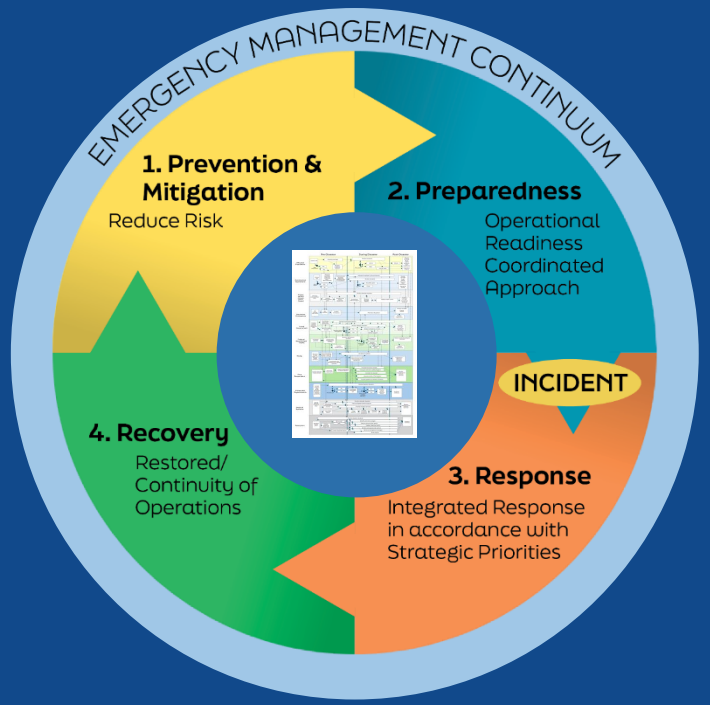
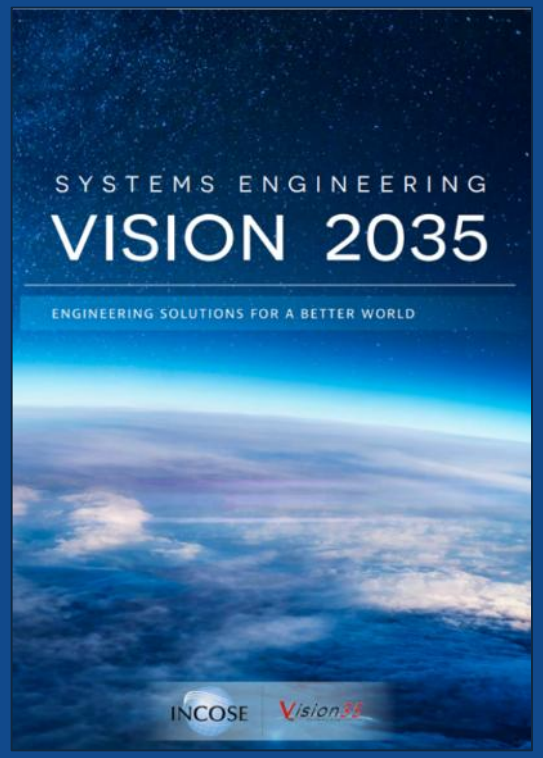
Project Wildfire – insights from applying mission engineering to a multi-agency Public Response System





Alan Harding
AJB Creative Solutions Limited/INCOSE

Project Wildfire Objective



Explore application of systems engineering to a **community mission-driven capability**

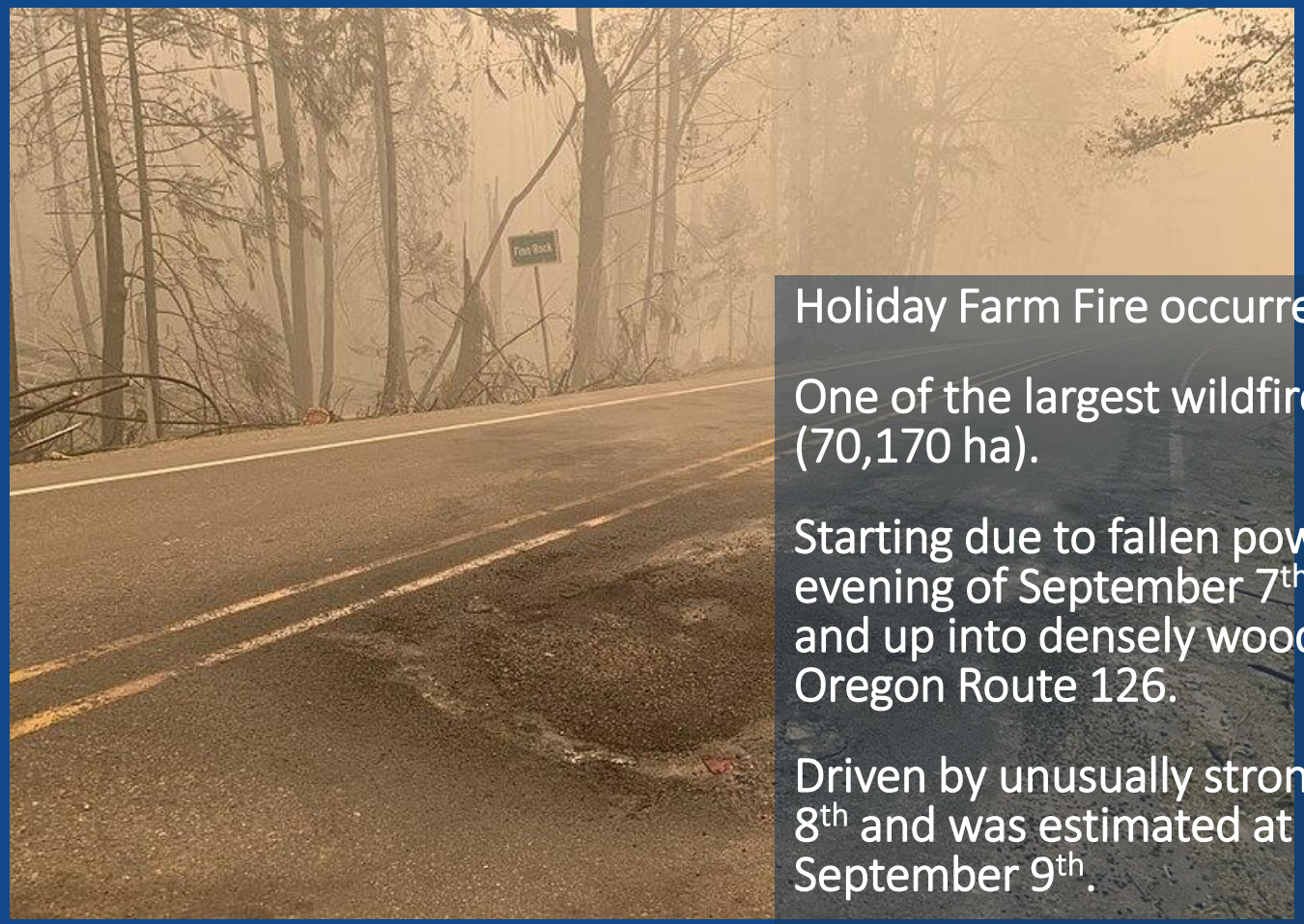
- Focused on emergency response, particularly **wildfire preparation and response** building on **Holiday Farm Fire Scenario**
- Drawing on INCOSE working group core competencies

Provide a venue for working groups and individual systems engineers to **collaboratively** apply a

- Systems engineering approach designed to achieve an effective mission driven capability outcome – **mission engineering**

Initiated with an international workshop in 2025, follow-up in 2026

Context: 2020 Holiday Farm Fire



Holiday Farm Fire occurred in the U.S. state of Oregon in 2020.

One of the largest wildfires in Oregon history, burning 73,393 acres (70,170 ha).

Starting due to fallen power lines near the Holiday Farm RV Resort on the evening of September 7th, fire spread rapidly down the McKenzie valley and up into densely wooded foothills on both sides of the river and Oregon Route 126.

Driven by unusually strong easterly winds, fire grew most on September 8th and was estimated at 105,000 acres (42,000 ha) by the morning of September 9th.

Many people evacuated. Most structures in the community of Blue River were destroyed, as were numerous properties in nearby communities.

First-hand view of the challenges

Patence Winningham Current Role: Deputy Director, Oregon Department of Emergency Management
Former Role: Lane County Emergency Manager – Lead Response Agency



Critical infrastructure & lifeline impacts

Major impact on primary watershed and drinking water source

- Power and communications outages
- Transportation routes previously known to be fragile underscored systemic access risks



Resource limitations & statewide strain

- Statewide wildfire crisis - seven large fires at once
- All resources were effectively exhausted; some incidents got incident management teams; others were told "you're on your own."
- Smaller fires had hundreds of structures lost with minimal support, showing uneven coverage.



Evacuation and alerting challenges

- Existing gaps in evacuation planning and alert & warning identified in earlier fires.
- Power shutoffs meant some residents turned off phones and missed notifications.
- Reliance on multiple channels (mass alerts, social media, neighbors) necessary to reach people.



Overreliance on a single local node (Local County Emergency Manager)

- Current model: locally executed, state-managed, federally supported, routed through single county emergency manager
- Highlights stove-piped system-of-systems and need for more distributed, scalable command/support structures



Human & organizational dependencies

- Heavy dependence on pre-existing relationships and trust with 29 fire chiefs, sheriffs, ESF partners, etc.
- Success (e.g., only one fatality) tied to rapid local decision-making on alerts and evacuations, which not all jurisdictions are currently empowered or prepared to do.

Mission Engineering – practical approach to engineer a System-of-Systems



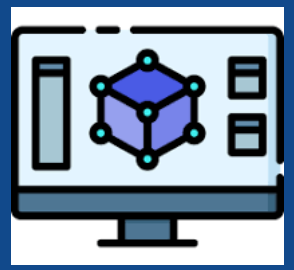
Problem Definition

- Purpose



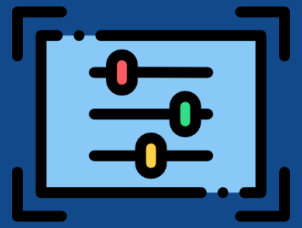
SoS/Mission Characterization

- SoS Mission Context
- Mission/ Capability Measure and Metrics



Baseline Model and Analysis

- Baseline Metrics
- Gaps and root causes



Analysis of Options and Trades

- Impact on Mission/ Capability metrics

- Treats the end-to-end mission driven capability as the “system”
- Individual systems, including organizations and other non-material elements, are components of the larger mission ‘system’ or system-of-systems
- Systems engineering applied to systems-of-systems supporting operational outcomes of the mission driven capability
- Goes beyond interfaces among systems to address cross cutting functions, end to end control and trades across systems
- Technical trades exist at multiple levels; not just within individual systems or components

Characteristics of a Complex Socio-Technical System-of-Systems


Comprised multiple independent organizations with their own objectives, resources and authority structures


Are not 'engineered' but evolve based on interactions among enterprise elements and external factors


No top-level cross-cutting authority for the enterprise as a whole


Objectives of elements of the enterprise may or may not be aligned and may be in conflict


Outcomes result from aggregate effect of actions and interactions among enterprise elements


Boundaries can be difficult to define, external factors can be as influential as elements of the enterprise, on enterprise outcomes


Technology is an enabler rather than a core element

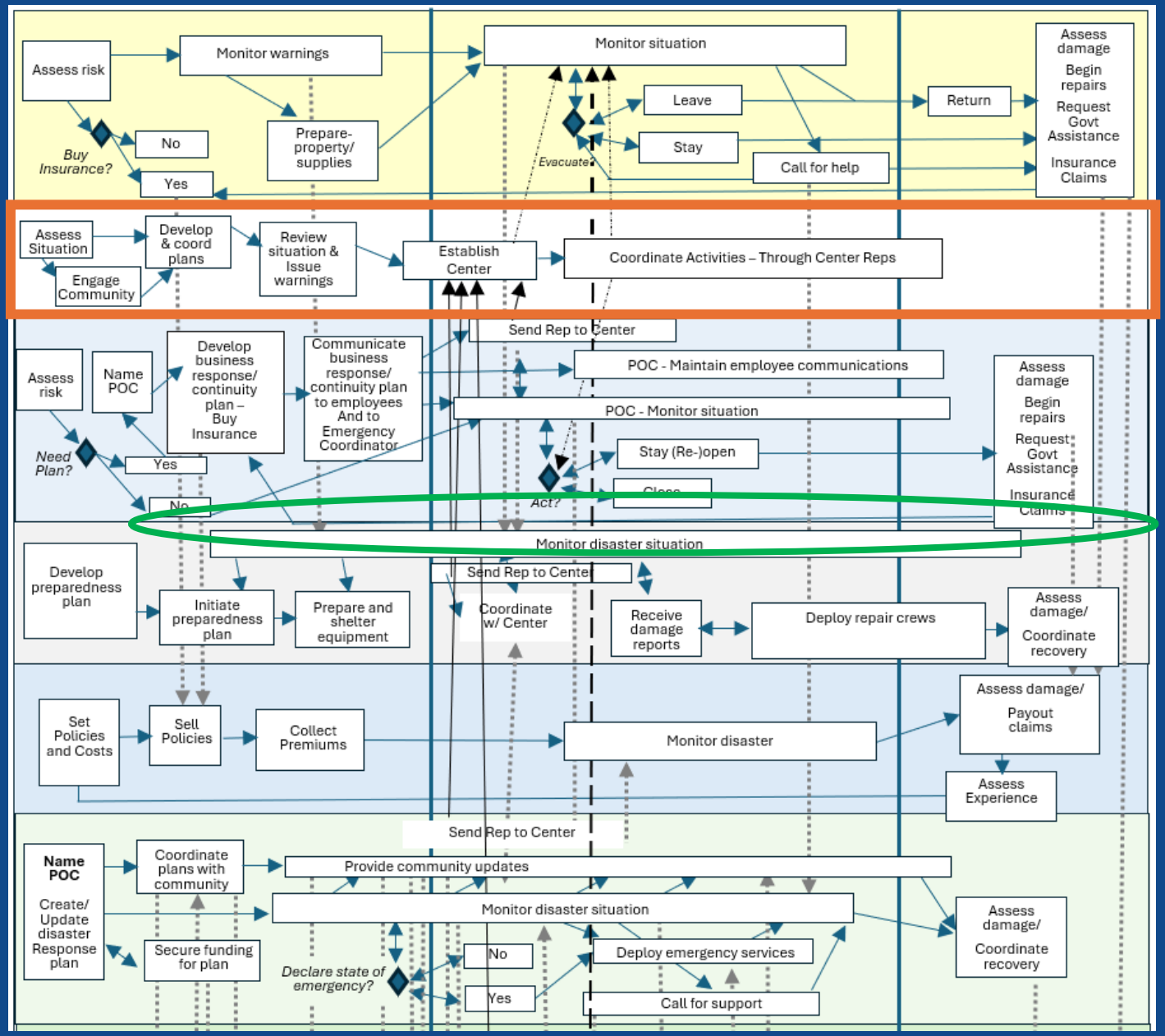
These challenge our traditional approach to systems engineering

Maier (1998) SoS characteristics

- Operational independence
- Managerial independence
- Geographical distribution,
- Emergent behavior, and
- Evolutionary development

Strawman Model of Major Elements of the Emergency Response SoS

Actions and Interactions Among Elements (examples)



Actions

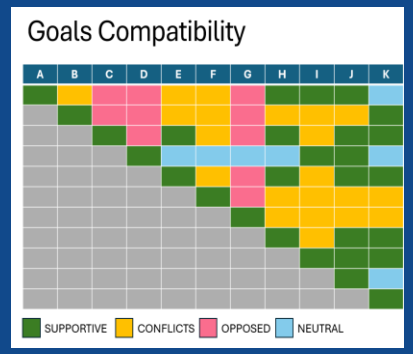
Interactions



Analysis of Options and Trades

Impact on Mission/ Capability Metrics

Workshop sessions - implications for SE

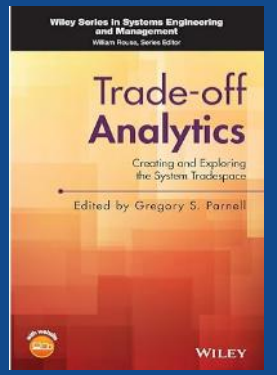


Systems of Systems

Explored individual stakeholder priorities and whether they align or compete with one another

Decision Analysis

Explored how classic “technical” decision analysis is affected by this type of broad socio-technical SoS



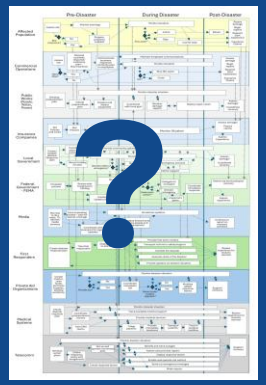
Model Based Systems Engineering

INNOSLATE®

CATIA

Systems Engineering Laboratory

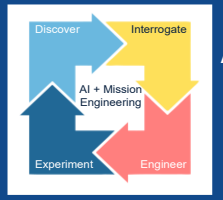
Explored how model-based implementations of wildfire model better inform and enable mission engineering



AI-Enabled Systems Engineering

Explored use of ChatGPT to analyze wildfire model and could better support Mission Engineering

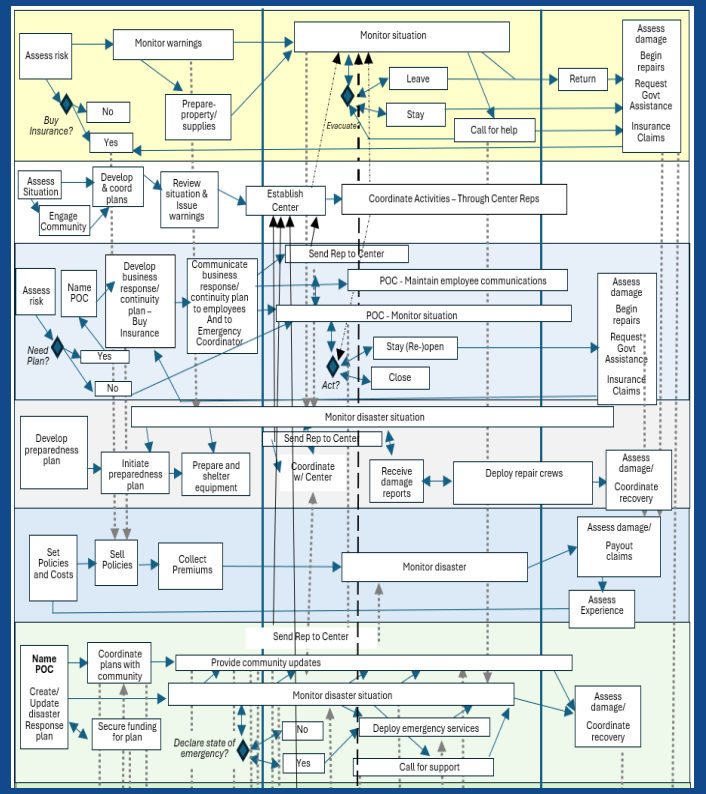
ChatGPT



AI for ME

Findings from Project Wildfire

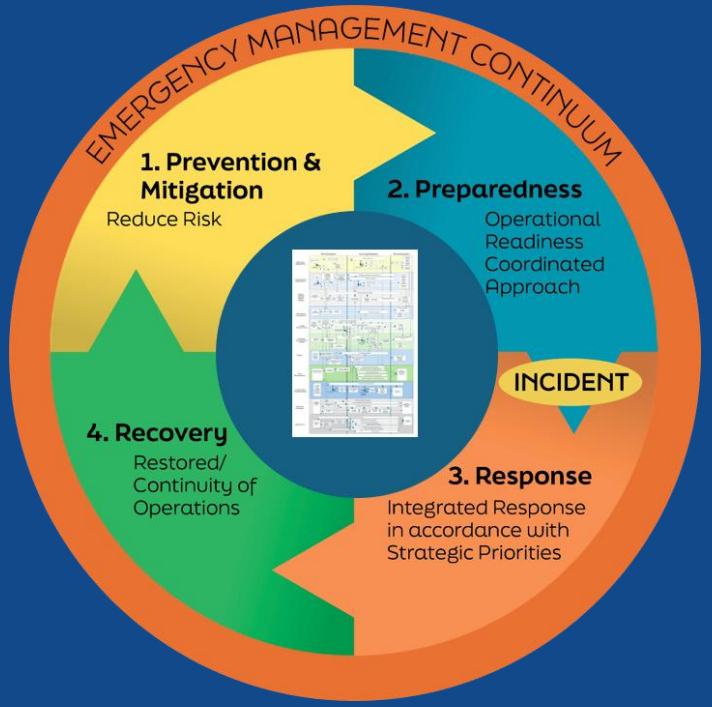
1. Wildfire scenario has great resonance and relevance to the global systems community.
2. Misson Engineering is recognized as a practical approach to manage/improve operational SoS.
3. Interest from WFEO Committee on Disaster Risk Management to understand these systems approaches.
4. Having noted technical bias of classic systems engineering we plan to explore softer approaches to “socio” aspects:
   - Systems Thinking
   - Social Systems
   - Complex Systems
   - Resilience
   - Natural Systems

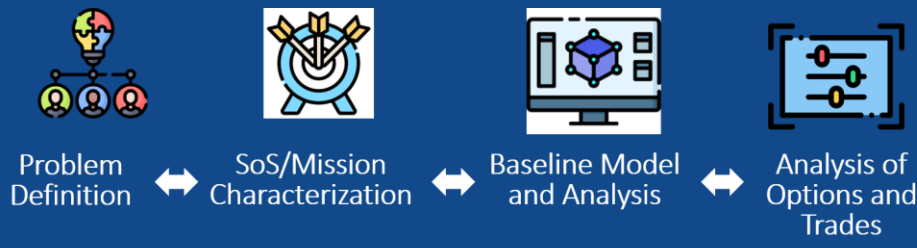




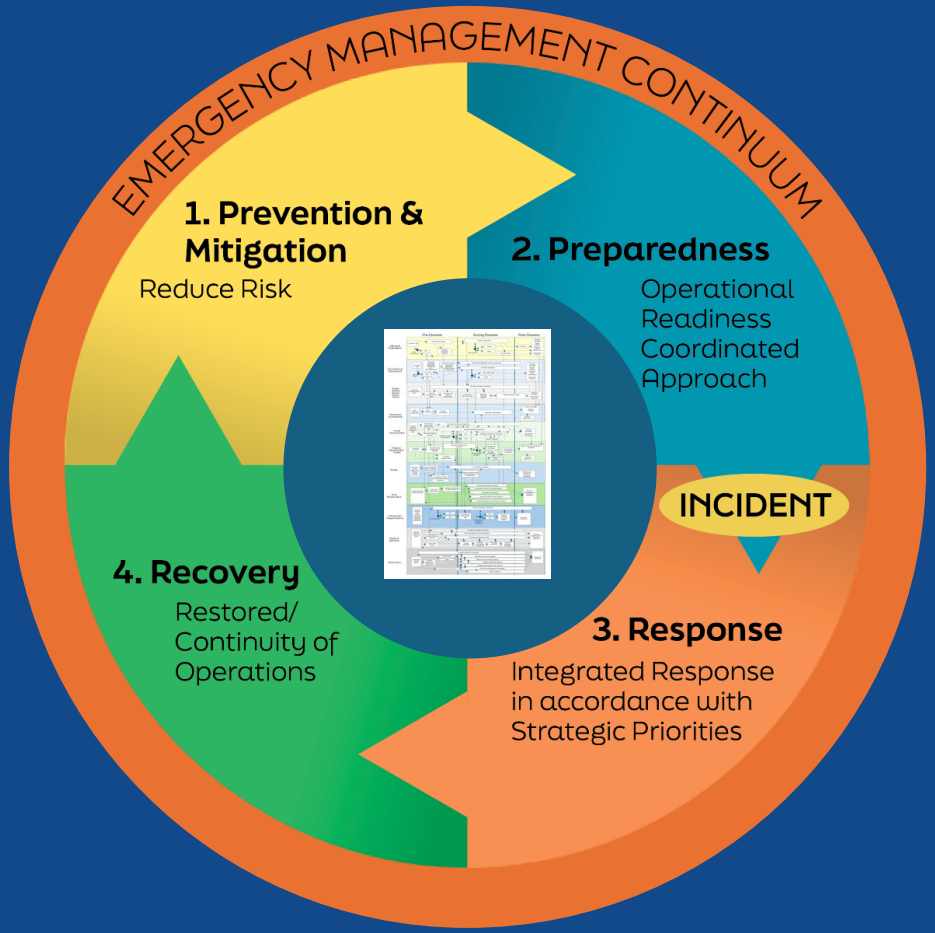
Recommendations to the Summit

1. Systems Engineering, in particular Mission Engineering, is a vital approach for a world where most complex challenges involve systems-of-systems.
2. We must ensure SE specialists are involved in all aspects of emergency management, building communities to share evolving good practice.
3. We must educate and enable systems practitioners to understand and choose between classic and softer techniques dependent on the problem at hand.





Thank-you


EMERGENCY MANAGEMENT CONTINUUM
1. Prevention & Mitigation
Reduce Risk
2. Preparedness
Operational Readiness Coordinated Approach
INCIDENT
3. Response
Integrated Response in accordance with Strategic Priorities
4. Recovery
Restored/ Continuity of Operations



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