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RenaissanceRe
RISK SCIENCES FOUNDATION, INC.

The Risk of Cascading Failures in Catastrophic Events

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RenaissanceRe

RenaissanceRe – A Leader in Risk Management

- A leading global catastrophe reinsurer, established in 1993
- Highly rated for financial strength: AA- from S&P, and A+ from A.M. Best
- The highest Enterprise Risk Management rating from S&P - one of the few with this distinction
- Provider of property catastrophe coverage in the global market
- “Best Global Reinsurance Company for Property Catastrophe” award from *Reactions* Magazine, 2009-2013
- Proud 20-year history of paying claims

Key Themes

- Interconnections in the risk finance and infrastructure system increase cascade-driven losses in a catastrophic event.
- Trends in business and technology are increasing the propensity for cascading risks.
- Cascading risks are measurable and diversifiable. Global private reinsurers have the risk tools and systems to do so.
- Global information sharing on loss reporting and risk aggregation is critical for identifying cascading failure trends.

(Photos: US Navy/Matthew M. Brady)

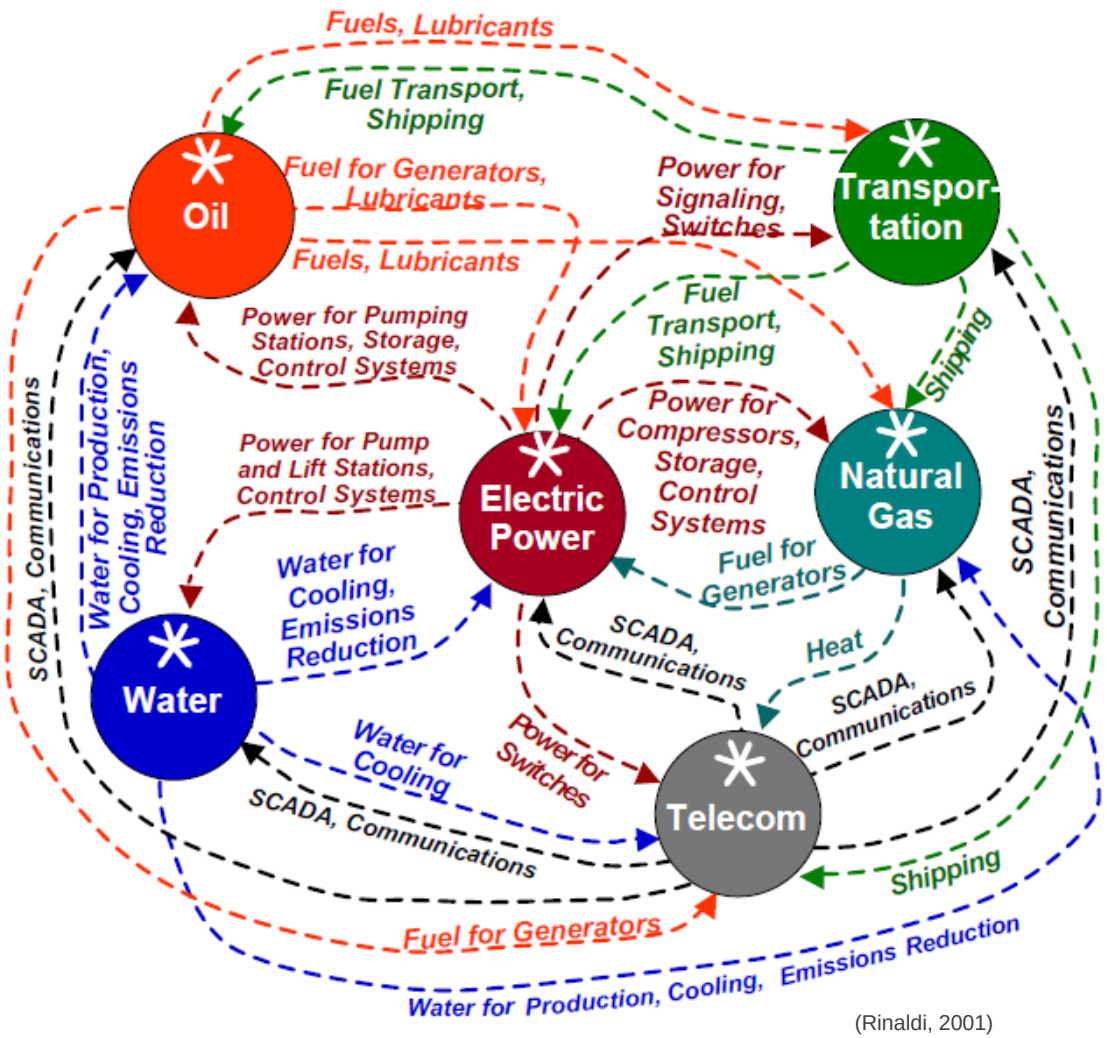
“Cascading Failures” defined

- Failure of individual components in a network, which affects performance of the system or connected systems
  - e.g., gas system damage resulting in post-earthquake fire, which is exacerbated by damage to water distribution systems
- We are distinguishing between catastrophic damage and cascading failures

(Chis 73/Wikimedia Commons)

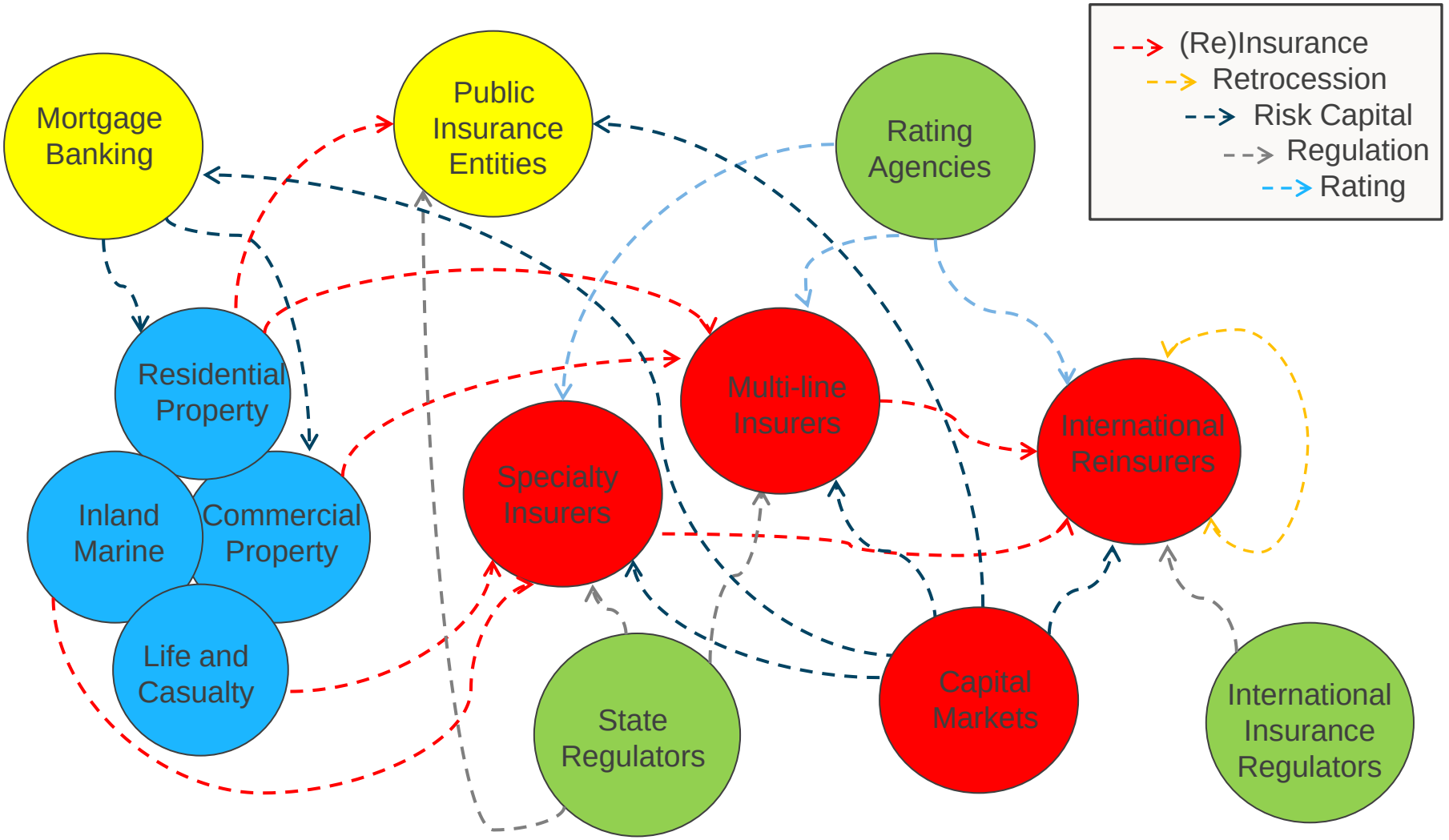
Infrastructure Interdependency:- a cause of cascading failures.

- An individual failure is communicated to other infrastructures
- Cascading opportunity proportional to
  - Compactness of inter and intra-network functions – density and immediacy
  - "Health" of the infrastructure – resiliency and adaptability



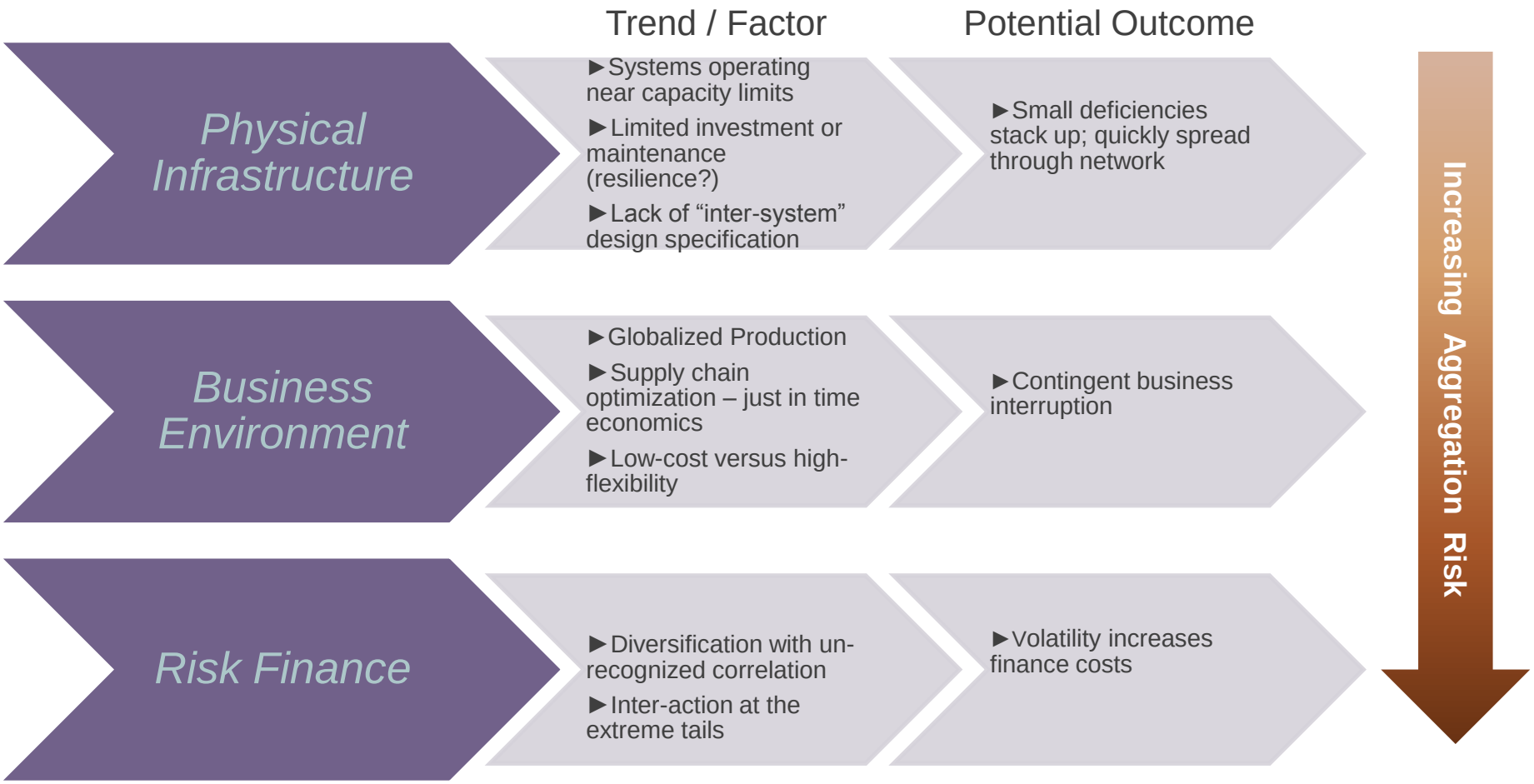
(Rinaldi, 2001)

Simplified Risk Finance System- (re)insurers observe the interconnectedness directly



(Tillman, 2012)

Potential outcomes of increased cascading failures



Global interconnection requires maximum global diversification to most efficiently decrease loss impacts

Events With Cascading Failures- interconnections exacerbated outcomes

Event/Location	Year	Contributors to Cascade	Effects
San Francisco, CA Earthquake	1906	Post-EQ fire caused by ruptured gas mains, loss of water supply system, excessive demolition during fire fight	25,000 buildings and 490 city blocks destroyed
Kanto, Japan Earthquake	1923	Post-EQ Fire, loss of water supply, tsunami	>100,000 deaths
Oakland, CA Firestorm	1991	Fire damage to power lines feeding 17 water pumping stations (Oakland water) Lack of interoperability of communication systems and fire responder equipment. Access limitations on wildland-urban interface roadways	25 deaths, $1.5B in damage. Fundamental change in the way disasters are managed in CA.
Hurricane Katrina, LA, MS, AL	2005	Failure of levees (80% of NO flooded), loss of power, roadway damage, incomplete evacuation, uncoordinated disaster response.	>1,800 deaths, >1 million people relocated, $81B in damage, including widespread unemployment, reduced tax revenue.
Tohoku, Japan	2011	Triple disaster: EQ, Tsunami, nuclear crisis	>200,000 evacuated, power shortage, future of nuclear power in question in Japan and elsewhere, serious interruptions in global supply chains for car parts and electronics

Value of reinsurance in dealing with cascading risks

- Cascading failure risk is observable & quantifiable
  - A global market
  - Modeling tools to measure tail correlations
- Max. diversification- spread catastrophic risks globally (increase efficiency)
- Reinsurance incentivized to mitigate such risks leading to resilient infrastructure.

So what's missing?

- Models capabilities exist to capture interdependent cascading failures
- BUT there is a need for better data to power the models
  - What and where are the interconnections?
- Role of government stakeholders, development agencies
  - Trans-national loss reporting
- Investments in resilient infrastructure pays off.

(Photo by M. Rymer)

(Kerry Sieh)

Summary

- Trends are intensifying interconnections globally
- Global reinsurers have risk models to quantify this risk and help businesses and governments take proactive measures to limit the worst consequences of cascading failures- diversification
- Information sharing of data to be encouraged.
- Investment is needed in resilient infrastructure.

(Phillip Capper, 2005)

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