Accessibility IDT Team:
Specific Indicator Data Sources and Estimation Methods

To: Sam Seskin, CH2M HILL

From: Theresa Carr, CH2M HILL
Sara Hajiamiri, HDR
Stéphane Gros, HDR

Date: July 16, 2012

Introduction

The role of the Accessibility Indicator Development Team (IDT) is to develop the set of specific indicators for the Accessibility category of transportation system performance for the Oregon Least Cost Planning (LCP) project. This work includes developing a list of specific indicators and the estimation methods for evaluating them. This memorandum presents a refined list of specific indicators, documents the data that would be used, and lays out the steps involved in estimating the indicators for use in LCP.

This memo is the second for the Accessibility IDT. On November 18, 2011, the IDT submitted a memo that provided a draft list of specific indicators, and a brief overview of how the IDT would approach developing them. In response to this communication, the LCP core leadership team met throughout December to look across the nine categories of transportation system performance to ensure that the set of specific indicator was complete (addressing all key aspects of LCP), manageable, operational, and avoids duplication. The result of these discussions was a set of guidance back to the IDTs to reassess several indicators within their category, including questions about operationality and recommendations to eliminate specific indicators for reasons of duplication and manageability. This memo picks up from that set of guidance.

Refined Specific Indicators

The Accessibility IDT met to discuss this proposed guidance in January 2012, and this section documents its progress in listing a refined set of specific indicators. Table 1 provides a list of refined specific indicators that responds to the core leadership team's guidance. This table is and will continue to be a work in progress and may be revised as the Accessibility IDT members work to further develop the specific indicators.

Table 1: Refined Specific Indicators

General Indicator	Refined Specific Indicator(s)	Response to Comments from Leadership Team and Others
Proximity	• Transportation Accessibility Index • Population within *X* minutes between work and home	Name of general indicator changed from "Land Use" to "Proximity"
Connectivity / Ease of Connections	• Location of industrial jobs in relation to the regional freight network	Added at the request of the SSC
Modal Availability	• Population and employment within ¼ mile of a transit stop served by at least 30 vehicles per day • Amount of multi-use paths and bike boulevards • Sidewalk coverage	Three specific indicators proposed because it was determined that no single indicator could cover all relevant modes

For the **Proximity** general indicator, the Accessibility IDT selected the specific indicator "Cost to access a reference market basket of goods, services, and desired activities (Transportation Cost Index)" and removed the specific indicator "Percentage of population able to travel between work and home within 45 minutes."

The IDT went back and forth on which specific indicator to select, and only landed on the Transportation Accessibility Index after discussions with ODOT's Transportation Planning and Analysis Unit over the ability to measure this indicator without using the statewide integrated model. It was decided that the confirmed specific indicator would have a broader application and would cover more purposes.

The specific indicator "Percentage of population able to travel between work and home within 45 minutes" was subsequently reintroduced into the list, as members of the WG and Project Management Team felt that it was a good indicator of accessibility and quality of life. The definition of the indicator was modified slightly, so that users could specify the travel time threshold (*X* minutes, instead of 45 minutes).

For **Connectivity/Ease of Connection**, the specific indicator "Location of industrial jobs in relation to the regional freight network" was chosen.

The specific indicator "Percentage of O-D pairs that are connected by transit, biking, and pedestrian facilities" was removed from the list.

The specific indicator "Number of 4-way intersections per square mile" was removed from the list as well. Although this indicator is broadly used as a measure for connectivity in travel models, it might not be as useful for evaluation purposes with LCP at the planning level. One

reason is that usually this level of detail is not available at the planning level. Second, this indicator would only provide a measurement for the level of connectivity for auto users.

The specific indicator "Direct distances divided by actual travel distances between O-D pairs, by mode" was removed from the list because the concept of direct distance might be misleading. Natural or man-made barriers such as rivers or highways would not be accounted for when calculating the direct distance.

The specific indicator "Percentage of roadways without sidewalk" was replaced with "Sidewalk coverage" and moved to the **Modal Availability** general indicator.

Two other specific indicators were selected for Modal Availability: "Population and employment within ¼ mile of a transit stop served by at least 30 vehicles per day" and "Amount of multi-use paths and bike boulevards."

Overall, in the process of selecting specific indicators, one IDT member mentioned that given the differences that exist between the specific indicators in each of the general indicator categories and the limitations discussed above, it would be better to keep more than one specific indicator per general indicator in the tool and allow the user to select the indicator that would be most meaningful, given the application and data availability. The Project Management Team, however, felt that it was important to have a consistent set of indicators across all applications. In the end, all agreed that more than one specific indicator would be needed to cover the scope of the general indicators. Thus, there are now two specific indicators for Proximity, and three specific indicators for Modal Availability.

Data Sources and Estimation Methods for Specific Indicator "*Transportation Cost Index*"

The following paragraphs were taken from "Transportation Planning Performance Measures" final report SPR 357 dated October 2005. IDT member Bud Reiff and TPAU staff member Brian Gregor co-wrote this paper. The estimation methods listed below come directly from this source.

The Transportation Accessibility Index is an accessibility measure that is analogous to the Consumer Price Index (CPI). The CPI measures the relative price for acquiring a reference market basket of goods and services. It may be used to compare living costs in different areas and changes over time. The Transportation Accessibility Index measures the relative cost of accessing a market basket of travel destinations. It may be used to compare accessibility by trip purpose, travel mode, income group, geographic area and time period. Travel demand models provide information that may be used to define the travel market basket and to calculate transportation costs.

The Transportation Accessibility Index is primarily intended to be a measure of accessibility and the effects of the transportation / land use system on the quality of life. It can also serve as an indicator of transportation / land use system compatibility and of balance. The primary purpose of the transportation system, from the standpoint of the individual household, is to provide affordable access to the goods, services, and daily activities that the household desires,

and which often play an important role in how household members perceive their quality of life. Like the CPI, which may be used to indicate relative change in the cost of the goods and services themselves, the Transportation Accessibility Index may be used to indicate changes in the costs to access goods and services. The Transportation Accessibility Index may be used to measure how transportation affordability varies across an urban area, how it changes over time, and how it is affected by various land use and transportation system alternatives.

Areas having excessively high Transportation Accessibility Indices in future year scenarios are indicative of problems with land use / transport system compatibility and balance. Extreme traffic congestion, combined with limited alternatives for accessing the "market basket" will result in reduced quality of life, with the household having to either endure higher costs or accept a more limited number of choices. Such situations might be addressed in a variety of ways, including land use changes, investment in alternative modes, transportation system management (TSM) measures, and additional roadway capacity, any of which could reduce the Transportation Accessibility Index. An overall regional Transportation Accessibility Index can be computed for each alternative solution to indicate relative effectiveness.

Estimation Methods

The Transportation Accessibility Index may be computed for different forms of travel demand models, but the specifications presented below are for use with the JEMnR model. The specifications could be readily adapted to other disaggregated discrete choice travel demand models.

A. Define a market basket of travel destinations

The goal of defining a market basket of travel opportunities is to identify a set of destinations that provide a good set of choices for meeting daily living needs. The process of identifying this market basket involves three steps:

1. Identify the categories of travel for which market baskets of travel destinations are to be defined;
2. Identify a market area that will serve as the reference for quantifying travel destinations; and
3. Calculate the number of travel destinations in the reference market area.

The travel categories are defined based on their definition in the model used for calculating the measure. For this study they include work, shopping, recreation and other non-school trips made from the home.

The second step involves identifying a market area that will serve as the reference for quantifying the market basket of travel destinations. The reference market area is a TAZ within the urban area and a set of zones located around the TAZ that represent a large number of destinations. The reference TAZ may be identified through the use of expert judgment or through a structured analytical process.

The final step is to identify the total quantity of market attractions located within the market area for each trip purpose. Disaggregated discrete choice models provide the information needed to measure the relative attractiveness of places in the urban area to different categories of households. The cumulative attractiveness of destinations within the reference market area may be measured using components of the destination choice model. This is the reference market basket.

B. Calculate travel costs to access the market basket

Once the travel destination market basket has been defined for each trip purpose, the average cost to access each market basket is calculated for each TAZ and income group in the model area. The information for calculating these costs comes from "access utilities" calculated for the JEMnR destination choice model. The access utilities measure the perceived "costs" of traveling between TAZs by trip purpose, income group and travel mode. The model-derived costs are converted into monetary units and are aggregated across travel modes and averaged across the market place for the TAZ.

Since the cost that is to be averaged varies by travel mode, it is necessary to combine the mode costs into one representative cost to be averaged across each TAZ market place.

The average cost to access the market basket from each TAZ is computed as a weighted average of the travel costs from that TAZ to each other TAZ in the market place containing the market basket of destinations for that TAZ. The weighting factor in calculating the average is the proportion of the market basket that is located within each TAZ in the market place. The market place for each TAZ is identified as the set of TAZs that contain the market basket of destinations and may be accessed at the lowest cost from the target TAZ.

C. Compute Travel Cost Indices

Transportation Accessibility Index values for each cost array are computed by dividing the values for each TAZ by the values for the reference TAZ. This produces TCI values by TAZ and income, by TAZ and trip purpose, and by TAZ for all incomes and purposes.

Data Sources and Estimation Methodology for Indicator "*Population within X Minutes between Work and Home*"

Data Sources

To measure current conditions:

- American Community Survey (ACS), Longitudinal Employer-Household Dynamics (LEHD) that combined the state administrative data on employers and employees with core Census Bureau censuses and surveys, and Oregon Household Activity Survey (OHAS) can be used to get information on existing travel patterns, in particular journey-to-work (JTW) data.
- Travel demand models at different geographical levels can be used: Oregon Statewide Integrated Model (SWIM) at the state level, regional models at MPO levels, Oregon State Urban Model (OSUM) for the smaller non-MPO areas, including rural areas and smaller urban areas outside of the metropolitan areas.

- OSUM models do not have transit data in them. Also, only SWIM identifies whether long-distance commute trips are work trips or not. MPO models differentiate trip purposes within the MPO, but do not differentiate long-distance external trips, and OSUM models do not differentiate for trip purpose. Using the state-wide model is the only way to get the longer distance trips. IDT members mentioned that ODOT and MPOs are aware of this shortcoming and are currently working on improving their models, but were not aware of the progress or any timeline.

To forecast future conditions:

- The travel demand models mentioned above could be used for forecasting future travel patterns.
- Note that in cases where ACS is used to measure current conditions and travel demand models to forecast future conditions, there is no direct link between ACS and travel demand models data and as a result there will be a significant amount of data manipulation required to make the measure work. One IDT member mentioned that LCOG provided model TAZ structure to CTTP so that the JTW data could be disaggregated to the LCOG TAZ level, but that this is not true for anywhere else.

To resolve definition issues:

- The "*X*-minute" threshold needs to be refined. This threshold would be dependent on whether the area under consideration is an urban or a non-urban area, and in case of the former, whether it is a large or small urban area. The reasonable time by geographical region could be identified via literature review and/or specified by the user.

Estimation Methods

- Once the appropriate geography is selected (state, metropolitan area, county, etc), identify an acceptable time threshold based on geography. Using the survey data and travel demand models mentioned above, calculate the percentage of population that are able to travel between work and home within *X* minutes, with and without the plan.
- One limitation of this specific indicator is that it is very dependent on the size of the area under consideration. For example, while it is a meaningful measure for the Portland urban area, it might not be that meaningful for a rural area, where this percentage is going to be high (e.g. 90%) and relatively constant. In such areas, this measure is not going to vary much, whatever we do with the transportation plan.
- This specific indicator is measured using travel demand models and thus, all the usual uncertainties that exist with using a travel demand model is also present here; namely uncertainties in travel demand models structure and input data such as population, land use, and employment forecasts. One possibility to address this uncertainty is to run different scenarios within the travel demand models and get an estimate of a range of values for the indicator. Also, if the noise in the estimate is more or less the same across alternatives, the risk associated with the uncertainty is small. But if the noise in the

estimate is pertinent to only one of the planning alternatives, then the risk would be higher since this would result in a biased evaluation.

Data Sources and Estimation Methodology for Indicator "*Location of Industrial Jobs in Relation to the Regional Freight Network*"

Data Sources

To measure current conditions:

- Travel demand models at different geographical levels: SWIM model at the state level, regional models at MPO levels, OSUM models for the smaller non-MPO areas, including rural areas and smaller urban areas outside of the metropolitan areas. Each of these models will have information on both the number of jobs and the labor classification. These can be filtered for industrial and manufacturing jobs.
- Modeling information can be supplemented with GIS data which can provide information on current land use and/or zoning. This can be used to check information from the demand model. In addition, GIS information will have a roadway layer which will designate the functional classification of the roadway, the capacity of the facility, and its ownership. Some geographies will also code the regional freight network directly into the GIS.

To forecast future conditions:

- Travel demand models forecast future land use in much the same manner as they do current land use. Coordinating with county population and employment forecasts and specific jurisdictions about how those forecasts are distributed, the models allocate jobs by labor classification into areas at a Traffic Analysis Zone scale.

Estimation Method

- Once the appropriate geography is selected (state, metropolitan area, county, etc.), define what is considered "connected" for freight employment areas to reach the regional freight network. It is recommended that a **travel time threshold** be established, or an average speed or acceptable level of congestion.
- Import data from the model into the GIS or vice-versa (import data from the GIS into the model) so that assessments can be made between points (e.g., employment centers, freeway on-ramps).
- Assess whether the path, speed, and/or congestion is considered acceptable along the route between employment centers and the regional freight network.

Data Sources and Estimation Method for Indicator "*Percentage of Population and Employment within a Quarter Mile of a Transit Stop Served by at Least 30 Vehicles per Day*"

Data Sources

To measure current conditions:

- Population data can be obtained from Census block data or from parcel data that locate dwellings.
- Employment data can be obtained from Local Employment Dynamics (LED), which is a partnership between state labor market information agencies and the U.S. Census Bureau to develop new information about local labor market conditions. LED is publically available at the census block level but it requires certain confidentiality agreement. Oregon Employment Department is another source that publishes quarterly reports of employment. This data is very precise, but has issues with confidentiality. This data is available on request for planning agencies who have signed confidentially agreements.
- Data on transit stops and level of service can be obtained from transit agencies. The same data is provided in files meeting the "General Transit Feed Specification" (GTFS).

To forecast future conditions:

- For future conditions, we would know where the routes are, but not necessarily where the stops are going to be. So, we need to make some assumptions. For example, based on the new routes we could identify segments that are stop-eligible and segments that are not stop-eligible. For existing routes, we might assume that the stops stay in the same locations. Or we could make assumptions on where the new transit stops are going to be, based on assumptions on land use development and location of new employment and dwellings. We might not have accurate information on future employment and dwelling locations, but we might be able to get information on where the buildable land is. Or we could ask the travel agencies to provide us with their assumptions on transit stops and level of service for new routes.

To resolve definition issues:

- What is a "reasonable radius from transit stop"? The distance that people are willing to walk to and from a transit stop is typically between ¼ miles and ½ mile. People might be willing to walk further to get to an LRT stop than to a bus stop. This can be identified by literature review and from on-board surveys.
- What is an "acceptable transit service frequency"? For example, a maximum of 15-min headways during peak hours and 45-min headways during off-peak hours or a total of 30 services per day. This needs to be identified via literature review or via interviewing transit agencies.

Estimation Method

- Distance to transit stop can be calculated through a spatial analysis of data on the locations of population and employment and data on the locations of transit stops.
- One uncertainty with this indicator is that the direct distance to a transit stop might be within the acceptable threshold, but the actual walking distance to get there might be much longer. For example, someone who is physically within ¼ mile from a transit stop might need to walk 2 miles to actually get to the stop, due to some natural or man-made barriers. Another uncertainty is related to assumptions on the location of the stops on new transit routes and their level of service.

Data Sources and Estimation Method for Indicator "*Amount of Multi-Use Paths and Bike Boulevards*"

Data Sources

- Potential data sources for current conditions include: the Oregon Bicycle and Pedestrian Plan; inventories of existing multi-use and bicycle facilities; bicycle and pedestrian LOS databases; and the street networks coded in travel demand models.
- Future conditions would be assessed directly from project data, as specified in the plans or bundles (e.g., additional mileage of multi-use paths and bike boulevards).

Estimation Method

- The indicator would be estimated as the total mileage of multi-use paths and bike boulevards under various plans or bundles.
- Alternatively, the indicator could be expressed as an index, with a value of 100 in the Base Case (i.e., the Do-Minimum scenario against which all plans or bundles will be assessed).
- The identification and selection of paths and boulevards within a given area, and the summation of mileage estimates, would be done within GIS.

Data Sources and Estimation Method for Indicator "*Sidewalk Coverage*"

Data Sources

- The availability of sidewalk coverage data may vary across geographies. Good data are found in many urban areas, but the indicator may be difficult to estimate accurately in rural Oregon. Sometimes, neighborhood organizations can be employed to gather this data for smaller cities.
- Potential data sources for current conditions include: the Oregon Bicycle and Pedestrian Plan; inventories of existing pedestrian facilities; bicycle and pedestrian LOS databases; and travel demand model street networks. As with the previous indicator, future conditions would be assessed directly from project data, as specified in the plans or bundles (e.g., proposed location and mileage of new sidewalks).

Estimation Methods

- Sidewalk coverage may be defined in multiple ways. Thus, Portland Metro uses two related measures, estimated as follows:

Sidewalk Density = Sidewalk miles / gross acre

Sidewalk Coverage = Sidewalk miles / roadway centerline miles

- Sidewalk coverage may also be measured as the percentage of streets with sidewalks along both sides. A complete sidewalk system would provide sidewalks on both sides of every street (within a given area), and receive a value of 100 percent.
- A related indicator is Average Sidewalk Width, estimated by considering all streets; including those with a sidewalk width equal to zero (a weighted average would be estimated, with sidewalk lengths used as weights).The indicator would be estimated within GIS.

IDT Membership

The members of the Accessibility IDT are:

- Paul Thompson, Lane Council of Governments
- Rich Arnold, ODOT TPAU
- Bud Reiff, Portland Metro

An IDT conference call was held on January 18, 2012, to finalize the list of indicators and discuss estimation methodology and data sources. A second conference call was held on January 24, 2012, to further discuss estimation methodology and data sources.

Subsequent discussions were held between the Project Management Team and individual members of the IDT in March and April of 2012.