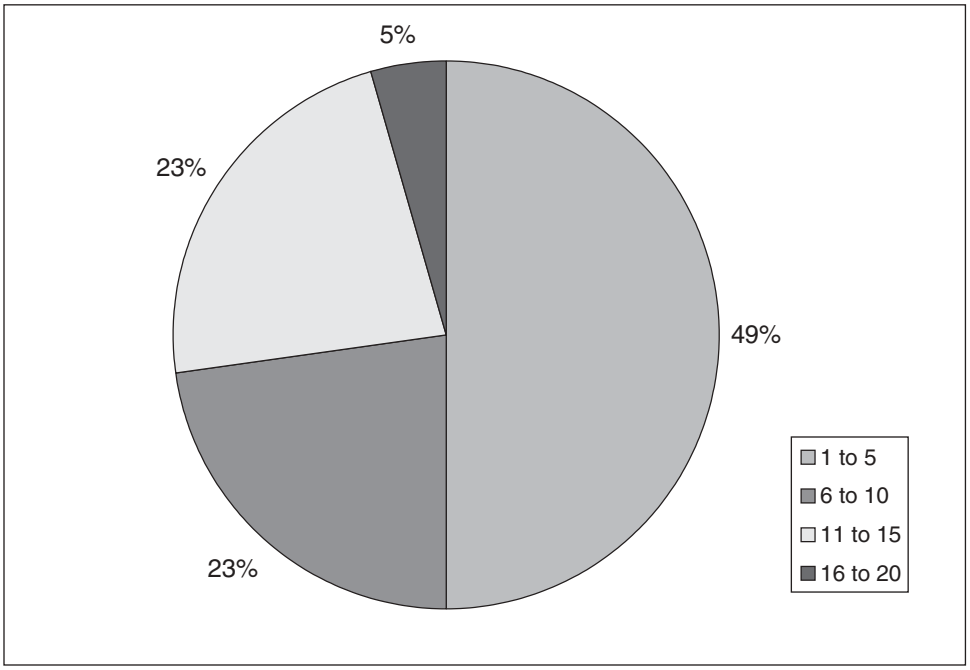


FIGURE 8 Number of indicators collected by agencies.

would be especially useful, because planners could then begin to quantify not only localized outcomes but also regional impacts on traffic congestion and air quality as well.

Rankings

Respondents were asked to list the three to five most important and least important indicators. Transit ridership was the most important cited indicator, followed by density, various parking indicators, various design quality indicators, and tax revenue. One respondent noted that there were no least important indicators, but overall, air pollution, gasoline consumption, and vehicle miles traveled were most commonly cited as the least important indicators. Other less favored indicators mentioned a few times were household diversity, tax abatements, and disposable income.

Because of the small number of respondents and the variability within the answers, it was not possible using these data to determine whether there was any variation by type of government/agency. It is theorized that certain indicators may be more appropriate for certain types of governments; that is, municipalities may be more interested in tax revenue, while transit agencies may be more interested in transit ridership. But these data do not lend themselves to this kind of analysis. As noted above (and as shown in Figure 8), most agencies state that they do not collect much data associated with TOD outcomes. Therefore, collecting data on a minimum number of important indicators that universally indicate success may be the best approach. This could change over time as more attention and possibly public funding are dedicated to TOD.

CONCLUSIONS AND SUGGESTIONS FOR EVALUATING TOD

On the basis of this research, the following conclusions are offered to aid in more effectively monitoring TOD outcomes.

Conclusion and Suggestion 1

The results of this study clearly point to a number of TOD success indicators that enjoy consensus. *From the website/print review and from the survey of transit professionals, the following top 10 measurements were identified as the foundation for an evaluation program:*

FIGURE 9 Alexandria, Virginia: TOD has been a popular development strategy in suburban Washington. The Washington Metropolitan Area Transit Agency (WMATA) is a role model for public–private partnerships. Not only has TOD in Washington helped to generate high levels of transit usage, but more than 52 joint development projects (worth more than $4 billion in market value) generate about $6 million in annual revenues for WMATA (Cervero et al., 2004).

- Transit ridership;
- Density—population/housing;
- Quality of streetscape design;
- Quantity of mixed-use structures;
- Pedestrian activity/pedestrian safety;
- Increase in property value/tax revenue;
- Public perception—resident and merchant surveys;
- Mode connections at the transit station; and
- Parking configuration—for commuters, for residents, and shared.

Conclusion and Suggestion 2

The results of the survey also indicate that the collection of data for many of these indicators is not straightforward. Specifically, pedestrian activity counts, public perception surveys, determination of economic outcomes, and quality of design call for more involved effort, expertise, and expense than may be available. *It is suggested that transit agencies/state DOTs/MPOs set aside special funds for TODs to support pedestrian activity surveys, resident and merchant surveys, analyses of property values and taxes, design assessment, and density tracking.*

Conclusion and Suggestion 3

Surprisingly, the value of environmental factors was downplayed by the respondents to the opinion survey of transportation professionals. And though transportation professionals may not see reduction in fuel consumption as a useful indicator, it is widely considered to be an important public benefit. *It is suggested that government agencies and MPOs concerned with the environment take on this measurement task and develop specialized programs to monitor changes in air quality*. Either this can be accomplished by measuring levels of ozone, nitrogen oxides, sulfur dioxide, carbon monoxide, and particulates or indirect measures could be used that look at the link between variables, such as vehicle miles traveled, single-occupancy trips, and fuel/energy consumption. By using individual household data, such as vehicle ownership and mode split, to model impacts at the local and regional levels, a comparison of households living inside and outside TODs could be made.

Conclusion and Suggestion 4

It is suggested that a regular schedule be set up for collecting data. The respondents overwhelmingly agree that data on the indicators need be collected only annually or even less often. Those indicators considered easy to collect data for could be reported annually; and those that are more difficult or expensive to collect data on, like pedestrian counts or resident surveys, could be reported on less frequently. It should be noted that the authors' experience in New Jersey suggests that, once the initial setup for surveys is done (i.e., creating the survey instrument), subsequent efforts to collect data should be less costly, although not necessarily inexpensive.

Conclusion and Suggestion 5

While the above core indicators have a fairly universal application, not all TODs are the same. Certain benefits accrue to certain types of environments. For example, gentrification may be an issue for some urban TODs but not necessarily for suburban TODs. Likewise, creation of specific uses, such as office space or housing, is not a mandate. Benefits need to be understood from the local perspective. *It is suggested that further research be done to develop a typology and assign certain benefits to certain types of TODs.*

Conclusion and Suggestion 6

Knowing which indicators to use is not the same as knowing how and where to find the data. Municipalities vary in their level of electronic sophistication—from parcel maps to building permits to even having a list of businesses within the TOD area. Furthermore, many have limited staffing capacity with little time to compile information for TOD monitoring. *It is suggested that more research be done to develop a guidebook on how to gather indicator information, particularly in the face of limited local resources.*

Conclusion and Suggestion 7

Finally, it is suggested that databases be created at the state level that will establish baselines and keep track of measurement outcomes for TODs on an annual basis. Not only could transportation professionals monitor progress across the state or along specific corridors, but outcomes could also be compared between states. However, setting minimum performance standards, per se, is not suggested. It would be unfair to rate a TOD on housing production if, in fact, the community's priority is better pedestrian access to the train station; likewise, there is no need to count brownfield clean-ups when contaminated properties do not exist in the TOD area. The process of assessing the performance of TODs should not pit them against each other as if in a contest. Rather, each site should be judged against stated goals set forth for it through an inclusive planning process.

Conclusion

The benefits of TOD are widely acknowledged, as the website/print review found. Through a survey, those indicators that are considered most useful among transportation professionals have been isolated. However, the survey results also indicate that data for many of these indicators are not easy to acquire. This fact most likely explains why nearly half of the survey respondents reported using only five or fewer indicators in evaluating TOD success.

Monitoring the benefits and outcomes of TODs is essential to better understanding the return on public investment. Transportation professionals and planners should be encouraged to use at least the top 10 indicators described above to more fully ascertain the impact of TOD. However, more investigation,

more financial support, more expertise, and more formal reporting are needed to help them do this successfully.

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APPENDIX A
Agencies Studied

Agency Name	TOD-Related Material on General Website	TOD Specific Website	TOD Report	Telephone Interview	Contacted with no reply
TRANSIT AGENCY					
New Jersey Transit	X	X	X		
LA County Metropolitan Transportation Authority	X				
Southeastern Pennsylvania Transportation Authority (SEPTA)	X				
Washington Metropolitan Area Transit Authority (WMATA)	X				
Maryland Transit Administration *				X	
Port Authority of Allegheny County (PA)	X	X			
San Francisco Municipal Railway (MUNI)	X				
Regional Transportation District (RTD) (Denver, CO)	X				
Utah Transit Authority (UTA)					X
Metropolitan Atlanta Rapid Transit Authority (MARTA)	X				
MTA Metro Railroad (NY)					X
Tri-County Metropolitan Transportation District of Oregon (TRI-MET)	X				
Greater Cleveland Regional Transit Authority (RTA)	X				
Miami-Dade Transit Agency (FL)				X	
Dallas Area Rapid Transit (DART)	X				
San Francisco Bay Area Rapid Transit District (BART)	X	X			
Santa Clara Valley Transportation Authority (VTA)	X	X			
Puerto Rico Department of Transportation and Public Works; Metropolitan Bus Authority					X
Niagara Frontier Transportation Authority (NY)	X				
Sacramento Regional Transit District	X				
Northern Virginia Transportation Commission (NVTC)	X				
North San Diego County Transit District	X				
Port Authority Transit Corporation (PATCO) (NJ) *				X	
Kenosha Transit *				X	
Connecticut Department of Transportation				X	
Northeast Illinois Regional Commuter Railroad Corporation (METRA)			X		
MTA Long Island Rail Road					X
Peninsula Corridor Joint Powers Board (Caltrain)	X				

Agency Name	TOD-Related Material on General Website	TOD Specific Website	TOD Report	Telephone Interview	Contacted with no reply
Capitol Corridor Joint Powers Authority (CA)					X
CITY/COUNTY AGENCY					
Los Angeles, CA: Dept. of City Planning					X
Seattle, WA: Department of Transportation		X			
Dallas, TX: Dept. of Planning and Development					X
Baltimore, MD: City Dept. of Planning				X	
Washington D.C.: Office of Planning	X				
Portland, OR: Office of Transportation	X				
Portland Development Commission	X				
Sacramento, CA		X			
Englewood, CO				X	
San Diego, CA	X				
Columbus, OH: Planning Divison	X		X		
Mountain View, CA: Community Development		X			
Davis, CA					X

Agency Name	TOD-Related Material on General Website	TOD Specific Website	TOD Report	Telephone Interview	Contacted with no reply
Seattle, WA	X				
Charlotte, NC: Planning Department	X				
Buffalo, NY *				X	
Fremont, CA					X
Salt Lake City, UT				X	
Maui, HA					X
New Haven, CT					X
South Bend,IN: Division of Community Development					X
San Mateo, CA	X				
Sandy City, UT					X
Beaverton, OR					X
REDEVELOPMENT AGENCY					
Houston, TX: Midtown Redevelopment Authority *				X	
Redwood City, CA: Redevelopment Agency				X	
Contra Costa County, CA: Redevelopment Agency	X				

Agency Name	TOD-Related Material on General Website	TOD Specific Website	TOD Report	Telephone Interview	Contacted with no reply
San Diego, CA: Centre City Development Corporation *				X	
Salt Lake City, UT: Redevelopment Agency	X				
Sacramento, CA: Economic Development Dept.				X	
La Mesa, CA: Community Redevelopment Agency	X				
Boston, MA: Redevelopment Authority	X				
MPO					
Delaware Valley Regional Planning Commission		X			
Metropolitan Washington Council of Govts National Capital Region Trans. Pln Board					X
Atlanta Regional Planning Commission	X				
San Diego's Regional Planning Agency	X				
Portland Metro		X			
Capital District Transportation Committee: Albany, NY				X	

Agency Name	TOD-Related Material on General Website	TOD Specific Website	TOD Report	Telephone Interview	Contacted with no reply
Southeast Michigan COG			X		
East-West Gateway Coordinating Council				X	
Baltimore Metropolitan Council					X
Puget Sound Regional Council		X	X		
Hillsborough County Metropolitan Planning Organization (FL)					X
Northeast Ohio Areawide Coordinating Agency					X
North Central Texas Council of Governments	X				
Indianapolis MPO	X				
Mid-Ohio Regional Planning Commission		X			
Mountain Lan AOG (UT)					X
Greensboro DOT-Greensboro Urban Area MPO (NC)					X
Greater Buffalo-Niagara Regional Transportation Council (NY)	X				

Agency Name	TOD-Related Material on General Website	TOD Specific Website	TOD Report	Telephone Interview	Contacted with no reply
First Coast MPO (Jacksonville, FL)					X
North Jersey Transportation Planning Authority					X
Sarasota Manateo MPO (FL)					X
Metroplan/Little Rock *				X	
Battle Creek MPO (MI)					X
Kyova Interstate Planning Commission (WV-KY-OH MSA)					X
Northeastern Illinois Planning Commission				X	
STATE DOT					
Massachusetts					X
California	X	X	X		
New Jersey	X	X			

Agency Name	TOD-Related Material on General Website	TOD Specific Website	TOD Report	Telephone Interview	Contacted with no reply
Oregon	X				
Georgia					X
Rhode Island					X
Ohio					X
Missouri					X
Utah					X
Indiana					X

Note: A total of 96 agencies were surveyed

* Agency holds no general opinion on Transit-Oriented Development (TOD)

APPENDIX B
Survey Design and Results

Cover Letter

You have been selected to provide input on a national study on

Transit-Oriented Development (TOD).

The Alan M. Voorhees Transportation Center at Rutgers University is working on a grant sponsored by the Transportation Research Board of the National Academies (Transit Cooperative Research Program and the National Highway Cooperative Research Program). The goal of this study is to develop a strategy to measure the success of transit-oriented development and we would appreciate if you could complete a web survey which should only take approximately 8–10 minutes of your time:

There are a few items to point out before you take the survey:

1) We are using the web survey technology of our sister institution at Rutgers, the John J. Heldrich Center for Workforce Development. Hence, you will see their masthead at the top of the survey.

2) We have gathered a number of indicators from places across the United States to gauge the success of TOD. We are asking you to first rate the usefulness of each indicator, then the difficulty in obtaining the data, and finally how often the data should be collected. You may want to interpret an indicator as change over a period of time. For example, "number of existing housing units" could also mean "change in the number of housing units".

3) Lastly, unless otherwise indicated, please assume that all indicators are measuring activity within the general TOD area around a transit station. A good definition of transit-oriented development, from the California Department of Transportation (2002) is:

> Moderate to higher density development, located within an easy walk [approximately ½ mile] of a major transit stop, generally with a mix of residential, employment, and shopping opportunities designed for pedestrians without excluding the auto.

(http://www.dot.ca.gov/hq/MassTrans/tod.htm)

Here is the website location for the survey:

http://www.heldrich.rutgers.edu/Slice/StartSurvey.asp?SurveyID=132

Thank you for your time and if you have any questions, please feel free to email or call us.

Sincerely,

John Renne, Jan Wells, and Chris Riale

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P.S. For a link to research on transit-oriented development at the Voorhees Transportation Center, including a full evaluation of the New Jersey Transit Village Initiative, please visit:

http://www.policy.rutgers.edu/vtc/tod

Questionnaire

What region are you from?

- ☐ Chicago Region
- ☐ Northern California
- ☐ Southern California
- ☐ New Jersey
- ☐ Portland, Oregon
- ☐ Washington, D.C.
- ☐ Other

Who do you represent?

- ☐ State Government
- ☐ Metropolitan Planning Organization
- ☐ County Government
- ☐ Municipal Government
- ☐ Other

[Note for appendix: The next three questions all had the same list of indicators as subquestions. In order to save space, each question will be listed, followed by the indicators. The choices for each question will be listed in parentheses after each question.]

For the indicators below . . .

In determining the success of Transit-Oriented Development, please rate the usefulness of each indicator: (Options included: Very useful, Somewhat useful, Not very useful, and Not useful at all.)

Please rate the difficulty level of obtaining data on the following indicators: (Options included: Very easy to collect, Somewhat easy to collect, Somewhat difficult to collect, and Very difficult to collect.)

Please indicate how often data pertaining to each of the following indicators should be collected: (Options included: 4 times a year or more, 3 times a year, 2 times a year, Once a year, and Less than once a year.)

The indicators for each of the above three questions were:

Number of parking spaces for commuters
Number of transit boardings
Number of bus, ferry, shuttle or jitney services connecting to transit station
Number of bicycle racks or lockers
Number of single-occupant trips for TOD residents
Vehicle miles traveled (VMT) for TOD residents
Bicycle activity counts
Number of shared parking spaces
Amount of air pollution (i.e., NO_x, CO_2, PM)
Consumer gasoline consumption of residents
Number of traffic flow or traffic improvements (i.e., traffic-calming devices)
Amount of crime
New or improved cultural/artistic institutions or establishments
Number of neighborhood institutions (i.e., local clubs and organizations)
Public perception (administered survey)
Amount of household type diversity
Number of parking spaces for residents

Increase in disposable household income
Number of affordable housing units
Number of parking spaces for shoppers
Qualitative rating of streetscape (i.e., pedestrian orientation/human scale)
Length of improved streetscape
Number of improved intersections/street crossings for pedestrian safety
Length of facade improvement
Mileage of bicycle lanes
Pedestrian activity counts
Number of parking spaces for employees
Number/acreage of brownfield properties remediated
Number/size of vacant buildings rehabilitated or replaced
Number/amount of underutilized vacant lots reclaimed for construction or green/recreation space
Amount of improved public park area/public space
Number/square feet of mixed-use structures
Population/housing density
Amount of municipal funds spent or dedicated to TOD
Amount of state grants or loans spent or dedicated to TOD
Amount of federal grants or loans spent or dedicated to TOD
Total public investment
Amount of tax abatements given
Amount/number of new or substantially rehabilitated retail/office space
Estimated amount of private investment
Estimated amount of property taxes generated
Number of substantially rehabilitated housing units
Estimated amount of private investment by type of land use
Estimated amount of new property taxes generated
Estimated increase in property value
Number of subsidized housing units
Vehicle miles traveled (VMT) for workers in the TOD
Number of single-occupant trips for workers in the TOD
Consumer gasoline consumption of workers in the TOD
Number of bedrooms for each (new) housing unit
Rating of quality of lighting for each street
Number of convenience retail establishments (i.e., dry cleaning, video rental)
Tenure (rental vs. ownership) of new housing units
Employment density (i.e., number of jobs per acre/square mile)

How many indicators listed above does your agency keep track of?

- ☐ None
- ☐ 1–5
- ☐ 6–10
- ☐ 11–15
- ☐ 16–20
- ☐ 20+

What percentage of these are available in electronic format?

What percentage are available online?

Are there any indicators that you believe are important that were not listed above? If so, please list them.

In your opinion, what are the 3–5 most important indicators for measuring the success of TOD?

In your opinion, what are the 3–5 least important indicators for measuring the success of TOD?

If you are willing to discuss these issues further in a phone interview with the researchers from the Alan M. Voorhees Transportation Center, please indicate your first name, phone number, and best time to call. All information collected is confidential.

TRB
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