

Memorandum



To: Stakeholder Working Group

From: Ray Delahanty, AICP, DKS Associates

Date: August 19, 2015

Subject: Clackamas Regional Connections Study Task 4.1.2 Draft Evaluation Matrix

The attached set of evaluation matrices provides a draft prioritization of potential performance measures for the Clackamas Regional Connections study area. We assembled an initial set of over 60 performance measures, and they are prioritized in the attached matrices according to the following categories:

- Pedestrian
- Bicycle
- Transit
- Freight
- Motor Vehicle
- Safety

Why Are New Transportation Performance Measures Important?

Like many communities, Clackamas County currently relies on the traditional, auto-based measure of roadway volume-to-capacity (v/c) ratios to evaluate performance of the transportation system. This measure sets a maximum v/c ratio in the weekday mid-day and weekday p.m. peak periods, with more stringent v/c-based targets at highway interchange ramp terminals. When performance at a location on the transportation system exceeds the established v/c ratio, comprehensive plan changes and land development can become constrained due to Transportation Planning Rule (TPR) and Oregon Highway Plan (OHP) requirements, as well as the County's own policies.

Alternative Mobility Targets for Intersections

Oregon's policy framework allows for development of alternative road capacity performance standards in locations where meeting v/c-based mobility targets is infeasible or impractical. OHP Policy 1F allows for development of alternative mobility targets that recognize the need for a balanced and efficient transportation system and are measurable by objective, standardized procedures.

New Performance Measures for Walking, Biking, and Transit

This memorandum also explores potential new measures for walking, biking, and transit. Performance measures in these areas can help:

- Identify gaps and deficiencies in the multimodal transportation system and identify improvements that will help the area develop in a desirable way.
- Provide a basis for impact assessment and fee calculations to inform potential new funding tools such as a multimodal Transportation System Development Charge (TSDC) within the area.




Evaluation Criteria, Scoring, and Weighting

The attached matrices are intended to help narrow down the initial list of performance measures to form a set of up to 20 preferred measures that will collectively best support evaluation and development review within the study area. In coordination with County staff, we selected the following criteria:

Criteria	Description	Scoring Scale	Relative Weight
Level of Effort	What is the level of effort needed to use the measure relative to the usefulness of the output?	Low / Medium / High (1-3 points)	3
Readiness	Are the tools and methodology tested and ready for use?	Low / Medium / High (1-3 points)	1
Applicability to study area	Is the measure appropriate for the scale and type of analysis needed?	Low / Medium / High (1-3 points)	Multiplier (pass/fail)
Tool Availability	Is the tool reasonably available for County staff as well as private developers/firms?	Low / Medium / High (1-3 points)	3
Data Availability	Will timely, high quality data be available for the type of analysis needed?	Low / Medium / High (1-3 points)	3
Appropriateness for Development Review¹	Is the measure useful in a development review process?	Pass/Fail (3 or 0 points)	2

¹ Applicable planning levels are shown in the "Planning Level" field in the matrices: SP = system planning, MO = monitoring, PA = plan amendments, DR = development review

Within the matrices, the following symbols show how each measure scored against each evaluation criterion:

High =  Medium =  Low = 

The final field in the matrix, Overall Score, shows the point total for each measure based on the scoring and weighting shown in the table above.

Highest Priority Performance Measures

The following are the highest scoring measures for each category according to the draft evaluation. Some measures apply to more than one category.

Category	Measure	Score
Pedestrian	Modified Pedestrian LOS	87
	Pedestrian System Completeness	87
	Pedestrian Crossing Index	87
Bicycle	Bicycle Level of Traffic Stress	108
	Bicycle System Completeness	87
Transit	Duration of Congestion	96
	Destination Travel Time	90
	Accessibility to Transit	90
Freight	Duration of Congestion	96
	Destination Travel Time	90
Motor Vehicle	Volume-to-Capacity Ratio	108
	Duration of Congestion	96
	Destination Travel Time	90
Safety¹	Critical Crash Rate	108

¹ Safety measures and development review approach will be explored further under Task 4.2.

Pedestrian Measures

ID #	Alternative Performance Measure	Category	Description	Planning Level	Tools Needed	Data Needed	Strengths	Weaknesses	Level of Effort	Is measure ready for regular use?	Applicability to the CRCDDPA	Tool Availability	Data Availability	Appropriate for Dev Rev?	Mode	Overall Score
63	Modified Pedestrian LOS	Mobility	A quantitative stratification that represent a pedestrian's perceptions of quality of service by a facility.	SP, PA, DR	Excel, HCM	Traffic Volumes and Pedestrian Facility Data	Reflective of user experience. Can be calculated based on existing data.	Not as robust as true HCM MMLOS methodology.	●	●	●	●	●	●	Pedestrian	87
28	System Completeness	Infrastructure	Percent of planned arterials that are built Percent of planned bike facilities that are built Percent of planned pedestrian facilities that are built The System Completeness measure is a progress tracking measure that allows jurisdictions to track the completion of planned network improvements in a TSP. While primarily a TSP related measure, this measure can also be used in certain land use plan amendment settings and zone changes where the impacts of the potential subsequent development under the new zoning and/or plan designations could be evaluated and mitigated based on the ability to show progress toward completing the planned infrastructure.	SP, PA, DR, MO	GIS, Excel	In application, this measure requires detailed inventories of constructed arterials, bike lanes, sidewalks, and multi-use paths. A quantified database of planned arterials, bike lanes, sidewalks, and multi-use paths is also required in order to track progress.	Provides a good measuring tool for assessing progress of the transportation plan or capital improvement plan.	Requires detailed dataset. May not be best approach for all modes.	●	●	●	●	●	●	Bicycle, Pedestrian, Motor Vehicle	87
27	Pedestrian System Completeness	Infrastructure	Progress tracking measure that allows jurisdictions to track the completion of planned pedestrian network improvements. While primarily a TSP related measure, this measure can also be used in certain land use plan amendment settings and zone changes where the impacts of the potential subsequent development under the new zoning and/or plan designations could be evaluated and mitigated based on the ability to show progress toward completing the planned infrastructure.	SP, PA, DR, MO	GIS, Excel	Detailed inventories of constructed sidewalks, and multi-use paths. A quantified database of planned sidewalk and multi-use paths is also required in order to track progress.	Provides a good measuring tool for assessing progress of the transportation plan or capital improvement plan.	Requires detailed dataset.	●	●	●	●	●	●	Pedestrian	87
11	Pedestrian Crossing Index	Accessibility	Measures distances between crossings along a corridor, creates heat map showing where crossings are most needed. Can incorporate transit stop locations.	SP, PA, DR	Excel, GIS	GIS network	Correlates user experience across multiple modes. Good measure to understand if crossing spacing standards are being met using appropriate treatments.	Appropriateness of crossing treatment may depend on more detailed contextual factors than basic roadway characteristics.	●	●	●	●	●	●	Pedestrian	87

Pedestrian Measures

ID #	Alternative Performance Measure	Category	Description	Planning Level	Tools Needed	Data Needed	Strengths	Weaknesses	Level of Effort	Is measure ready for regular use?	Applicability to the CRCDDPA	Tool Availability	Data Availability	Appropriate for Dev Rev?	Mode	Overall Score
26	Intersection Density	Infrastructure	Number of intersections per square mile.	SP, MO	Excel, LEED-ND	GIS Data	Good measure to evaluate a study area's efficiency of travel or its degree of connectivity. Has been shown to correlate with non-SOV mode share.	To be effective, local jurisdictions need to establish localized intersection density measures.	●	●	●	●	●	○	Bicycle, Pedestrian, Motor Vehicle	81
38	Multi Modal Level of Service	Mobility	A quantitative stratification that represent a traveler's perceptions of quality of service by a facility.	SP, PA, DR	Excel, HCM	Traffic Volumes, Facility Data for Each Mode	Addresses multiple modes of travel. Reflective of user experience.	More data intensive than LOS calculated for roads or other multimodal measures.	●	●	●	●	●	●	Bicycle, Pedestrian, Transit	78
2	Accessibility to Destinations	Accessibility	Number of "essential destinations" (hospitals, medical centers, pharmacies, grocery stores, schools, major retail, transit stations, parks/open spaces, and social service centers with more than 200 monthly LIFT pickups, colleges and universities, and major government sites) within a certain walk/bike/transit time or distance.	SP, MO	Excel, GIS	Routable GIS network, Essential Destinations	Good measure for assessing land use impacts. Considers access for all modes.	Measures access to network, but is not reflective of user experience. Requires selection/definition of "destinations."	●	●	●	●	●	○	Bicycle, Pedestrian, Transit, Motor Vehicle, Land Use	69
8	Bike/Pedestrian Route Directness Index (RDI)	Accessibility	Ratio of shortest path route distance to straight line distance for two selected points. Applied to an area, the average RDI for multiple essential destination types is averaged for each taxlot or TAZ.	SP	Excel, GIS	Routable GIS network	Useful in measuring general connectivity of the network.	Does not take into account user experience in determining safest or least stressful route.	●	●	●	●	●	○	Bicycle, Pedestrian	60
42	Person Hours of Travel (PHT)	Mobility	Person hours of travel within a specified area and time period	SP, MO	Travel Demand Model/Synchro	Traffic Volumes	Measures impact on productivity and quality of life. Can be combined with a value of time measure.	Does not directly relate to planning goals. May be difficult to interpret.	●	●	●	●	●	○	Bicycle, Pedestrian, Transit, Motor Vehicle	52
41	Pedestrian Mode Share	Mobility	Percent of trips made by pedestrians.	SP, MO	Travel Demand Model	Model Inputs, Including Mode Choice	Mode share connects directly to local and regional goals.	Not reflective of user experience.	●	●	●	●	●	○	Pedestrian	46
39	Non Drive-Along Mode Share	Mobility	Percent of trips using non-drive alone mode (public transit, walking, bicycling)	SP, MO	Travel Demand Model	Model Inputs, Including Mode Choice	Mode share connects directly to local and regional goals.	Not reflective of user experience.	●	●	●	●	●	○	Bicycle, Pedestrian, Transit, Motor Vehicle	46

Pedestrian Measures

ID #	Alternative Performance Measure	Category	Description	Planning Level	Tools Needed	Data Needed	Strengths	Weaknesses	Level of Effort	Is measure ready for regular use?	Applicability to the CRCDDPA	Tool Availability	Data Availability	Appropriate for Dev Rev?	Mode	Overall Score
3	Accessibility to Employment and Population	Accessibility	Measures access to job markets by single or composite modes within a specific time period.	SP, MO	Excel, GIS, Forecasting Tools	Requires extensive data on employment, routable street and transit network	Good measure for assessing land use impacts.	Detailed and up-to-date employment data may not be available.	◐	●	◐	◐	○	○	Bicycle, Pedestrian, Transit, Motor Vehicle, Land Use	36
43	Person-throughput	Mobility	Measures how many people can be served along a corridor, incorporating personal vehicle and transit vehicle occupancy	SP, MO	Travel Demand Model, Bike Model, Excel	Transit service data, traffic counts (for base year)	Incorporates multiple modes within the measures, can be stratified by mode.	Data intensive, limited applicability beyond corridor planning.	○	○	◐	◐	◐	○	Bicycle, Pedestrian, Transit, Motor Vehicle	32
13	Street Layout	Accessibility	A measure of the street layout in an area. For instance, small blocks and grid system may be preferable to long, winding streets, cul-de-sacs and dead ends.	SP	Excel, GIS	GIS network	Gives a basic measure of how grid-like the street network is.	Difficult to apply consistently, more subjective and not quantifiable. Doesn't account for facility quality.	◐	◐	○	●	●	○	Bicycle, Pedestrian, Motor Vehicle	26

Bicycle Measures

ID #	Alternative Performance Measure	Category	Description	Planning Level	Tools Needed	Data Needed	Strengths	Weaknesses	Level of Effort	Is measure ready for regular use?	Applicability to the CRCDDPA	Tool Availability	Data Availability	Appropriate for Dev Rev?	Mode	Overall Score
6	Bicycle Level of Stress	Accessibility	Index that classifies segments and points (i.e., crossings) along a bike route into stress categories from 1 (low) to 4 (high).	SP, PA, DR	Excel, GIS	Bike facility data, traffic volumes, speeds, number of lanes, crossing control types	Good measure for reflecting user experience. Can be used as a standard on	None identified.	●	●	●	●	●	●	Bicycle	108
28	System Completeness	Infrastructure	Percent of planned arterials that are built Percent of planned bike facilities that are built Percent of planned pedestrian facilities that are built The System Completeness measure is a progress tracking measure that allows jurisdictions to track the completion of planned network improvements in a TSP. While primarily a TSP related measure, this measure can also be used in certain land use plan amendment settings and zone changes where the impacts of the potential subsequent development under the new zoning and/or plan designations could be evaluated and mitigated based on the ability to show progress toward completing the planned infrastructure.	SP, PA, DR, MO	GIS, Excel	In application, this measure requires detailed inventories of constructed arterials, bike lanes, sidewalks, and multi-use paths. A quantified database of planned arterials, bike lanes, sidewalks, and multi-use paths is also required in order to track progress.	Provides a good measuring tool for assessing progress of the transportation plan or capital improvement plan.	Requires detailed dataset. May not be best approach for all modes.	◐	◐	●	●	◐	●	Bicycle, Pedestrian, Motor Vehicle	87
25	Bicycle System Completeness	Infrastructure	Progress tracking measure that allows jurisdictions to track the completion of planned bicycle network improvements. While primarily a TSP related measure, this measure can also be used in certain land use plan amendment settings and zone changes where the impacts of the potential subsequent development under the new zoning and/or plan designations could be evaluated and mitigated based on the ability to show progress toward completing the planned infrastructure.	SP, PA, DR, MO	GIS, Excel	Detailed inventories of constructed bike lanes, multi-use paths, and other infrastructure. A quantified database of planned infrastructure is also required in order to track progress.	Provides a good measuring tool for assessing progress of the transportation plan or capital improvement plan.	Requires detailed dataset.	◐	◐	●	●	◐	●	Bicycle	87
26	Intersection Density	Infrastructure	Number of intersections per square mile.	SP, MO	Excel, LEED-ND	GIS Data	Good measure to evaluate a study area's efficiency of travel or its degree of connectivity. Has been shown to correlate with non-SOV mode share.	To be effective, local jurisdictions need to establish localized intersection density measures.	●	●	●	◐	●	○	Bicycle, Pedestrian, Motor Vehicle	81

Bicycle Measures

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1	Accessibility to Bike Facilities	Accessibility	Number and percent of population or households living within "X" miles or "Y" minutes of access to bicycle network.	SP, MO	Excel, GIS	Routable GIS network, housing or population data	Good measure for identifying how convenient a facility is to the surrounding land uses.	Measures access to network, not reflective of user experience (quality of facility).	●	●	●	●	◐	○	Bicycle, Land Use	81
38	Multi Modal Level of Service	Mobility	A quantitative stratification that represent a traveler's perceptions of quality of service by a facility.	SP, PA, DR	Excel, HCM	Traffic Volumes, Facility Data for Each Mode	Addresses multiple modes of travel. Reflective of user experience.	More data intensive than LOS calculated for roads or other multimodal measures.	◐	◐	●	◐	◐	●	Bicycle, Pedestrian, Transit	78
2	Accessibility to Destinations	Accessibility	Number of "essential destinations" (hospitals, medical centers, pharmacies, grocery stores, schools, major retail, transit stations, parks/open spaces, and social service centers with more than 200 monthly LIFT pickups, colleges and universities, and major government sites) within a certain walk/bike/transit time or distance.	SP, MO	Excel, GIS	Routable GIS network, Essential Destinations	Good measure for assessing land use impacts. Considers access for all modes.	Measures access to network, but is not reflective of user experience. Requires selection/definition of "destinations."	◐	◐	●	●	◐	○	Bicycle, Pedestrian, Transit, Motor Vehicle, Land Use	69
24	Bicycle Lane-Miles	Infrastructure	Miles of striped bicycle lanes	SP MO	Excel	GIS	Provides a basic assessment of the availability of bicycle facilities (overall or by facility type) within a specific area.	Snapshot measure only evaluates existing supply and does not differentiate between facility quality. Limited applicability in assessing non-infrastructure changes such as development review.	●	●	◐	●	●	○	Bicycle	60
8	Bike/Pedestrian Route Directness Index (RDI)	Accessibility	Ratio of shortest path route distance to straight line distance for two selected points. Applied to an area, the average RDI for multiple essential destination types is averaged for each taxlot or TAZ.	SP	Excel, GIS	Routable GIS network	Useful in measuring general connectivity of the network.	Does not take into account user experience in determining safest or least stressful route.	●	●	◐	●	●	○	Bicycle, Pedestrian	60
42	Person Hours of Travel (PHT)	Mobility	Person hours of travel within a specified area and time period	SP, MO	Travel Demand Model/Synchro	Traffic Volumes	Measures impact on productivity and quality of life. Can be combined with a value of time measure.	Does not directly relate to planning goals. May be difficult to interpret.	◐	◐	◐	●	●	○	Bicycle, Pedestrian, Transit, Motor Vehicle	52

Bicycle Measures

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39	Non Drive-Along Mode Share	Mobility	Percent of trips using non-drive alone mode (public transit, walking, bicycling)	SP, MO	Travel Demand Model	Model Inputs, Including Mode Choice	Mode share connects directly to local and regional goals.	Not reflective of user experience.	●	●	●	●	●	○	Bicycle, Pedestrian, Transit, Motor Vehicle	46
31	Bicycle Mode Share	Mobility	Percent of trips made by bicycle.	SP, MO	Travel Demand Model	Model Inputs, Including Mode Choice	Mode share connects directly to local and regional goals.	Not reflective of user experience.	●	●	●	●	●	○	Bicycle	40
32	Bicycle VMT	Mobility	Bicycle-miles traveled within a specified area and time period.	SP, MO	Metro Bike Model	Bike volumes	Provides a basic benchmark for assessing overall bicycle travel.	Not reflective of user experience.	●	●	●	○	○	○	Bicycle	36
3	Accessibility to Employment and Population	Accessibility	Measures access to job markets by single or composite modes within a specific time period.	SP, MO	Excel, GIS, Forecasting Tools	Requires extensive data on employment, routable street and transit network	Good measure for assessing land use impacts.	Detailed and up-to-date employment data may not be available.	●	●	●	●	○	○	Bicycle, Pedestrian, Transit, Motor Vehicle, Land Use	36
43	Person-throughput	Mobility	Measures how many people can be served along a corridor, incorporating personal vehicle and transit vehicle occupancy	SP, MO	Travel Demand Model, Bike Model, Excel	Transit service data, traffic counts (for base year)	Incorporates multiple modes within the measures, can be stratified by mode.	Data intensive, limited applicability beyond corridor planning.	○	○	●	●	●	○	Bicycle, Pedestrian, Transit, Motor Vehicle	32
13	Street Layout	Accessibility	A measure of the street layout in an area. For instance, small blocks and grid system may be preferable to long, winding streets, cul-de-sacs and dead ends.	SP	Excel, GIS	GIS network	Gives a basic measure of how grid-like the street network is.	Difficult to apply consistently, more subjective and not quantifiable. Doesn't account for facility quality.	●	●	○	●	●	○	Bicycle, Pedestrian, Motor Vehicle	26
7	Bike Storage Facility Utilization	Accessibility	Percent of total available bike storage capacity used on an average (hourly, daily, etc) basis.	SP	Excel	Bike storage facility utilization data; inventory of total storage capacity	Good measure to help prioritize use of funding and resources.	Limited application in assessing the adequacy of TSPs or PA.	○	●	○	●	○	○	Bicycle	17

Transit Measures

ID #	Alternative Performance Measure	Category	Description	Planning Level	Tools Needed	Data Needed	Strengths	Weaknesses	Level of Effort	Is measure ready for regular use?	Applicability to the CRCDDPA	Tool Availability	Data Availability	Appropriate for Dev Rev?	Mode	Overall Score
36	Duration of Congestion	Mobility	Number of hours that a facility exceeds a set volume-to-capacity ratio.	SP, PA, DR, MO	Travel Demand Model (Gamma)	Model data	Reflective of user experience. Can be used to identify project priorities based on extent of congestion measured.	Importance of peak hour may vary by context.	◐	◐	●	●	●	●	Motor Vehicle, Transit, Freight	96
35	Destination Travel Times	Mobility	Evaluates mid-day and pm peak motor vehicle travel time between regional origin-destination pairs. OR Evaluates mid-day and pm peak transit travel time between regional origin-destination pairs.	SP, MO	Travel Demand Model, Synchro	Model Inputs	Can evaluate travel times for both auto and transit modes for most important O-D pairs.	Importance of peak hour may vary by context.	●	●	●	●	●	○	Motor Vehicle, Transit, Freight	90
5	Accessibility to Transit	Accessibility	Number and percent of population or households living within "X" miles or "Y" minutes of access to fixed-route transit.	SP, MO	Excel, GIS	GIS-based housing and transit data	Good measure for identifying gaps in network accessibility.	Measures access to network, but is not reflective of user experience.	●	●	●	●	●	○	Transit, Land Use	90
29	Transit Supply	Infrastructure	Miles of transit service, service frequency, average headway, etc.	SP, MO	Excel	GIS, Transit Performance Data	Provides a basic assessment of transit service provided within a geographic area. Used to identify the gap between level of transit service (supply) and needs of a particular population (demand).	Snapshot measure only evaluates existing supply. Limited applicability in assessing non-infrastructure changes such as development review.	●	●	●	●	◐	○	Transit	81
21	Accessibility to Frequent Transit Service	Equity	Number or percent of homes and environmental justice communities within half mile of high capacity transit or quarter mile of frequent bus service.	SP, MO	GIS, Excel	Routable GIS network, transit data, land use data.	Correlates population to proximity of high capacity transit. Easily understood by the public.	Measures access to high capacity transit, but is not reflective of user experience.	●	●	●	●	◐	○	Transit, Land Use	81

Transit Measures

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38	Multi Modal Level of Service	Mobility	A quantitative stratification that represent a traveler's perceptions of quality of service by a facility.	SP, PA, DR	Excel, HCM	Traffic Volumes, Facility Data for Each Mode	Addresses multiple modes of travel. Reflective of user experience.	More data intensive than LOS calculated for roads or other multimodal measures.	●	●	●	●	●	●	Bicycle, Pedestrian, Transit	78
2	Accessibility to Destinations	Accessibility	Number of "essential destinations" (hospitals, medical centers, pharmacies, grocery stores, schools, major retail, transit stations, parks/open spaces, and social service centers with more than 200 monthly LIFT pickups, colleges and universities, and major government sites) within a certain walk/bike/transit time or distance.	SP, MO	Excel, GIS	Routable GIS network, Essential Destinations	Good measure for assessing land use impacts. Considers access for all modes.	Measures access to network, but is not reflective of user experience. Requires selection/definition of "destinations."	●	●	●	●	●	○	Bicycle, Pedestrian, Transit, Motor Vehicle, Land Use	69
45	Transit LOS	Mobility	Quantitative measure that represents a traveler's perception of quality of service	SP	Excel, HCM	Facility data, vehicle data, service characteristics	Correlates to user experience.	Forecasting requires estimates of difficult-to-predict attributes such as delay and passenger crowding.	●	●	●	●	●	○	Transit	60
50	Buffer Index	Reliability	Percent of extra travel time travelers add to expected travel time to ensure on-time arrival X percent of time	SP, MO	Travel Demand Model, Synchro	Model Inputs	Reflective of user experience and indicative of congestion levels and impacts to productivity/quality of life.	Addresses only a single mode of transportation.	○	○	●	●	●	○	Motor Vehicle, Transit, Freight	57
23	Ridership Productivity	Equity	Ratio of passenger boardings to vehicle hour of service.	Transit Planning	Excel	Transit Utilization Data	Is a good measure of how productive the route for prioritization of needs and resources.	Does not define quality for the rider, it is a transit owner/operator measure of productivity.	●	●	●	●	●	○	Transit	54
42	Person Hours of Travel (PHT)	Mobility	Person hours of travel within a specified area and time period	SP, MO	Travel Demand Model/Synchro	Traffic Volumes	Measures impact on productivity and quality of life. Can be combined with a value of time measure.	Does not directly relate to planning goals. May be difficult to interpret.	●	●	●	●	●	○	Bicycle, Pedestrian, Transit, Motor Vehicle	52
46	Transit Mode Share	Mobility	Percent of trips using transit.	SP, MO	Travel Demand Model	Model Inputs, Including Mode Choice	Mode share connects directly to local and regional goals.	Not reflective of user experience.	●	●	●	●	●	○	Transit	46

Transit Measures

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40	O-D Travel Time	Mobility	Time required to travel between a given origin-destination pair.	SP, MO	Excel	Traffic Volumes, Bluetooth Study	Relatable measure to the public and a good indicator of the system performance. New GPS and smartphone applications are making data collection and analysis of this measure easier than was historically.	Data intensive; methodology only applicable to existing conditions.	●	●	●	●	●	○	Motor Vehicle, Transit, Freight	46
39	Non Drive-Along Mode Share	Mobility	Percent of trips using non-drive alone mode (public transit, walking, bicycling)	SP, MO	Travel Demand Model	Model Inputs, Including Mode Choice	Mode share connects directly to local and regional goals.	Not reflective of user experience.	●	●	●	●	●	○	Bicycle, Pedestrian, Transit, Motor Vehicle	46
33	Corridor Travel Time	Mobility	Time required to traverse a segment or corridor.	SP, MO	Excel	Traffic Volumes, Bluetooth Study	Relatable measure to the public and a good indicator of the system or individual corridor performance. New GPS and smartphone applications are making data collection and analysis of this measure easier than was historically.	May fluctuate considerably during different days/time periods. Data intensive; methodology only applicable to existing conditions.	●	●	●	●	●	○	Motor Vehicle, Transit, Freight	46
49	80th Percentile Travel Time index	Reliability	Travel time corresponding to the 80th highest out of 100 trips.	SP, MO	DTA	Traffic Volumes	Reflective of user experience and indicative of congestion levels.	Addresses only a single mode of transportation.	●	●	●	○	●	○	Motor Vehicle, Transit, Freight	40
3	Accessibility to Employment and Population	Accessibility	Measures access to job markets by single or composite modes within a specific time period.	SP, MO	Excel, GIS, Forecasting Tools	Requires extensive data on employment, routable street and transit network	Good measure for assessing land use impacts.	Detailed and up-to-date employment data may not be available.	●	●	●	●	○	○	Bicycle, Pedestrian, Transit, Motor Vehicle, Land Use	36

Transit Measures

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43	Person-throughput	Mobility	Measures how many people can be served along a corridor, incorporating personal vehicle and transit vehicle occupancy	SP, MO	Travel Demand Model, Bike Model, Excel	Transit service data, traffic counts (for base year)	Incorporates multiple modes within the measures, can be stratified by mode.	Data intensive, limited applicability beyond corridor planning.	○	○	◐	◐	◐	○	Bicycle, Pedestrian, Transit, Motor Vehicle	32



Freight Measures

ID #	Alternative Performance Measure	Category	Description	Planning Level	Tools Needed	Data Needed	Strengths	Weaknesses	Level of Effort	Is measure ready for regular use?	Applicability to the CRCDDPA	Tool Availability	Data Availability	Appropriate for Dev Rev?	Mode	Overall Score
36	Duration of Congestion	Mobility	Number of hours that a facility exceeds a set volume-to-capacity ratio.	SP, PA, DR, MO	Travel Demand Model (Gamma)	Model data	Reflective of user experience. Can be used to identify project priorities based on extent of congestion measured.	Importance of peak hour may vary by context.	◐	◐	●	●	●	●	Motor Vehicle, Transit, Freight	96
35	Destination Travel Times	Mobility	Evaluates mid-day and pm peak motor vehicle travel time between regional origin-destination pairs. OR Evaluates mid-day and pm peak transit travel time between regional origin-destination pairs.	SP, MO	Travel Demand Model, Synchro	Model Inputs	Can evaluate travel times for both auto and transit modes for most important O-D pairs.	Importance of peak hour may vary by context.	●	●	●	●	●	○	Motor Vehicle, Transit, Freight	90
34	Delay on Regional Freight Network	Mobility	Evaluates traffic delay for freight movement in the one-hour mid-day travel period and in the two-hour pm rush hour.	SP, MO	Travel Demand Model/Synchro	Traffic Volumes	Reflective of user experience.	Addresses only a single mode of transportation.	●	●	●	●	◐	○	Freight	81
4	Accessibility to Freight	Accessibility	Number and percent of industry specific jobs within "X" miles or "Y" minutes of the regional freight network.	SP, MO	Excel, GIS	GIS-based employment and regional freight network data	Good measure for assessing connectivity of jobs to freight network.	Measures access to network, but is not reflective of user experience.	●	●	●	●	◐	○	Freight, Land Use	81

Freight Measures

ID #	Alternative Performance Measure	Category	Description	Planning Level	Tools Needed	Data Needed	Strengths	Weaknesses	Level of Effort	Is measure ready for regular use?	Applicability to the CRCDDPA	Tool Availability	Data Availability	Appropriate for Dev Rev?	Mode	Overall Score
53	Vehicle-Hours of Delay (VHD) for Freight	Reliability	Vehicle hours of delay per truck trip during the two-hour PM peak period.	SP, MO	Travel Demand Model, Synchro	Model Inputs	Focuses on congestion impacts for the most economically valuable movements.	Addresses only a single mode of transportation; relies on assumption of time of day for freight movement.	●	●	●	●	●	○	Freight	69
50	Buffer Index	Reliability	Percent of extra travel time travelers add to expected travel time to ensure on-time arrival X percent of time	SP, MO	Travel Demand Model, Synchro	Model Inputs	Reflective of user experience and indicative of congestion levels and impacts to productivity/quality of life.	Addresses only a single mode of transportation.	○	○	●	●	●	○	Motor Vehicle, Transit, Freight	57
51	Cost of Delay to Economy	Reliability	Cost of delay on regional freight network in mid-day and PM peak	SP, MO	Travel Demand Model/Synchro	Traffic Volumes, Value of Time.	Estimates a dollar amount of economic impact, is relatable for industry and decision-makers.	Value of time for freight can vary substantially depending on industry sector; requires assumption of likely time of day for freight movements.	●	●	●	●	●	○	Freight	46

Freight Measures

ID #	Alternative Performance Measure	Category	Description	Planning Level	Tools Needed	Data Needed	Strengths	Weaknesses	Level of Effort	Is measure ready for regular use?	Applicability to the CRCDDPA	Tool Availability	Data Availability	Appropriate for Dev Rev?	Mode	Overall Score
40	O-D Travel Time	Mobility	Time required to travel between a given origin-destination pair.	SP, MO	Excel	Traffic Volumes, Bluetooth Study	Relatable measure to the public and a good indicator of the system performance. New GPS and smartphone applications are making data collection and analysis of this measure easier than was historically.	Data intensive; methodology only applicable to existing conditions.	●	●	●	●	●	○	Motor Vehicle, Transit, Freight	46
33	Corridor Travel Time	Mobility	Time required to traverse a segment or corridor.	SP, MO	Excel	Traffic Volumes, Bluetooth Study	Relatable measure to the public and a good indicator of the system or individual corridor performance. New GPS and smartphone applications are making data collection and analysis of this measure easier than was historically.	May fluctuate considerably during different days/time periods. Data intensive; methodology only applicable to existing conditions.	●	●	●	●	●	○	Motor Vehicle, Transit, Freight	46
49	80th Percentile Travel Time index	Reliability	Travel time corresponding to the 80th highest out of 100 trips.	SP, MO	DTA	Traffic Volumes	Reflective of user experience and indicative of congestion levels.	Addresses only a single mode of transportation.	●	●	●	○	●	○	Motor Vehicle, Transit, Freight	40

Motor Vehicle Measures

ID #	Alternative Performance Measure	Category	Description	Planning Level	Tools Needed	Data Needed	Strengths	Weaknesses	Level of Effort	Is measure ready for regular use?	Applicability to the CRCDPA	Tool Availability	Data Availability	Appropriate for Dev Rev?	Mode	Overall Score
48	Volume-to-Capacity Ratio	Mobility	Ratio of traffic volume compared to traffic capacity of a link or intersection.	SP, PA, DR, MO	Travel Demand Model, Synchro or Vistro	Traffic counts, model data	The volume-to-capacity measure is clear, objective, and precise.	Is not a multimodal performance measure as it only applies to auto travel.	●	●	●	●	●	●	Motor Vehicle	108
36	Duration of Congestion	Mobility	Number of hours that a facility exceeds a set volume-to-capacity ratio.	SP, PA, DR, MO	Travel Demand Model (Gamma)	Model data	Reflective of user experience. Can be used to identify project priorities based on extent of congestion measured.	Importance of peak hour may vary by context.	◐	◐	●	●	●	●	Motor Vehicle, Transit, Freight	96
35	Destination Travel Times	Mobility	Evaluates mid-day and pm peak motor vehicle travel time between regional origin-destination pairs. OR Evaluates mid-day and pm peak transit travel time between regional origin-destination pairs.	SP, MO	Travel Demand Model, Synchro	Model Inputs	Can evaluate travel times for both auto and transit modes for most important O-D pairs.	Importance of peak hour may vary by context.	●	●	●	●	●	○	Motor Vehicle, Transit, Freight	90
28	System Completeness	Infrastructure	Percent of planned arterials that are built Percent of planned bike facilities that are built Percent of planned pedestrian facilities that are built The System Completeness measure is a progress tracking measure that allows jurisdictions to track the completion of planned network improvements in a TSP. While primarily a TSP related measure, this measure can also be used in certain land use plan amendment settings and zone changes where the impacts of the potential subsequent development under the new zoning and/or plan designations could be evaluated and mitigated based on the ability to show progress toward completing the planned infrastructure.	SP, PA, DR, MO	GIS, Excel	In application, this measure requires detailed inventories of constructed arterials, bike lanes, sidewalks, and multi-use paths. A quantified database of planned arterials, bike lanes, sidewalks, and multi-use paths is also required in order to track progress.	Provides a good measuring tool for assessing progress of the transportation plan or capital improvement plan.	Requires detailed dataset. May not be best approach for all modes.	◐	◐	●	●	◐	●	Bicycle, Pedestrian, Motor Vehicle	87

Motor Vehicle Measures

ID #	Alternative Performance Measure	Category	Description	Planning Level	Tools Needed	Data Needed	Strengths	Weaknesses	Level of Effort	Is measure ready for regular use?	Applicability to the CRCDPA	Tool Availability	Data Availability	Appropriate for Dev Rev?	Mode	Overall Score
26	Intersection Density	Infrastructure	Number of intersections per square mile.	SP, MO	Excel, LEED-ND	GIS Data	Good measure to evaluate a study area's efficiency of travel or its degree of connectivity. Has been shown to correlate with non-SOV mode share.	To be effective, local jurisdictions need to establish localized intersection density measures.	●	●	●	●	●	○	Bicycle, Pedestrian, Motor Vehicle	81
2	Accessibility to Destinations	Accessibility	Number of "essential destinations" (hospitals, medical centers, pharmacies, grocery stores, schools, major retail, transit stations, parks/open spaces, and social service centers with more than 200 monthly LIFT pickups, colleges and universities, and major government sites) within a certain walk/bike/transit time or distance.	SP, MO	Excel, GIS	Routable GIS network, Essential Destinations	Good measure for assessing land use impacts. Considers access for all modes.	Measures access to network, but is not reflective of user experience. Requires selection/definition of "destinations."	●	●	●	●	●	○	Bicycle, Pedestrian, Transit, Motor Vehicle, Land Use	69
47	VMT (total or per capita)	Mobility	Vehicle miles traveled within a specified area and time period. Metro RTP includes system-wide evaluation of average weekday (AWD) total and per person vehicle miles traveled (VMT).	SP	Travel Demand Model	Traffic Volumes	Provides a basic benchmark for assessing overall auto travel.	Typically a region/system wide evaluation. VMT changes in smaller study areas may be difficult to interpret and/or appear insignificant.	●	●	●	●	●	○	Motor Vehicle	60
50	Buffer Index	Reliability	Percent of extra travel time travelers add to expected travel time to ensure on-time arrival X percent of time	SP, MO	Travel Demand Model, Synchro	Model Inputs	Reflective of user experience and indicative of congestion levels and impacts to productivity/quality of life.	Addresses only a single mode of transportation.	○	○	●	●	●	○	Motor Vehicle, Transit, Freight	57
42	Person Hours of Travel (PHT)	Mobility	Person hours of travel within a specified area and time period	SP, MO	Travel Demand Model/Synchro	Traffic Volumes	Measures impact on productivity and quality of life. Can be combined with a value of time measure.	Does not directly relate to planning goals. May be difficult to interpret.	●	●	●	●	●	○	Bicycle, Pedestrian, Transit, Motor Vehicle	52

Motor Vehicle Measures

ID #	Alternative Performance Measure	Category	Description	Planning Level	Tools Needed	Data Needed	Strengths	Weaknesses	Level of Effort	Is measure ready for regular use?	Applicability to the CRCDPA	Tool Availability	Data Availability	Appropriate for Dev Rev?	Mode	Overall Score
54	Vehicle-Hours of Delay (VHD) per person	Reliability	Vehicle hours of delay per person in the two-hour PM peak period.	SP, MO	Travel Demand Model, Synchro	Model Inputs	Can reflect positive benefit of moving travelers to modes, times, and routes that experience less delay; reflective of user experience and indicative of congestion levels.	May be complex calculation depending on how many modes are included in the calculation.	●	●	●	●	●	○	Motor Vehicle	46
40	O-D Travel Time	Mobility	Time required to travel between a given origin-destination pair.	SP, MO	Excel	Traffic Volumes, Bluetooth Study	Relatable measure to the public and a good indicator of the system performance. New GPS and smartphone applications are making data collection and analysis of this measure easier than was historically.	Data intensive; methodology only applicable to existing conditions.	●	●	●	●	●	○	Motor Vehicle, Transit, Freight	46
39	Non Drive-Along Mode Share	Mobility	Percent of trips using non-drive alone mode (public transit, walking, bicycling)	SP, MO	Travel Demand Model	Model Inputs, Including Mode Choice	Mode share connects directly to local and regional goals.	Not reflective of user experience.	●	●	●	●	●	○	Bicycle, Pedestrian, Transit, Motor Vehicle	46
33	Corridor Travel Time	Mobility	Time required to traverse a segment or corridor.	SP, MO	Excel	Traffic Volumes, Bluetooth Study	Relatable measure to the public and a good indicator of the system or individual corridor performance. New GPS and smartphone applications are making data collection and analysis of this measure easier than was historically.	May fluctuate considerably during different days/time periods. Data intensive; methodology only applicable to existing conditions.	●	●	●	●	●	○	Motor Vehicle, Transit, Freight	46
49	80th Percentile Travel Time index	Reliability	Travel time corresponding to the 80th highest out of 100 trips.	SP, MO	DTA	Traffic Volumes	Reflective of user experience and indicative of congestion levels.	Addresses only a single mode of transportation.	●	●	●	○	●	○	Motor Vehicle, Transit, Freight	40

Motor Vehicle Measures

ID #	Alternative Performance Measure	Category	Description	Planning Level	Tools Needed	Data Needed	Strengths	Weaknesses	Level of Effort	Is measure ready for regular use?	Applicability to the CRCDDPA	Tool Availability	Data Availability	Appropriate for Dev Rev?	Mode	Overall Score
3	Accessibility to Employment and Population	Accessibility	Measures access to job markets by single or composite modes within a specific time period.	SP, MO	Excel, GIS, Forecasting Tools	Requires extensive data on employment, routable street and transit network	Good measure for assessing land use impacts.	Detailed and up-to-date employment data may not be available.	●	●	●	●	○	○	Bicycle, Pedestrian, Transit, Motor Vehicle, Land Use	36
52	On-Time Arrivals	Reliability	Percent of trips that reach a given destination over a designated facility within a specified travel time.	SP, MO	DTA	Traffic Volumes	Reflective of user experience and indicative of congestion levels.	Addresses only a single mode of transportation.	●	○	●	○	●	○	Motor Vehicle	32
43	Person-throughput	Mobility	Measures how many people can be served along a corridor, incorporating personal vehicle and transit vehicle occupancy	SP, MO	Travel Demand Model, Bike Model, Excel	Transit service data, traffic counts (for base year)	Incorporates multiple modes within the measures, can be stratified by mode.	Data intensive, limited applicability beyond corridor planning.	○	○	●	●	●	○	Bicycle, Pedestrian, Transit, Motor Vehicle	32
13	Street Layout	Accessibility	A measure of the street layout in an area. For instance, small blocks and grid system may be preferable to long, winding streets, cul-de-sacs and dead ends.	SP	Excel, GIS	GIS network	Gives a basic measure of how grid-like the street network is.	Difficult to apply consistently, more subjective and not quantifiable. Doesn't account for facility quality.	●	●	○	●	●	○	Bicycle, Pedestrian, Motor Vehicle	26

Safety Measures

ID #	Alternative Performance Measure	Category	Description	Planning Level	Tools Needed	Data Needed	Strengths	Weaknesses	Level of Effort	Is measure ready for regular use?	Applicability to the CRCDDPA	Tool Availability	Data Availability	Appropriate for Dev Rev?	Mode	Overall Score
56	Critical Crash Rate	Safety	Establishes a threshold to which to compare each site's crash rate. Sites with crash rates above the threshold are flagged for further investigation.	SP, DR, MO	Excel, GIS	Crash Data, Traffic Volumes	Establishes a crash rate threshold to identify sites for focus on safety improvements. Can be evaluated for target severities, for example using fatal and injury crash rate or by mode.	Works best with a large, representative reference population to establish statistical significance. Requires threshold be determined.	●	●	●	●	●	●	Safety	108
62	Annual Total of Serious + Fatal Crashes	Safety	Total number of serious injuries and fatalities resulting from collisions on an annual basis.	SP, MO	Excel, GIS	Crash Data	Establishes annual benchmark to measure reduction in serious+fatal crashes compared to overall goal.	More global indicator of systemwide safety, but does provide an annual benchmark in which to assess trends in total serious+fatal crashes involving different modes.	●	●	●	●	●	○	Safety	90
61	Excess Proportions of Specific Crash Types	Safety	Measures whether certain crash types are overrepresented at a specific site.	SP, DR, MO	Excel, GIS	Crash Data	Evaluates crash types quantitatively, can be used to evaluate safety for pedestrians and bicyclists.	Works best with a large, representative reference population to establish statistical significance.	◐	◐	●	●	●	◐	Safety	90
59	Crashes Involving Heavy Trucks	Safety	The number of collisions involving heavy truck or freight annually, in total, involving cars, and involving vulnerable users.	SP, DR, MO	Excel, GIS	Crash Data	Can be used to identify high frequency crash locations where involvement of heavy trucks is a reoccurring factor.	Difficult to forecast. While crash frequencies alone are not indicative of needed improvements, can	◐	◐	●	●	●	◐	Safety	90
58	Crashes Involving Excessive Speed	Safety	The number of collisions attributed to speeding annually, in total, involving cars, and involving vulnerable users.	SP, DR, MO	Excel, GIS	Crash Data	Can be used to identify high frequency crash locations where excessive speed is a reoccurring factor.	Difficult to forecast. While crash frequencies alone are not indicative of needed	◐	◐	●	●	●	◐	Safety	90
57	Crashes Frequency Involving Vulnerable Users	Safety	The frequency of fatalities plus serious injuries for vulnerable users including pedestrians, bicyclists, and motorcyclists.	SP, DR, MO	Excel, GIS	Crash Data	Can be used to identify high frequency crash locations that involve vulnerable users.	Difficult to forecast. While crash frequencies alone are not indicative of needed improvements, can	◐	◐	●	●	●	◐	Safety	90

Safety Measures

ID #	Alternative Performance Measure	Category	Description	Planning Level	Tools Needed	Data Needed	Strengths	Weaknesses	Level of Effort	Is measure ready for regular use?	Applicability to the CRCDDPA	Tool Availability	Data Availability	Appropriate for Dev Rev?	Mode	Overall Score
60	Speed Limit Exceeded	Safety	The percentage of vehicles traveling over the posted speed limit along a specified corridor.	SP, MO	Excel, GIS	Speed Data, Traffic Volumes	Can be used to identify areas where the posted speed limit is frequency exceeded.	Behavioral measure intended to identify areas for additional enforcement.	◐	◐	●	●	◐	○	Safety	69

