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Standardized Metrics for Accessibility:
Establishing a Federal Policy-Relevant Knowledge Base

Joe Grengs
Jonathan Levine
Terra Reed
Nicholas Grisham

University of Michigan
Urban and Regional Planning
Art and Architecture Building
2000 Bonisteel Boulevard
Ann Arbor MI 48109-2069

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TECHNICAL SUMMARY

Standardized Metrics for Accessibility: Establishing a Federal Policy-Relevant Knowledge Base

1 Introduction: Standardized Metrics to Assist Decision Makers on Progress with Accessibility-Based Policy

Planning agencies use performance measures to help public officials ensure careful and responsible stewardship of public resources, to monitor progress toward their adopted goals, and to evaluate whether their adopted plans are likely to achieve these goals. Researchers have emphasized that performance measures in practice are rarely effectively aligned with the complexity of the stated goals in plans, and as a result decisions commonly give too much weight to the particular goals that are most easily measured by current techniques and practices (Ewing 1995; Handy 2008; Hartgen and Neumann 2002).

A recent trend from political leaders is to demonstrate accountability in the spending of scarce public funds, and this is reflected in the most recent federal transportation bill. The Moving Ahead for Progress in the 21st Century Act (MAP-21) of 2012 created a new system for states and metropolitan planning organizations (MPOs) to measure the performance of their investments against federally required measures. The law establishes new requirements for performance management to ensure the most efficient investment of federal transportation funds (Federal Register Volume 81, Number 78, April 22, 2016). These changes resulted from a Congress that was seeking increased accountability and transparency of federal transportation spending, and they require agencies to implement techniques to better ensure that actions are leading to anticipated outcomes.[1] However, these recent changes requiring closer scrutiny of performance outcomes unfortunately retain a mobility-based perspective of transportation policy, with the goal of reducing congestion listed as the first and foremost goal. Under all such mobility-based evaluation measures, planners, engineers, and the general public continue to regard rapid movement as a defining success.

The problem with a mobility-based model of transportation policy is that movement is not what people seek from their transportation system. What travelers want is access to their destinations. Accessibility has been defined as the “potential of opportunities for interaction,” as opposed to mobility, which is the “ease of movement” (Hansen 1959). Shifting from mobility to accessibility as a primary criterion by which transportation policy is evaluated is a necessary step for improving transportation systems because such a shift can better align planning practice with transportation’s fundamental purpose. The

[1] For more on the recent changes to performance measurement, refer to: <https://www.fhwa.dot.gov/tpm/rule.cfm> and https://www.gpo.gov/fdsys/pkg/FR-2016-04-22/html/2016-08014.htm.

transition to accessibility-based planning cannot begin until measured accessibility is used as a guide to evaluating transportation success.

Transportation-system evaluation, whether mobility- or accessibility-based, rests on the availability of data. In the case of mobility-based evaluation, standardized metrics are abundantly available to planners and engineers through such widely used resources as the *Highway Capacity Manual* and the *Manual on Uniform Traffic Control Devices*. Standardized data definitions facilitate mobility-based evaluations of transportation that are consistent across both time and place. By contrast, no standardized metrics are currently available to assist decision makers about progress on accessibility and to facilitate consistent comparisons over space and time. Metropolitan planning organizations (MPOs), as part of their federally mandated modeling requirements, routinely generate data that might readily be used in accessibility metrics. But after collecting these data from over 50 MPOs in a previous project, we discovered that practitioners are using widely divergent software programs, data formats, and definitions of variables when producing the data required for computing accessibility metrics (Levine et al. 2011). This inconsistency hinders meaningful comparison among places. Furthermore, public agencies normally do not archive such data, undermining the ability to assess progress on accessibility over time.

This project aims to accomplish for accessibility that which current mobility-based metrics do for mobility: influence decisions and establish a measurable basis for policies that help travelers reach destinations. By proposing a scheme for standardized metrics that can be used to assess accessibility, this study offers the opportunity to inject accessibility principles into transportation decision-making. Recent advances within transportation circles toward accessibility-based transportation planning can be encouraged and accelerated with standardized data collection and dissemination.

Data input needed for accessibility assessment includes 1) zone-to-zone travel time and volume by travel mode; 2) population by location; and 3) indicators of destinations, such as jobs, square feet of development, or sales volumes. The first is regularly collected as part of the transportation-planning process in the course of development of regional travel-demand models. Yet despite the nominal straightforwardness of counting minutes or travelers, inconsistencies in practice abound. These enter in definitional issues pertaining to modes, trip purposes, transit headways, service areas, and so forth. They also enter in the form of fundamentally different definitions used in collecting the travel survey data that form the basis of travel-demand models.

This report seeks opportunities for standardization of these data and explains findings on three principal tasks. First, it assesses the current state of standardized transportation data. By studying documentation of other programs of standardized data, including the National Transit Database (NTD) and the Highway Performance Monitoring System (HPMS), and by conducting interviews with key officials and users of these programs, we identify lessons about how transportation data are collected, compiled, disseminated, and archived. Second, this report documents the range of current practice with regard to the needed inputs to accessibility analysis. By conducting a review of documents and reports, and interviewing relevant users at various levels of government, we provide an assessment of the range of current practice with an evaluation of the characteristics and methods most appropriate for accessibility indicators. Finally, the report provides a recommended framework for standardizing the inputs to accessibility metrics. The primary goal is to eventually assemble a reliable and trustworthy data set for evaluating accessibility performance, but to do so while minimizing the burden on respondents and without suppressing the creativity and distinctiveness of initiatives at the local and regional level. We carried out interviews and focus groups with experts from several metropolitan planning organizations to respond to and modify the proposed approach to a standardized data scheme.

2 Models of Standardized Data in Transportation

Two principal federal programs serve as models for collecting and disseminating standardized transportation data. The first is the National Transit Database (NTD), which documents the performance of all transit agencies that receive federal transit funding, and provides perhaps the most effective model for collecting standardized data from diverse sources. The other is the Highway Performance Monitoring System (HPMS), the official federal government source of data on the extent, condition, performance, use, and operating characteristics of the nation's highways.

2.1 National Transit Database

Transit agencies are required to submit annual reports of their performance to the Federal Transit Administration as part of the Uniform System of Accounts, in order to remain eligible for federal funding. Transit agencies are highly diverse – in their size, mission, and technical capacity – and yet they are capable of providing consistent data that meet the same accounting and reporting requirements. More than 660 transit agencies report data on their transit activities each year. The NTD, as the repository for these data, serves as a primary tool for planning, policy, investment decisions, and apportioning FTA funds for transit purposes. By using consistent data standards, the NTD allows transit agencies to compare their performance with peer agencies and to track progress over time.

We examined the NTD because it is an example of a rigorous database, with standard definitions that allow users to make consistent comparisons across agencies and through time. Many agencies use NTD data for their own planning, and they are motivated to report accurate data because it is mandated as a condition for receiving the funds that they depend on to maintain their service levels.

2.1.1 *History of the National Transit Database*

Congress created the NTD in 1978 to gather information about transit systems for supporting local, state, and federal transportation service planning. Recipients of grants from the Federal Transit Administration (FTA) are mandated by statute to submit data to the NTD. Each year, NTD performance data are used in part to apportion FTA funds to transit agencies, and annual reports are submitted to Congress summarizing transit service and safety data (National Transit Database, 2013a). Section 5335 of the US Code gives the following justification for the NTD (49 USC 5335 (a)):

> To help meet the needs of individual public transportation systems, the United States Government, State and local governments, and the public for information on which to base public transportation service planning, the Secretary of Transportation shall maintain a reporting system, using uniform categories to accumulate public transportation financial and operating information and using a uniform system of accounts. The reporting and uniform systems shall contain appropriate information to help any level of government make a public sector investment decision.

Prior to the development of the NTD, the transit industry collected its own data from transit agencies in order to foster a better understanding of the conditions of transit. The NTD is the result of an attempt on the part of both the transit industry and the federal government to make the data more uniform.

2.1.2 *Transportation Statistics Prior to the NTD*

The United States Bureau of the Census collected transportation statistics as early as 1890. The Government Printing Office produced a *Report on Transportation Business* that "presents the results of an investigation into the financial transactions and the traffic operations of companies and corporations engaged in transportation" (Adams, 1895, vii). Some transportation statistics were compiled in the 1880 census, but they consisted of railroads and water transportation. The 1890 census is the earliest instance of data on street railways, making it the oldest source referenced by the American Public Transportation Association (APTA) *Fact Book* as a predecessor to today's data on public transit (American Public Transportation Association, 2013b).

The Census Bureau continued to collect and report transportation data through 1937.[2] In 1943, the American Transit Association (ATA) published the *ATA Fact Book*—which would later become the *APTA Fact Book*. The ATA compiled "financial and statistical reports received by the American Transportation Association from transit companies representing 85 to 95 per cent of the transit industry" (American Transit Association, 1944, preface). An important change that took place when ATA began compiling the statistics is that they did not have authority to require the reporting of data (American Public Transportation Association, 2013b, 5-6):

> Because transit agencies were required by law to report their data [for the Census], it can be assumed that the data represented nearly the entire transit industry for those vehicle modes for which data were collected. When the ATA began compiling the *Fact Book*, data were obtained by survey from ATA member organizations. There was not, of course, a legal requirement for ATA members or non-member transit agencies to report data. In order to estimate data for the entire U.S. transit industry, the ATA expanded the sample data from their survey to represent the entire transit industry using statistical methods.

Annual ATA Fact Books were a primary source of national transit industry data until the early 1970s, when the federal government intervened to gather transportation statistics. The justification for early transportation statistics is not readily evident in the available documentation. The 1890 Census collected data on mileage, equipment, employment, and various financial records for the railroad and street railway systems in the country. Although formal justifications for collecting such data are difficult to determine, the usefulness of such data for making decisions with data comparable across both space and time is evident from writing at the time (Adams, 1895, 5):

> The data … render possible a comparison of railroad construction in the various states during the past decade, as also of the railroad facilities with which each state has been provided, expressed with reference to square miles of area and to population. The question of localization of construction during the decade is also suggested by this summary.

[2] 1930 was the start of the census of business, which collected trade information. This census was suspended during WWII, and was resumed in 1948. Today, the census of business is known as the Economic Census, which is completed every five years. Starting in 1963 the census of transportation began as part of the Economic Census. It consists of "a set of surveys covering travel, transportation of commodities, and trucks" (US Bureau of the Census, n.d.). The data mostly cover transportation for freight purposes. The Census Statistical Abstract also contains transportation-related data, but they come from the Department of Transportation and APTA reports.

The ATA took up the cause of collecting transit operations data when the federal government stopped collecting it (Arthur Andersen & Company, 1973, i):

> Prior to 1971, the Accounting Committee of the American Transit Association had recognized an urgent need for comparative operating and financial data for the urban mass transit industry. The need for reliable, comparative financial and operating data was also recognized and expressed by researchers involved in industry analysis and planning activities.

This early report suggests that developing and maintaining a reliable repository of transit data would have value for practitioners and researchers alike.

2.1.3 *Development of the NTD*

Public and private interests in gaining access to reliable data can be traced back to an initiative known as the Uniform Financial Accounting and Reporting Elements (FARE) (Federal Transit Administration, 2013a). NTD documentation states, "both the private and public sectors have recognized the importance of timely and accurate data in assessing the continued progress of that nation's public transportation systems" (Federal Transit Administration, 2013a, 2).

FARE was a project of the Industry Control Board (ICB)—representing "mass transit systems, commuter rail operations, the ATA, the [Institute for Rapid Transit] IRT, the National Governors' Conference, the National League of Cities and the U.S. Conference of Mayors"—and the Urban Mass Transportation Administration (Arthur Andersen & Company, 1973, ii). The goal of the project "was to develop and test a reporting system which would accumulate transit industry financial and operating results by uniform categories…to be eventually implemented on an industry-wide basis" (Arthur Andersen & Company, 1973, ii).

In 1971, ATA and IRT "submitted a grant request to the Urban Mass Transportation Administration (UMTA) defining a proposed project to develop a uniform industry reporting system," which led to Project FARE (Arthur Andersen & Company, 1973, i). Arthur Andersen & Company, which produced the documentation about Project FARE for the UMTA, pointed out that ATA statistics were the primary source of transit data, but found two important issues with their data (Andersen & Co, 1973, 1-4):

> The ATA reporting system provides for voluntary submission of reports by all transit systems in the United States and Canada, and only 10-15% of the systems file reports. Further, the ATA system does not use a standard definition of reporting categories applied uniformly by all reporting entities.

They went on to describe the varied reporting systems and charts of accounts used by transit agencies and other industry organizations. They claimed that such variation means that some agencies cannot be compared or consolidated into aggregate statistics. Although much of the Project FARE documentation is focused on financial reporting, collecting operations data was an important goal of the project.[3]

[3] There are five information categories that Project FARE was designed to cover (Arthur Andersen & Company, 1973, 2-5): (a) "Resources used in producing transit services—physical measures and cost. (b) Transit Services offered—physical measures. (c) Transit services consumed—physical measures and revenues. (d) Social effects of transit system operation—physical measures and cost. (e) Financial condition of the transit system."

In developing Project FARE, researchers surveyed representatives of the transit industry "to provide a general impression of industry reporting capabilities" and performed field studies for more in-depth information (Arthur Andersen & Company, 1973, 2-7). Once they had developed an instrument, the researchers tested it on 23 transit agencies to validate the system. Following the validation process, they found that most transit agencies were not set up to report their data in the format proposed by FARE, but that many agencies expressed support for establishing a framework like that of the FARE guidelines (Arthur Andersen & Company, 1973, 5-1). But to accomplish such a framework would "require a long-range, coordinated program at the national level" and it should be "designed to effectively satisfy transit industry information requirements for operating transit entities and government agencies, as well" (Arthur Andersen & Company, 1973, 5-2).

One year later, in 1974, the Urban Mass Transit Act was amended to require the use of a Uniform System of Accounts (USOA) and reporting system. Also, the U.S. Department of Transportation performed two "National Transportation Studies" — one in 1972 and another in 1974 — in order to assess the state of public transportation systems (Weiner, 1992, 112-113):

> The National Transportation Study process introduced the concept of tying state and urban transportation planning into national transportation planning and policy formulation … Although these concepts were not new, the National Transportation Studies marked the first time that they had been incorporated into such a vast planning effort.

The NTD required that all agencies receiving federal funding report their data in 1978 (National Transit Database, 2013a), at a time when the federal government began investing more heavily in transit programs.[4] The NTD allowed for the federal government to audit the use of this federal aid (C. White, Interview, 27 September 2013).

2.1.4 *Uses of NTD*

Since 1978, the NTD has become the primary repository for all public transit data in the United States. The data being collected and the methodologies have changed somewhat as the technology and transit systems evolved, but much of the data have remained as originally designed, allowing for comparisons over time for better understanding how the industry has changed over the past decades. Transit agencies have access to data from their peer organizations, which allows them to compare their own progress to other agencies.

Transit agencies are not the only users of NTD data. Researchers and policy analysts regularly use NTD datasets, which are readily available online. ATA's successor, the American Public Transportation Association (APTA), continues to publish annual Fact Books and now uses primarily NTD data, supplemented by other data from their member organizations. Taking advantage of the data that has been collected since the beginning of the 20th Century, they include an appendix of historical tables where "many data items are reported for every year beginning in the 1920s and ridership is reported from 1907" (American Public Transportation Association, 2013b, 4).

[4] The Urban Mass Transit Act (UMTA) of 1964 provided $375 million in transit capital assistance. AMTRAK, the first federally subsidized intercity passenger railroad was created in 1971 (National Transit Database, 2013a). The 1974 National Mass Transit Act was the first time that federal funds were authorized for operating assistance—before this time they were only used for capital investments (Weiner, 1992). 1976 was the first "two billion dollar year for federal transit assistance. (National Transit Database, 2013a)

The federal government also uses NTD data to better understand the condition of the system, as well as to allocate federal transit dollars. Until the 1980s, federal formula funds for transit were allocated based on population and population density of the urbanized area of a transit agency (Weiner, 1992). The 1982 Surface Transportation Assistance Act modified the formula that would be used for transit grants: "…the funds were to be apportioned by several formulas using such factors as population, density, vehicle miles, and route miles (Weiner, 1992, 182).[5] Early NTD data were used in this formula (National Transit Database, 2013a). The apportionment formula today is largely the same, although it is now split up into bus and fixed guideway tiers. This was an important change for two reasons. First, it meant that funds were more responsive to the amount of service provided. Second, it required more rigorous oversight of the data: "they were giving money out on it, so [they had] to figure out a way to audit it and put a system into effect" (C. White, Interview, 27 September 2013). Over time, the oversight provided through the NTD system of data collection has evolved to ensure that the data is adequate for decision-making.

2.1.5 *NTD Reporting Requirements*

Because federal funding is tied to NTD, reporting is required for any "transit provider, state, or Metropolitan Planning Organization (MPO) that receives Urbanized Area Formula Program grants, or that directly benefits from these grants" (Federal Transit Administration 2013a, 6).[6] Any operator that does not receive federal grants is not required to report, but is encouraged to do so (Federal Transit Administration, 2013a, 7):

> FTA encourages all providers of transit service in urbanized areas to report to the NTD, regardless of whether they are public or private, and regardless of whether or not they receive or benefit from §5307 grants. To be accepted as a voluntary reporter in the NTD, you must be a provider of transit services in at least one urbanized area (UZA), and be able to comply with all of the NTD reporting requirements and the Uniform System of Accounts (USOA).

NTD uses a specific procedure for reporting data, and provides detailed user manuals for both monthly and annual reporting (Federal Transit Administration, 2013b and 2013a, respectively). These manuals define what transit operators should be documenting and how to submit reports.[7] All reporting is done through online forms, which were recently overhauled to be more responsive to user needs than the older system (C. White, Interview, 27 September 2013). FTA provides detailed definitions and reporting instructions to make reporting the data as simple as possible for transit agencies. The online system

[5] For urbanized areas with population above 200,000, the formula was as follows: 50% based on "total bus revenue vehicle miles operated," 25% based on population, and 25% based on population density (USC, 96 Stat. 2142).
[6] 49 USC 5307 is the Urbanized Area Formula Program, which provides federal funding for "transit capital and operating assistance in urbanized areas and for transportation related planning." Small transit operators—those operating 30 vehicles or less—may be awarded a reporting waiver, which results in reduced reporting requirements. Rural agencies that receive §5311 (Other than Urbanized Area Formula Program) grants also report less detailed data than urban agencies. Providers of "purchased transportation" are not required to report, because the purchasers of their services have to report their service (Federal Transit Administration, 2013a).
[7] The reporting system is made up of six modules: basic information, financial, asset, service, resource, and federal funding allocation statistics. Some of the major data points are sources of funds; operating and capital expenses; number of vehicles—broken down by mode and type of service; ridership and passenger miles; station information; service miles and hours; service supplied and consumed; employee information; and accident and crime statistics (Federal Transit Administration, 2013a and C. White, Interview, 27 September 2013).

takes advantage of user accounts that store much of the basic information so that agencies do not have to complete sections that have not changed in subsequent years.

Auditors monitor NTD reports for the FTA. Financial records are audited much like any other set of records, but there is also some monitoring of non-financial data. For the most part, the auditors assigned to a transit agency look at the procedures that the agency follows to collect the data, as opposed to auditing the individual data items (C. White, Interview, 27 September 2013). In addition to the checks for consistency and reasonableness used by the analysts employed by the FTA, transit agencies that operate more than 100 vehicles across all modes are required to have an independent audit agency review their procedures for collecting and compiling non-financial data.

The NTD reporting system itself is equipped with several checks and balances. Because transit agencies report monthly and annually, the system is able to identify anomalies in the data. If a transit agency reports a significant change in any of the reported data, the system flags the data item and the transit agency is required to review the data and provide an explanation for the change. This system of checks and balances can be quite rigorous at time, as explained by one transit agency representative (C. White, Interview, 27 September 2013):

> Every year when we submit the NTD report, there's a series of automatic checks that happen and we have to explain if anything changes a great deal or if anything is outside of a range that they have set. It gets really silly sometimes. A couple years ago we had to tell them why our gas prices went up—why we were spending more than 10% more on fuel than we were the year before. It was silly, but we put in an explanation that gas prices went up and it was fine.

In this example, the anomaly was easily explained, but this mechanism can also identify reporting or collection errors, and helps ensure that the NTD data is complete and accurate.

While most agencies are required to report to the NTD, the FTA expects different levels of precision and rigor from various agencies. Agencies are currently divided into tiers for reporting based on the population of the urbanized area and size of the transit agency—larger agencies in larger cities report more detailed data and are under more strict scrutiny by auditors (C. White, Interview, 27 September 2013):

> The only real difference moving into the highest tier…is that the auditors have to review procedures. Over 1,000,000 [urbanized area population] they have to do sampling every year as well. The feds have tried to vary the amount of effort with the importance of the data—for big agencies, they are more interested in making sure the data is accurate.

Finally, transit agencies are required to report data by mode – local bus, commuter rail, demand response, and so forth – a level of detail that readily supports evaluating accessibility measures by various transit modes.

2.1.6 *Achievements and Challenges of the NTD*

The NTD contains data on hundreds of transit agencies over more than three decades. While some of the data items and definitions have changed—primarily in the first few years of implementation—the data are generally comparable over time. Since the definitions were developed in collaboration with

industry experts and research institutions like the TRB and AASHTO,[8] the data are widely considered to be useful to many users in a range of contexts.

NTD reporting requirements present a substantial amount of work for transit agencies. Even though many data items would be collected by transit agencies regardless of the NTD reporting requirements, some data elements would not be collected if not for the NTD. And some data elements require a level of rigor that many transit agencies would not pursue if not for the NTD (C. White, Interview, 27 September 2013):

> Ridership by fare category is very important. Ridership by routes is important, ridership by location is important, but the passenger mile part is not nearly as important … so that's a piece of data that transit wouldn't be collecting—or at least not very rigorously—that we have to pay attention to and be very rigorous about.

The incentive to continue receiving federal funding—upon which transit agencies are heavily reliant—is what drives agencies to report and provide accurate information to NTD. When describing the process of collecting passenger-mile data, Chris White (Interview, 27 September 2013) explained:

> The ability of the feds to tell transit agencies to report in a standardized fashion is based on money. If we don't comply with NTD we don't get funded—there's no question there. But the push from those organizations to clean up the data is a factor. I think there's an interest in the industry to see reporting done consistently.

The burden placed on transit agencies results in benefits that go beyond improving performance in practice. The data are useful for other purposes, and especially for carrying out research. AASHTO and TRB, organizations that pushed for the inclusion of service-related information from the beginning, promote the collection of NTD data for making comparisons and testing research ideas (C. White, Interview, 27 September 2013):

> TRB's interest is in research—making data available that can be used by universities and other researchers … It's a really nice feature to see not only academic research on transit issues, but you also see political research on transit issues. It's something to know that they are using a common definition.

NTD data are intended to be accessible for research purposes such as monitoring performance across peer transit agencies.[9] NTD data are available through a number of sources. A lag time of a year or two is common before the data are publicly available, in part because agencies sometimes follow a reporting schedule based on their own fiscal year, and also because it takes time to compile and prepare data for public use (C. White, Interview, 27 September 2013). The NTD website has databases from 1997-2011 available for download (National Transit Database, 2013b). APTA publishes an annual Fact Book that

[8] Project FARE, which NTD evolved out of, involved testing of different data items to report. Through this process, they received feedback from transit agencies and industry experts about what items and definitions were and were not successful.

[9] A recent report by the Transit Cooperative Research Program developed a methodology for peer comparison among transit agencies to assist researchers interested in monitoring performance (Transit Cooperative Research Program, 2010).

relies heavily on the NTD, as well as drawing on other data sources. To illustrate the lag time, the 2013 APTA Fact Book is based on 2011 data (American Public Transportation Association, 2013a).

Agencies and researchers in some cases may be able to access more recent data from transit agencies directly. In the recent past, each agency had a viewer password for the NTD website that they can provide to others at their discretion if they want to share their data for research purposes. Outside users with this password could access but not change the data. This was not a widely known feature—some transit agencies were not aware that they have such a password, let alone that they can share it with others (C. White, Interview, 27 September 2013).

Research and peer-comparison is now much more readily available through the Florida Transit Information System (FTIS), a freely available, online software tool that provides access to the full National Transit Database. Users can quickly identify a group of potential peer transit agencies, retrieve standardized performance data for them, and perform a variety of comparisons (Transit Cooperative Research Program 2010).

2.1.7 *Conclusion: NTD as Model of Effective Data Standardization*

The NTD offers an example of an effective centralized database that uses standardized data definitions. Because of a federal mandate that requires most transit agencies in the country to report information as a condition for receiving federal funding, the data are considered to be reasonably comprehensive and reliable. Transportation research organizations like APTA and TRB have been influential in standardizing and improving the types of non-financial data that are collected, helping to ensure that the database is useful for monitoring the performance of service provision among transit agencies as well as for advancing broader knowledge through research.

2.2 Highway Performance Monitoring System

The Highway Performance Monitoring System (HPMS) is a reporting system used by the Federal Highway Administration (FHWA) and Congress to better understand the state of national roadways. The data, reported by state departments of transportation (DOTs) annually, inform federal decision makers and forms the basis for decisions about transportation policies and the allocation of federal highway dollars. The HPMS represents the official federal government source of data on the extent, condition, performance, use, and operating characteristics of the nation's highways. Developed in 1978 as a national database on highway performance, it includes data items such as lane-miles and traffic counts from statistically drawn samples of over 100,000 highway sections, as well as projections of future travel growth on a section-by-section basis. The HPMS contains data on travel and road conditions that are collected from state Departments of Transportation (DOTs). The mandate of the HPMS is not as specific as the NTD, but it is a common source to inform policy. An important drawback of the HPMS, however, is that most of the data are reported at a highly aggregate level of the state, presenting a serious shortcoming for carrying out planning or policy at a local or regional scale. It also continues to measure highway travel only in terms of vehicle movement, not in terms of person movement, a characteristic that perpetuates the unfortunate but common misunderstanding that the purpose of transportation infrastructure is to serve vehicles rather than people. Despite its lack of relevance for local and regional planning applications, the HPMS was studied here to gain insights into implementing data standardization.

2.2.1 *History of the Highway Performance Monitoring System*

The HPMS responds to a number of federal requirements:

- 23 USC 502(h) requires biennial reports to Congress on the condition of the nation's highways.
- 23 CFR 315 places the responsibility on the Secretary of Transportation for all management decisions affecting transportation.
- 23 CFR 1.5 provides the Federal Highway Administrator with authority to request any information they deem necessary to advance federal highway agenda.
- 23 CFR 420.105(b), which requires state DOTs to "provide data that support the FHWA's responsibilities to the Congress and to the public."

Prior to 1978, states would report highway condition information, in response to 23 USC 502(h), but these reports were often uncoordinated. HPMS was developed in 1978 to "replace numerous uncoordinated annual state data reports as well as biennial special studies conducted by each state" with a more standardized reporting system (Office of Highway Policy Information, 2008, 7). While the general objectives of HPMS have remained the same over time, "HPMS has gone through an evolutionary process that has recognized over time the changing needs for data" (Office of Highway Policy Information, 2008, 7). Over time, some of the data items have changed in response to stakeholder needs, and the FHWA has worked to make the reporting process more user-friendly. According to one Michigan DOT transportation planner, "they have made vast improvements to HPMS in the past couple of years" (K. Faussett, Interview, 4 October 2013).

HPMS forms the basis for the biennial Conditions and Performance reports to Congress, which "support development and evaluation of the [FHWA's] legislative, program, and budget options" (Office of Highway Policy Information, 2003). It also forms the basis for "the annual Highway Statistics publication and…other FHWA publications" (Office of Highway Policy Information, 2013, 1-2). While HPMS data may help inform budget decisions, "there is really not a direct connection between HPMS and funding allocations" (D. Cameron, Interview, 4 October 2013).

2.2.2 *Reporting Requirements*

Each state DOT is responsible for compiling and reporting HPMS data. They may use their State Planning and Research Funds (23 CFR 420) to reduce the financial burden of the reporting process (D. Cameron, Interview, 4 October 2013). Maintaining HPMS data is considered "an item of national significance and … must be adequately addressed in each State's annual work program. This extends beyond the simple reporting of data each year and includes taking actions to ensure that all data are complete, current, and accurate" (Office of Highway Policy Information, 2013, 1-7). While most State DOTs have staff devoted to data collection, including HPMS data, they are also encouraged to work with local governments and metropolitan planning organizations (MPOs) to collect more detailed data and reduce the burden on the state agency. FHWA audits some HPMS data, but ultimately, the state DOTs are responsible for ensuring "accuracy and timely reporting of HPMS data" (Office of Highway Policy Information, 2013, 1-7).

Data sets for HPMS include (Office of Highway Policy Information, 2013, 1-2):

- "Full Extent data items" (length, lane-miles, and travel) are collected for "all public roads that are eligible for Federal-aid highway funds."

- "Sample Panel items" are more detailed data collected on randomly selected roadways.

- "Summary data" are aggregated data "for roadways functionally classified as minor collectors in rural areas and local roads in any area."

The Full Extent and Sample Panel data include data items that address road inventory, route information, traffic, geometry, and pavement. Summary data are broken down into five different datasets: statewide summaries, vehicle summaries, urban summaries, county summaries, and National Ambient Air Quality Standards (NAAQS) summaries (Office of Highway Policy Information, 2013). HPMS datasets have a geospatial component, which allows all of the data to be represented spatially.

By June 1, each state DOT must submit a Certification of Public Road Miles, which indicates the total number of miles of public roadway in the state, including but also identifying the number of road miles on Indian reservations (23 CFR 460.3). These certified miles are used in vehicle miles traveled (VMT) counts for the state. By June 15, each state DOT must report HPMS data via an online portal. HPMS data "can either be submitted to FHWA as character separated value (CSV) files or entered manually on-screen via the HPMS software web application provided by FHWA" (Office of Highway Policy Information, 2013, 3-3).

The FHWA provides a field guide for state DOTs (Office of Highway Policy Information, 2013) to use when reporting transportation data. The manual contains detailed descriptions of the various data that are required for HPMS, including tables to demonstrate what tables might look like for submission. This manual illustrates how complex the reporting system is, as well as how many opportunities there are for data collection and reporting to vary from one agency to the next.

2.2.3 *Achievements and Challenges of HPMS*

Congress and the FHWA are the primary users of HPMS data, but the data are also available to a number of other entities for various purposes (Office of Highway Policy Information, 2013 1-2):

> HPMS data are widely used throughout the transportation community, including other governmental entities, business and industry, institutions of higher learning … and the general public. The HPMS data may also be used for performance measurement purposes in national, state and local transportation decision-making to analyze trade-offs among the different modes of transportation as part of the metropolitan and statewide transportation planning process.

Despite these stated aspirations, this study's investigation through interviews with transportation planners in both the public and private sectors, and through our own tests of data portals, suggests that the HPMS is not commonly used for planning purposes, in part because the data are difficult to access and use. Planners consistently explained that HPMS data are rarely used for their planning processes, and the data we were able to access were not found to be comprehensive or user friendly.

In the public sector, several interviewees suggested a sense among planners that the HPMS is not often useful for most state or local planning, and they perceived it principally to be a requirement from the federal level that others use for congressional decision-making. Several representatives of the private sector expressed indifference toward the data, including consultants who develop travel demand

models for MPOs and state DOTs. Three of these consultants spoke briefly about HPMS, but each indicated that, if they used HPMS at all, it did not play a major role. The travel demand models they develop use VMT and traffic information, but not commonly from the HPMS.

In the public sector, some agencies use HPMS data to supplement locally collected data. A transportation planner for the Michigan Department of Transportation has used it for two applications (K. Faussett, Interview, 4 October 2013):

> One was for air quality because you have to use HPMS VMT to normalize the model. Way back when I worked at SEMCOG we used HPMS VMT to see how the model was doing. That was essentially because we didn't have enough counts.

Pollution monitoring and modeling for air quality purposes is one area where HPMS data seems to be a particularly valuable resource. According to 40 CFR 93.122, which addresses "procedures for addressing regional transportation-related emissions," HPMS "shall be considered the primary measure of VMT" estimates for non-attainment or maintenance areas for NAAQS (40 CFR 93.122(b)(3)). A representative of the FHWA explained that the reasoning behind this is that some non-attainment air sheds do not follow urban area or municipality lines, so states and MPOs "can use HPMS VMT for the areas that are outside the geographic area that is modeled" (D. Cameron, Interview, 4 October 2013).

A commonly cited concern that explains in part why HPMS date are not widely used for local decision-making is that the data are collected too sparsely and are not reliable for needs at the local level. As one planner explained, "what we get [from municipal and state data sources] are observations of particular locations within the network, but HPMS is building an estimate for the entire region. People often forget that HPMS is an estimate" (R. Picado, Interview, 2 August 2013). For HPMS, public traffic counts are generally collected using electronic traffic monitors placed at intersections over a period of about 48 hours. No specific mandate exists for conducting these counts, but HPMS requires a minimum of 48-hour counts every three years for each roadway segment (Office of Highway Policy Information, 2013, 5-14). Estimation factors are used to apply these counts over time, while accounting for seasonal changes as well estimating data points in years where counts were not collected. Aside from the sparse geography of the data, consultants also expressed concerns about a lack of quality and inconsistency in the way HPMS data are reported (R. Picado, Interview, 2 August 2013; R. Milam, Interview, 8 August 2013).

Our own investigation of the data available from the FHWA support the claims made by these planners. Highway mileage and VMT data are aggregated to the national, state, and urbanized area level. Most data can be downloaded as PDF or Excel files, and each type of data and level of aggregation are in separate tables, making for difficult database manipulation. To illustrate the highly aggregate nature of these data, tables that compare mileage and VMT from 1980 are available at the level of the nation, but not at the level of the state or urbanized area. These types of tables are useful for broad comparisons, but are unlikely to be useful for the kind of planning or decision-making that is most commonly carried out at the metropolitan or smaller scale. Furthermore, the FHWA provides geo-spatial data for roadways, but these files do not contain travel information—they simply contain characteristic data for the roadways in the United States. [10]

[10] Roadway statistics tables: < http://www.fhwa.dot.gov/policyinformation/quickfinddata/qfroad.cfm >. Geospatial highway data can be accessed: < http://www.fhwa.dot.gov/policyinformation/hpms/shapefiles.cfm >.

The FHWA has developed a tool that they refer to as an Analytical Process that can be used by various levels of government to "assess the physical condition, safety, service, and efficiency of operation of their respective highway systems" (Office of Highway Policy Information, n.d.a). According to the FHWA, some state agencies use these models in their planning processes, and their website offers some examples (Office of Highway Policy Information, n.d.a). In many of these examples, however, the HPMS data are used not as a principal source of data but rather as a complement to other data, and the HPMS data tends to be limited to financial or road condition data rather than travel-related data.

2.2.4 *Conclusion: HPMS Not a Model of Effective Data Standardization*

Like the NTD, the HPMS is a centralized database of transportation data supported by federal legislation. Unlike the NTD, however, where data are available in a number of forms and is used by multiple levels of government, transit agencies, research institutions, and the public, local planners and decision-makers do not see HPMS as an important tool for collecting standardized transportation data. Consultants typically require more detailed data than the HPMS provides, so they use data collected by the cities and MPOs, rather than using HPMS (R. Picado, Interview, 2 August 2013). The HPMS is aimed at meeting more specific federal purposes than the NTD, and a principal shortcoming of the HPMS data is the course level of aggregation, making it of little use for local decision-making and peer comparisons.

It may be that attaching funding to HPMS would make it possible to collect more specific, localized data. As Rosella Picado pointed out, "with transit data, much of what has improved transit system data has been FTA pushing for it as part of their New Starts program. There doesn't seem to be any equivalent in FHWA" (R. Picado, Interview, 2 August 2013). On the other hand, tying funding to this type of data may also cause some issues with the data:

> If your formula is tied a certain way, like you get more money if you have really highly utilized arterials, or if you have more lane miles of arterials, people will code lots of collectors as arterials. There are not enough resources for people to go back and check that. (R. Milam, Interview, 8 August 2013)

HPMS is an important national database that helps states and the federal government understand and monitor the condition of the nation's roadways. But since data are collected at a highly aggregate level, it is not conducive to use as a basis for travel demand modeling at the local scale and does not appear to provide appropriate lessons for the collection of standardized data for accessibility modeling.

3 Potential Inputs to Accessibility Analysis: The Range of Current Practice

No standardized metrics are currently available to assist decision makers about progress on accessibility. Metropolitan planning organizations (MPOs), as part of their federally mandated modeling requirements, routinely generate data that might readily be used in accessibility metrics. But after collecting these data from over 50 MPOs in a previous project, we discovered that practitioners are using widely divergent software programs, data formats, and definitions of variables when producing the data required for computing accessibility metrics (Grengs, et al. 2010; Levine et al. 2011; Levine et al. 2012). This inconsistency hinders meaningful comparison among places. Furthermore, public agencies normally do not archive such data, undermining the ability to assess progress on accessibility over time. Although the required inputs into accessibility metrics are developed currently by

metropolitan planning organizations (MPOs) as part of the travel demand modeling process, without standardization or guidelines, these data are difficult to compare over space or time.

This section of the report assesses which data are currently collected with the aim of identifying the methods used for defining, collecting, storing, and publishing data. It provides an overview of the range of current practice with an evaluation of the characteristics and methods most appropriate for accessibility indicators.

3.1 Metropolitan Planning Organizations: Mandates for Data Collection

With the passage of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), along with the associated subsequent amendments, Congress established that "metropolitan transportation planning would best be conducted on regional bases, with states and local governments being active partners in the planning process" (Goetz, Dempsey, & Larson, 2002, 87-88). Since MPOs have shifted away from principally playing an advisory role to producing plans and overseeing project implementation, they have incrementally become subject to increasing mandates and expectations from state and local governments. This section will provide an overview of the mandates that MPOs face and assess how likely they might be capable of adopting any new data standardization proposals.

MPOs are subject to varying degrees of mandates and expectations from other levels of government. The clearest reference to MPOs is their definition in federal legislation: "a metropolitan planning organization shall be designated for each urbanized area with a population of more than 50,000 individuals" (49 USC 5303(1)). These organizations are required to include units of local government, and to act in accordance with state and local laws. Under the language of the law, MPOs are also encouraged to collaborate as much as possible with state and local governments, other MPOs, and public transit providers.

This same section of the US Code (49 USC 5303), which delineates all the requirements for MPOs, explains that MPOs are required to develop a long-range transportation plan (LRTP) based on a 20-year forecast period.[11] One of the primary requirements for the LRTP is that it includes "the projected transportation demand of persons and goods in the metropolitan planning area over the period of the transportation plan" (23 CFR 450.322(f)(1)). The plan is to be updated or replaced at least every five years—or four years for MPOs that are non-attainment or maintenance areas under the Clean Air Act (49 USC 5303(i)(1)(B)). MPOs are also required to prepare and update a transportation improvement plan (TIP) every four years (49 USC 5303(j)). MPOs that represent a transportation management area (TMA)—an urbanized area with a population of 200,000 or more—are subject to additional requirements, including conducting a congestion management process and an MPO certification review process.

3.1.1 *MPO Certification Process*

The U.S. Department of Transportation has a process for certifying MPOs that represent transportation management areas (TMAs), which are urbanized areas with populations over 200,000. This process "ensures that the planning requirements of 23 USC 134 and 49 USC 5303 are being satisfactorily implemented. In a broader sense, the certification review process is a valuable opportunity to provide

[11] In the Code of Federal Regulations (CFR), the LRTP is referred to as a metropolitan transportation plan (MTP) and is described in 23 CFR 450.322.

advice and guidance to a Transportation Management Area" (Transportation Planning Capacity Building Program, n.d.).

The certification review process takes place once every four years for all MPOs representing a TMA (23 USC 134(k)(5)(ii)). The goal of the review is to objectively assess the planning process in each TMA. The certification process covers many areas related to transportation planning, and requires input from MPOs, state DOTs, transit operators, as well as any other partner organizations that work with the MPO. The review process assesses compliance with federal regulations as well as technical and administrative elements of the planning process.[12] The scope is wide, so the depth of the review in any one element may be in a summary form: it is "not necessary to cover all possible topics to same extent or in same manner" (Transportation Planning Capacity Building Program, n.d., 1-1).

Representatives from both the FHWA and FTA conduct certification reviews (A. Pickard, Interview, 4 October 2013):

> Each state has an FHWA division, usually located in the state capital. FTA is structured a little differently, so our partners there are in Chicago. We run the review meetings and write the report with FTA, and develop findings and report back to the MPO and the state DOT.

On the FHWA side, the focus of the analysis and interviews of this report, state FHWA division office staff members are assigned to an MPO in the state. In Michigan, for example, the certification team consists of three representatives. With 14 MPOs in the state, each member of the team is assigned to four or five MPOs. As much as possible, these representatives attend regular meetings of their assigned MPOs and stay abreast of what is going on at that MPO. In this way, when the certification review begins in a cycle, the representatives get underway already having substantial information and connections for the review (A. Pickard and D. Cameron, Interview, 4 October 2013). The FTA, on the other hand, has regional offices instead of state offices, so their staff representatives are typically apportioned more widespread across the regions and may not be as well connected with MPO staff and procedures as their FHWA counterparts.

The review focuses primarily on "process and procedure" as opposed to data collection (D. Cameron, Interview, 4 October 2013). For example, the U.S. DOT Transportation Planning Capacity Building Program's *Transportation Management Area Planning Certification Review Primer*[13] includes the Congestion Management Process (CMP) as a review topic, and one of the requirements for CMP is that there be "data collection and system performance monitoring," but the documentation does not give any indication of what this means (Transportation Planning Capacity Building Program, n.d., 2-13). Representatives of the FHWA supported this assertion. For example, "very little data is actually mandated" (E. Christopher, personal communication, 1 October 2013) and "there are not a lot of hard and fast requirements for data" (A. Pickard, Interview, 4 October 2013).

What is more clearly defined in the documentation is the need for a modeling procedure—particularly for non-attainment areas under National Ambient Air Quality Standards (NAAQS)—in the Metropolitan Transportation Plan (MTP) development process, which is a requirement for MPOs. 23 USC 134(i)

[12] U.S. DOT's primer on the certification review process identifies 22 certification topics—neither travel demand modeling nor data are included in this list.

[13] This Primer does not "set a standard, establish a policy, or promulgate a regulation for TMA planning processes"—rather, it "provides a basic understanding of the key concepts and expectations addressed through a review" (Transportation Planning Capacity Building Program, n.d.).

requires that the MTP be based on at least a 20-year forecast period, which implies the need for a model. The type of model and the inputs to that model, though, are not mandated. Modeling techniques like the four-step model have evolved over time to become "commonly accepted practice" (E. Christopher, Email, 1 October 2013): "At this point, the four-step model has been around for 50 years or so. It's well engrained in MPOs … it's pretty much a given that they'll at least be using that to predict" (A. Pickard, Interview, 4 October 2013).

In reviewing the travel forecasting methods, the Certification Review Team should consider the technical capabilities of the agency or consultant conducting the forecast, as well as documentation of the assumptions and methods used (Transportation Planning Capacity Building Program, n.d., 3-2). However, no guidance is provided about particular methods that ought to be used. The lack of specific guidance is consistent with the general principle that local and regional experts should have the flexibility to design methods that are most suitable to the particular context in which an agency works.

The regulations are most specific for NAAQS non-attainment and maintenance areas. 40 CFR 93.122 contains the EPA Air Quality Conformity Rule. MPOs with jurisdiction over non-attainment and/or maintenance areas are required to monitor and plan for travel more closely than those that do not. The rule explains that those MPOs should use "network-based travel models (40 CFR 93.122(b)(1)(i)) and use of HPMS VMT counts in the model (40 CFR 93.122(b)(3)). The latter requirement is for those areas that do not have more accurate counts:

> The reference to HPMS is for cases where there's an air quality area that's urbanized, and there's a model for that, but if the total air shed group is larger, they can use HPMS VMT for the areas that are outside the geographic area that's modeled. I think we have some examples of that in areas like Grand Rapids, Muskegon, Holland—each has a separate model for their urban area, but there are some rural places in between, and those rural places can use the HPMS VMT, and someone has to merge it all together and come up with the final total number. So if you have a model, use the model. If you don't have a model, use HPMS. (D. Cameron, Interview, 4 October 2013)

MPOs hold considerable freedom to determine which procedures are most suitable for their particular planning needs, and in consideration for the resources at their disposal, as long as their decisions are based on sound practices. The MPO certification review process is long, and seems to be generally considered better served with a focus on procedures than particular types of inputs and data: "For the certification process, a better use of our time is to talk in more general terms—are you just making this up or how are you going about this, in a more general sense?" (A. Pickard, Interview, 4 October 2013). As long as the results of an MPO's model seem reasonable and the procedures they have in place are documented, the certification review process appears to avoid inquiring into such specifics as data quality: "if they're predicting wild growth that we know just isn't going to happen, then we might step back and look at their predictive processes, what data they're using" (D. Cameron, Interview, 4 October 2013).

The FHWA offers MPOs the opportunity to go through a Travel Model Improvement Program (TMIP) review, which amounts to a peer review of the MPO's model. The TMIP provides experts to examine an MPO's model and data inputs, and give advice about how to improve the process. The TMIP is not a required part of the MPO certification, but it is a resource that the FHWA provides for MPOs.

3.1.2 *Consequences of MPO Certification*

The goal of reviewing an MPO for certification is to ensure that the planning process is following federal law, and a review typically examines several specific steps and products.[14] Examples include failing to providing a discussion of a region's planning goals or failing to provide a disclaimer of the federal government in the documents. In such cases, an MPO might receive a corrective action from the review, identifying specific products or actions that must be addressed with deadlines. Two notable consequences of failing to achieve certification are clear. The first clearly articulated consequence is that failing to meet the requirements of MPO certification can lead to the withholding of federal funding (23 CFR 450.334(b)(2)):

> If, upon the review and evaluation conducted under paragraph (b)(1)(iii) of this section, the FHWA and the FTA do not certify the transportation planning process in a TMA, the Secretary may withhold up to 20 percent of the funds attributable to the metropolitan planning area of the MPO for projects funded under title 23, U.S.C., and title 49, U.S.C., Chapter 53, in addition to corrective actions and funding restrictions. The withheld funds shall be restored to the MPO when the metropolitan transportation planning process is certified by the FHWA and FTA, unless the funds have lapsed.

A second consequence is that an MPO's transportation improvement program (TIP) might be delayed, resulting in an inability to advance new projects, and in particular the kinds of projects with wide political support like those that add capacity might be delayed (D. Cameron, Interview, 4 October 2013).

While these are possibly serious consequences, many officials view an inability to achieve certification approval as something that comes only as a last resort, and that much of the value in conducting such a review is in the feedback that comes with outside review (D. Cameron, Interview, 4 October 2013):

> Our certification process is not intended to be "I gotcha," it's intended to figure out how we can help MPOs improve their process. If there's something going on and they aren't up to par, we try to work with them. Most of the things in the certification review are recommendation. Occasionally we will have a corrective action.

The MPO certification review process appears to be aimed principally at helping MPOs follow basic procedures and to provide outside expert input into whether their plans are reasonable, that the procedures are justified, and ultimately whether the funds they receive are being efficiently spent. The emphasis seems to be mainly on providing advice and guidance, with less emphasis on regulating or otherwise compelling particular kinds of actions or procedures.

3.1.3 *MPO Certification: A Mechanism to Encourage Data Standardization?*

Standardized reporting of data would assist the widespread use of accessibility metrics in transportation planning practice. MPOs are a plausible source for such standardizations of data. For example, MPOs might provide consistently defined outputs of metropolitan travel models to a central collection agency, much like transit agencies are required to do for the National Transit Database. And because MPO Certification is already an ongoing institutional practice, mandated for all MPOs with populations larger

[14] Examples of certification review items pertaining to travel demand models, for instance, can be found at "Certification Checklist for Travel Forecasting Methods," at < http://www.fhwa.dot.gov/planning/certcheck.cfm>.

than 200,000, folding the review of standardized data elements into the review would help accomplish the goal of introducing standardized data into current workflows at local and regional levels.

However, practitioners expressed some uncertainty about whether data standardization could feasibly be added to the certification review process. Because the review process does not currently require MPOs to submit data for review, adding data review would require significant changes, and it is not clear where in the process such a review could readily be accomplished (X. Liu, Interview, 14 August 2013). Furthermore, the existing review process is already perceived as highly time-intensive, often taking months to review MPO documentation and formulate recommendations (A. Pickard, Interview, 4 October 2013). Adding a review of data into this lengthy process would add substantial time and staff resources, and would likely be met with resistance by MPOs and the FHWA alike.

3.1.4 *Travel Demand Modeling by MPOs*

Federal legislation requires that a Regional Transportation Plan be based on at least a 20-year forecast period for the MTP, so MPOs must be capable of estimating future travel demand over such a period (23 USC 134). While the procedures for developing such a model are not delineated in the law, many MPOs use a traditional four-step modeling process, which has been commonly used in one form or another for over 50 years.[15]

Legislation provides no mandate for developing new procedures. This allows for flexibility among MPOs to explore new techniques and innovations in modeling. Some MPOs are currently using or developing more sophisticated models, such as activity-based modeling. However, the lack of clear guidance also means that little oversight is provided of modeling techniques. Without established standards in place, assessing and monitoring models and data quality is more challenging.

While the federal government does not provide for specific requirements in modeling, it does offer volunteer guidance to MPOs in the form of programs like the Transportation Model Improvement Program (TMIP). The lack of specificity on the part of the federal government has also created an opportunity for researchers and consultants to develop standards and recommendations for travel demand modeling. For example, a National Cooperative Highway Research Program (NCHRP) report provides a useful summary and overview of various travel demand modeling approaches (National

[15] An example comes from the Southern California Association of Governments (SCAG), which uses the traditional four-step travel demand modeling approach. Travel demand modeling is considered integral to Regional Transportation Plans and Regional Transportation Improvement Plans, both of which are federally mandated planning documents. SCAG also refers to California State Senate Bill 375 as part of mandated efforts to reduce GHG emissions (LSA Associates, Inc., 2012, 1-2). SCAG employs a model called Simulator of Activities, Greenhouse Emissions, Networks, and Travel (SimAGENT), developed specifically for SCAG. One of the important aspects of this model is that it models greenhouse gas emissions, which are being targeted by California policies (Goulias et al., 2013, 3). The data used for SCAG models comes from a number of sources. Travel data primarily comes from a 2000 Household Travel Survey (LSA Associates, Inc., 2012, 3-3). Socioeconomic and other data comes from the Highway Network Inventory Program, Census/ACS, 2000 CTPP, InfoUSA, and land use and parcel databases. The model has been tested against actual trip data from HPMS, independent traffic counts, Freeway Performance Measurement System, etc. and has been found to be valid. Another example comes from the Atlanta Regional Commission (ARC) which, like SCAG, uses the traditional four-step modeling approach, but has also more recently supplemented this approach with an activity-based model. The ARC also cites transportation planning requirements (LRTP and TIP) as one of the primary mandates for travel demand modeling. For this region, though, the primary federal mandate is the EPA transportation conformity rule (40 CFR Parts 51 and 93), because many of the states in the Atlanta Region are NAAQS nonattainment areas (Atlanta Regional Commission, 2011, 4).

Cooperative Highway Research Program, 2012). The report describes sources of data and steps for the modeling process. MPOs have resources available to help improve travel demand modeling, in the form of reports like the NCHRP report and voluntary participation in the TMIP for peer evaluation.

MPOs and their consultants who prepare models place high value on having the flexibility to create models that fit local contexts. One consultant expressed a sense that modeling procedures need to be flexible and responsive to the needs of the MPO in this way (R. Milam, Interview, 8 August 2013):

> [When] you talk about most local planning, where most land use decisions occur, you need to make sure that the models are relevant to the scale, relevant to the type of questions being asked, and are sensitive to the context of the area.

But the high value placed on having the flexibility to be responsive to local needs does not necessarily mean that having some form of widely accepted common guidelines is also viewed as valuable, up to a point. One consultant suggests seeking a compromise that satisfies flexibility without undue rigidity of strict standards, while simultaneously offering some common guidelines (R. Picado, Interview, 2 August 2013):

> I think it's always helpful to have guidelines. We are often asked if we have a document of guidelines … In terms of guidelines that explain what people should do, that would be helpful. To move to the level of a standard is very hard—you can't really implement something like that. When I think of a standard, there is a process for making sure that people are meeting the standard … Certainly in terms of guidelines, that would be helpful and there has been some activity in that direction, from TRB to have, at least, accessible information about travel survey data and methods.

Such skepticism of strict standards imposed from above was common among the practitioners interviewed for this study, with many expressing interest at some level of standardization, but to proceed with some caution about going so far that it undermines the capacity to meet local needs by removing the flexibility that local officials need to craft methods and data that meet their particular contexts.

3.1.5 *EPA Requirements for Travel Demand Modeling*

One of the most direct federal mandates for travel demand modeling comes from the U.S. Environmental Protection Agency (EPA) Conformity Rule, which requires states with areas that do not meet the National Ambient Air Quality Standards (NAAQS) under the Clean Air Acts and Amendments (CAAA) to maintain a State Implementation Plan (SIP) and monitor emissions (40 CFR Parts 51 and 93). For severe nonattainment areas, the Conformity Rule mandates network-based travel demand modeling. In these areas, HPMS VMT estimates are to be used (National Cooperative Highway Research Program, 2012, A-2). Other than these conditions, engaging in a modeling exercise is not strictly required, but because accurate estimates of emissions typically require travel speeds and volumes, travel demand models normally form the basis for meeting EPA conformity. The requirements for determining regional transportation-related emissions are described in federal law in some detail (40 CFR 93.122):

> (1) By January 1, 1997, estimates of regional transportation-related emissions used to support conformity determinations must be made at a minimum using network-based travel models according to procedures and methods that are available and in practice and supported by

current and available documentation. These procedures, methods, and practices are available from DOT and will be updated periodically. Agencies must discuss these modeling procedures and practices through the interagency consultation process, as required by §93.105(c)(1)(i). Network-based travel models must at a minimum satisfy the following requirements:

> (i) Network-based travel models must be validated against observed counts (peak and off-peak, if possible) for a base year that is not more than 10 years prior to the date of the conformity determination. Model forecasts must be analyzed for reasonableness and compared to historical trends and other factors, and the results must be documented;
>
> (ii) Land use, population, employment, and other network-based travel model assumptions must be documented and based on the best available information;
>
> (iii) Scenarios of land development and use must be consistent with the future transportation system alternatives for which emissions are being estimated. The distribution of employment and residences for different transportation options must be reasonable;
>
> (iv) A capacity-sensitive assignment methodology must be used, and emissions estimates must be based on a methodology which differentiates between peak and off-peak link volumes and speeds and uses speeds based on final assigned volumes;
>
> (v) Zone-to-zone travel impedances used to distribute trips between origin and destination pairs must be in reasonable agreement with the travel times that are estimated from final assigned traffic volumes. Where use of transit currently is anticipated to be a significant factor in satisfying transportation demand, these times should also be used for modeling mode splits; and
>
> (vi) Network-based travel models must be reasonably sensitive to changes in the time(s), cost(s), and other factors affecting travel choices.

(2) Reasonable methods in accordance with good practice must be used to estimate traffic speeds and delays in a manner that is sensitive to the estimated volume of travel on each roadway segment represented in the network-based travel model.

3.1.6 *Federal Agency Requirements for Travel Demand Modeling*

MPOs are required by federal legislation to prepare long-range regional transportation plans and those plans must include “projected transportation demand of persons and goods in the metropolitan planning area over the period of the transportation plan” [23 CFR 450.322 (f)(1)]. The FHWA does not provide any specific requirements for carrying out travel demand modeling, but it does provide some technical assistance to MPOs has created a checklist for forecasting methods (National Cooperative Highway Research Program, 2012, A-3).

Like the FHWA, the FTA does not have specific travel demand modeling requirements, but does offer guidance to agencies seeking to do such modeling. This guidance imposes no standards but rather acknowledges that many approaches to modeling travel demand for transit are available and allows for a variety of methods in modeling (National Cooperative Highway Research Program, 2012, A-4).

4 A Proposed Framework for Standardizing the Inputs to Accessibility Metrics

Practitioners have expressed a desire for flexibility in the kinds of data they collect and report so that their work can best meet the needs of local conditions. National standards that impose strict limitations on data are viewed with some skepticism, yet the research and interviews here indicate that planners and modelers would welcome some level of guidance in the data they are responsible for collecting and maintaining. This section provides a proposed framework aimed at achieving consistency in commonly used data items from travel demand modeling that would also be beneficial for accessibility metrics.

The framework is built upon actual travel demand modeling data sets collected from 38 MPOs in 2007 and 2008 (Levine et al. 2011). A careful review of these data sets revealed a great deal of variation in the way that data elements are defined by MPOs. Even though inconsistencies in data definitions are widespread, they tend to represent fairly marginal differences from one agency to the next, suggesting that perhaps with slight modifications, a scheme might be designed that would not dramatically alter current practice for most MPOs even while allowing for consistency across agencies.

The framework divides travel demand modeling data into three main data types: Trip Type, Mode Choice Factors, and Mode. This section explains the proposed framework, and then discusses the results of interviews and focus groups with a range of practitioners who provided feedback on the proposed framework. The results indicate that most representatives of MPOs are interested in and open to the idea of moving toward some kind of a standardized data framework, in part because standardization would bring the benefits of allowing more peer-to-peer comparisons, along with substantially reduced efforts and updating the documentation of their data and models.

The comparison of current travel demand modeling data and the associated documentation across 38 MPOs was carried out with the aim of identifying elements that were consistent, inconsistent, and those with only slight variation. Nearly all the data were collected from similar underlying sources, such as household travel surveys, and economic and population data, yet the variables that ultimately were used in modeling by MPOs were typically defined and aggregated differently from one MPO to the next. The effect is that otherwise nearly identical data elements are rendered incomparable across MPOs.

4.1 Method of Devising the Framework

Table 1 below provides an illustration of the kinds of inconsistencies found across the data collected from MPOs. In this example, two MPOs collect data on trip types, in this case traveling from home to a range of destinations: work, grocery store, social visit (e.g., visiting a friend's home), and a park. For the case of trips from home to work, both MPO 1 and MPO 2 aggregate all trips into a category that define as "home-based work." In practice, nearly all MPOs aggregate work trips in this way, to a category typically called "home-based work," with a high level of consistency across agencies for work trips. Collecting data on work trips has long been a central element in travel demand modeling and finding consistency in this particular category is not surprising.

Although MPOs tend to show consistency in how trips are aggregated for the destination of work, other destinations typically show much more variation in the way they are aggregated into categories. For example, Table 1 shows that MPO 1 aggregates all trips to a grocery store into a category called "home-based shopping." By contrast, MPO 2 mixes all trips to grocery stores with trips for social visits, with both of these destinations aggregated into a single category of trips called "home-based

social/recreation." So in this example, grocery store trips are available at a more disaggregate level for MPO 1 than for MPO 2.

Continuing with the example of Table 1, MPO 1 combines trips for social visits and parks into a single category called "Home-based social/recreation," while MPO 2 places trips to parks into a category called "Home-based other." In this case, trips from home to parks are available at a more disaggregate level for MPO 2 than for MPO 1.

Table 1. Example of Inconsistencies in Definitions, Trip Type Categories, Two MPOs

<table>
<tr><th>Trip Destination (from home)</th><th>MPO 1</th><th>MPO 2</th></tr>
<tr><td>Work</td><td>Home-based work</td><td>Home-based work</td></tr>
<tr><td>Grocery Store</td><td>Home-based shopping</td><td rowspan="2">Home-based shopping/recreation</td></tr>
<tr><td>Social Visit</td><td rowspan="2">Home-based social/recreation</td></tr>
<tr><td>Park</td><td>Home-based other</td></tr>
</table>

The first step in developing a data framework for consistency across MPOs was to map out all the key data elements that were collected from 38 MPOs in a way that revealed inconsistencies like those illustrated in the table above.

The second step was to devise a nested, hierarchical arrangement of data elements. The goal of is this step is to categorize all data currently collected by MPOs in a mutually exclusive way. That is, any data collected by an MPO should ideally fit into one and only one category within the framework. The hierarchical arrangement of data elements proposed here was designed to eliminate (or at least in a few cases, minimize) common inconsistencies that we found across MPO definitions.

An example of how the data can be defined in a hierarchical arrangement is provided in Figure 1, which shows a three-level arrangement of several trip categories. The most aggregate level of data occurs at the top of the figure (with the boxes *Home-Based Work*, *Home-Based Shopping*, and so forth). Some, but not all, of the top-level categories offer more refined definitions, allowing for the possibility of disaggregating the data into the second or third level. Consider, for example, the case of *Home-Based Work* in the figure below. Nearly all MPOs define their data on trips from home to work at the most aggregate level, shown at the top. Some MPOs, particularly the largest ones, prefer to maintain more detail than offered by the first level, and they could choose to move to the more disaggregated level 2. At level 2, trips that proceed directly from home to work are assigned to the category *Direct* while trips with one or more stops occurring between home and work are assigned to *Strategic*. The trips in *Direct* and *Strategic* are subcategories of *Home-Based Work*, and their sum would equal the number of trips at the top level.

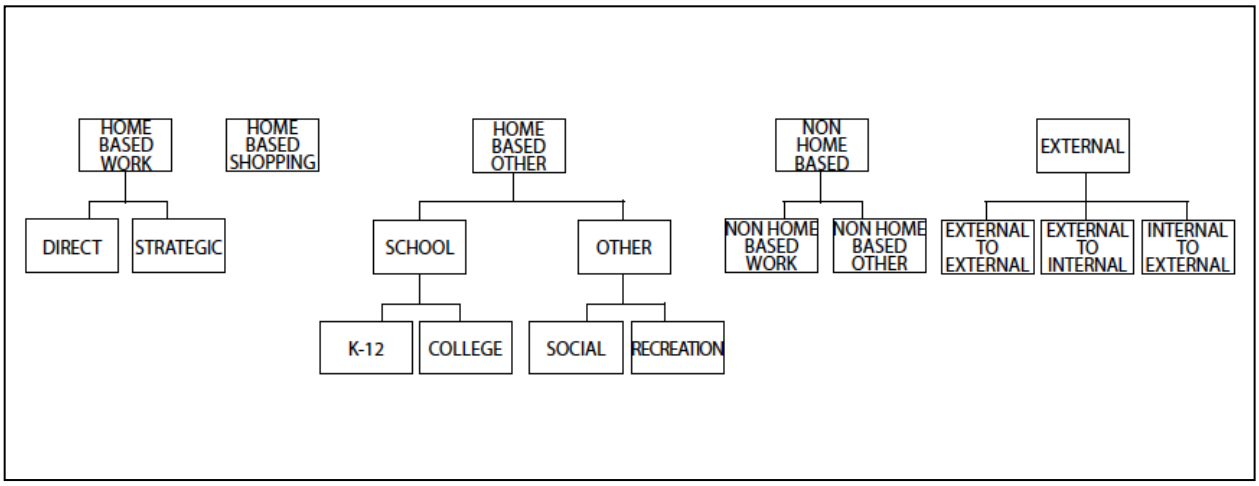

Figure 1. Example of Proposed Hierarchical Data Elements

The hierarchical arrangement provides flexibility for an agency, allowing for maintaining data at a level of detail that best suits local conditions. But to achieve the goal of consistency in data so that data can be meaningfully compared across agencies, all data must be assigned only to the elements that appear in the framework. If an MPO were to define their own category that does not appear in the framework, this would undermine the capacity for others to understand which data are collected and at which level of aggregation.

Notice that each tree in Figure 1 (e.g., *Home-Based Work*) is exclusive of the other trees (e.g., *Home-Based Other*), so an MPO has the flexibility to define data at different levels for different trees. The level of aggregation does not need to carry through across all the trees in the figure. For example, an MPO might maintain data for *Home-Based Work* at level 1, *Home-Based Shopping* at level 1, *Home-Based Other* at level 3, and *Non-Home Based* at level 2.

While an MPO has flexibility to decide which level of aggregation for any tree, the nested nature of the proposed framework requires that data be maintained at every element of a particular level. For example, an MPO that defines *Home-Based Other* at level 3 must include both *K-12* and *College* categories for all trips under the *School* category.

The framework illustrated here is intended to allow an MPO to retain the flexibility to define the level of detail that best fits local needs, but adhering to the definitions of the framework ensures that data are mutually exclusive and can be consistently compared across agencies. The proposed framework consists of three separate schemes: (1) Trip Type (purpose and locations of travel trips); (2) Mode Choice Factors (travel times and costs that influence which travel mode a traveler chooses for a trip); (3) Mode (the means of making a trip, such as by car, bus, walk, and so forth).

4.2 Trip Type Scheme

A trip is travel from an origin to a destination by one person in any mode of transportation, and forms the most basic and universal measure of personal travel. Trips are typically categorized by the purpose of travel, such as traveling from home to work. Figure 2 represents the proposed hierarchical scheme for Trip Type, with descriptions summarized in Table 2.

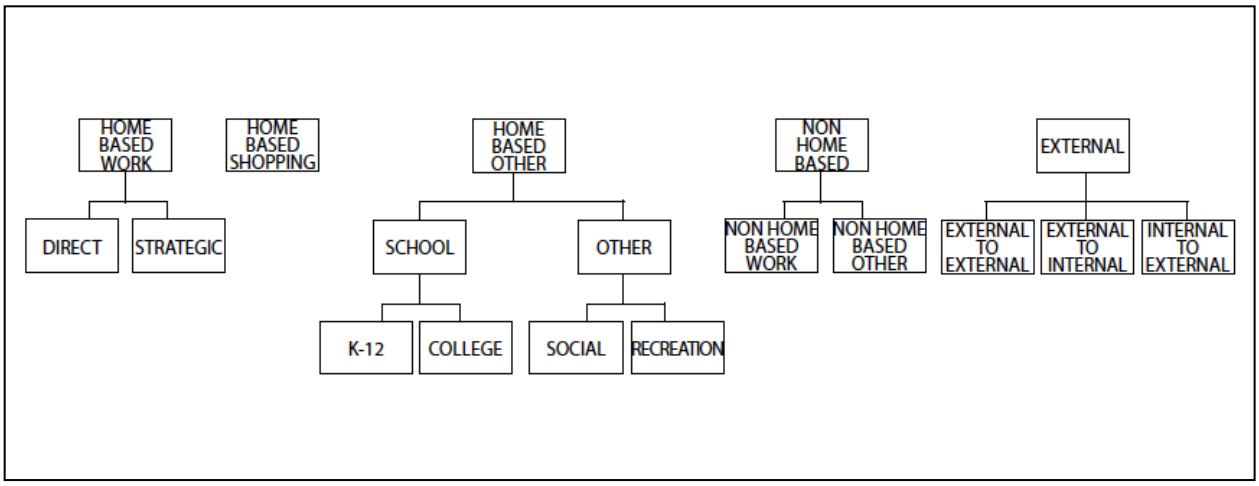

Figure 2. Proposed Scheme for Trip Type

Table 2. Trip Type Descriptions

Trip Type	**Abbreviation**	**Description**
Home Based Work	HBW	Trip originating from home and ending at work, regardless of any stops made along the way.
Home Based Shopping	HBS	Trip originating from home and ending to at destinations such as a grocery or retail store to purchase commodities for use or consumption elsewhere.
Home Based Other	HBO	Trip originating from home but not ending at work or shopping destinations, including for reasons such as school, social, and recreation.
Non Home Based	NHB	Trip originating from a location other than the home.
External	--	Trips originating and ending either internally or externally to a study area.

4.3 Mode Choice Factors Scheme

The second scheme is Mode Choice Factors, shown in Figure 3 below. These include the costs that influence which mode a traveler chooses when making a trip. These Mode Choice Factors are typically not well documented among the data and reports examined for this study. *In-Vehicle Travel Time* (IVTT) and *Out-of-Vehicle Travel Time* (OVTT) form the two main branches of this scheme, while a *Menu of Categorical Costs* covers a range of others data items such as fares and parking.

The first two trees are nested hierarchies in the fashion of the Trip Type scheme described above. Here, *IVTT* divides into auto and transit times, then descends to an auto, transit, and non-motorized level. Data collected for this study revealed that few MPOs collect non-motorized IVTT, so the proposed

scheme here demotes that item to a secondary level. *OVTT* divides into transit and non-motorized, with the former subdividing into various wait and walk times.

The *Menu of Categorical Costs* reflects factors that influence mode choice but which do not readily fit into a hierarchy of nested categories. Parking costs and transit fares, for instance, surely influence whether a traveler chooses to drive or take transit for a trip. But these factors cannot be nested under a single tree like the others. Under this proposed scheme, an agency would denote which, if any, of these data they collect and maintain.

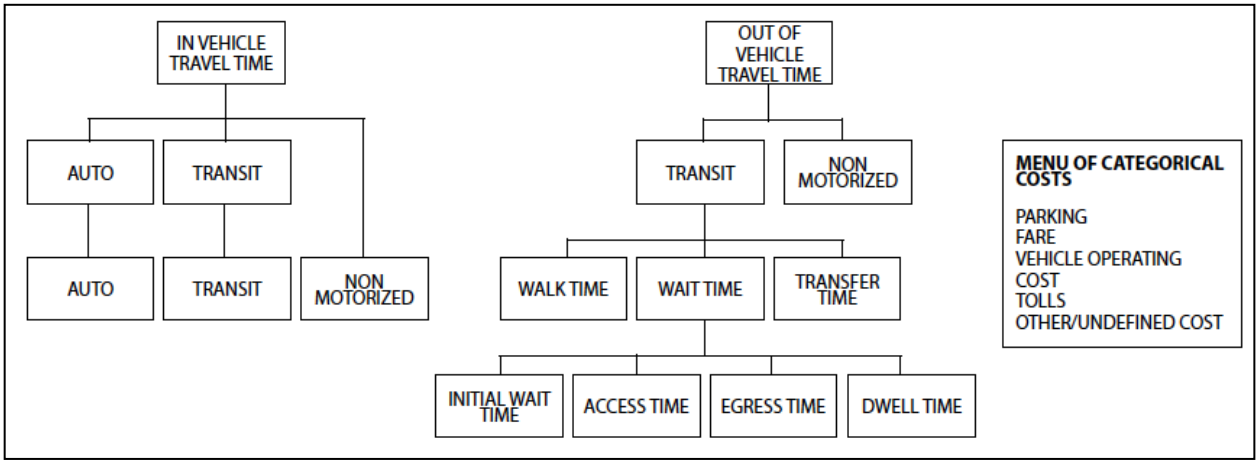

Figure 3. Proposed Scheme for Mode Choice Factors

4.4 Mode Scheme

The third and final scheme is called Mode, shown in Figure 4 below, and includes vehicles used to reach a destination. *Auto* divides into the number of vehicle occupants, with most MPOs using some version of *Drive Alone* and *Shared Ride*. *Non-Motorized* includes bicycle and walking modes. *Motorized Other* refers to modes like paratransit and taxi that do not fit into transit categories, and are presented as a menu of non-hierarchical data categories, mainly because these data were rarely found in the data inspected for this project. For example, the Chicago Metropolitan Agency for Planning (CMAP 2006) reports taxi as a mode but no other MPO in the data set includes this as a mode. The category *Shared Ride* may potentially become more important data to collect for agencies as the popularity of such services as Uber and Lyft increases.

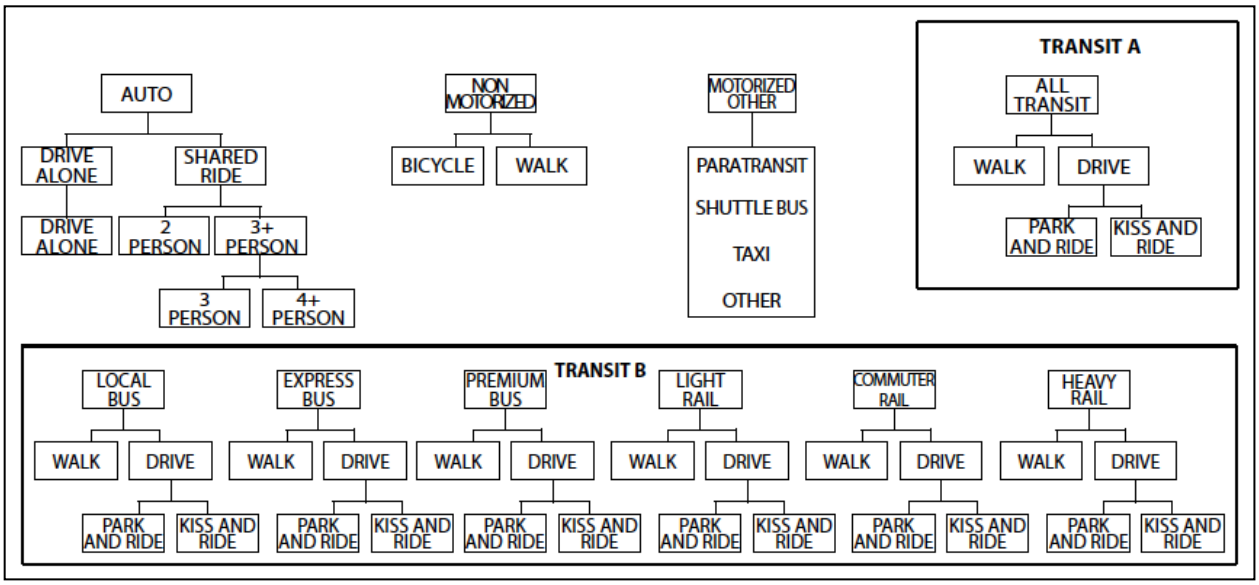

Figure 4. Proposed Scheme for Mode

4.5 Case Studies: Comparing the Proposed Framework to Current Data at Regional Agencies

We tested the proposed framework by comparing its elements to data and documentation that we collected from five MPOs, including the Atlanta Regional Commission (ARC), the Chicago Metropolitan Agency for Planning (CMAP), the Portland Metropolitan Service District (Metro), the Puget Sound Regional Council (PSRC), and the Southern California Association of Governments (SCAG).

For each of the schemes (Trip Type, Mode Choice Factors, and Mode) and for each of the five MPOs, we created charts to indicate the degree of agreement between our proposed framework and the actual data used by MPOs, based principally on our reading and interpretation of data documentation. We created these charts to be shared with MPOs as part of our effort to gather feedback on our proposal. Figure 5 illustrates the approach to showing four kinds of consistency between the proposed framework and actual data, using the Mode Choice scheme as an illustration:

- Green indicates a data item where the proposed framework and actual MPO data match.
- Yellow indicates a data item that we expected to find but could not locate within MPO data documentation, and for which we were unsure whether it was actually used by an MPO. For example, in the figure below, it is conceivable that out-of-vehicle travel time might be collected for Non-motorized modes (shown in yellow in the figure) at the same hierarchical level as the other modes of transit and auto.
- Red indicates areas of inconsistency. The most common type of inconsistency is the case where a particular MPO uses a data item that is not typically used by most other MPOs and therefore was not included in our framework. The figure below shows the example where two data items (Auto, Walk Time) were not common among other MPOs and do not appear in our proposed scheme (as shown at Figure 3).

- Grey indicates a data item that we included in our proposed framework but is not used by the MPO. Whereas yellow represents items for which we were unsure, grey represents items for which we were reasonably certain were not used by MPOs, based on our reading of data and accompanying documentation.

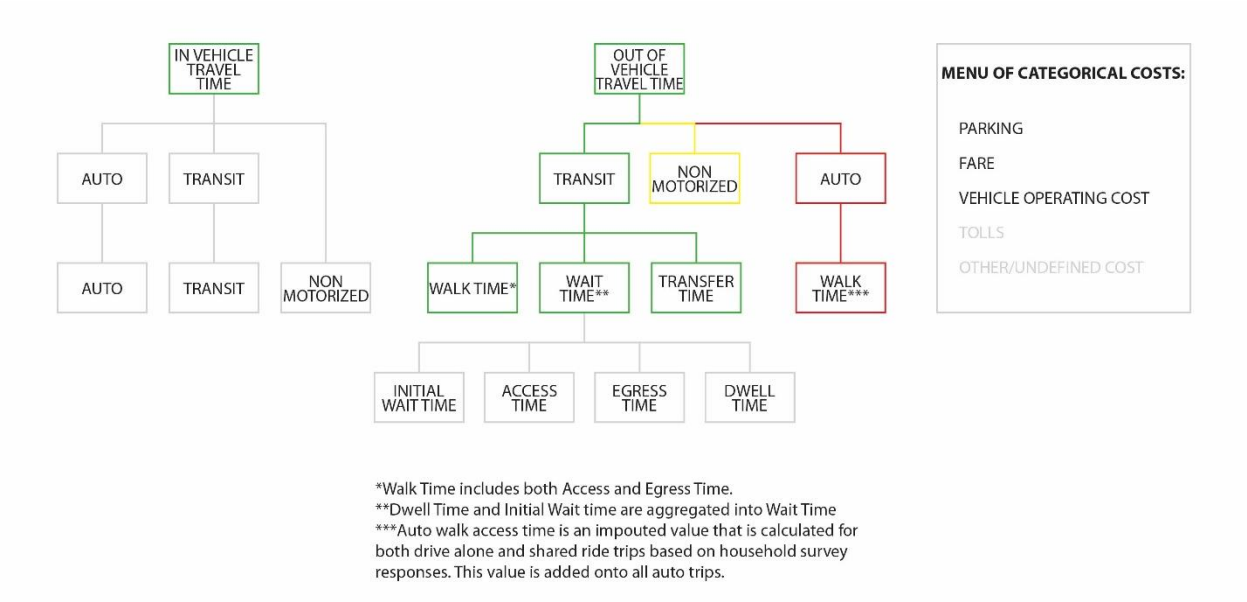

Figure 5. Example of Color-Coded Consistency Assessment, Portland Metro, Mode Choice

4.6 Responses to the Proposed Framework from Experts in Practice

A goal of this research is to determine whether eventually assembling a reliable and trustworthy data set for evaluating accessibility performance might be feasible, and whether it might be done while minimizing the burden on respondents and without suppressing the creativity and distinctiveness of current practice at the local and regional level. We seek to identify the minimum set of data and methods that would need to be standardized, and to determine how the data might be collected readily under current work flows at local and regional levels. This section reports on the results of interviews with experts from six regional planning agencies. The experts participated by responding to questions about the framework proposed here, and they offered suggestions for modifying the proposed approach to a standardized data scheme.

The experts from six regional planning agencies are listed in Table 3. All interviews except one were conducted in person, and the interviews were structured as follows: A slide presentation was used to explain the goals of the research project, to demonstrate the kinds of inconsistencies that we had found in collecting data from a range of agencies, and to present our proposed framework as a possible means of resolving the inconsistencies. Copies of the slides and summaries were provided prior to the presentation to help guide the discussion. Following the presentation, interviewers guided in-depth discussions to determine how current practice at each agency compares with the proposed framework, and to elicit feedback on how the framework could be improved.

Table 3. Respondents by Agency and Date of Interview

Agency	Respondent	Date
Atlanta Regional Commission (ARC)	Guy Rousseau	April 25, 2014
Chicago Metropolitan Agency for Planning (CMAP)	Kermit Wies	April 4, 2014
Portland Metropolitan Service District (Metro)	Peter Bosa, Chris Myers	June 10, 2014
Puget Sound Regional Council (PSRC)	Suzanne Childress, Billy Charlton, Stefan Coe, and Chris Johnson	June 12, 2014
Southeast Michigan Council of Governments (SEMCOG)	Xuan Liu	August 14, 2013
Southern California Association of Governments (SCAG)	Hsi-Hwa Hu	April 29, 2014 (remote)

Notes: Xuan Liu was interviewed at an early stage to guide development of the framework. His-Hwa Hu was interviewed remotely through a screen-sharing web conference.

4.6.1 *Assessing the Feasibility of the Proposed Framework*

To evaluate whether the framework we are proposing is feasible from the perspective of practicing experts, we first inquired about the inconsistencies that we observed between the framework and the data documentation that we studied for each MPO. We were particularly interested in learning whether the inconsistencies that we observed were substantial enough to undermine the viability of the framework. On the whole, the interviews confirmed that our approach showed promise without major shortcomings. A respondent offered two main factors that explain the inconsistencies between the proposed framework and MPO documentation (K. Wies, CMAP). First, data documentation is typically not presented in comprehensive detail. Many of the data items that we did not find in CMAP documentation are actually collected and used by the agency, even though they do not appear in the documentation. He suggested that some documentation might be written not with data users as the intended audience but rather as a record for demonstrating compliance with regulations. Our interviews with several other MPOs substantiated the suggestion that data documentation does not always reliably cover all the data items actually collected and used by an agency. To illustrate, we found no documentation from SCAG on several mode choice data items such as in-vehicle travel time and out-of-vehicle travel time. Another respondent suggested that these data items are collected but that they are not included in the data documentation (H. Hu, SCAG). Reasons for not including the definitions of such items in the documentation include the fact that they are a relatively inconsequential level of detail that few people require, or because the data originate from lower levels of government such as a county.

The second main factor that explains inconsistencies is that these data are intended to serve needs that may well differ from one region to another, and data should be expected to differ to the extent that they reflect these varying needs (K. Wies, CMAP). For instance, we would expect Florida to have an interest in collecting data on the travel behavior of tourists and older people to an extent probably not required in Chicago.

The proposed framework seeks to partly address the need for meeting local conditions through the hierarchical arrangement of the schemes, recognizing that standardizing data like these would be best accomplished if it allows for the flexibility to collect data for the particular conditions of a metropolitan or local jurisdiction.

4.6.2 *Benefits of the Proposed Framework*

Interview respondents pointed out a wide range of potential benefits that they perceived from the proposed framework.

Advancing Current Standardization Efforts: Several respondents indicated that through their professional contacts they were aware of other efforts already underway to bring some level of standardization to common data, and the respondents suggested that the framework proposed here was consistent with those other efforts (Childress of PSRC; Hu of SCAG; Rousseau of ARC; Wies of CMAP). Examples of other efforts that the framework might support is the work of Travel Forecasting Resource, an online open-source encyclopedia of travel demand modeling, and the Transportation Research Board's (TRB) Transportation Demand Forecasting Committee and related sub-committees.[16]

Encouraging Collaboration among Agencies: Respondents indicated that the FHWA and FTA are encouraging more collaboration among MPOs. For example, Bosa and Myers from Portland's Metro cited the Oregon Metropolitan Planning Organization Consortium (OMPOC), which seeks to encourage collaboration between MPOs in Oregon and the Oregon Modeling Steering Committee, which oversees the Oregon Modeling Improvement Program, as efforts that would likely welcome a method for making data consistent and comparable across agencies. Several respondents indicated that the framework proposed here could help MPOs better understand one another by providing a conceptual common ground (Rousseau of ARC; Wies of CMAP).

Sharing Data and Resources among Agencies: A respondent suggested that MPOs are interested in sharing data and noted that they have been working with other MPOs to develop Open Model Data, an open-source data format that allows for sharing data between MPOs, regardless of any proprietary software used by an MPO (S. Childress, PSRC). Similarly, another respondent raised the issue of advancing the possibility that certain model parameters might be transferable between MPO model platforms (G. Rousseau, ARC. He indicated that ARC, the San Diego Association of Governments (SANDAG), and San Francisco's Metropolitan Transportation Commission (MTC) pool funds together to develop a common platform for travel demand modeling. The effort has been successful, but he suggested that ensuring that the data across agencies were consistent and comparable would elevate the effort.[17]

Fostering Peer Analysis: The proposed framework offers potential for more readily carrying out peer analysis, to assist MPOs in learning how other similarly situated MPOs are performing on a range of metrics. As one respondent pointed out, the ability to quickly pull data from other MPOs could assist in supporting staff recommendations by providing evidence from other MPOs (P. Bosa, Metro). Furthermore, it would allow MPOs to share best practices more easily through a platform for critiquing and learning from one another.

Increasing Efficiency of Workflow Operations: Several respondents indicated that the proposed framework has potential to reduce workloads by increasing the efficiency in time and labor of current activities. First, a Portland respondent noted that they commonly receive requests for data, sometimes several times a month (P. Bosa, Metro). He indicated that if the framework could enable a standardized data repository, perhaps as a secured online resource, with a structure that could be understood from users both inside and outside of the agency, then Portland's Metro could simply direct such external

[16] Travel Forecasting Resource can be found at: < http://www.tfresource.org >.
[17] For more information about the ongoing pooled funding effort, refer to < https://udst.github.io/activitysim/ >.

requests for data through a web link, reducing the need to collect and package the data to send to an outside client. Second, a common benefit cited by several respondents is the possibility to reduce the burden of keeping data documentation up to date, an activity that is costly in both time and effort (K. Wies, CMAP), and for which little guidance currently exists (P. Bosa, Metro).

4.6.3 *Concerns about the Proposed Framework*

Although the interviews revealed a wide range of benefits of the proposed framework, two particularly notable concerns emerged. The first is in regard to the ability to implement such a change. A respondent noted that to implement a change such as the framework proposed here would likely require support from the federal government (Wies, CMAP). He explained that if the federal government were to mandate the proposed framework, it is possible that it could be implemented in less than a year. He further noted that if it were a mandate backed by additional funding, the private sector would likely respond to the incentive to work collaboratively with MPOs in fostering the change. But without the backing of a federal mandate, he noted that it could take 10 to 15 years of hard work to gain widespread support for such a change. Despite the importance of gaining federal support, he noted that federal mandates might also be met with resistance. For example, MPO staff and leadership might understandably have concerns that such a mandate might be repealed or defunded in the next election cycle, and therefore hesitate to adopt the mandate in a timely manner. A second concern raised by two other respondents noted that programmers at private consulting firms may resist efforts to standardize the data inputs for fear that it would alter existing travel demand models, and that any standardization scheme would be more likely to succeed if we can show that the models themselves would not require adapting to the data framework (P. Bosa and C. Myers, Metro).

5 Conclusion

If moving accessibility to a more central position in transportation policy is to proceed, then the diffusion of accessibility metrics in transportation planning practice will be greatly assisted by the standardization and standardized reporting of data. MPOs, for example, might provide consistently defined outputs of metropolitan travel models to a central collection agency, much like transit agencies are required to do for the National Transit Database. The data framework proposed here is intended to demonstrate how a standardized set of data generated by regional agencies might be collected in a repository to facilitate consistent and dependable accessibility-based analysis among places and through time.

To successfully make the case for eventually implementing standardized metrics for accessibility, next steps will likely require coordination with federal agencies such as the Federal Highway Administration and the Federal Transit Administration, and perhaps to consider incentives for modifying procedures for data collection and publication at federal and regional levels. Metropolitan Planning Organizations and local governments may be capable of adjusting their data collection procedures in ways that allow for consistent definitions across the industry, so that accessibility and other modeling outputs can be meaningfully compared among peers and performance can be tracked through time. Scholars and public policy analysts, through their research, will be better positioned to track progress in accessibility over time and across regions, and to discover new approaches to policy making that enhances accessibility.

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Contacts

For more information:

Joe Grengs (PI)
University of Michigan
Urban and Regional Planning
Art and Architecture Building
2000 Bonisteel Boulevard
Ann Arbor MI 48109-2069

(734) 763-1114
grengs@umich.edu

NEXTRANS Center
Purdue University - Discovery Park
3000 Kent Ave.
West Lafayette, IN 47906

nextrans@purdue.edu
(765) 496-9724

www.purdue.edu/dp/nextrans