Supply Chain Network Disruptions due to Earthquakes: Lessons Learned from Previous Disasters to Keep the Economy Moving

Sal Hernandez, PhD
Assistant Professor
School of Civil and Construction Engineering
Oregon State University
email: sal.hernandez@oregonstate.edu
“It is not the strongest of the species that survive nor the most intelligent, but the one most responsive to change”.

Charles Darwin
Supply Chain Trends >>> Consequences

- The trend towards just-in-time and lean practices >>> **efficiency** rather than **effectiveness**.
- The trend towards reducing costs (at almost any cost) >>> **globalization** of supply chains, more **complex** and **vulnerable**.
- The trend towards economies of scale >>> **centralized** distribution and manufacturing >>> **lower costs** but at the same time **less flexibility**.
- The trend towards outsourcing non-core business activities >>> **loss of control** of the supply chain when it is most needed.
- The trend towards consolidation of suppliers (intentional and incidental mergers and acquisitions) >>> increased potential for **supply failure**.
What is meant by Supply Chain Disruption?

• A disruption is defined as:
  “...A disturbance or problem that interrupt an activity or process.”

• Disruptions to the supply chain can have serious consequences.
  ➢ Risk of production delays,
  ➢ Risk of crippling competitive disadvantages
  ➢ and harm to the company’s brand and value.
Categorizing Supply Chain Disruptions

Disruptions happen for various reasons and the nature of their impact also varies.

For example, earthquakes

Bubble size indicates potential impact of disruption
What is a resilient supply chain?

- **Anticipate** events like an earthquake
- **minimize** the impact of the disruption by taking proactive risk-mitigating steps
Supply Chain Vulnerability: Japan Earthquake Examples

- **Toyota’s** operations were affected to the extent that it took over six months before complete recovery was possible.
  - The delay in the launch of two models caused an estimated production loss of over 140,000 vehicles, the company's profits fell by over 30% and it lost its position as the largest automaker in the world.

- **Sony Ericsson**
  - Reported suffering from component shortages following the earthquake, which limited volumes in its smart phone offerings and delayed.

- **Toshiba**
  - Meanwhile, said an assembly plant in Japan making small liquid crystal displays closed for a month and computer maker Lenovo Group voiced worries over parts
Global Impact of a Cascadia Quake

- Oregon Seismic Safety Policy Advisory Commission

Based on comparisons with the 2011 Japanese quake and tsunami, the Oregon study predicts a massive Cascadia quake could kill 10,000 people and cause over $32 billion in damages in an area ranging from Vancouver Island to Vancouver and down as far as northern California (Oregon Resilience Plan).

Source: WiserTrade, Oregon Office of Economic Analysis
Oregon Supply Chain
Why Does Resiliency Matter to Oregon Today?

- **Resilience** is the ability to anticipate, absorb, adapt to, and recover from disruptions (Peizer 2014)
  - Important to Oregon because the more resilient Oregon is to a Cascadia Quake the more people will survive after **and** the stronger and more economically competitive Oregon will be locally, nationally, and globally

- **From a supply chain perspective**
  - The resilience of the transportation network is a **key factor** for re-establishing service
Challenges

• Uncertainties associated with Cascadia earthquake/tsunami and its ripple effects
• Insufficient resources to implement mitigation measures at local and state levels
• Insufficient collaboration across sectors
• Many more...

Current research inspired from the need to shape resilient supply chains
How Can Oregon Increase its Resilience?

• One example is through the principle of maintaining diversity and redundancy
  • i.e., don’t put your eggs in one basket

• Current Cascadia Lifelines Project (CLiPs)
  • Developed Resiliency Framework to identified local alternative routes for response and recovery that incorporated heavy vehicle routes using the City of Portland Transportation Network as a case study
Current Projects

• Summer Undergraduate Research Fellowship Program (SURF)
  ➢ Collaborative planning for rapid post earthquake recovery
  ➢ Development of a deterministic resource location and transportation network routing problem
• ODOT Project: Potential for Freight Mode Shifting in Oregon

➢ The study provides a high-level investigation of how private sector decisions are made for freight movement, identify key factors influencing these decisions, and identify market conditions likely to result in shifts in freight modes in Oregon given existing information and data. In addition, this report describes data challenges and limitations.
Concluding Remarks

• A Cascadia Quake can have far reaching effects on global supply chains as witness from the more recent Japan Earthquake and tsunami
• Oregon is on the right path to increasing transportation network resiliency to keep the economy moving
• Several projects are in the works to provide some guidance to increase supply chain resilience in the state
Thanks

Graduate Research:
Jasmine Pahukula
Jason Anderson
Dejan Dudich

Undergraduate Research:
Eric North