Literature Review:

Oregon State Studies and Plans

(Task 3.2)

ODOT Freight Highway Bottlenecks Project

TGM 2D-14: Technical Memo

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FINAL

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1 INTRODUCTION AND EXECUTIVE SUMMARY

Six plans and reports are summarized in this memorandum. They represent Oregon bottleneck or congestion studies and/or related economic analyses. Each study focuses on various key data and emerging metrics. To the extent possible, key findings from each study are introduced and summarized to note data sources used, available tools and methods, factors of success, lessons learned, and transferability.

To assist the reader, each of the plans and reports are briefly highlighted here, noting their key findings and chapter reference. General observations are noted at the end of this section.

- ✓ **ODOT** – Oregon State Highway Performance Data and Metrics Related to Freight: Statewide review of 19 corridors. Builds on previous work done for the Oregon Freight Plan using Highway Performance Monitoring System (HPMS) and the FHWA Highway Economic Requirements State version (HERS-ST) and ODOT Statewide Integrated Model (SWIM) data (Chapter 2).
- ✓ **Greater Portland Export Initiative** – Westside Freight Access and Logistics Analysis: Focused on movement of Washington County computer and electronics goods to Portland International Airport using a range of data sources including probe data (INRIX, Tom Tom), American Transportation Research Institute (ATRI) freight data, ODOT incident logs, and Washington County volume data (Chapter 3).
- ✓ **ODOT** – 2013 Corridor Bottleneck Operations Study: Portland Metro region identification of recurring bottlenecks on the ODOT freeway system using ODOT freeway detector data, travel time runs and staff knowledge (Chapter 4).
- ✓ **Portland Business Alliance, Oregon Business Council, and Port of Portland** – Economic Impacts of Congestion in Oregon: Statewide economic study which examined the impacts of congestion to the state economy with emphasis on highway freight impacts. Metropolitan Planning Organizations travel demand models were used for analysis of the impact of congestion on highway freight mobility (Chapter 5).
- ✓ **ODOT** – Estimated Impact of Cascadia Subduction Zone Earthquake: Evaluation of the economic impact on the transportation system in the event of a 9.0 earthquake. This study used ODOT's SWIM model (Chapter 6).

General Observations

The studies reviewed in this report are varied in their methods, data sources and evaluation measures, which makes direct comparisons challenging. Each methodology and data source has its limitations, which are not all summarized in this review. Some general observations about the trends and data sources include:

- The Oregon State Highway Performance Data and Metrics related to freight conducted by ODOT provides a strong technical and methodological base applicable to this study with the following notes:

    - Expanding the study to all state highways will provide a more comprehensive review.
    - Integrating probe data, which includes direct measurement of current speeds, would allow additional travel time and reliability measures, which are critical to the freight industry. It would also provide more data coverage from a geographic perspective, although it is still limited in rural locations with low volumes.

- Both the Westside Freight Access and Logistics Analysis and the Corridor Bottleneck Operations Study covered only the Portland Metro area.
- The Westside Freight Access and Logistics Analysis used a combination of probe data from INRIX, TomTom and freight specific data from ATRI. The TomTom data was dropped from the study due to limited ability of the historical data to capture unique operating issues.
- Engagement with a broad set of stakeholders in the Westside Logistics study helped identify issues quickly and foster support.
- Economic Impacts of Congestion in Oregon study used MPO travel demand models and the Transportation Economic Development Impact System (TREDIS) model. The SWIM model would provide broader coverage than the MPO models but may not have the detail those models provide.
- The Cascadia Subduction Zone study looked at economic impacts of failures of key transportation links, not specifically at capacity or operational bottlenecks. The study suggests the potential to use the SWIM model for freight bottleneck analysis.

2 OREGON STATE HIGHWAY PERFORMANCE DATA AND METRICS RELATED TO FREIGHT[1]

This report evaluated the performance of 19 highway corridors using standardized metrics. The report presents a detailed profile for each corridor using a variety of measures. It provides summary comparisons for the following metrics:

- top three industries utilizing each corridor by value and weight
- top three commodities moving across each corridor by value and weight
- congestion by type
- truck share of VMT
- total VMT
- total delay

DATA SOURCES USED

The metrics used in the analysis are from 2010 and come from two sources: the *Highway Economic Requirements System – State* version (HERS-ST) and the *Oregon Statewide Integrated Model* (SWIM).

- HERS- ST metrics used include:
    - average annual daily traffic
    - daily vehicle miles traveled
    - percent trucks
    - vehicle operating costs (dollars per 1000 VMT)
    - vehicle travel time costs (dollars per 1000 VMT)
    - annual crash costs (dollars per 1000 VMT)
    - annual hours of delay (hours per 1000 VMT)
    - volume to capacity ratio
    - hours of delay per 1000 VMT
    - corridor average user (auto and truck) costs (dollars per 1000 VMT for operational costs, travel time, and crash costs)
    - proportion of corridor miles by grade and curvature category.

- SWIM metrics included corridor commodity flows by value and tonnage and industries using corridor commodities
- Oregon crash data from 2010

SIGNIFICANT ISSUES IDENTIFIED

The available HERS-ST data was for year 2006. HERS-ST data comes from the Highway Performance Monitoring System (HPMS) data submittal to the Federal Highway Administration (FHWA). The HPMS data format changed between years 2006 and 2011. ODOT had not yet developed an automated process to produce a HERS-ST input database. Thus, updating the input data required significant effort and manual processes. Given the ambitious timeline of this bottleneck study, ODOT updated the data

[1] *Source: ODOT, 2013*

for 2010 using a methodology that produced about 90% accuracy and completeness. Thus, the highway use data was estimated for 2010, but the detailed infrastructure inventory conditions data was assumed to be the same as it was in 2006. As a result, there were a small number of errors within the data set, which were not expected to significantly affect the outcome of the analysis.

AVAILABLE TOOLS AND METHODOLOGY

Each corridor profile included a number of measures noted above in data sources. Each profile followed a consistent format:

Corridor overview includes the location of the corridor, length, average daily traffic volume, and the amount of truck contribution to traffic.

Economic characteristics are identified by the industries that represent highest use of the corridor measured by value and by weight. Two graphs are provided; the first reports the corridor's share of all commodity flows moving along all 19 bottleneck corridors, the second shows individual industry use of the corridor as a percentage of total industry use. This data came from the Oregon Freight Plan reference scenario.

Corridor performance is analyzed using several performance metrics, including: traffic volumes, volume to capacity ratios, corridor geometrics, delay and reliability, user costs (operational, time, and crashes), crash incidents (total number of crashes, share of crashes truck related, accident rate), number of SPIS sites, and corridor restrictions. The section includes a table showing the truck share of ADT and VMT along the highway and a figure showing the range of volume to capacity ratios and AADT for the highway.

Corridor geometrics are summarized by the degree of curvature and grade along the corridor. Highway segments with a grade of 2.5% or greater, or with curves of 3.5 degrees or greater, are identified as geometrical causes of vehicle delay. The data is summarized in a table showing percentage of the corridor with incremental degrees of curvature and grade.

Corridor delay and reliability is analyzed using average annual hours of delay and sources of delay (geometrics, urban or rural traffic incidents, capacity constraints). The data is presented in a graph showing the annual average delay for each mile point and a table that presents a breakdown of corridor delay for rural and urban segments by cause (zero volume delay [delay related to geometry of the road and not the number of cars present], incident delay, congestion delay, and total delay).

User costs are reported using the following reported as dollars per 1000 VMT: truck operating costs, truck travel time costs, and vehicle crash costs. Total average user costs are broken down in a table showing vehicle operating costs, travel time costs, and crash costs (crash costs are based on HERS-ST data). The final table in each section summarizes crash statistics by: total number of crashes, truck involved crashes, corridor crash rate, statewide crash rate (for the same functional class), corridor average crash costs, number of top 10% SPIS sites on corridor, and whether the corridor is a truck safety corridor.

SIGNIFICANT FACTORS OF SUCCESS OR *LESSONS LEARNED*

The methodology was developed to accommodate a periodic update effort. Preparation for updating this study should address the following:

- Input files to HERS-ST compatible with the new HPMS data format need to be created and data quality control issues resolved. This was a task identified by the Transportation Data Section, but it was not completed by the time this study was conducted. If the data are not available in a compatible format for HERS, additional time will be required to resolve this issue. There are several options:
    1. Manually produce the HERS-ST input file
    2. Create new process to generate metrics directly from HPMS data
    3. Develop a process to update key elements of the HERS-ST input data, similar to the methodology followed for this study

TRANSFERABILITY (OR TRANSFERABLE MEASURES/TOOLS)

The data-driven approach presented in this study builds off of previous work done for the Oregon Freight Plan. The data would need to be updated for this study. ODOT has access to HERS-ST and SWIM models and metrics used in this study. The methodology is applicable to this project. Incorporating probe data into the methodology would allow more direct measurement of reliability measures and may be beneficial given the importance of these measures to the freight industry. Expanding the analysis to all state freight route corridors would provide a more comprehensive statewide review. Replication of the study would need to include the resolution of quality control issues with the data and the creation of an input file for the newer HPMS information into HERS-ST.

3 GREATER PORTLAND EXPORT INITIATIVE: PORTLAND REGION WESTSIDE FREIGHT ACCESS AND LOGISTICS ANALYSIS[2]

The purpose of the analysis was to identify and evaluate projects that would benefit movement of high-value technology exports in the Portland Metropolitan region. Regional agency representatives and the consultant team worked with freight stakeholders to establish freight needs and criteria. Transportation alternatives were developed, analyzed, and recommended to benefit freight primary movements of the region's high-tech goods.

The analysis focused on the outbound movement of the region's westside computer and electronics (C&E) goods to the Portland International Airport (PDX) freight consolidation area located in the northeast part of the metropolitan area. The project team interviewed manufacturers, freight forwarders, and carriers to identify the key freight routes, understand time-of-day and global market logistics needs, and developed performance metrics based on their concerns.

The project team evaluated over 30 improvement concepts identified from existing transportation plans or generated by the project team against the performance metrics to identify strategies with the potential to make significant improvements. Three near-term improvement strategies were identified, focusing on corridor management and ITS solutions, including predictive travel time information, freight ramp-meter bypass lanes, and enhanced freeway incident response.

DATA SOURCES USED

The study used the following array of data sources to support the analysis:

- INRIX travel time data was used to measure average travel time and travel time reliability by time of day. Note ODOT no longer maintains a subscription, but a similar HERE dataset is available.
- TomTom Historical Profiles (travel time) data set was considered but was not used due to the limitations that did not capture unique operational issues[3]. This data is available through ODOT.
- ATRI speed/routing data provided a summary of freight movements accessing the Westside area.
- ODOT incident log was used to determine the number and duration of lane closures along the US 26 and I-5 route segments.
- Washington County traffic count archive provided a summary of heavy vehicles on major county roads.

SIGNIFICANT ISSUES IDENTIFIED

The following issues were identified in the analysis through stakeholder interviews and data analysis:

- Specific issues related to movement of Westside C&E goods include:
    - Limited route choice from Westside to PDX (US 26 or Cornelius Pass)

[2] *Source: DKS, 2013*

[3] The dataset included average fitted travel time profiles by hour of the day, but did not include raw data. Therefore, it did not reflect delay at ramp meters or other extreme peaking in travel time.

    - US 26 travel time reliability
    - I-5 travel time reliability
    - US 30 to Columbia Boulevard connection
    - Cornelius Pass Road condition
    - Freeway access and ramp meters
- Bottlenecks identified by stakeholders specific to the Westside-to-PDX route are:
    - US 26 at the Vista Ridge Tunnel
    - I-5 from the Terwilliger curves to I-405
    - I-5 from I-405 to the Interstate Bridge over the Columbia River
    - The I-5/I-405 loop (including the I-5/I-84 interchange)
    - The St. Johns Bridge, particularly conflicts in the St. Johns neighborhood as freight movements connect to Marine Drive and Columbia Boulevard
- Other regional bottlenecks identified by stakeholders include:
    - The I-205/I-84 interchange
    - The Airport Way/I-205 interchange, particularly for traffic headed north of I-205
    - I-84 east of I-205

AVAILABLE TOOLS AND METHODOLOGY

Many components of the analysis were focused to the specific scope of the project and/or are limited to the Portland region. However, the general measures that were identified as important to stakeholders based in interviews, could be applied for future analyses.

General Goal or Issue Identified	Evaluation Criteria
Fastest Routing[4]	Average travel time (minutes)
Most Direct / Optimal Proximity[5]	Travel Distance (miles) Number of Travel Segments/Corridors Used
Minimize System Performance Variability[6]	Travel time reliability (Buffer Index)
Improve System Redundancy (Connectivity) [7]	Qualitative assessment

SIGNIFICANT FACTORS OF SUCCESS OR *LESSONS LEARNED*

Engagement with a broad set of public and private stakeholders helped foster regional support for the analysis. The analysis built support for the application for, and successful procurement of, TIGER grant funding for advanced traffic management system (ATMS) improvements.

TRANSFERABILITY (OR TRANSFERABLE MEASURES/TOOLS)

While the overall analysis and findings were focused on a specific regional need, components of analysis that are transferable include:

- Specific bottlenecks in Portland region identified by stakeholders could be considered
- Application of performance measures that respond to stakeholder concerns

[4] "Fastest routing" identified as a factor that drives decisions
[5] ibid
[6] "System performance variability (congestion-related)" was identified as a ground routing issue.
[7] Stakeholders universally agreed that the "System lacks redundancy"

- Datasets
    - Travel time dataset (INRIX was used but HERE is available). Such data will likely provide better data in urbanized areas but should also provide some coverage of rural areas. Data is free but additional processing will be required.
    - ODOT Incident log can be applied for statewide facilities. Note that data is free but will require processing.
    - ATRI freight data may require a fee and will require processing.

4 2013 CORRIDOR BOTTLENECK OPERATIONS STUDY[8]

The purpose of Corridor Bottleneck Operations Study (CBOS) was to identify bottleneck locations along five metro area corridors (I-5, I-205, I-84, I-405, and US 26) and recommend measures to alleviate specific congested locations. The findings are the result of a comprehensive review of each corridor, where bottlenecks were evaluated based on their impacts on the system as a whole. The project was broken up into three phases:

1. Phase 1: Corridor-level reconnaissance to identify and validate bottleneck activity and causes
2. Phase 2: Specific site investigation and alternative screening/selection
3. Phase 3: Alternatives analysis, costing, and prioritization

Phase 1 consisted of six technical memoranda presenting corridor-level reconnaissance that provide the foundation for specific site investigation and mitigation options determined in Phases 2 and 3. Phase 2 was focused primarily on design and operations and identified potential mitigation measures that were evaluated and screened by an expert design panel. Phase 3, conducted a more thorough operational and design evaluation of mitigation measures deemed feasible in Phase 2. Though the study was not specific to freight bottleneck operations, the detailed evaluation included traffic modeling to assess various performance measures, which allowed for prioritization of projects on each corridor. The project identified the location and extent of recurring bottlenecks and low cost, easily implementable solutions on the five metro area corridors.

DATA SOURCES USED

The CBOS study used the following data sources to support the analysis:

1. Portland State University Portal website (free of charge) – Used to identify recurring bottleneck locations and the extent of the associated queuing using ODOT freeway detector data archived in the Portal system.
2. Location specific travel time runs (project cost) – Used to confirm the locations and extents of recurring bottleneck locations and provide visual observations to allow the identification of causes for the bottlenecks.
3. ODOT staff knowledge from personal experience or prior project work (free of charge) – Used to supplement the travel time data and inform and confirm field observations.
4. Project team knowledge from personal experience or prior project work (free of charge) – Used to supplement the travel time data and inform and confirm field observations.
5. Data collected from ODOT traffic cameras and/or travel time videos (project cost) – Used as a final source of field observations if initial observations were unsuccessful in identifying the cause(s) of the bottlenecks.

SIGNIFICANT ISSUES IDENTIFIED

The most common causes of bottlenecks identified were lane drops, high volume weaving areas, facility-to-facility interchange ramps, limited sight distance areas, and narrow lanes or lack of shoulders. Specifically, the study found bottlenecks on each corridor as follows:

[8] *Source: ODOT, 2013*

- I-5 - Seven bottlenecks were identified, mostly near the I-205 interchange.
- I-205 - Twelve bottlenecks, spread throughout the corridor, were identified.
- I-84 - Seven bottlenecks identified. Recently constructed projects have addressed four of identified bottlenecks, the remaining three are in the middle of the corridor.
- I-405 - Four bottlenecks, spread throughout the corridor, were identified.
- US 26 -Six bottlenecks were identified, mostly near the Vista Ridge Tunnel and I-405.

Prioritizing the implementation of the identified projects proved to the challenging due to varying perspectives on need along with uncertainty about the priorities and size of potential funding sources. To provide more flexibility, the project moved to a menu approach which provided an overview of the issues, purpose, cost and anticipated benefits of each project. Projects were limited to $20 million and, other than that, no prioritization was performed.

AVAILABLE TOOLS AND METHODOLOGY

For this study, the term bottleneck was used to identify corridor operations that result in a speed of 35 miles per hour or less across all lanes. There were two tiers of analysis used to identify bottlenecks.

The first tier included a corridor-level reconnaissance utilizing loop detector data from the Portland Oregon Regional Transportation Archive Listing (Portal), historical crash data (5 years) from ODOT's Online Crash Database, and a review of Oregon Highway Plan (OHP) mobility standards as they relate to the current operations of each facility. The Portal data was used to identify recurring bottleneck locations for a typical weekday commute during the AM and/or PM peak periods.

The second tier of bottleneck analysis included validation of the Portal observations by means of existing documentation, or further investigation in the form of ODOT video camera footage, field travel time data, and traffic volume collection (to determine saturation flow rates). After validation, the bottleneck locations, activation and deactivation times, duration, and average queue lengths were verified and translated to graphics to combine and visually assess correlations between crash frequency and lane geometry on the facilities.

SIGNIFICANT FACTORS OF SUCCESS OR *LESSONS LEARNED*

While Portal provides a free and easily accessible data source, the validity of the data is not always apparent. It is important to have another source from which to compare the Portal data to obtain an acceptable level of confidence in the data. It was also very important to visually observe (in person or through video) the bottleneck locations to determine the contributing factors to the congestion.

TRANSFERABILITY (OR TRANSFERABLE MEASURES/TOOLS)

While the analysis and findings were focused on general vehicular bottlenecks on five of ODOT's main corridors in the Portland metropolitan area, components of the analysis that are transferable include:

- A large portion of the bottlenecks identified, while not specific to freight, cause congestion across all lanes during multiple hours of the day. The impact to freight on these routes is likely similar to the impact to the typical vehicles.
- Expert technical workshops could be used to identify feasible improvements that are specific to freight movement.

- The improvements, while geared toward improving overall vehicular performance, would likely also improve freight operations in those areas.

5 ECONOMIC IMPACTS OF CONGESTION IN OREGON[9]

The study was sponsored by the Portland Business Alliance, in cooperation with Metro, the Port of Portland, and the Oregon Department of Transportation. The purpose of the study was to examine the economic effects of congestion to the state (with emphasis on highway freight impacts), and the economic impact of investing in seismic retrofits to retain statewide transportation system functionality (resiliency) in the possible event of a major earthquake.

This report examines in detail the nature of business dependence on Oregon's highway system, and the degree of vulnerability to current and future growth in traffic congestion levels. The study documents the core industries in western Oregon, particularly 'traded' industry which relies on high-quality transportation network service. Key characteristics of 'traded' industries are:

- Provide products and services to markets beyond Portland metro area (and Oregon)
- International and intra-US trade
- Support local-serving industries
- Depend on transport connections
- Can expand or relocate elsewhere if Portland/Western Oregon location becomes less competitive

The analysis of traffic congestion and the impact of congestion on highway freight mobility is restricted to the travel demand models for the Metro, Bend, Corvallis and Mid-Willamette Valley Metropolitan Planning Organizations (MPOs). Statewide bottleneck corridors from the 2013 TPAU effort are referenced, but no new bottleneck analysis was performed.

The study included interviews with key Oregon businesses as to the nature and extent of congestion impacts on their operations.

DATA SOURCES USED

MPO travel demand models (Portland, Salem, Bend, Corvallis) to summarize base and future year travel and traffic congestion data. A "Congested Future Scenario", which only included existing and committed projects, was compared to an "Improved Future Scenario", which included the full preferred future scenario (non-financially constrained) for each Regional Long Range Transportation Plan.

An input-output model[10] was used to calculate the economic impact of the changes in congestion over time. The study utilized a number of data sources for the economic indicators portion of the effort, including jobs and commodity data from the Bureau of Labor Statistics and FAF.

SIGNIFICANT ISSUES IDENTIFIED

Relative to the broader context of the Freight Bottleneck Study, a number of issues were identified in the business stakeholder interviews, including:

[9] *Source: Portland Business Alliance, Oregon Business Council, and Port of Portland, 2014*
[10] Transportation Economic Development Impact System (TREDIS)

Current Issues

- More freight-dependent businesses operating at night
- Higher density of operations in "off-off-peak"
    - Issues of driver safety and regulatory limits on hours
    - Delivery acceptance hours limit distribution "off-off-peak" options
- Businesses continue to lose "turns" for regional runs
- Staggered shifts nearing implementation limits
    - Many start at 2AM

Emerging Issues

- Increasingly complex logistics practices
    - Medium sized export-oriented businesses heavily reliant
    - Omni channel demands for distribution/delivery
    - Bifurcation of warehousing size and functions
- Shift to 3rd party logistics and for-hire services
    - To limited private operations to core services
    - To reduce operating risks of capital tie-up and labor costs
    - Especially for smaller firms
- Focus on exports and out-of-state markets
    - Increases role of Portland transportation freight infrastructure
    - Extensive use of Pacific Northwest and California ports
- Hours of service limits driver deployment

The travel forecasting analysis concluded that the Portland metropolitan area faces significant congestion today. Truck trips represent 2.5 times the mileage of cars. It found that 35% of trips take place during the peaks when speed are 7% slower. Compared to Portland the other areas are relatively less congested today. Whereas Portland households experience 27 hours a year of congestion today, the other areas spend about 3-7 hours a year in congested conditions.

In the future, analysts found that a 40-50% growth in car trips and a more than 70% increase in truck trips. They found more, shorter trips in the Portland area compared to other parts of the state. As a result, time spent in congestion is expected to triple in the Portland metropolitan area and more than triple in the other regions.

AVAILABLE TOOLS AND METHODOLOGY

The base and future year scenarios were adjusted to 2010 and 2040, respectively for each of the four MPO models. Analysts then developed and compared the following measures for each MPO and each scenario:

- vehicle trips
- vehicle-miles-traveled
- vehicle-hours traveled
- average miles per trip
- average speed

- percent of vehicle hours of travel in congestion

TREDIS was used to calculate a number of direct economic impacts as well as user and societal benefits. Direct economic effects and traveler monetary benefits included:

- Output
- Value Added
- Jobs
- Labor Income
- Business time and reliability cost savings
- Business operating cost savings
- Household operating cost savings

Traveler non-monetary benefits and other considerations included:

- Household personal time and reliability savings
- Safety savings
- Shipper logistics and productivity
- Market access and productivity
- Social and environmental benefit
- Indirect congestion costs such as:
    - Cost of time delay
    - Cost of travel time variability
    - Cost of excess mileage to avoid congestion bottlenecks

The authors developed a "variability penalty factor" to account for the effect of decreased reliability.

SIGNIFICANT FACTORS OF SUCCESS OR *LESSONS LEARNED*

Much of this study is not directly transferable to this effort, as outlined below. However, the input-output analysis was able to put dollar amounts on economic and household impacts, which provide very simple and powerful messages to the general public. The authors were able to argue that the benefits of funding projects in the RTPs would result in direct benefits of $928 million in output, $530 million in GDP and 8,317 additional jobs. The Improved Future would result in user and social benefits, including business time and reliability cost savings, with total annual benefits of $1 billion a year. It would lead to $12.6 billion in increased output and $7 billion in added value on an NPV basis over the 25 years.

TRANSFERABILITY (OR TRANSFERABLE MEASURES/TOOLS)

The study is primarily focused on economic impact analysis of congestion and did not specifically identify freight bottlenecks. Also, the reliance on the MPO models may make it difficult to replicate for this effort. Although the MPO models are available for this analysis, the statewide model (SWIM) would provide broader coverage. However, SWIM might not have the local data detail that is needed to fully capture some of the congestion effects. Finally, the main focus of the effort was an economic analysis. While the resulting data points (such as net impact on the economy and households) provides for a simple and provocative conclusion, this type of economic impact analysis is outside of the scope of the current effort. However, it is something to consider as a possible follow on to this analysis.

6 ESTIMATED ECONOMIC IMPACT ANALYSIS DUE TO FAILURE OF THE TRANSPORTATION INFRASTRUCTURE IN THE EVENT OF A 9.0 CASCADIA SUBDUCTION ZONE EARTHQUAKE [11]

At the time of the study ODOT reported there is a twelve percent (12%) chance of a major seismic event (9.0 earthquake) along the Cascadia Subduction Zone within the next 50 years. (Shortly after the report was released this figure was revised to 38%.)

The Oregon Statewide Integrated Model (SWIM) was applied in the study to evaluate potential, avoidable economic impacts as a result of a major earthquake off the coast of Oregon (for analytical purposes the earthquake was assumed to occur in 2014).

SWIM (short for SWIM2) was applied in the assessment of future year scenarios:

1. **Reference** – baseline comparison scenario with current highway conditions and assuming no earthquake impacts and continued economic growth,
2. **Major Seismic Event** – reflecting highway conditions after a 9.0 subduction zone earthquake – worst-case example reflecting a hypothetical worst-case reflecting significant highway and bridge damage (identified by ODOT Bridge Section to fail), and assumes a five-year repair program following the seismic event.

Several detailed scenarios were developed to evaluate the economic impacts of different levels of investment in seismic upgrades on key corridors prior to the event. The difference in economic production between the different scenarios was compared. Results of the study indicate that the monetized value of avoided losses in state economic production is significantly greater than the cost of advanced, seismic retrofitting investments.

While the study assumes a seismic event that affect transportation infrastructure only in western Oregon, the SWIM model and transportation-economic analyses cover all 36 Oregon counties (including state highway and parallel, local road/street network supporting the state highway routes and networks) and 39 adjacent counties from bordering states (Washington, Idaho, Nevada and California).

DATA SOURCES USED

SWIM2 – see Available Tools/Methodology below.

SIGNIFICANT ISSUES IDENTIFIED

Memorandum compares and highlights economic/transportation impacts of seismic event scenarios (purpose), it does not discuss SWIM model structure and outcomes related to bottleneck identification or ranking.

[11] *Source: ODOT, 2013*

AVAILABLE TOOLS AND METHODOLOGY

The SWIM (SWIM2) modeling application included analytical measures and feedback connectivity between key, statewide economic, land use, and transportation systems, all within a singular, dynamic modeling environment. The feedback connectivity is accounted for amongst the following integrated sub-models:

- **Economic module (ED) -** provides characteristics of the state economy, based on the forecast used for the state revenue forecast produced by the Department of Administrative Services (DAS);
- **Population synthesizer (SPG) -** control totals consistent with official state population estimates, locates households, which provide labor to business production activity;
- **Production location module (PI) -** allocates business productions and transactions;
- **Aggregate land development (ALD) -** simulates land availability;
- **Person travel (PT) -** activity-based model with short and long distance travel;
- **Commercial travel (CT) -** simulates transportation of goods (also related to this module is the External Transport (ET) module which generates truck trips for import, export and through movements); and
- **Traffic assignment (TS) -** assigns travel to the transportation network

SWIM model utility is noted in the memorandum. The scenario analysis conducted within SWIM indicates that only highway (roadway) network parameters were modified and modeled. Points of highway/bridge 'failure' as a result of the seismic event were identified by ODOT Bridge Engineering.

SIGNIFICANT FACTORS OF SUCCESS OR *LESSONS LEARNED*

The key findings of the memorandum indicate that significant avoidance in the loss of economic productivity (~$84 billion, 2011 dollars) could be realized by investing in significant seismic retrofitting of key Oregon bridges and highway segments.

TRANSFERABILITY (OR TRANSFERABLE MEASURES/TOOLS)

The memorandum summary indicates a potential for future adaptation and refinement of the SWIM model for the identification and ranking of statewide, freight bottlenecks. In particular, the improvements to the *Transport Sup*ply module, which are nearly complete and will be tested shortly, offer potential benefits to future freight highway bottleneck project evaluation.