Comparison of Jurisdictional Seismic Resilience Planning

Initiatives

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Abstract

Three jurisdictional earthquake resilience planning initiatives conducted in California, Washington State, and Oregon are compared: SPUR Resilient City (SPUR), Resilient Washington State (RWS), and Oregon Resilience Plan (ORP). This paper presents an exploratory analysis that reveals divergent and convergent themes across the initiatives to inform similar initiatives in the future. The SPUR initiative was the inspiration for both RWS and ORP. As such, an evolution of ideas is evident from the first initiative to the most recent. While the SPUR initiative was a model for the RWS and ORP initiatives, the process and outcomes of the latter two initiatives were more similar than to the original SPUR initiative. Major examples of this are the smaller scopes, as well as increased prominence and continued innovation of recovery-based performance measurement frameworks to help identify seismic resilience recommendations. The importance of this innovation is not clear, however, based on the small amount of explicit integration with the respective initiative definitions of resilience, goals and recommendations. More systematic research into elements of the SPUR, RWS, and ORP initiatives, such as development of the performance measurement frameworks, is warranted given the initiatives' popularity and influence on the National Institute of Standards and Technology's Community Resilience Planning Guide. The paper concludes

28 by situating the NIST guide in the context of the three seismic resilience planning
29 initiatives.

30 **Keywords:** Resilience, Planning, Earthquake, Recovery, Mitigation

Introduction

The purpose of this exploratory study is to analyze and synthesize three jurisdictional earthquake resilience planning and policy initiatives conducted in California, Washington State, and Oregon. The study provides evidence-based information for use in evaluating the analyzed initiatives, as well as related current and future initiatives. An objective of the study is to reveal divergent and convergent themes across the initiatives and their respective documents, as well as to help identify possibly overlooked or underemphasized themes. The intention is to understand the unique contributions from the approaches taken by the three seismic resilience planning initiatives, as well as the resulting documents and outcomes. Ultimately, it is hoped that this study engenders an informed discussion and systematic research on seismic resilience planning initiatives.

SPUR (San Francisco Planning + Urban Research Association) conducted the first of the seismic resilience planning initiatives. It was called the Resilient City initiative and it focused on the City and County of San Francisco (SPUR 2016). The SPUR initiative produced nine reports, published between 2008 and 2013 (Johnson et al. 2013, Poland et al. 2012, McCann et al 2010, Maffei 2009, Barkley 2009, Poland 2009, Bonowitz 2009, Aldrich 2008, Hansen 2008). SPUR Resilient City inspired two state-level earthquake resilience initiatives conducted by the State of Washington Seismic Safety Committee (WASSC) and the Oregon Seismic Safety Policy Advisory Commission (OSSPAC). The Resilient Washington State (RWS) final report and the Oregon Resilience

Plan (ORP) were published in 2012 and 2013, respectively (WASSC 2012a, OSSPAC 2013).

The author is a member of the WASSC and played a significant role in the design and facilitation of RWS. Data for this exploratory study comes primarily from the reports of the initiative, but also initiative presentations, limited interviews of initiative participants, and personal experience. In addition, extensive computer-assisted text analysis was done to summarize and compare initiative reports. Only a portion of text analysis results are presented here because of space constraints.

This study begins with a brief overview of the SPUR, RWS, and ORP initiative processes to put the initiative reports into context. The third section attempts to differentiate and synthesize the content across the SPUR, RWS, and ORP reports. The fourth section attempts to reconcile a core feature across the initiatives. The SPUR, RWS, and ORP documents all include timetables — referred to in the initiatives as performance measurement frameworks — that present estimates of expected and desired target recovery times for different assumed sectors of resilience, such as housing, utilities, and economic development. A sample of estimates from each initiative are converted and reformatted to facilitate comparison. The fifth section of the report provides an overview of the respective recommendations that are presented in the SPUR, RWS, and ORP documents. Subsequently, the sixth section describes the relative progress towards implementation of the respective recommendations. The paper concludes with a critique of insights revealed from the study in context with potential future earthquake resilience planning initiatives.

Seismic Resilience Planning Processes

This section provides an overview of the motivation and approach taken for each of three earthquake resilience initiatives analyzed for this study. Unfortunately, the story of each initiative is much longer and nuanced than can be summarized in a single article. The initiation of each effort was distinctly sequential: SPUR Resilient City began first, then RWS, and ORP third. This sequence allowed WASSC and OSSPAC to review and incorporate ideas from what had been done to that point by the other initiatives. It is possible then to see what ideas were carried forward from each initiative, what ideas were not, and what new ideas were required to achieve objectives unique to a particular initiative. The approaches are described in sequence below. Throughout the paper, an attempt is made to describe features and insights related to each initiative and the respective reports in sequential order. This facilitates seeing the evolution of ideas for doing earthquake resilience planning.

Before describing the process and products of each of the initiatives, it is insightful to present the working definitions of resilience used for the respective initiatives. In each case a contextual definition of resilience was developed for the purpose of guiding the different multi-stakeholder jurisdictional-level initiatives. For each initiative, developing a unique definition was seen as a way to build a shared understanding among participants and stakeholders regarding the goal of each process and inform the jurisdictionally-specific recommendations for increasing seismic resilience. These definitions are juxtaposed for comparison in Table 1.

SPUR: "[A resilient San Francisco has the ability] to remain safe and usable after a major earthquake A resilient city is able to contain the effects of earthquakes when they occur, carry out recovery activities in ways that minimize social disruption, and rebuild following earthquakes in ways that mitigate the effects of future earthquakes.

RWS: "[A resilient Washington State] is one that maintains services and livelihoods after an earthquake. In the event that services and livelihoods are disrupted, recovery occurs rapidly, with minimal social disruption, and results in a new and better condition."

ORP: "[In a resilient Oregon State] citizens will not only be protected from life-threatening physical harm, but because of risk reduction measures and pre-disaster planning, communities will recover more quickly and with less continuing vulnerability following a Cascadia subduction zone earthquake and tsunami."

95 The RWS definition takes some inspiration from SPUR's definition. Both focus on
 96 minimizing social disruption during the recovery process, for example. Definitions for
 97 both SPUR and ORP focus on maintaining safety in the face of earthquakes, while the
 98 RWS presents a higher standard of maintaining livelihoods of residents. SPUR and ORP
 99 state goals of improving mitigation or reducing vulnerability during recovery; the RWS
 100 recovery goal focuses on more than just seismic safety.

101 ***SPUR Resilient City***

102 SPUR brands the Resilient City initiative as “creating a new framework for disaster
 103 planning” (SPUR, 2016)—a claim that is supported by the initiative’s influence on
 104 subsequent earthquake resilience planning initiatives. The initiative was a volunteer
 105 effort, but some funding for the initiative was provided by Degenkolb Engineers, U.S.
 106 Geological Survey, and U.S. Department of Homeland Security. The intended audience
 107 of the initiative is not explicitly stated in the initiative reports, but most
 108 recommendations were aimed generally or specifically at the executive and legislative
 109 branches of the City and County of San Francisco.

110 The SPUR initiative was initially organized by the organization's Disaster Planning Policy
111 Committee to evaluate the seismic performance needs of buildings and infrastructure in
112 San Francisco at a city scale based on the initiative's definition of resilience. The original
113 goals of the initiative as stated in its first report are the following (Poland 2009, pg. 3):

- 114 1. Define the concept of resilience in the context of disaster planning
- 115 2. Establish performance goals for the expected earthquake that supports [the]
116 definition of resilience
- 117 3. Define transparent performance measures that help ... reach [the] performance
118 goals
- 119 4. Suggest next steps for San Francisco's new buildings, existing buildings and
120 lifelines

121 The SPUR Disaster Planning Policy Committee first created the Before the Disaster Task
122 Force of about sixteen volunteers to work on four reports of the Resilient City initiative.
123 Arguably, the work of this task force and their four reports are the biggest innovations
124 from the initiative and what SPUR Resilient City is known for most. The four reports
125 largely focus on defining earthquake engineering performance goals for buildings and
126 infrastructure, as well as developing a means to measure progress towards these goals
127 (Poland 2009, Bonowitz 2009, Maffei 2009, Barkley 2009). The task force met once a
128 month for over two years. The recommendations in the four reports are meant to be
129 implemented over a 50-year timeframe. The time horizon was chosen to make costs for
130 any new structural design and retrofit requirements or related policies politically
131 daunting and financially onerous.

132 The Before the Disaster Task Force considered the performance of buildings and
133 infrastructure for an expected M7.2 San Andreas earthquake through the lens of post-
134 disaster recovery. While the M7.2 scenario was emphasized in defining San Francisco's
135 resilience and determining engineering performance goals, routine and extreme
136 earthquake scenarios were also defined to provide context for the initiative. The task
137 force worked to understand gaps between expected and desired recovery outcomes to
138 facilitate working backwards to develop their policy and planning recommendations. To
139 do this the task force innovated a new performance measurement framework in the form
140 of a recovery timetable, which is presented in the task force's first report (Poland 2009).
141 The recovery timetable explicitly outlines how quickly certain aspects of San Francisco
142 should recover from the expected earthquake to determine what levels of performance—
143 relative to current performance levels—for new buildings, existing buildings, and
144 lifelines are necessary for increasing San Francisco's earthquake resilience. Specifically,
145 the timetable depicts estimated anticipated and target recovery times for four categories
146 of facilities and systems with respect to the expected earthquake scenario: 1) critical
147 response facilities and support systems, 2) emergency housing and support systems, 3)
148 housing and neighborhood infrastructure, and 4) community recovery. The recovery
149 time estimates and targets for each category were determined by the task force using
150 expert judgement, as well as outside consultation. The timetable was intended by the
151 Before the Disaster Task Force as a tool for three sub-committees to develop reports and
152 recommendations about existing buildings (Bonowitz 2009), new buildings (Maffei
153 2009), and lifelines (Barkley 2009), respectively.

The Resilience City initiative was significantly expanded beyond the work of the Before the Disaster Task Force to include other issues of earthquake resilience. Additional task forces were formed to make recommendations for better emergency response capacity, as well as increased capacity for rebuilding and recovering after a disaster. The various initiative task forces did not necessarily work closely together, but were aware of each other's work.

A Shelter-in-Place Task Force was created to leverage the Before the Disaster Task Force recommendations and make their own recommendations to improve the likelihood that San Francisco residents can stay in their homes after a future earthquake while their structures are repaired (Poland et al. 2009). A Disaster Preparedness Task Force assessed and made recommendations to improve San Francisco's culture of disaster preparedness (Aldrich et al. 2008) and its emergency response capacity (Hansen et al. 2008). A report was created by a separate task force that outlines how San Francisco can rebuild its transportation infrastructure more quickly and effectively after a future earthquake (McCann et al. 2010). A Land Use Planning and Rebuilding Task Force published an extensive report laying out recommendations to increase the likelihood for successful post-earthquake rebuilding and recovery (Johnson et al. 2013). In all, SPUR's Resilient City planning initiative published nine reports between 2008 and 2013.

Resilient Washington State

The origination of Resilient Washington State initiative was directly tied to the outcome of the SPUR Resilient City initiative. A member of WASSC presented the SPUR

performance measurement framework timetable to the committee, suggesting that WASCC adapt the city-scale initiative for Washington State. The WASCC member was aware of SPUR's initiative because of their affiliation with Degenkolb Engineers. (The Before the Disaster Task Force chair was also affiliated with Degenkolb Engineers, who provided some funding for the Resilient City initiative.)

The RWS initiative sought to develop a set of recommendations for improving the state's earthquake resilience within a 50-year timeframe—the same timeframe used for the SPUR Resilient City initiative. The initiative's primary audience was the governor, executive cabinet, and state legislature. The audience of RWS was more explicitly stated than for SPUR Resilient City and of course from a different jurisdictional level. Six volunteers from the WASSC created the RWS subcommittee. It was tasked with adapting the Resilient City initiative for the state-level, conducting the process, making recommendations, and drafting the initiative reports. The RWS subcommittee laid out four goals in their first report (WASSC 2010, pg. 1), taking inspiration from the work of SPUR's Before the Disaster Task Force. The RWS goals hew closely to the development of performance measurement framework timetables and do not reflect goals of the other SPUR Resilient City task forces:

1. Evaluate the current condition of infrastructure in the state relative to earthquake resilience
2. Develop targets for the desired level of performance
3. Develop target timeframes for the restoration of services
4. Prepare recommendations for statewide action to achieve desired targets

The RWS subcommittee meant infrastructure to refer to more than lifelines and, in fact, less specific than the SPUR Before the Disaster Task Force's scope of new buildings, existing buildings, and lifelines. Unlike SPUR, RWS did not emphasize a single expected earthquake because of the state scale—multiple earthquake scenarios are expected for the various seismic sources in the state. The RWS subcommittee based the initiative on multiple earthquake scenarios for different sources in the state, collectively referring to the scenarios as earthquakes of statewide significance. The scenarios provided a basis for discussing the state's earthquake resilience, but were not individually considered explicitly in the analyses and recommendations of the initiative.

A kickoff workshop was held in September 2010 that involved approximately 50 volunteer participants from all levels of government, the private sector, and academia, representing disciplines such as civil engineering, emergency management, and human services. Following the kickoff workshop, four workgroups were organized around four statewide sectors: 1) critical services, 2) transportation, 3) utilities, and 4) housing and economic development. Taking inspiration from the development of the Resilient City performance measurement framework, the RWS sector work groups were asked to evaluate the current recovery capacity of their sector, develop recovery targets for state-level earthquake resilience, and prepare recommendations to achieve desired recovery targets. The four workgroups were given autonomy to achieve their objectives how they saw fit over the spring and summer of 2011. The work groups accomplished their work through ad hoc combinations of in-person meetings, teleconferences, online work (e.g.,

218 web surveys), and individual contributions. A second workshop was held in December
219 2011 to present and get feedback on the sector workgroup outcomes.

220 The RWS subcommittee synthesized the recommendations produced by the workgroups,
221 which were reviewed by participants of the second workshop, to produce a final
222 unranked list of ten detailed recommendations. Each of the ten recommendations
223 included specific action items, as well as references to state agencies that could
224 potentially lead implementation of the action items. The WASSC released the final report
225 with these recommendations and the finalized performance measurement framework to
226 the public. The report was presented to the state's Emergency Management Council,
227 which advises the governor and the director of the state's military department, in 2012.

228 Part of the recommendations of the RWS subcommittee was to continue the initiative via
229 an executive-level committee in the governor's office. The RWS initiative was effectively
230 on hold until November 2016 when the governor's Resilient Washington subcabinet was
231 formed, which will be advised by the WASSC, to facilitate further progress towards the
232 initiative goals. The governor's subcabinet is expected to broaden the original four goals
233 of the initiative listed above.

234 ***Oregon Resilience Plan***

235 The Oregon Seismic Safety Policy Advisory Commission learned of the SPUR Resilient
236 City and Resilient Washington State initiatives prior to the completion of either initiative.

237 There were certainly professional connections between the SPUR Disaster Planning
238 Policy Committee, WASSC, and OSSPAC at the time that likely facilitated this awareness.

More so, there was a direct connection between three members of the three jurisdiction's committees because of their affiliation with Degenkolb Engineers. This connection heightened OSSPAC's awareness of the first two initiatives and facilitated subsequent knowledge sharing—each member took leadership roles in the three initiatives.

OSSPAC created a volunteer steering committee to shepherd the ORP initiative. Similar to RWS, the ORP initiative's primary audience was the governor and state legislature. The stated goals of the ORP initiative are similar to the SPUR Before the Disaster Task Force and the RWS initiative. Like the RWS initiative the goals the ORP goals focus largely on development of performance measurement framework timetables; conversely, like SPUR Resilient City emphasize a single scenario earthquake (OSSPAC 2013, pg. xiv):

1. Determine the likely impacts of a magnitude 9.0 Cascadia earthquake and tsunami on [different] sector[s], and estimate the time required to restore functions in [each] sector if the earthquake were to strike under present conditions
2. Define acceptable timeframes to restore functions after a future Cascadia earthquake to fulfill expected resilient performance
3. Recommend changes in practice and policies that, if implemented during the next 50 years will allow Oregon to reach the desired resilience targets

The goals of the ORP initiative appear the broadest in scope compared to the SPUR's Before the Disaster Task Force and the RWS initiative. Thus, the ORP's scope is closer, but lesser, in scope to the entire nine-report scope of the SPUR Resilient City initiative than the original RWS initiative scope. To match this broader scope, eight task groups

were established for developing the ORP. One task group was responsible for developing the earthquake and tsunami scenario. The other seven task groups conducted analysis and developed recommendations related to seven sectors: 1) business and workforce continuity, 2) coastal communities, 3) critical and essential buildings, 4) transportation, 5) energy, 6) information and communications, and 7) waste and wastewater. In sum, approximately 170 volunteers participated in the ORP task groups. Compared to the other initiatives, the ORP initiative emphasized lifeline sectors most.

A kickoff workshop was held on January 26, 2012 so that the eight task groups could meet and form their work plans and approaches to collaboration. Task groups met at least once a month over roughly a year and were given freedom to collaborate as they saw fit. In July 2012, there was a check-in workshop to allow task groups to share information and consult with each other. Another larger meeting was held in October 2012 to focus on developing recommendations. The final 300-page ORP report was published in February 2013 and delivered by OSSPAC to the 77th Oregon Legislative Assembly on February 28, 2013. The initiative continued with the establishment of the governor's Resilience Plan Implementation Task Force, mandated by Senate Bill 33. The governor's task force developed a two-page report, published in 2014, that presented next steps for implementing the recommendations in the ORP.

Seismic Resilience Plan Contents

Considering the collective length of the SPUR, RWS, and ORP reports, it is difficult to manually compare the published results of the three initiatives. To facilitate more

efficient comparison, two text analysis methods were employed using the Python library Natural Language Toolkit NLTK: collocations and word dispersion. (A large variety of text analysis software and programming libraries exist; NLTK was chosen because of the author's familiarity with the Python programming language and the library's popularity.) Collocations are meaningful phrases automatically extracted from a document having a specified length that appear prominently throughout the document's text. Dispersion analysis automatically identifies the location of each instance of a single word along the length of a document. Typically, these are presented using dispersion diagrams that graphically depict where select words appear within a document.

Several sets of words were selected for conducting dispersion analysis of the reports published by each resilience planning initiative. These words were selected to nominally represent 1) phases of disaster management, 2) level of government, 3) critical services and socio-economic sectors, 4) buildings and housing, and 5) lifeline infrastructure. In cases where obvious synonyms exist, each synonym was analyzed to determine which word occurred more frequently. If there was significant difference between the initiatives, the choice of word was made based on the frequency of occurrence in the SPUR reports because it is the standard for the other initiatives. In cases where multiple reports were published (SPUR and RWS initiatives), the reports were concatenated in order of publication date before being analyzed.

Table 2 and Figure 1 summarize the content of all nine SPUR reports (shown in sequential order). The collocations communicate the place-based nature of SPUR Resilient City, as well as its intended focus on a local jurisdictional scale—very little

focus on the state jurisdictional level. The collocations and dispersion diagram clearly show that the SPUR initiative addresses all phases of disaster management, which is not surprising given the initiative's nine-report scope. Interestingly, it appears that the concept of resilience is not carried through the entire set of reports. Response and preparedness are not concurrent with the use of the term resilience. While recovery co-occurs with the use of resilience in the initial reports, it is prominently independent of the term resilience in the last two reports (McCann et al. 2010, Johnson et al. 2013). Topically, the SPUR reports dedicate a lot of space to various discussions about the performance of city's building and housing stock. While buildings are discussed throughout the reports, discussion of lifeline infrastructure is somewhat contained in the initial reports, with transportation issues having continued prominence in subsequent reports. Surprisingly little reference is given to aspects of critical services or socio-economic sectors. However, based on the collocations, the SPUR reports appear to be the only documents that make prominent reference to historical preservation, faith-based organizations, affordable housing, low-income populations, and land use planning.

The RWS reports are summarized by

Table 3 and Figure 2. Based on the corresponding collocations, the RWS reports clearly focus most on the state jurisdictional scale and little reference is made to the city or local level—opposite the focus of the SPUR Resilient City reports. More specifically, the RWS reports make prominent reference to liquefaction hazard, law enforcement, backup generators, mutual aid crews, and economic development—relatively unique compared to the other initiatives. The collocations for the RWS reports show prominent references to

326 phrases related to time. These relate to descriptions of the various RWS performance
327 measurement timetables and their development. The RWS reports are much more
328 succinct than the publications from the other initiatives; the reports do not include much
329 background information or analysis and reflect the smaller stated scope of the initiative
330 relative to the other two initiatives. As a result, the timetable references are more
331 prominent in the RWS report in comparison to the other initiatives. The post-event
332 phases of disaster management (response and recovery) are referenced more often than
333 the pre-event phases of preparedness and mitigation. The phases of recovery and
334 response are emphasized relatively equally throughout the reports. It appears that topical
335 focus on critical services and socio-economic issues shifts after the first report. The topics
336 of facilities and transportation are referenced most frequently throughout the reports.
337 Closer inspection of the RWS reports reveals that the term facilities is used to refer to a
338 wide range of critical built assets (e.g., commercial facilities, industrial facilities, daycare
339 facilities, school facilities, medical facilities, etc.).

340 Table 2. SPUR. Prominent two-word phrases (collocations) in SPUR's Resilient City report series.

local governments; near term; long term; emergency management; planning departments; emergency response; disaster response; disaster recovery; red cross; responsible parties; east bay; bay bridge; golden gate; soft story; unreinforced masonry; wood frame; building code; historic preservation; safe enough; enough stay; shelter place; seismic performance; task force; faith based; transportation infrastructure; land use; hazard mitigation; low income; first responders; affordable housing

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343 Figure 1. SPUR. Occurrence of selected words across all SPUR reports. Tick marks indicate one
344 occurrence at the location in a particular report. Reports are shown in topical order according to
345 SPUR (Poland 2009, Bonowitz 2009, Maffei 2009, Barkley 2009, Poland et al. 2009, Aldrich et al.
346 2008, Hansen et al. 2008, McCann et al. 2010, Johnson et al. 2013).

347

348 Table 3. RWS. Prominent two-word phrases (collocations) in the RWS report.

resilient state; short term; long term; current capacity; response recovery; timeframe current; target timeframe; anticipated timeframe; time required; timeframe response; 24 hours; week month; months year; law enforcement; mutual aid; emergency response; repair crews; critical services; cascadia subduction; cascadia zone; pump stations; following earthquake; backup power; life safety; minor

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351 *Figure 2. RWS. Occurrence of selected words across all RWS reports. Tick marks indicate one*
 352 *occurrence at the location in the report. Reports are shown in order of publication date (WASSC*
 353 *2010, WASSC 2012a, WASSC 2012b).*

354 Table 4 and Figure 3 serve to summarize the Oregon Resilience Plan, including the two-
 355 page follow-up report by the Resilience Plan Implementation Task Force (OSSPAC 2013,
 356 Ashford et al. 2014). Similar to RWS and opposite of SPUR Resilient City, ORP is most
 357 focused on state-level government, with prominent place-based references. Compared to
 358 the SPUR and RWS initiative, there is more discussion of connection between state and
 359 local government. The term resilience is used most concurrently with references to the

360 recovery phase. Within the ORP, the post-disaster phases of response and recovery are
361 emphasized over the pre-event phases. Although, reflecting the initiative's broader goals,
362 the latter topic is more prominent in the ORP than in the RWS reports, but less so than
363 for SPUR Resilient City. Topically, discussion of critical services and socio-economic
364 sectors is lighter than the focus on buildings, housing, and lifeline infrastructure. It's
365 worth noting, however, that the ORP frequently uses the term "critical buildings" to refer
366 to critical services. Discussion of the built environment in the ORP exceeds that found in
367 the RWS reports. In comparison to the SPUR reports, the ORP has roughly equivalent
368 space given to discussion of buildings. But significantly more space is given o
369 components of lifeline infrastructure, particularly energy infrastructure, reflecting the
370 more numerous task groups, sectors, and participants of the ORP. The collocations from
371 the ORP show uniquely prominent references to the tsunami hazard on Oregon's coast,
372 which is reflective of the initiative's scenario earthquake and statewide scale.

373 *Table 4. ORP. Prominent two-word phrases (collocations) in the ORP.*

coastal communities; life safety; emergency response; long term; liquid fuel; natural gas; cei [critical energy infrastructure] hub; water
wastewater; pump stations; treatment plants; information communications; life safety; public transit; police stations; state highway; raw
sewage; unreinforced masonry; non-ductile concrete; subduction zone; zone event; ground shaking; tsunami inundation; inundation
zone; lateral spreading; columbia river; klamath falls; willamette valley

Figure 3. ORP. Occurrence of selected words within the Oregon Resilience Plan (OSSPAC 2013, Ashford et al. 2014). Single tick mark indicates one occurrence relative to the location in the plan.

Seismic Resilience Performance Measurement Frameworks

A central feature of the SPUR, RWS, and ORP initiatives are the respective performance

measurements frameworks that take the form of timetables showing expected and target

recovery times for key sectors. The role of the timetables was much more central for both

the RWS and ORP initiatives than for SPUR Resilient City, which only utilized the

timetables in two of nine reports. Both the RWS and ORP initiatives were explicitly

organized around the construction of multiple sector-specific recovery timetables, while

only the work of the SPUR Before the Disaster Task Force was organized this way. The scope of the RWS and ORP performance measurement frameworks and the effort to develop them exceed that for SPUR's framework. Whereas the SPUR performance measurement framework is included in two tables across one and a half pages, the RWS framework spans four timetables filling three pages, while the ORP framework requires ten timetables that fill 16 pages of the plan. One could see a city-scale performance measurement framework being more detailed because of greater feasibility to do refined analysis. Or a state-level framework might be larger because of the greater geographic area. For these three initiatives, the difference is less likely an issue of the difference in jurisdictional scale and more a matter of emphasis between the three initiatives—the RWS and ORP frameworks are both larger and more detailed even though they represent much larger jurisdictions.

It is informative to compare the timetables created by SPUR, RWS, and ORP given their persuasiveness and prominent role in the latter initiatives. A key question is how the expected and target recovery time estimates compare across initiatives. Unfortunately, comparison of the published timetables is difficult.

The initiatives organized and approached development of the timetables in a significantly different manner. So, there are not many instances where the sector components and facility types are identified in the same way to facilitate one-to-one comparison. SPUR made estimates for specific or named on-the-ground systems in only a couple of instances. RWS provides estimates for several specifically identified components of the state's transportation network. The ORP presents a high level of detail

both geographically and with respect to specific transportation system components. The approach that each initiative took to determine current and target recovery estimates varied considerably. In general, each subsequent initiative used more time, analysis, and people in determining the estimates. In other words, the process was least emphasized in the SPUR initiative and most so in the ORP initiative. For example, some ORP task groups utilized HAZUS-MH loss estimates to inform their assessment-the only initiative to publish that quantitative analysis was employed in determining current recovery time estimates. The ORP is also the only report to reference specific past earthquake disasters as a baseline for estimates. The approach taken by RWS split the middle between the SPUR and ORP approaches. Considerable time and perspectives were used, but with a relatively ad hoc or experiential approach to estimation similar to SPUR.

Another reason it is difficult to compare the recovery timetables across the initiatives is the lack of consistent temporal units and resolution. SPUR made distinct but nominal estimates in units of hours, days, and months. RWS made estimates using inconsistent time intervals using units of hours, days, weeks, months, and years. The format and content of the ORP timetables are a synthesis of the SPUR and RWS approaches. The units and resolution are typically similar to the SPUR timetables. But the approach taken for each ORP timetable is different for each sector (task group).

To facilitate comparison for this exploratory study, a subset of sector components was extracted from each plan and the corresponding estimates were converted into common units of days. For RWS and ORP, a significant degree of simplification was required in most instances to facilitate the comparison. The comparisons are grouped by three

themes: critical services (Table 5), buildings, housing and economic development (Table 6), and lifeline infrastructure (Table 7).

Overall, estimates for both current and target recovery times vary widely across the initiatives, except for a few instances. For some components, estimates differ by more than 1000 days; in one instance a single RWS recovery estimate varies by 275 days. Critical services recovery estimates are most straightforward to compare across initiative—at least as interpreted for this study. There is little consistency between estimates for current critical services recovery times across the initiatives, but there is relative agreement for target recovery times. For the buildings, housing, and economic development sector, there is very little convergence across the three initiatives. However, it is more difficult than for critical services to create straightforward comparisons between sector components. Even though the SPUR initiative put a lot of effort into advocating and planning for sheltering in place, their performance framework presents the longest acceptable target recovery time for housing across the three initiatives. For the RWS initiative, it is apparently acceptable for housing recovery to take longer for multi-family dwellings than for single-family dwellings. Of the three sector themes in this section, recovery estimates for lifeline infrastructure are the most varied. A major reason for this is the large difference in how detailed each initiative was in representing the different lifeline sectors. SPUR's estimate for current utilities recovery time is significantly different, in most cases, from the estimates generated for RWS and the ORP, which have more instances of similarity. The ORP and RWS initiatives included many participants in general and utility provider representatives specifically, while the SPUR

initiative had more limited participation generally and specifically. With respect to estimated target recovery times, SPUR provides only one estimate for all lifeline components: 30 days. Whereas, target times for RWS and the ORP vary considerably with respect to each lifeline component (within and between initiatives).

Table 5. Comparison of estimates for current recovery capacity (Current) and target recovery (Target) timeframes related to critical services. Time units have been converted to days. Common shading indicates category similarity across reports.

	Current	Target	Notes
SPUR Resilient City	Days	Days	
Emergency operations center	?	0	To safe & operational
Hospitals	1095	0	To safe & operational
Medical providers offices	1095	30	To safe & usable after repairs
Police & fire	1	0	To safe and operational
Essential city service facilities	120	30	To safe & usable after repairs
Schools	120	30	To safe & usable after repairs
Resilient Washington State	Days	Days	
Emergency response	3-7	1-3	80-90% operational
Health & medical care	90-365	7-30	80-90% operational
Law enforcement	3-7	3-7	80-90% operational
Government administration	7-30	3-7	80-90% operational
Social services	30-90	7-30	80-90% operational
Schools	90-365	7-30	80-90% operational
Oregon Resilience Plan	Days	Days	
Emergency operations center	120	0	80-90% operational; Valley
Healthcare facilities	120	0	80-90% operational; Valley, Structures
Police stations	120	0	80-90% operational; Valley
Fire stations	60	0	80-90% operational; Valley
Critical government facilities	30	30	80-90% operational; Valley
Schools	540	30	80-90% operational; Valley

459 Table 6. Comparison of estimates for current recovery capacity (Current) and target recovery
 460 (Target) timeframes related to housing and economic development. Time units have been converted
 461 to days. Common shading indicates category similarity across reports.

	Current	Target	Notes
SPUR Resilient City	Days	Days	
Retail businesses	1095	120	95% businesses open, Safe & usable after repairs
Offices and workplaces	1095	120	50% buildings open, Safe & usable after repairs
Housing	1095	120	All residences repaired, replaced, or relocated
Resilient Washington State	Days	Days	
Finance and banking	7-90	7-90	80-90% operational
Commercial facilities	30-90	7-90	80-90% operational
Manufacturing	30-90	30-90	80-90% operational
Housing: single family	7-30	1-3	80-90% operational, Newer construction
Housing: multi-family	30-90	7-30	80-90% operational, Newer construction
Oregon Resilience Plan	Days	Days	
Finance and banking	30	30	80-90% operational, Valley
Retail businesses	30	30	80-90% operational, Valley
Housing	3	3	80-90% operational, Valley, Newer construction

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Table 7. Comparison of estimates for current recovery capacity (Current) and target recovery (Target) timeframes related to lifeline infrastructure. Time units have been converted to days. Common shading indicates category similarity across reports.

	Current	Target	Notes
SPUR Resilient City	Days	Days	
All utilities	1095	30	95% of system, Safe & usable after repairs
Roads & highways	60	30	90%
Airport	30	30	Commercial traffic
Rail	120	30	90% of system, Safe & usable after repairs
Transit	60	30	90% of system, Safe & usable after repairs
Resilient Washington State	Days	Days	
Water transmission	3-7	1-3	80-90% operational; No liquefaction
Water distribution	7-30	1-3	80-90% operational; No liquefaction
Wastewater treatment	30-90	7-30	80-90% operational; No liquefaction
Wastewater collection	30-90	7-30	80-90% operational; No liquefaction
Electricity transmission	365-1095	7-30	80-90% operational
Electricity distribution	90-365	7-30	>70% operational
Natural gas transmission	1-3	1-3	80-90% operational; No liquefaction
Natural gas distribution	30-90	7-30	90% operational
Information & communication tech.	30-90	3-7	80-90% operational
Major freeways	365-1095	30-90	80-90% operational; Puget Sound
Major bridges	90-365	30-90	80-90% operational; I-90
Arterials	365-1095	90-365	80-90% operational
Airports	365-1095	7-30	80-90% operational; Urban, Commercial traffic
Rail	365-1095	30-90	80-90% operational
Transit	365-1095	90-365	80-90% operational
Oregon Resilience Plan	Days	Days	
Water transmission	30-90	1	80-90% operational; Valley
Water distribution	180-365	7-14	80-90% operational; Valley
Wastewater treatment	1095	180-365	80-90% operational; Valley
Wastewater collection	365-1095	180-365	80-90% operational; Valley
Electricity transmission	21-30	7-21	80-90% operational; Valley
Electricity distribution	21-30	7-21	80-90% operational; Valley
Natural gas transmission	21-30	3-7	80-90% operational; Valley
Natural gas distribution	21-30	3-7	80-90% operational; Valley
Information & communication tech.	180-1095	7-90	80-90% operational; Valley, Simplified
Major highways	365-1095	30-365	80-90% operational; Valley, Simplified
Major bridges	365-1095	30-365	80-90% operational; Valley, Simplified
Airports	365-1095	180-365	80-90% operational; Valley, Commercial
Rail	180-365	30-90	80-90% operational; Valley
Transit	1095	180-365	80-90% operational; Valley

Seismic Resilience Plan Recommendations

Ultimately the purpose of the SPUR Resilient City, Resilient Washington State, and Oregon Resilience Plan initiatives is to affect change to build earthquake resilience. The documents published by each initiative lay out an extensive list of recommendations to catalyze this change. Although the initiatives share similar roots, the audiences, jurisdictional-levels, goals, approaches, and participants of the three initiatives result in different specific sets of recommendations. To facilitate some level of cross-comparison, the recommendations for all three initiatives were clustered into five loose themes. Because of the large number of recommendations and the overlapping nature of them, other themes can certainly be extracted. The five themes are 1) critical services, 2) buildings and housing, 3) lifeline infrastructure, 4) business and economic development, and 5) planning and preparedness. Of the five themes, critical services and business and economic development have the fewest recommendations. For the most part, economic issues were only considered in final Resilient City report on recovery (Johnson et al. 2013). The ORP does not give much attention to economic issues either, as well as critical services. In contrast, planning and preparedness is a peripheral focus of the RWS reports, reflecting the fact that RWS had the narrowest scoped goals of the three initiatives.

SPUR Resilient City

SPUR produced at least 272 recommendations. There are at least 23 recommendations related to critical services. At least 42 recommendations are about buildings and

housing. For lifelines, roughly 91 recommendations are given, including a recommendation to form a lifelines council. 111 recommendations were identified related to planning and preparedness. In categorizing the recommendations, at least five are clearly associated with the theme of business and economic development, although the recommendations were not made specifically for that context. Table 8 lists several prominent two-word phrases (collocations) used in the recommendations extracted from the SPUR Resilient City reports. The collocations give a broad sense of what the SPUR recommendations emphasize.

Of all the initiatives, SPUR puts the greatest emphasis and effort on pre-event recovery planning. SPUR makes a blanket recommendation to develop strategies for post-earthquake economic recovery as part of ongoing economic development efforts and advocates outreach to small businesses to inform them of building occupancy resumption programs. The SPUR initiative focused heavily on recommendations for pre- and post-event resilience of the transportation system, with an entire report dedicated to the topic (McCann et al. 2010). Considering the minor focus on utilities in their performance measurement framework, it is not surprising that less focus is given to making specific recommendations for other lifeline components compared to RWS and the ORP. The Resilient City report lays out many recommendations to improve seismic safety of existing and new buildings, including residential dwellings, such as mandatory retrofits of existing soft-story buildings and a program to mitigate critical existing non-ductile concrete buildings. Great emphasis is placed on enabling as many residents as possible to use their home as post-earthquake shelters. In general, the recommendations in the

511 SPUR reports are more targeted than the RWS and ORP recommendations. The initiative
512 focuses on a well-defined local jurisdiction, while the other initiatives focus on more
513 heterogeneous jurisdictions that in some cases have limited authority over their scope of
514 recommendations.

515 *Table 8. SPUR. Prominent two-word phrases (collocations) across all SPUR recommendations.*

occupancy resumption; golden gate; mutual aid; building resumption; building occupancy; retrofit replacement; mutual agreements; aid agreements; soft story; bay area; park ride; reserve fleet; bay bridge; resumption plans; non-ductile concrete; concrete structures; occupancy plans; shelter place; reliably functional; restricted vehicle; facilities safe; low income; post disaster; historic preservation; safe functional; safe reliably; ride locations; ferry landings; replacement redundancy; financial incentives; spontaneous volunteers; buses required; city owned; park locations; parking lots; credits deductions

516 ***Resilient Washington State***

517 The RWS initiative produced at least 153 recommendations. This is a considerable
518 number given the smaller scope of the initiative compared SPUR Resilient City, but also
519 likely reflects the larger number of RWS participants and perhaps the larger
520 jurisdictional scale. It is often cited that the RWS initiative resulted in only ten
521 recommendations. This refers to the ten categories of recommendations given in the final
522 report's executive summary. Each of the ten categories has additional recommendations
523 (or action items). In addition, the second RWS report includes a significantly longer list
524 of recommendations put forward by RWS workgroups and workshop participants
525 (WASSC 2012b). The RWS subcommittee analyzed the long list of recommendations
526 (with the help of Western Washington University students) to create the consolidated
527 priority recommendations included in the final report. Of the over 150 RWS
528 recommendations, at least 41 deal explicitly with critical services; 33 with buildings and

housing, 58 with lifelines infrastructure; 13 about business and economic development, and 8 for the theme of planning and preparedness.

Table 9 lists collocations from the recommendations extracted from the RWS reports to give an overall sense of the RWS recommendations. As already observed, fewer recommendations regarding general planning and preparedness efforts are given in the RWS reports in comparison to the other initiatives. For this theme, developing more and better information (e.g., higher resolution liquefaction hazard maps) connects most of the recommendations. The RWS reports provide the highest number of recommendations specific to business and economic development. RWS made multiple recommendations in relation to improving the resilience of buildings and housing, though often at a more basic level than SPUR (e.g., creating a statewide inventory of vulnerable buildings) because of the different jurisdictional roles between cities and states. Like SPUR, RWS highlights the issue of sheltering in place. RWS initiative recommendations related to critical services focus primarily on the assessment and mitigation of hospitals, as well as schools. Lifeline infrastructure is a major focus of the RWS recommendations. Like SPUR, RWS made a recommendation for a lifelines council, but at the state level. Greater emphasis on transportation is made in the RWS recommendations than for utilities lifelines. This is similar to the SPUR initiative, but the RWS recommendations are more numerous for each sector. Recommendations for electricity are most frequent in the RWS reports among utility-specific recommendations.

Table 9. RWS. Prominent two-word phrases (collocations) across all RWS recommendations.

mutual aid; following earthquake; local jurisdictions; operations plans; continuity operations; supply chains; continuity plans;

robust continuity; robust operations; aid agreements; mutual agreements; rules regulations; school districts; service providers; backup generators; transit agencies; enact requires; rerouting traffic; post disaster; actual stock; detailed actual; stock types; inventory actual; detailed inventory; enact legislation; legislation requires; self sufficient; interagency wsdot; vertical evacuation; agreements local; develop robust; restoration service; home owners; interagency agreements; retrofits across; facilitate rerouting; facilitate traffic; requires districts; state federal; requires school; building sold; owner building; assess risk; able withstand

550 ***Oregon Resilience Plan***

551 The ORP document includes at least 103 recommendations. This is the case even though
552 the ORP document is similar in length to all nine of the SPUR reports combined and was
553 created by the most participants focused on the most sectors. At least 19
554 recommendations can be related to the theme of critical services. 18 recommendations
555 relate to the theme of buildings and housing. 42 or more were associated with lifelines.
556 Business and economic development was not explicitly assessed, but at least 6
557 recommendations are associated with the theme for this study. Lastly, 18 or more
558 recommendations were given that deal with planning and preparedness. Table 10 lists
559 identified collocations in the recommendations that were extracted from the ORP
560 document.

561 Like SPUR, planning and preparedness was an explicit part of the ORP initiative (not so
562 for RWS). Related recommendations are mostly related to coastal/tsunami issues, as well
563 as the need to promote public self-sufficiency for a longer time than has previously been
564 communicated. Recommendations are not specifically listed for all components of critical
565 and essential buildings that were assessed during the initiative, though particular
566 attention is given to critical services within the tsunami zone. ORP recommendations
567 focus significantly on business continuity, again with an emphasis on coastal
568 communities. Similar to both RWS and SPUR Resilient City, the ORP advocates

569 inventorying and evaluation of critical buildings. In addition, recommendations are made
570 for a building vulnerability rating system and incentives for owners to upgrade existing
571 vulnerable buildings. Like RWS and SPUR, transportation is a major area of concern
572 within the ORP recommendations, particularly related to maintaining immediate post-
573 earthquake access. A number of recommendations are given specific to utility lifelines,
574 with particular emphasis given to wastewater systems compared to the other two
575 initiatives.

576 *Table 10. ORP. Prominent two-word phrases (collocations) across all ORP recommendations.*

cascadia subduction; subduction zone; earthquakes tsunamis; rating system; wastewater agencies; seismic vulnerability; vulnerability assessments; communities develop; comprehensive plans; coastal communities; compliance applicable; number days; following cascadia; citizen expect; days citizen; expect wait; homes multi-family; interoperability among; sharing among; sharing interoperability; statutory prescriptive; within local; recovery efforts; retrofit existing; sector companies; retirement full; accelerate retirement; accelerate full; full upgrade; retirement upgrade; gap analysis; help coordinated; periodic updates; permitting processes; position help; prescriptive routine; prescriptive waiver; quality DEQ; environmental DEQ; regulatory applicable; regulatory compliance; routine permitting; transit rail

577 **Seismic Resilience Plan Implementation Progress**

578 Between the three seismic resilience initiatives—SPUR Resilient City, Resilient
579 Washington State, and the Oregon Resilience Plan—approximately 500
580 recommendations have been put forward that might increase city- and state-level
581 resilience to earthquakes. Implementation (and planning for implementation) of these
582 recommendations is at different stages for each initiative and always will be. Regardless,
583 only limited progress should be expected at this point given the multiplicity of
584 recommendations and the five-decades long implementation horizon for each initiative.
585 It is premature to evaluate the individual effectiveness of the SPUR, RWS, ORP
586 initiatives. At the same time, it is important to monitor their respective progress and

587 impact. A clear outcome of these initiatives is an evolution of thinking on how to
588 approach increasing jurisdictional seismic resilience at the local and state levels.

589 It is difficult to determine the specific impacts of each initiative and any progress
590 described below is now out of date. But at the time of writing, the RWS initiative has
591 made least amount of progress and impact. Considering the higher stature of seismic
592 resilience issues in San Francisco compared to Oregon, it is easy to argue that the ORP
593 initiative has achieved as much or more relative progress and impact as SPUR Resilient
594 City. The different implementation progress between the three initiatives reflects the
595 relative amount of policy activity and coverage between the three states as quantified in
596 Miles and Gouran (2016). Washington State has lower state-level policy activity and
597 coverage related to earthquakes than Oregon, even though Oregon has significantly
598 lower seismic risk. Whereas, Oregon has the most seismic policy activity and coverage in
599 the United States other than California. For example, as of the time writing the
600 Washington State Seismic Safety Committee, which is not a mandated body, has not met
601 for over two years. This reduces the capacity for RWS organizers to advocate for RWS
602 recommendations. In contrast, the Oregon Seismic Safety Policy Advisory Commission is
603 a legally mandated body that meets on a bi-monthly basis. It is conceivable that
604 implementation progress for each seismic resilience plan is more reflective of each
605 jurisdiction's political activity and culture on the topic of seismic resilience in general
606 than because of the specific process or outcomes of the resilience planning initiatives. Of
607 course, the jurisdictions of the initiatives are different scales. It is possible that it is

politically and practically easier to make progress at the local level, which favors success for the SPUR initiative.

Unfortunately, all three initiatives have relatively little content focused on the recovery goals stated in their respective definitions of resilience for their jurisdiction. The initiatives put a great deal of emphasis on the goal of increasing the speed of recovery. Of course, recovery time is the core of their respective performance measurement frameworks. However, moderate to no attention is given within the initiative reports on how to minimize social disruption (SPUR and RWS), reduce vulnerabilities (ORP), mitigate effects of future earthquakes (SPUR), or facilitate new and better conditions (RWS) beyond simply building anew. The performance measurement frameworks of all three initiatives make no consideration of these goals. The SPUR Resilient City initiative did publish an entire report focused on making recovery recommendations (Johnson et al. 2013). However, the RWS and ORP initiatives use recovery to inform and prioritize recommendations for mitigation and preparedness (e.g., drills and continuity planning), rather than how to plan for improved post-earthquake recovery and building back better.

SPUR Resilient City

A significant measure of progress for the SPUR Resilient City initiative is just the number of task forces, corresponding reports, covered topics, and years of sustained volunteer work—well beyond the states of the RWS and ORP initiatives after similar durations. Additionally, the initiative has already had impact within the City and County of San Francisco and, of course, its inspiration for other resilience building initiatives. SPUR

629 Resilient City has likely hastened progress on San Francisco's Community Action Plan for
630 Seismic Safety (CAPSS). CAPSS lays out 50 tasks to be taken in 30 years to improve
631 seismic safety. In April 2013, San Francisco passed an ordinance requiring the evaluation
632 and retrofit some types of soft-story buildings. In the years since the last Resilient City
633 report was published, San Francisco has allocated significant funds for improving seismic
634 safety of city facilities. In February 2013, Pacific Gas and Electric announced allocation
635 of \$1.2 billion over five years to improve utilities infrastructure, with a focus on
636 earthquake resilience. The City of San Francisco Earthquake Safety and Emergency
637 Response Bond (Proposition A) was easily passed by a public vote in 2014. The San
638 Francisco Lifelines Council was formed in 2009 and published an interdependencies
639 study in 2014.

640 ***Resilient Washington State***

641 The final report of the Resilient Washington State initiative was released in November of
642 2012. In conjunction with the report's completion, the RWS subcommittee briefed the
643 state's governor, adjutant general, and emergency management director on the RWS
644 findings and recommendations. The report received limited print media attention in the
645 months following completion. The RWS initiative of course informed the approach taken
646 by OSSPAC to develop the Oregon Resilience Plan. The most obvious influence is on the
647 development of the recovery-focused performance measurement frameworks. The
648 emphasis and detail of the frameworks in both the RWS and ORP approaches exceed
649 what occurred in the completion of SPUR's initiative. Since the RWS final report was

published, significant progress has been made on Washington State's Project Safe Haven—a program to promote vertical evacuation for areas on the coast in tsunami inundation zones—a recommendation presented in the RWS reports. In April 2013, a school bond was passed in Westport, WA to fund reconstruction of Ocosta Elementary School. \$2 million of the bond was allocated to construct the first vertical evacuation structure in the state, which is now complete. In October 2015, FEMA and the Earthquake Engineering Research Institute provided funding to support seismic evaluations of three school districts in Thurston County, WA. The intent of the program is to provide a model that can be replicated statewide to achieve recommended school seismic safety. The RWS initiative met its goal to provide a model to local government when King County, WA kicked off the Resilient King County initiative in September 2013. In 2016, the RWS initiative has gained much more exposure from local news media because of heightened interest in seismic safety issues. To date, the most recent progress is the formation of the governor's Resilient Washington subcabinet, which is tasked to identify recommendations to move forward on and determine associated implementation strategies.

Oregon Resilience Plan

The Oregon Resilience Plan received significant media attention during its development and after the publication of the plan. The initial media attention exceeded that given to the RWS initiative and arguably what was given to SPUR's initiative within a similar timeframe. More political awareness has been achieved for the ORP initiative than for

671 RWS. The ORP was formally given to the Oregon's 77th Legislative Assembly in February
672 2013. Following, the ORP steering committee presented their results at multiple
673 legislative hearings to brief officials on what is needed to improve Oregon's resilience.
674 For example, in May 2013 the ORP findings were presented to the Oregon House
675 Committee on Transportation and Economic Development. Subsequently, Senate Bill 33
676 was passed in requiring the creation of the Oregon Resilience Task Force. This task force
677 was mandated to develop a report summarizing how to implement the ORP
678 recommendations. The report was submitted in September 2014. A \$680 million capital
679 bond was approved in Beaverton, OR to fund the construction of seven schools to
680 performance standards that ensure full functionality immediately after a major
681 earthquake. Beaverton school district representatives cited the ORP in the news media as
682 the major reason for this standard. Most recently, a high priority ORP recommendation
683 was fulfilled with the appointment of a resilience officer in the governor's office. Among
684 other responsibilities, the resilience officer will champion the implementation of the
685 other ORP recommendations.

686 ***NIST Community Resilience Planning Guide***

687 SPUR Resilient City, Resilient Washington State, and Oregon Resilience Plan initiatives
688 have had and likely will have demonstrably positive impacts in their respective
689 jurisdictions, even if just raising public and political awareness. The initiatives now have
690 had influence outside the three jurisdictions with the development of the National
691 Institute of Standards and Technology's community resilience planning guide (NIST

2015), which is intended as a model for other jurisdictions to design and conduct seismic resilience planning initiatives. The NIST guide was inspired and patterned after the SPUR Before the Disaster Task Force reports (Poland 2009, Bonowitz 2009, Maffei 2009, Barkley 2009) and the ORP. (The guide cites RWS once to note that the ORP built on the RWS initiative.) The chair of the SPUR Before the Disaster Task Force and one of the ORP steering committee members were selected as a NIST fellow and in turn helped developed NIST's community resilience planning guide. The San Francisco, Washington, and Oregon initiatives have grown a professional network for discussing earthquake community resilience planning. The initiatives and the eventual use of the NIST guide by other jurisdictions have and will create collegial inter-jurisdictional competition that should lead to further innovation. To hasten the positive influence of the seismic resilience planning initiatives and the related NIST Community Resilience Planning Guide, it is important in conclusion to take a critical look at aspects of the efforts.

Conclusion

The performance measurement frameworks (recovery timetables) developed as part of the SPUR, RWS, and ORP initiatives are one of the most notable and innovative features the work and so is the primary focus of conclusion. This innovation is sure to live on and evolve because it is the core feature of the NIST guide. SPUR's performance measurement framework timetable undoubtedly the primary persuasive force behind initiation of the RWS and ORP efforts. SPUR's framework was easy to communicate and compelling to WASSC and OSSPAC. Interestingly, the SPUR performance measurement

framework played a prominent role in inspiring the other initiatives and the NIST guide, but the framework was not referenced in seven of the nine Resilient City reports (2009a, Maffei 2009)—only two of the reports from the Before the Disaster Task Force who developed the framework. The SPUR framework was designed with structural mitigation and engineering performance but the framework’s unique recovery-lens can also inform recommendations for preparedness, response, and rebuilding as evidenced by the ORP. The performance measurement framework was the central organizing concept of the RWS and ORP initiatives to the exclusion of other aspects of the Resilient City initiative. Given the role of the performance measurement frameworks, it is surprising that the timetables and recovery estimates (current or target times) are almost never referenced in the respective SPUR, RWS, and ORP reports after first being presented within each document. For example, in the collective recommendations there does not seem to be references to identified recovery gaps as justification or prioritization for a recommendation. This is most surprising for the RWS and ORP initiatives, which were organized entirely around development of the timetables. Future seismic resilience planning initiatives should more explicitly reference their performance measurement frameworks in their recommendations and other outcomes. This will hopefully be facilitated by the NIST guide, which provides significant more detail than the original reports on how to develop and use a resilience planning performance measurement framework.

The two SPUR reports that include their performance measurement framework (Poland 2009, Bonowitz 2009) do not describe the methodology used to develop it, such as how

to estimate the recovery times presented in their recovery timetables. The number of participants and the jurisdiction itself are smaller than the case for RWS and ORP; the smaller scope perhaps made it less critical to predesign and describe an explicit collaborative process. The RWS subcommittee had the benefit of seeing SPUR's innovation and in turn saw the value of formalizing the development process to facilitate the much larger number of participants necessary to involve at a state-level. The ORP report does not provide much detail on the process for developing their framework, but OSSPAC had the RWS process to build upon and chose to have the eight ORP task groups develop their own approaches. The development process outlined in the NIST Community Resilience Planning Guide appears much more effortful and resource intensive than the SPUR, RWS, and ORP approaches. Again, NIST had the benefit of detailed knowledge of the three initiatives and logically sought to expand and improve upon their approaches. The most significant expansion is inclusion of steps for identifying social dimension and explicitly linking them to individual sectors of the built environment. The inclusion of social dimensions goes well beyond the original scope of SPUR's Before the Disaster Task Force of existing building, new building, and lifeline performance, but follows the broadening trend set by RWS and ORP. Consideration of social dimensions certainly complicates the development of a resilience planning performance measurement framework and it is yet to be seen how well the NIST guide lays out the process to do it.

A justification for putting increasing effort into developing performance measurement framework timetables is better understanding of a jurisdiction's recovery gaps and

757 improved ability to identify recommendations that would not be obvious if the recovery
758 timetables were not developed. As described above, the estimated current and target
759 recovery times vary considerably between the initiatives. This exploratory study does not
760 provide evidence that the ORP estimates, which were produced with the most time and
761 effort, are more realistic or meaningful than the others. It is difficult to conclude whether
762 development of the timetables resulted in the three initiatives making more numerous,
763 unexpected, or creative recommendations than they would have otherwise. A more
764 formal study is needed to better understand this. The ORP initiative spent the most effort
765 to develop the most recovery timetables and it produced about 103 recommendations,
766 which covered the broadest scope of topics. The RWS initiative allocated fewer
767 workgroups, participants, and timetables in development of their performance
768 measurement framework and came up with at least 153 recommendations, which
769 covered a smaller scope of topics than the ORP. The SPUR Before the Disaster Task Force
770 utilized the least amount participants and time to develop the fewest timetables, but
771 produced approximately 79 moderately-scoped recommendations of the 272 broadly-
772 scoped recommendations from the full initiative. It's currently difficult to argue that one
773 initiative's recommendations are more unusual or creative than another's, while all the
774 initiatives have recommendations that refer work that was already in progress. It is not
775 clear then that more time and resources spent on creating increasingly detailed
776 timetables translates to more informed or systematic metrics and recommendations. This
777 is an important consideration for jurisdictions that use the NIST guide to design their
778 own resilience planning initiative. What is clear for future jurisdictions is that a broadly

scoped initiative—promoted in the NIST guide—results in more comprehensive recommendations, even if only a moderate effort is spent on developing their performance measurement framework.

The innovation of how to develop the performance measurement recovery timetables can largely be attributed to the RWS and ORP initiatives based of the relatively limited original explanation given by SPUR. Development of the recovery timetables is now a central part of NIST’s Community Resilience Planning Guide. The NIST guide does not compare, critique, or synthesize the respective approaches taken by the RWS and ORP initiatives to justify or inform the new approach presented in the guide. The approaches to recovery timetable development for each of the initiatives, as well as presented in the NIST guide, are widely different. No discussion is given in the SPUR, RWS, ORP, and NIST documents on how to qualitatively or quantitatively measure progress of whether implemented recommendations are closing gaps between estimated current and target recovery times. In other words, no metrics are given for how to measure performance relative to the respective performance measurement frameworks. Thus, systematic research is needed to understand how the outcomes would differ based on the approach taken and, in turn, how best to go about developing such a performance measurement framework (e.g., more or less time; fewer or more participants; qualitative or quantitative).

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