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14. ABSTRACT
Problem Statement:
When confronting a peer adversary, operating in a degraded, denied or disconnected environment is a certainty. All echelons of command require resilient networks and communications infrastructures that, in the face of adversity, provide commanders with reliable options to accomplish their missions.

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Operating in a Degraded, Denied or Disconnected Environment Winning in the Face of Adversity

Mr. David Michalowicz

Mobile Deployable Communications Conference

Warsaw, Poland

30 - 31 January 2020

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Overview

- MITRE at a glance
- MITRE has been assessing “resiliency” and what it means in the national defense context
- A systems thinking methodology to holistically assess “resilience” against adverse events
- Determine “resiliency” requirements

MITRE at a Glance

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- Department of Homeland Security
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- Department of Veterans Affairs
- Administrative Office of the U.S. Courts
- Department of the Treasury
- Internal Revenue Service

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Organized as independent entities with limitations and restrictions on their activities

Assist the U.S. government with scientific research and analysis, development and acquisition, and systems engineering/integration

Bring together the expertise and outlook of government, industry, public-private partnerships and academia to solve complex technical problems

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Assessing resiliency in the national defense context

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Problem Statement

- **When confronting a peer adversary, operating in a degraded, denied or disconnected environment is a certainty.**

- **All echelons of command require resilient networks and communications infrastructures that, in the face of adversity, provide commanders with reliable options to accomplish their missions.**

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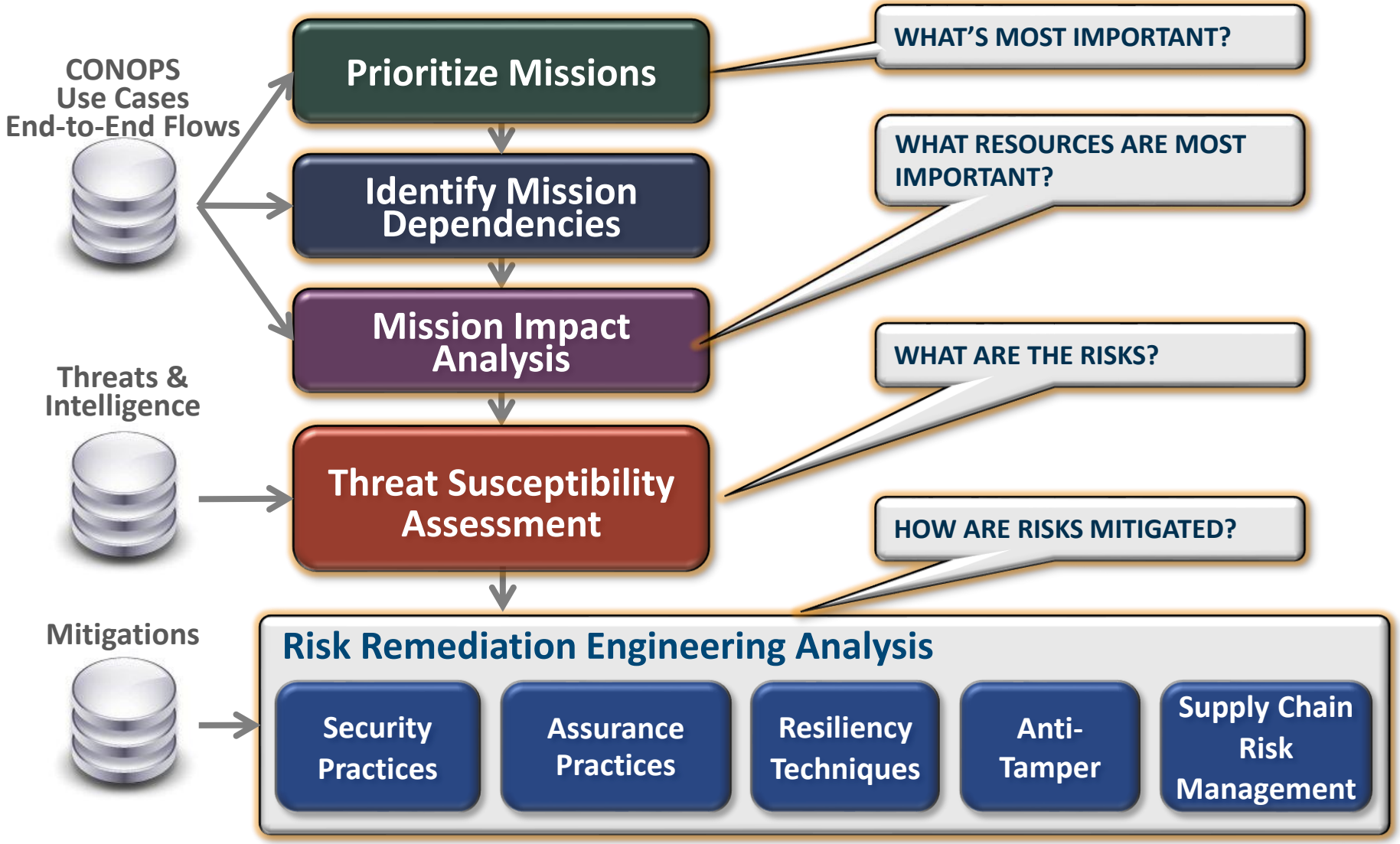
Transformation of Thought



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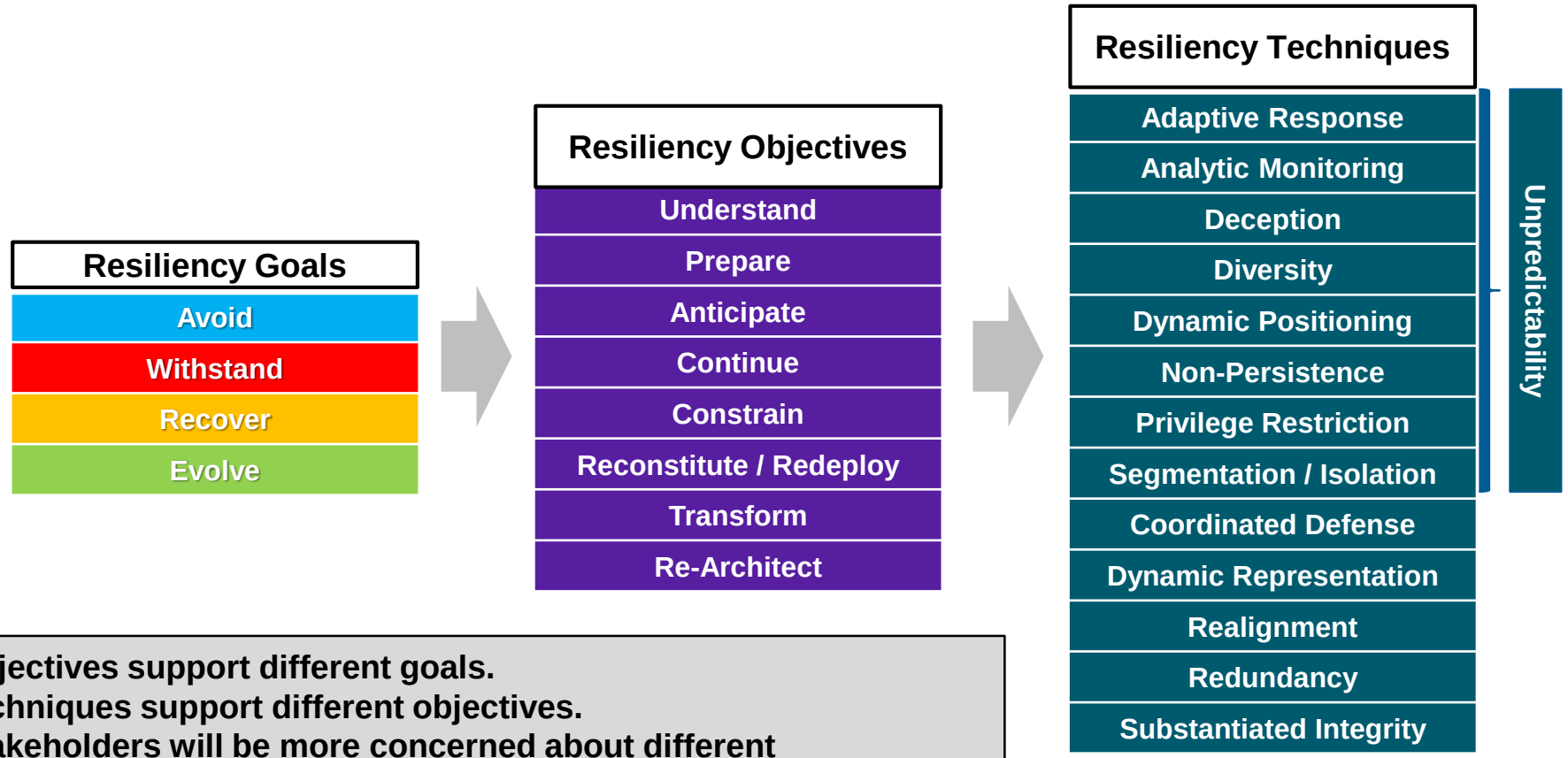
A Resiliency Engineering Framework



- Different objectives support different goals.
- Different techniques support different objectives.
- Different stakeholders will be more concerned about different goals & objectives.
- Techniques vary in maturity, applicability to architectural layers, and suitability to operational environments
- No system can (or should) apply them all.

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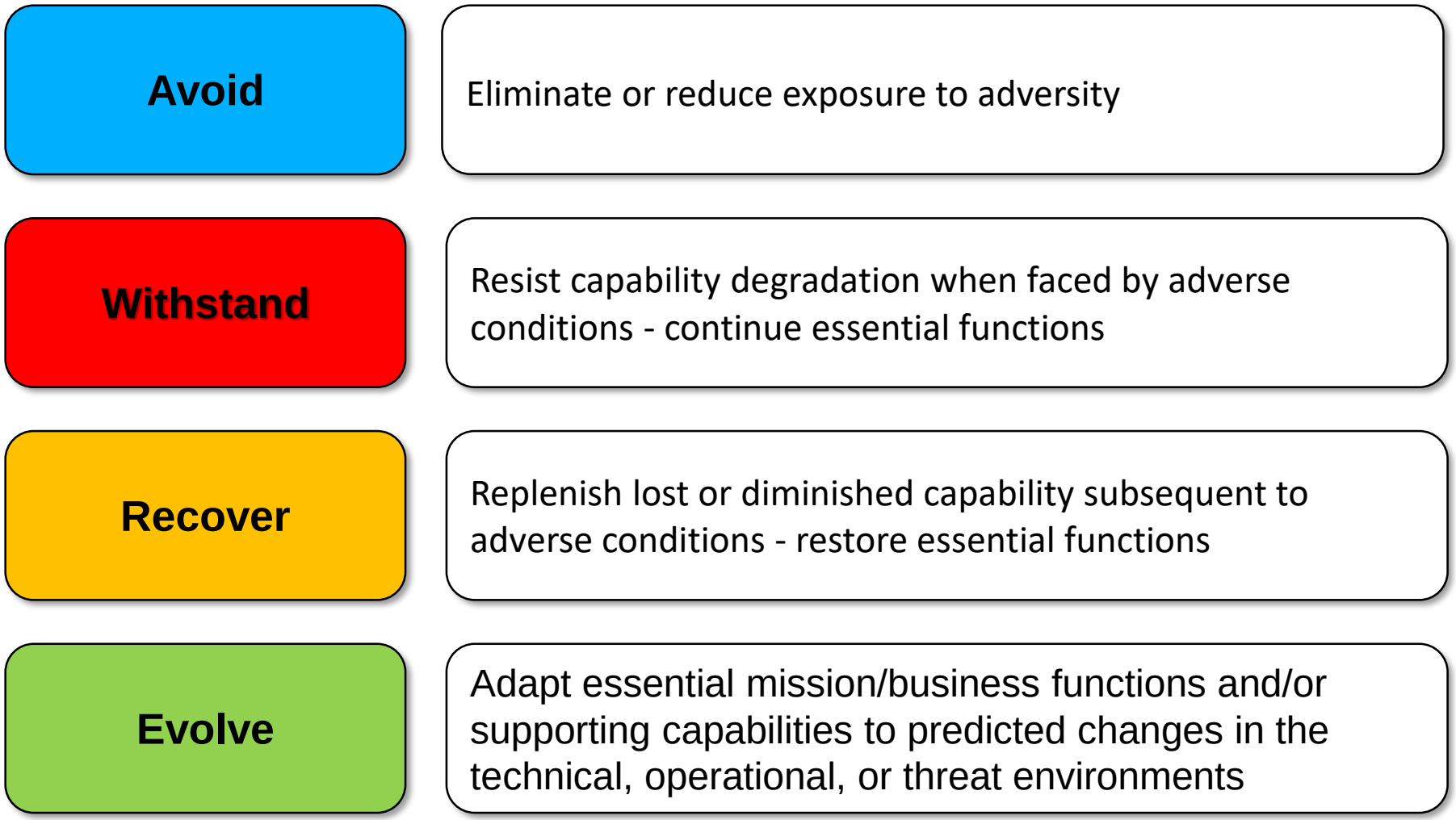
Resiliency Engineering Framework Goals



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A Systems Thinking methodology and resiliency

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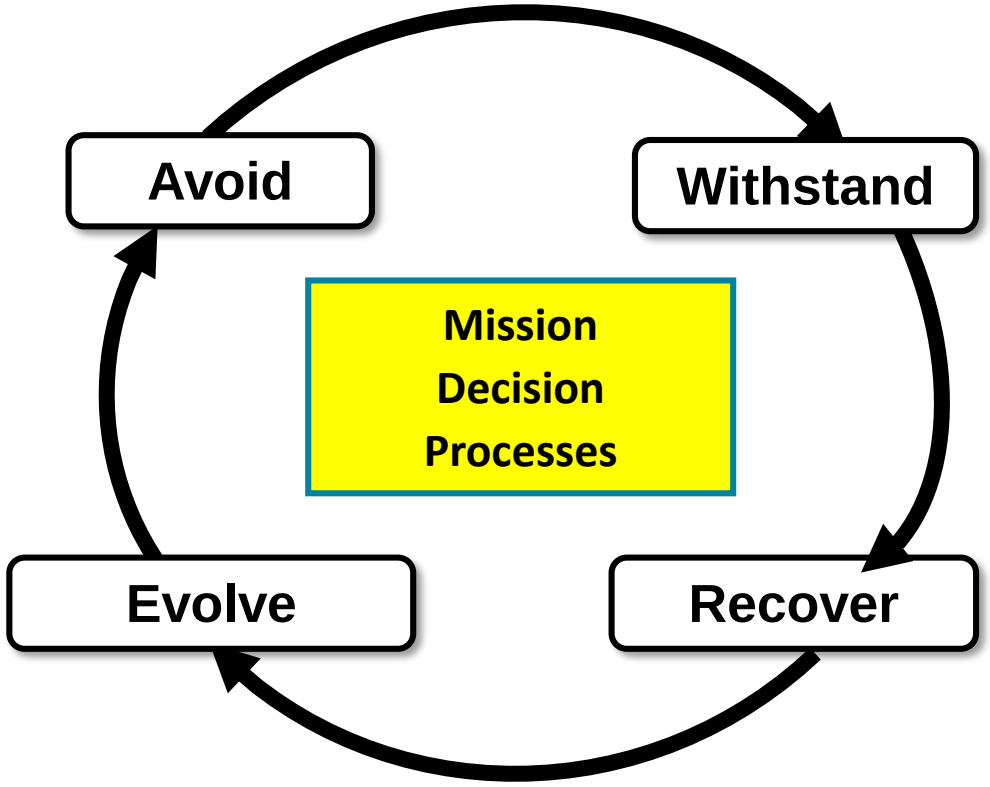
A Systems Thinking Model – An Iterative Process
Cyber Resiliency Engineering Framework Goals



Anticipate - Eliminate or reduce exposure to adversity

Withstand - Resist capability degradation when faced by adverse conditions - continue essential functions

Recover - Replenish lost or diminished capability subsequent to adverse conditions

Evolve - Adapt essential mission/business functions and/or supporting capabilities to predicted changes in the technical, operational, or threat environments

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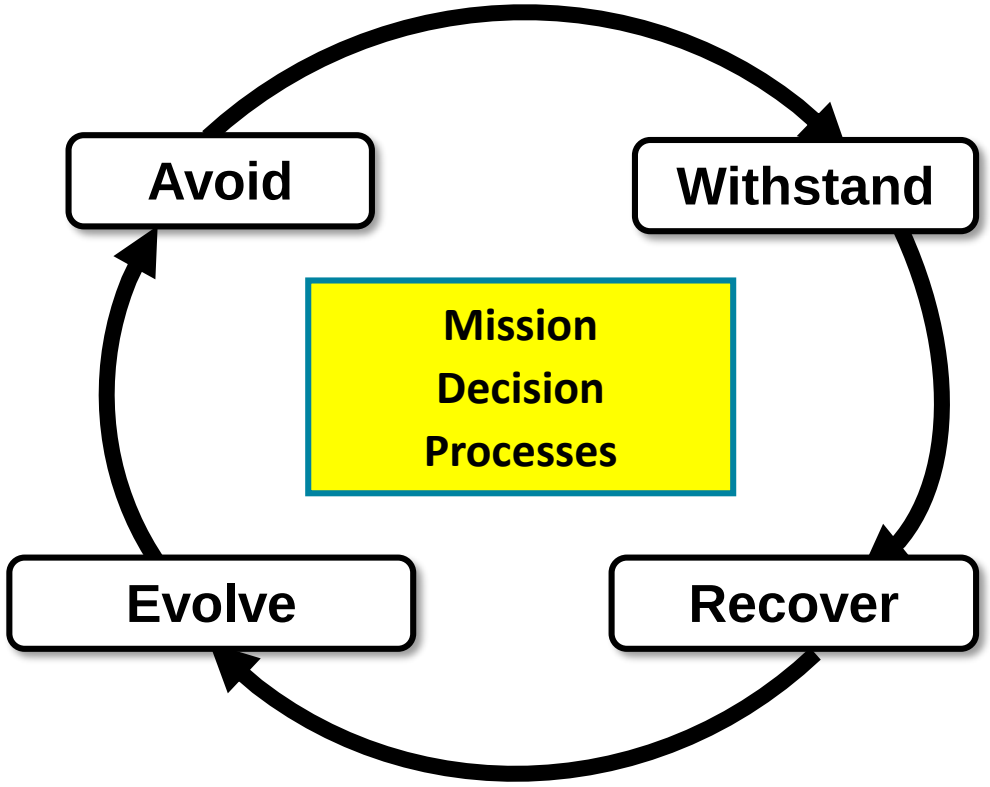
Conditions of Adversity
Infinite number of Events and Combinations

- **Natural Disasters**
  - Floods, Storms, Fires, Earthquake, Lightning Strikes, landslides
- **Kinetic Effects**
  - Bombs, Explosions, Impacts, Maneuvers
- **Non-Kinetic Effects**
  - Cyber-Attacks, Economic Warfare, Electronic Warfare, Psychological Operations
- **Human Error**
  - System misconfiguration, Lost Devices, Poor patch management, Cut cables from an excavation gone wrong

A Systems Thinking Model – An Iterative Process
Primary Communications and Networks to Conduct Mission



Primary Communications and Networks

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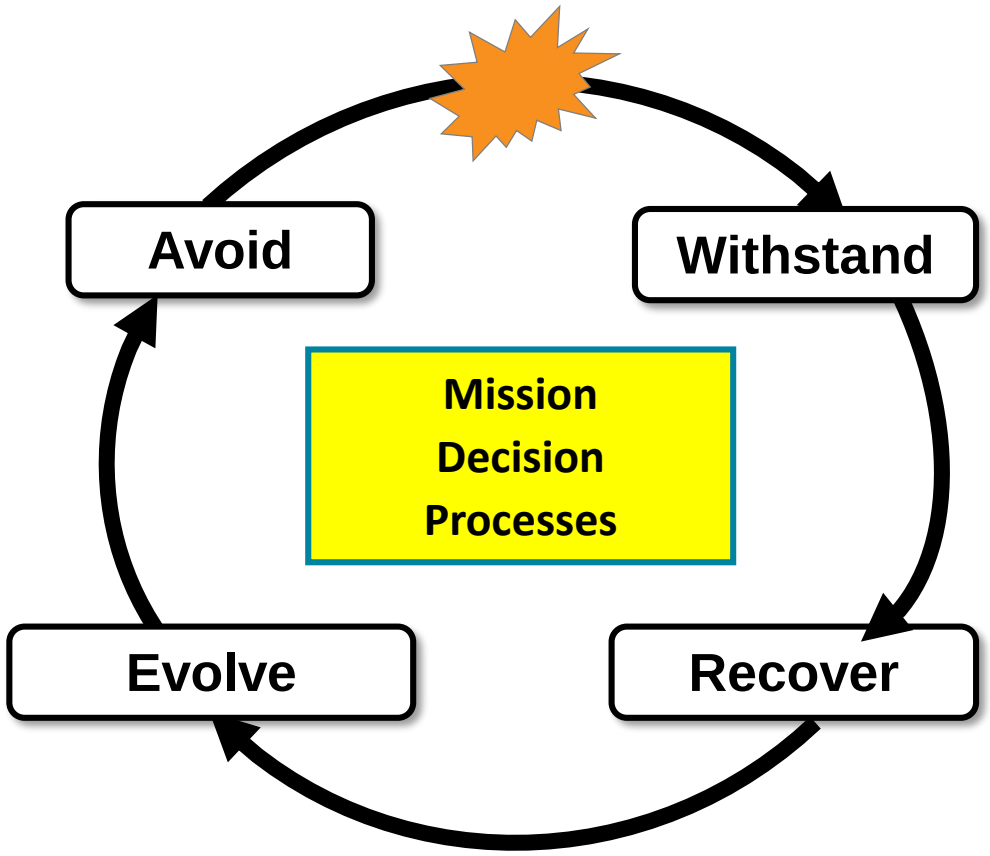
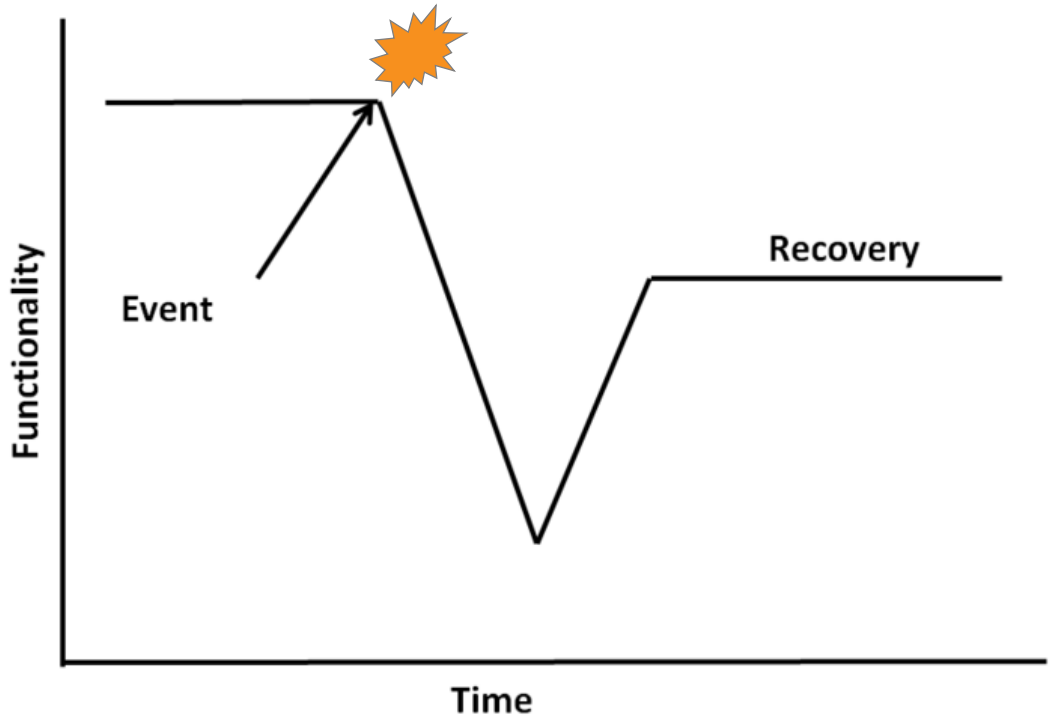
A Systems Thinking Model – An Iterative Process
Introduce Adverse Event(s)





Disruption Model for Resilience and Survivability

Source: Systems Engineering Body of Knowledge (SEBoK) – Resilience Engineering
http://sebokwiki.org/wiki/File:Disruption_Diagram.PNG

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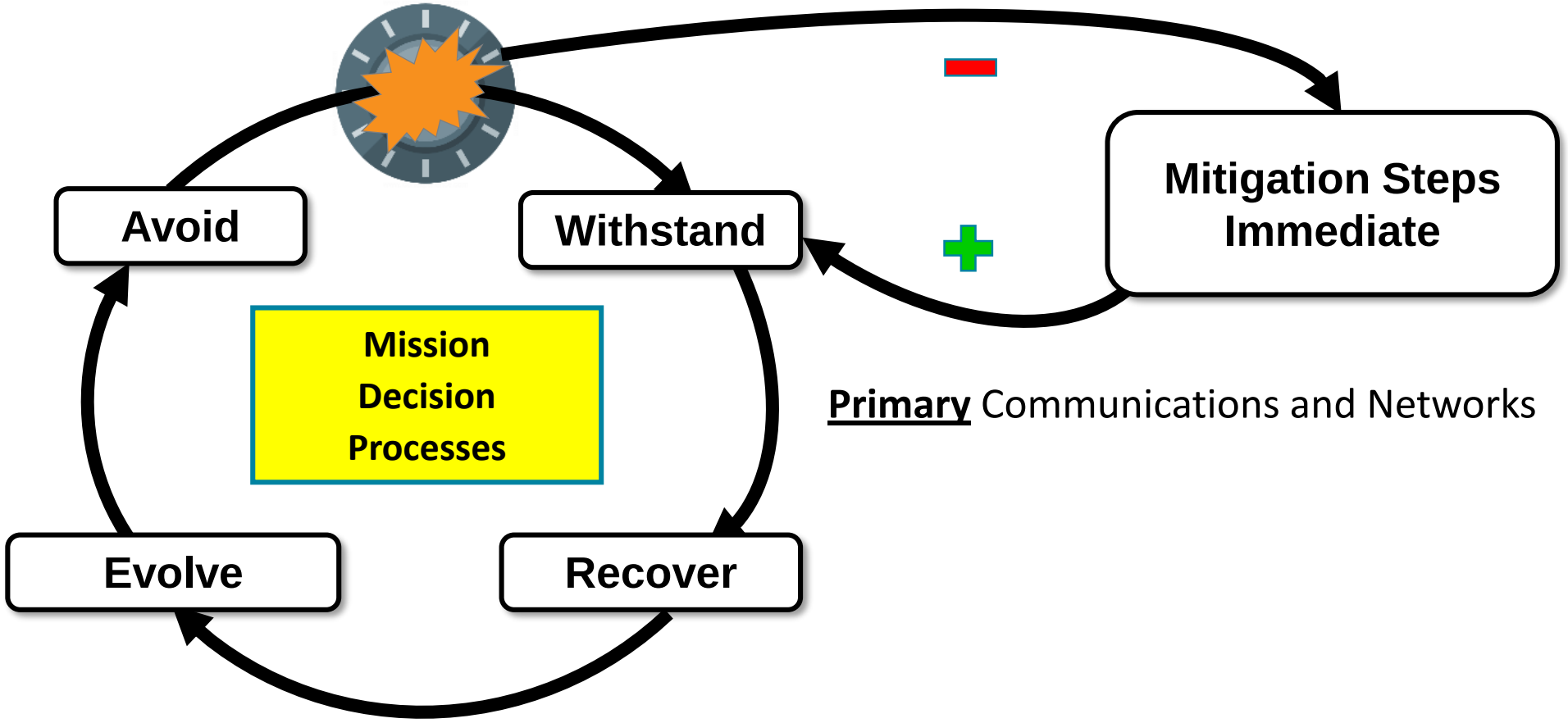
A Systems Thinking Model – An Iterative Process
Mitigation Steps - Immediate



Primary Communications and Networks

- **If a mitigation is in place to immediately fix the problem: Withstand the Event**

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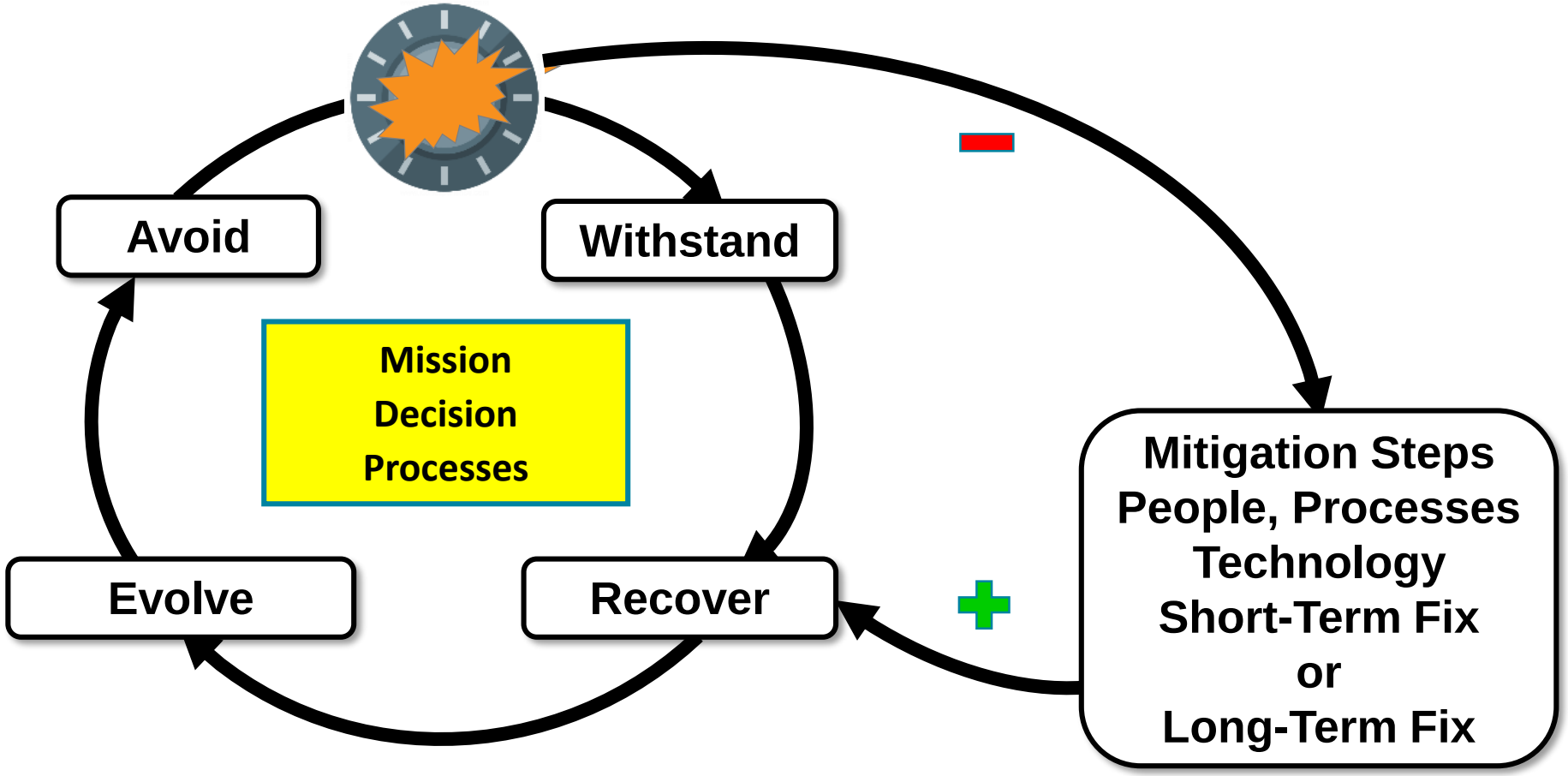
A Systems Thinking Model – An Iterative Process
Mitigation Steps – Short-Term or Long-Term Fix



- Other mitigation steps need to be considered: People, Processes and Technology

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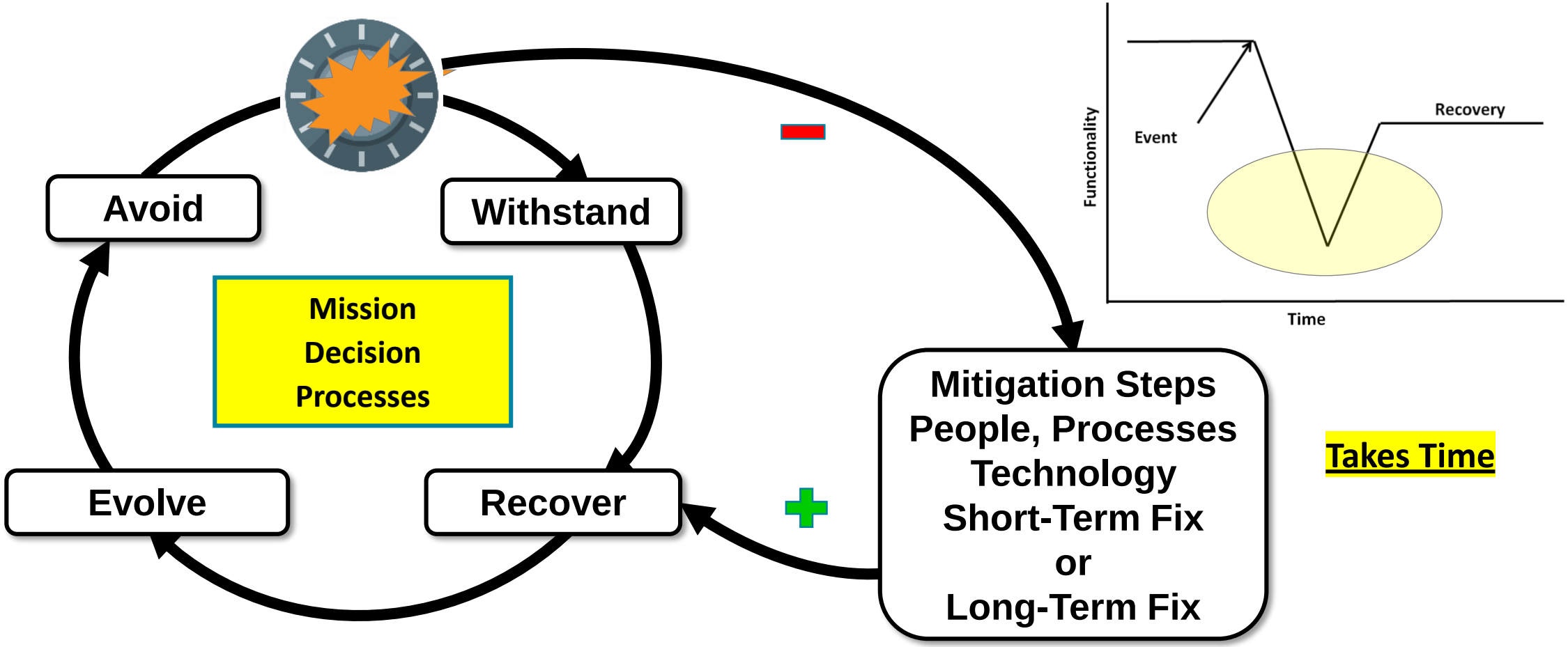
A Systems Thinking Model – An Iterative Process
Mitigation Steps – Short-Term or Long-Term Fix



- Other mitigation steps need to be considered: People, Processes and Technology

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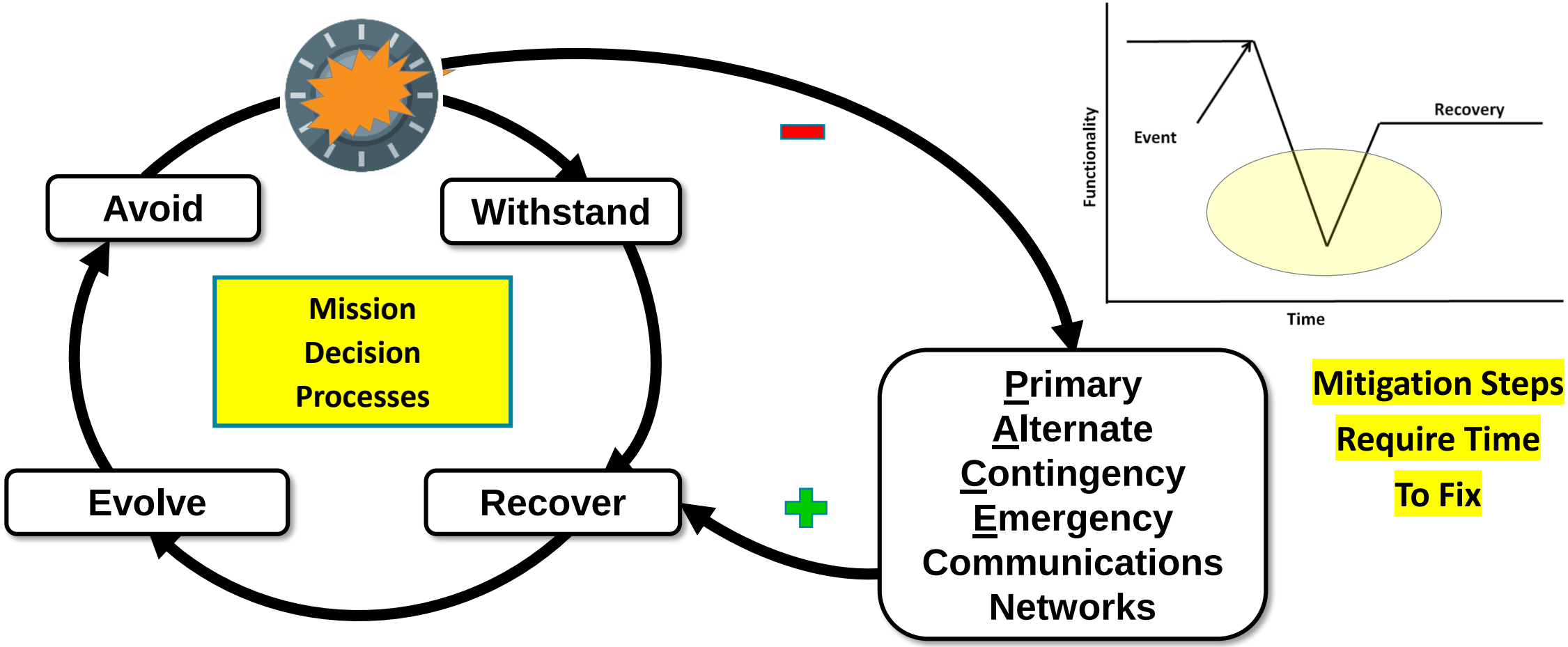
A Systems Thinking Model – An Iterative Process
Execute PACE Plan



- When mitigation steps take time, execute PACE Plan to Recover

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Determine Resiliency Requirements

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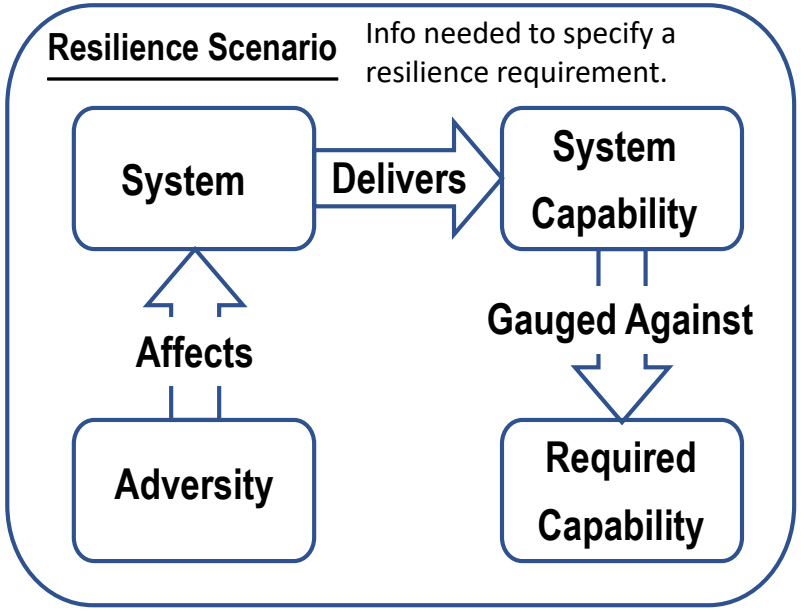
Determine Resilience Requirements

- **Resilience requirements are crafted from the parameters in the resilience scenario**
  - Adversity event considered
  - System capability of interest
    - A system can deliver several capabilities
  - Required capability (performance target)
    - Performance measure of the required capability
  - Timeframe of interest
  - Required resilience of the capability
    - Example: availability, maximum allowed degradation



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Some Example Resilience Requirements

- **In the event that electric power to a Hospital is lost: Backup power to all critical circuits shall be available within 300ms and available for up to 72 hours without any external sources of fuel. This shall be achieved with a 99.9% confidence.**
- **In the event that an end-user device (e.g. radio) is broken or lost: Spare parts or a complete replacement capability shall be made available within 24 hours. Mean time to repair shall take on average no more than 30 minutes to accomplish.**
- **In the event that communications connectivity for end user device is lost: Alternative communications capabilities or transport paths shall be provided at multiple geographical locations with inter-supporting systems to ensure that communications continue (i.e. no single points of failure).**
- **In the event that enterprise services provided from a data center fail: Enterprise services shall be locally hosted or forward deployed to ensure mission essential services are provided to support mission essential functions.**

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Summary

- **Operational decision processes and the ability to execute the mission dictates what resources are important.**
- **Systems Thinking can be used to holistically investigate adverse events and the resilience of your architecture to mitigate the risks.**
- **Adverse events will drive mitigation strategies and alternative communication and network capabilities.**
- **Having an informed understanding of resilience requirements can guide future investment decisions.**

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