Chapter 10: Dependencies and Cascading Effects

Presenter:

Kent Yu, PhD, PE, SE
SEFT Consulting Group, LLC
Cascading Effects

Power System
INTERNAL Cascading Failure (2003 NE Blackout)

Approximate Timeline
1:30pm 2:00pm 2:15pm 3:30pm 4:15pm

1. Electricity generating plant goes offline during high demand period.
2. High stress put on nearby high-voltage power lines due to loss of generating plant.
3. Fault of several power lines comes in contact with trees and trip relay.
4. Transmission lines overloaded, loss alarm is transferred to them causing trip relays.
5. Over 200 power plants forced to shut down due to transmission grid disruption.
Dimensions of Dependencies

- Internal and External
- Time
- Space
- Source

(These dimensions may not be independent)
Internal and External Dependencies

- **Internal Dependency (examples)**
  - Physical Infrastructure System
  - Equipment and Repair Supplies
  - Operations Center (and more)

- **External Dependency (examples)**
  - Transportation
  - Power
  - Communication (and more)

(It is also good to consider who may depend on your system)
Time Dimension

• Recovery Phases
  • Short-Term, Intermediate, and Long-Term

• Dependencies may change from one phase to another

• Performance goals, and restoration sequence and pace are influenced by external dependencies of other infrastructure systems and community needs

(Source: FEMA, 2014)
Space Dimension

(Source: The Oregon Resilience Plan, 2013)
Source Dimension

(Courtesy of Yumei Wang, DOGAMI)

Additional Examples

- Wholesale Water Supplier
- Wholesale Power supplier
- Centralized Warehouse of A Healthcare System