Research Problem Statement

ODOT Research Section
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I. TITLE

17-032 Developing a Framework for Integrating Resilience into Routine Transportation Planning, Engineering, Maintenance and Operational Practices

II. PROBLEM

Although the general concept of "resilience" has existed for decades in transportation, its emergence as a critical topic in the field has come about more recently in the wake of several major disasters and other high profile incidents and system failures. According to the Oregon Resilience Plan document, the challenges of resilience are not limited to disaster preparedness; they are being recognized in many areas that require foresight and the coordination of public and private sector efforts. The research proposed in this Problem Statement seek to create an application framework for use by ODOT for the creation more resilient transportation system and network resilience for natural hazards and climate change while also accounting for system dependencies, interdependencies, and cost constraints.

Resilience has been defined as the "ability of the system to recover from loss of functionality over a period of time." Under this definition, even routine incidents like traffic crashes and breakdowns that restrict a lane of capacity during the morning rush hour can be considered localized, smaller scale versions disturbances within this spectrum of events. The framework proposed here would be used to redefine, in the long run, routine transportation planning, engineering, and operational practices such that the preparedness for these routine and commonly occurring events, is viewed in the context of enhancing resilience

Recent review of practice and research, including the Oregon Resilience Plan, show that resilience cannot be assessed or planned in isolation. Transportation infrastructure systems and assets are fundamentally linked to other systems including communication networks, electrical power systems and fuel distribution to name just a few. As such, critical dependent and interdependent elements of transportation need to include highways, bridges, coastal and river ports, transit centers, and regional airports and how these elements are not only under risk from major earthquake like the one considered in the Oregon Resilience Plan (and flooding events potentially resulting from climate change not in the plan) as well as the effects of these hazards and conditions on allied systems which transportation supports and is, in turn, dependent upon. In this context, the proposed research may be seen as operationalization of the Oregon Resilience Plan for disasters and disruptions varying in cause and scale. The formalization of comprehensive and integrated resilience posture into routine planning, engineering, operational practice would permit ODOT and other agencies statewide to prepare and plan for, absorb, recover from, and more successfully adapt to decreases in functionality no matter what the cause, scale, or duration of the disruption.

III. PROPOSED RESEARCH, DEVELOPMENT, OR TECHNICAL TRANSFER ACTIVITY

The first task in the research will be address the fundamental issue of what resiliency is with respect to a wide range of disruptive events including those resulting from climate change. The task will require interviewing wide range of regional stakeholders. The transportation group involved in the effort to produce the Oregon Resilience Plan would be included in the stakeholders.

The goal of stakeholder survey would be to devise a framework that can be used to measure resilience and compare resiliency of different communities with respect to different disruptive events including those resulting from climate change. This resilience assessment process will also leverage knowledge gained from the ongoing community resilience planning and assessment efforts led, at the federal level, by the National Institute for Standards and Technology (NIST) (2015). The Oregon Resilience Plan provides some details of the strategic investment priorities for the state intercity highway system but no vulnerability and gap study exists for other key interdependent elements such as rail transportation, transit routes, air transportation, river ports, local highway system, and for travel routes within cities.

This work is also expected to be consistent with the NIST resilience assessment methods (NIST 2015) from the standpoint of key temporal perspectives including:

- Immediate and short-term periods within the first few hours and days of an event, during which immediate life-safety needs and the provision of essential emergency response activities is the primary focus;
- Medium-term period of several days to several weeks in which transportation services and functionality are restored to various levels of operation; and
- Long-term recovery period, lasting from months to several years, during which such systems gain complete functionality and/or strive to become more resilient to future events.

We recognize that raising the reliability and resilience of all modes and all elements of the transportation infrastructure, while a worthy goal in the long-run, is not feasible from a cost perspective. Hence, we propose an interdependency assessment framework that first identifies the minimum network of highway/railway routes and airports in a region (e.g., Western Oregon) and then identifies other elements of the transportation system around those elements as key support infrastructure to yield most benefit in terms of recue and long-term recovery operations. The vulnerability and high priority location interdependency assessment would be done in the context of several disruptions including those resulting from climate change. Development of interdependency assessment framework would require statewide evaluation of airports, railroads, coastal and river ports, and local agency roads and highways. Once this key multimodal network that is key to resilience of a region is delineated, the framework could be used by agencies to not only measure their disaster preparedness but also to build consensus between different agencies for an incremental program to achieve resilience over the long-run.

IV. POTENTIAL BENEFITS

The resilience of the transportation network is considered a key factor following a disruptive event of any appreciable scale. The project aims to improve the post-event safety and reliability of the transportation system by creating a framework that can be used by ODOT and jurisdictions statewide to make assessments about resilience of the key infrastructure network and guide routine planning, engineering, and operational decisions with an eye towards maintaining system resiliency in a region.

V. IMPLEMENTATION

The research will build on the ideas developed by the Transportation Task Group of the Oregon Resilience Plan (February 2013) in the context of Reducing Risk and Improving Recovery for the Next Cascadia Earthquake and Tsunami. The framework will be documented in the form of Resilience Action Plans for disruptive events varying in cause and scale.

VI. LIST OF REFERENCES *(optional)*

Oregon Seismic Safety Policy Advisory Commission (OSSPAC). *The Oregon Resilience Plan: Reducing Risk And Improving Recovery For The Next Cascadia Earthquake And Tsunami*. 2013.

National Institute for Standards and Technology (NIST), *Community Resilience Assessment Methodology, Task 5 Report, Physical and Social Systems Attributes and Interdependencies*, Report in progress, Gaithersburg, Maryland, 2015.

VII. CONTACT INFORMATION

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