

Workshop on Public Sector Governance of Emerging Risks

Managing the Risk of Aging Infrastructure

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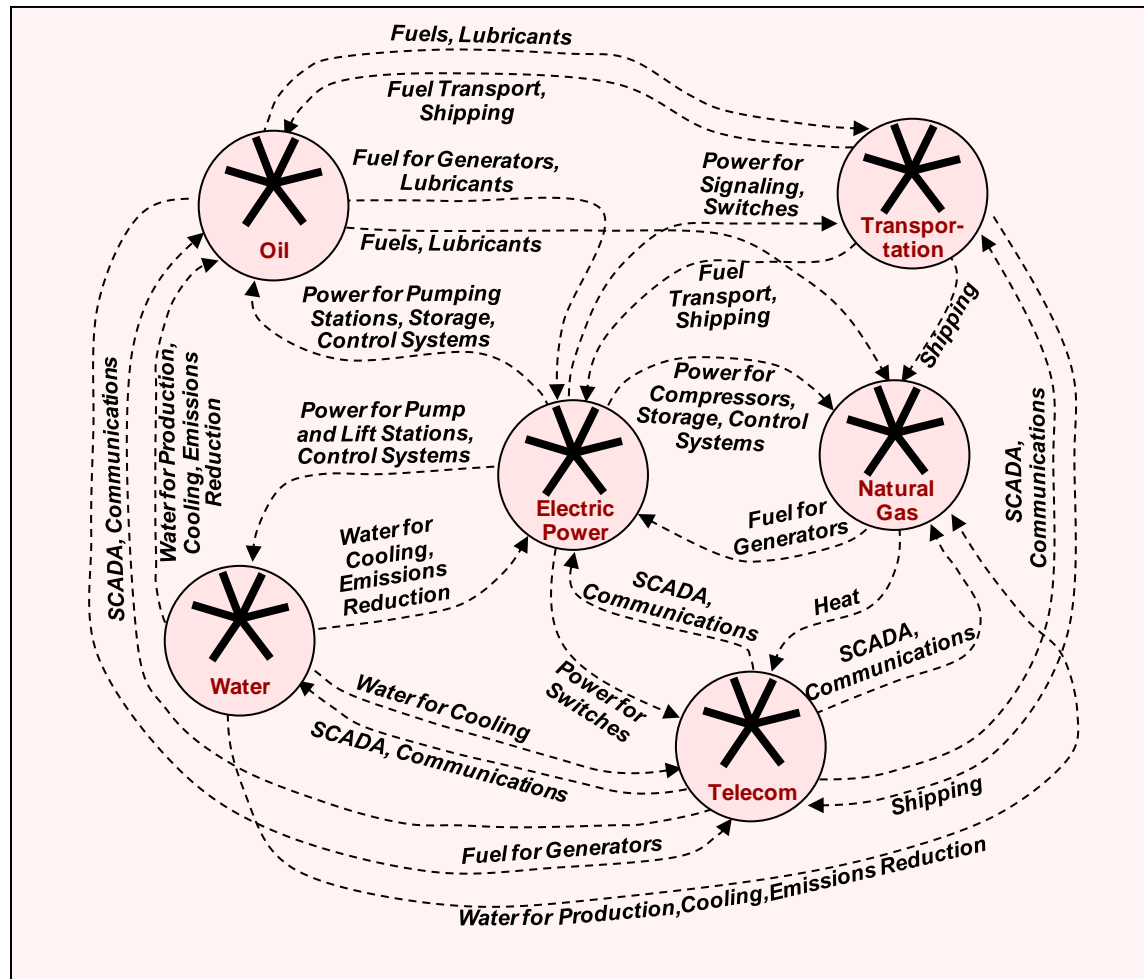
Presentation overview

- ❖ Infrastructure as a complex, socio-technical system
- ❖ Failures in complex systems
- ❖ Three case studies: Fukushima Daiichi, New Orleans levees, and the 2003 Northeast US power outage
- ❖ What have we learned?
- ❖ Where do we go from here?

Infrastructure vulnerability is more than an engineering issue

- ❖ Infrastructure is interconnected and interdependent
- ❖ Infrastructures are inherently socio-technological systems
- ❖ Organizational culture and values strongly influence the performance of physical systems

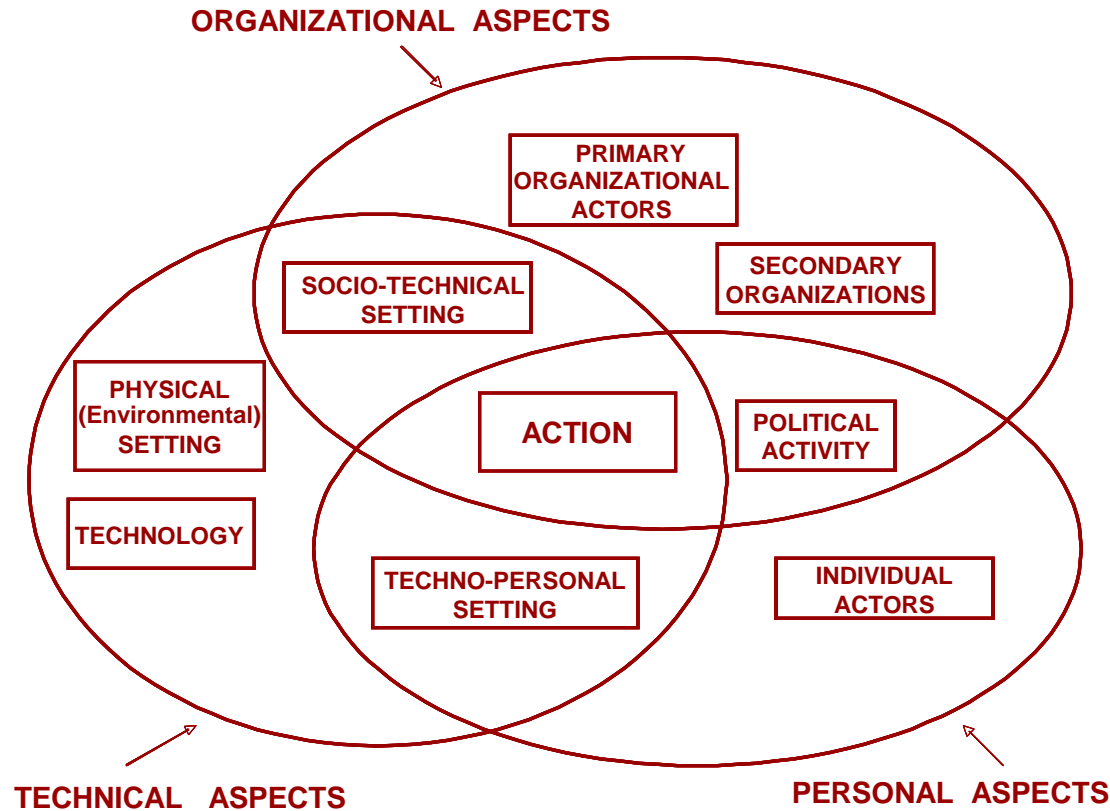
Infrastructure is interconnected, interdependent, and complex



Infrastructures are inherently socio-technological systems

Socio-technological systems are those where the technical artifacts, human participants, and institutional frameworks and procedures that combine to produce a service are so intertwined as to be inseparable. Multiple owners, operators, and regulators can complicate governance, preparedness, and response.

Infrastructures must be understood in a broad, holistic context



Our understanding of the range of infrastructure risks is uneven

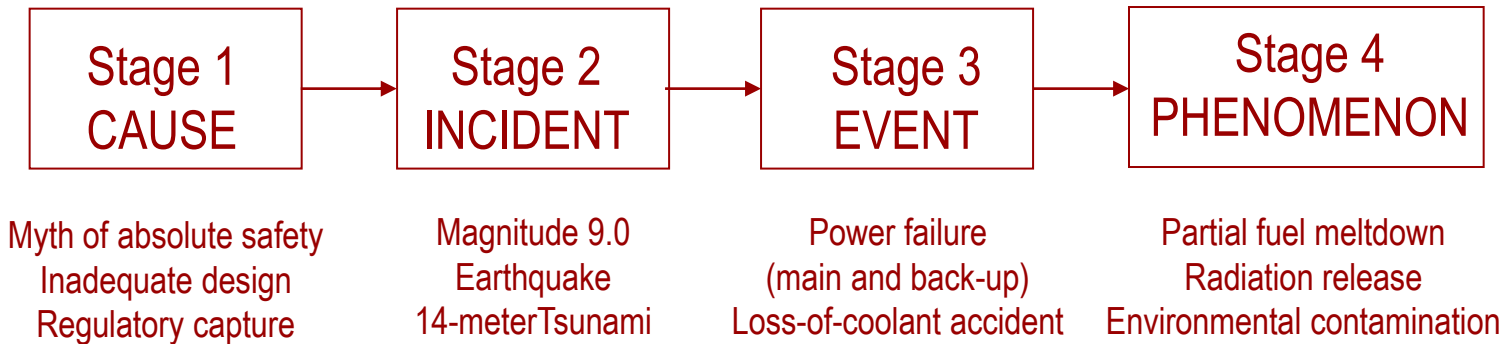
- ❖ Natural hazards ✓✓✓✓
- ❖ Malevolent acts ✓✓✓
- ❖ Wearout and breakdown ✓✓
- ❖ Tight-coupling of system elements ✓
- ❖ Socio-organizational factors ✓
 - ✧ Human error (including lack of knowledge or training)
 - ✧ Regulatory capture
 - ✧ Neo-liberal business practices
(capacity shedding, outsourcing, just-in-time delivery)
 - ✧ Perverse incentives

We need to be cautious in drawing lessons from complex infrastructure failures

"The complex coincidences that cause systems to fail could rarely have been foreseen by the people involved. As a result, they are reviewed only in hindsight; however, knowing the outcome of an event influences how we assess past events. Hindsight bias means that things that were not seen or understood at the time of the accident seem obvious in retrospect." (To Err is Human, 2000).

"The (narrative) fallacy is associated with our vulnerability to over-interpretation and our predilection for compact stories over raw truths. It severely distorts our mental representation of the world; it is particularly acute when it comes to the rare event." (The Black Swan, 2007).

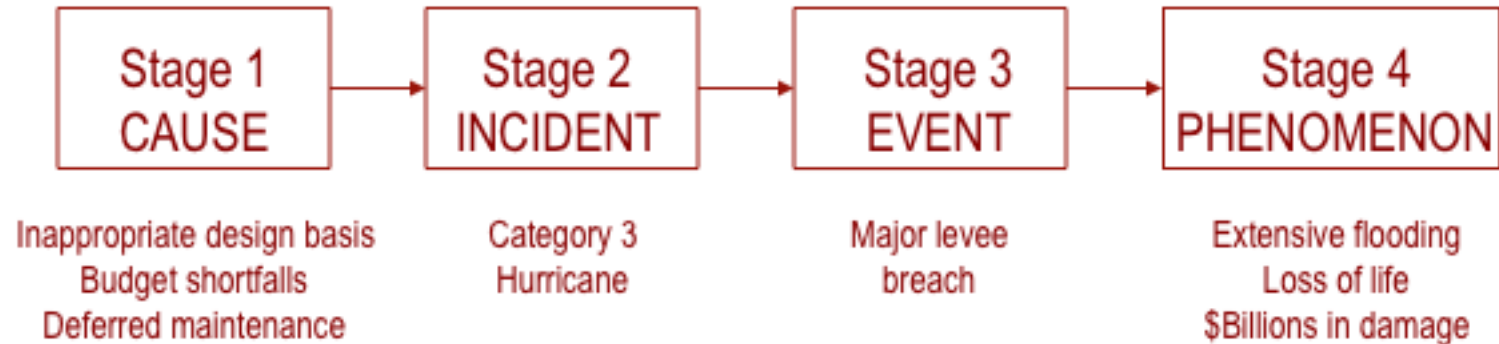
The case of Fukushima Daiichi



"...what this report cannot fully convey - especially to a global audience - is the mindset that supported the negligence behind this disaster. What must be admitted - very painfully - is that this was a disaster "Made in Japan." Its fundamental causes are to be found in the ingrained conventions of Japanese culture: our reflexive obedience; our reluctance to question authority; our devotion to 'sticking with the program'; our groupism; and our insularity."

Chairman of the Fukushima Nuclear
Accident Investigation Commission, 2012

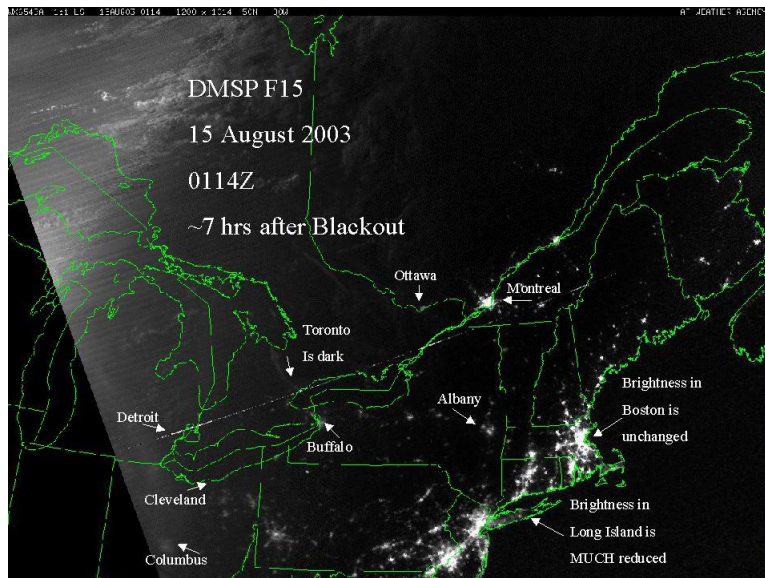
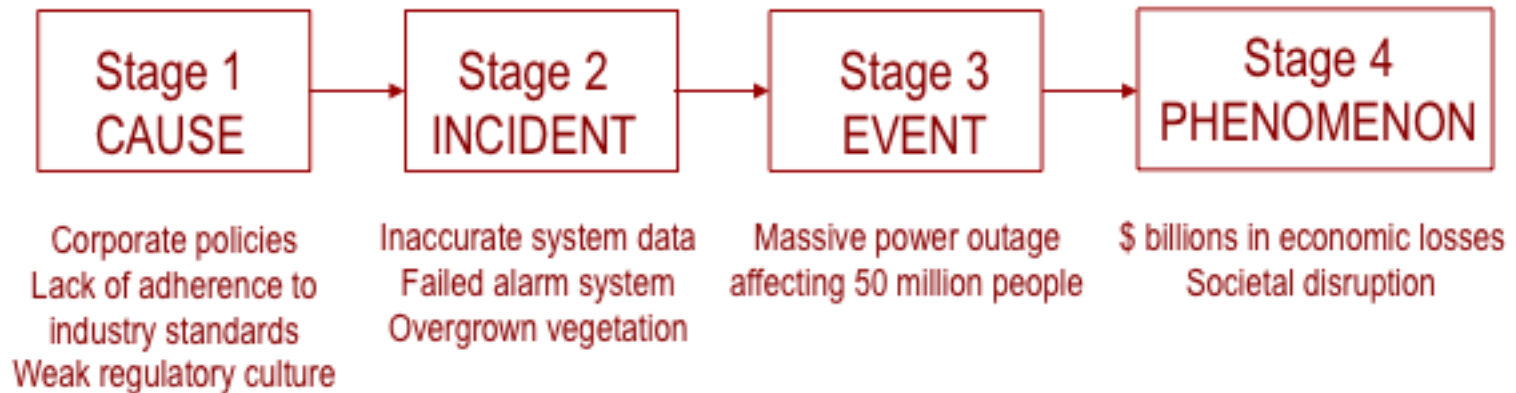
The case of New Orleans 2005



"The leadership failures that contributed to the events we witnessed on the Gulf Coast last August and September began long, long before Katrina came ashore. It literally took centuries to make the mistakes that rolled together to make Katrina such a vast natural and human-made calamity."

Report of the Independent Levee Investigation Team, July 31, 2006.

Northeast US Power Outage- 2003



"...deficiencies in corporate policies, lack of adherence to industry policies, and inadequate management of reactive power and voltage caused the blackout, rather than the lack of reactive power."

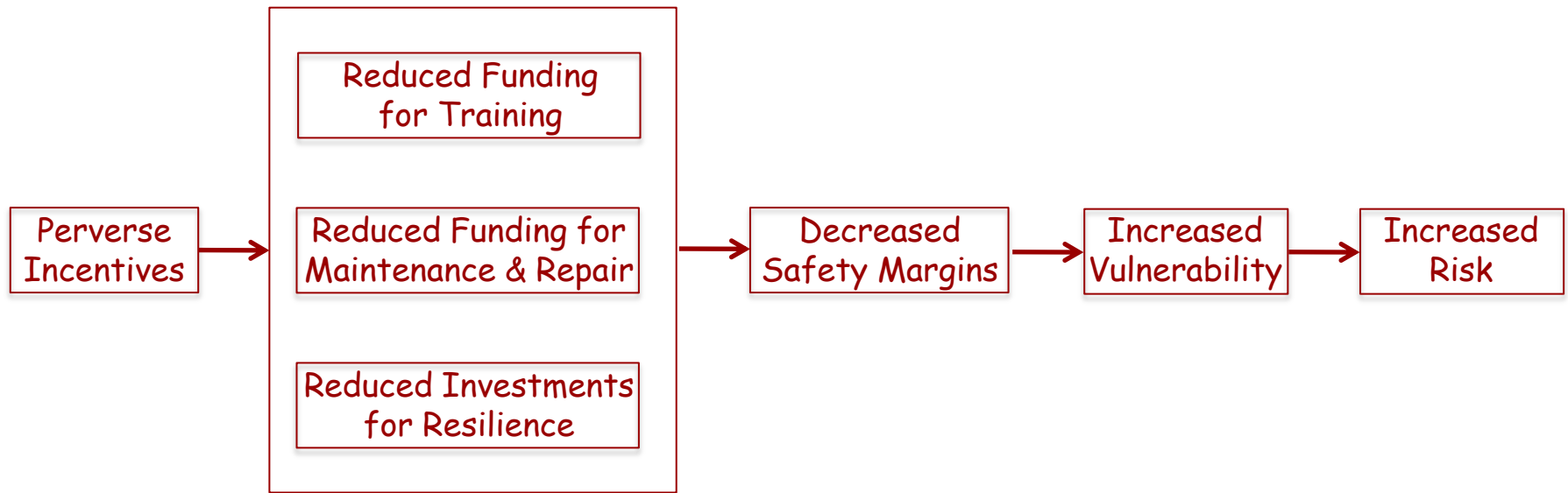
U.S.-Canada Power System Outage Task Force, 2004

What have we learned from these events?

- ❖ Institutional and organizational factors are critical elements in reducing the risk of complex failures
- ❖ We may not possess sufficient knowledge to specify the “design basis,” “maximum probable,” or “worst case” event for high consequence - low probability scenarios
- ❖ We should focus on approaches that are not vulnerable to common cause failures of multiple systems
- ❖ We should never be satisfied that “all eventualities have been addressed.” We do not know what we do not know.
- ❖ Risk management strategies need to be continuously tested and updated; the Fukushima Daiichi plant never received physical upgrades despite new knowledge on

the nature of the tsunami risk

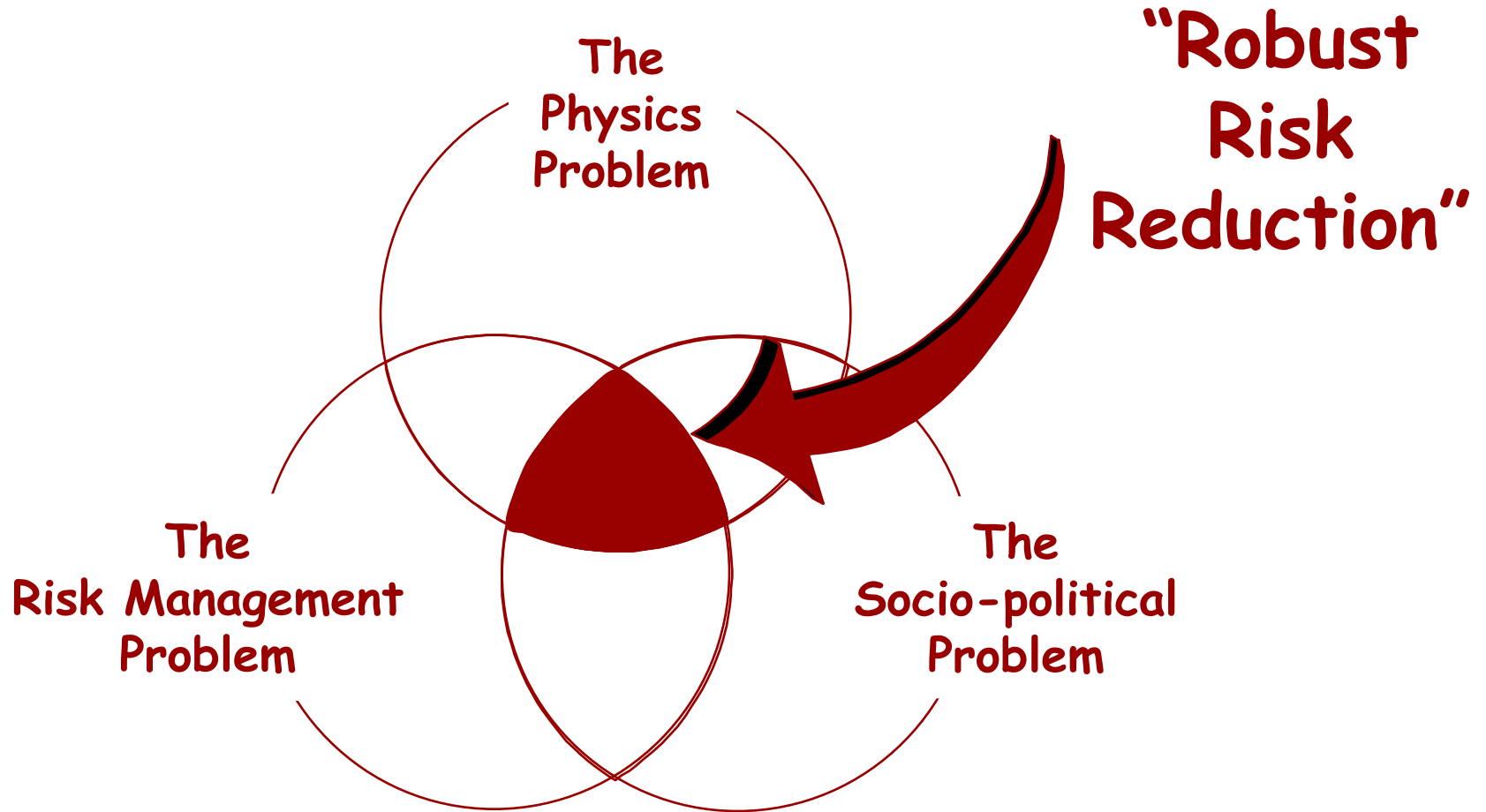
Perverse incentives greatly increase the risk of failure



Where do we go from here?

- ❖ Require planning and development to occur in a manner where the impacts of infrastructure failure can be isolated, not propagated
- ❖ Use robust risk-based approaches to understand and manage multiple risks
- ❖ Ensure independent oversight and control; avoid regulatory capture
- ❖ Ensure alignment of market and societal goals; minimize perverse incentives
- ❖ Treat failure as the stable system state; we must invest appropriately to avoid it!

To this



Thank you!

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