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Resilience as Safety

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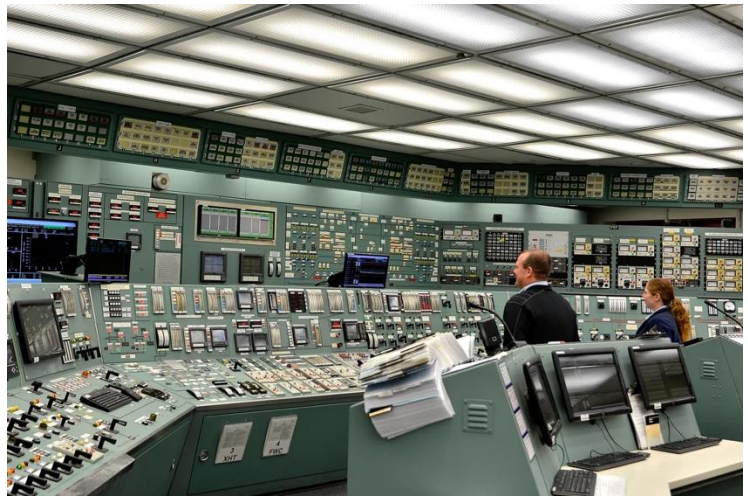
The Cognitive Systems Engineering Laboratory

Innovations at the intersection of people, technology, and work.



The 3 Rs of Dynamic Systems

Reliability	Robustness	Resilience (general)
The ability of the system to continue to meet routine-level demands when operating inside its performance envelope.	The ability to adjust to and continue operations in the face of expected and well-modeled challenges.	The ability to adjust to and continue operations, even in an impaired condition in the face of new/novel and surprising challenges.

Adapted from D.D. Woods, 2001.

4 Conceptions of Resilience

- Resilience as Rebound
- Resilience as Robustness
- Resilience as graceful extensibility
- Resilience as sustained adaptability

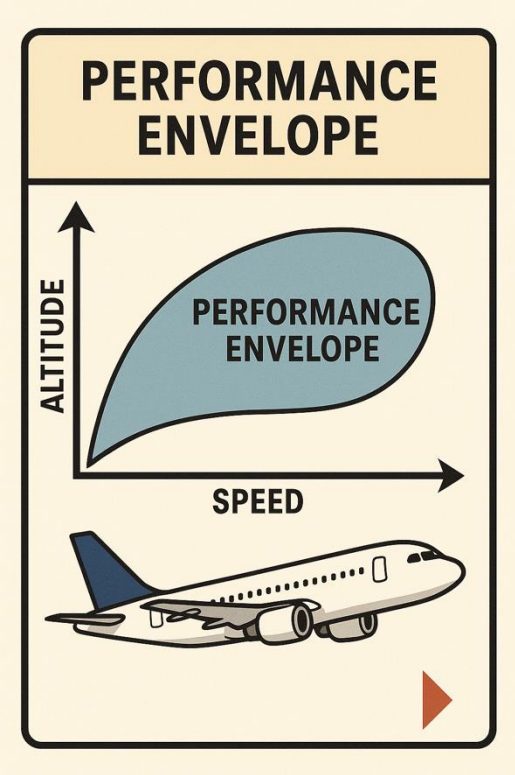
Woods, D. D. (2015). Four Concepts for Resilience and the Implications for the Future of Resilience Engineering. Reliability Engineering and System Safety, 141, 5-9.

Re-Considering Safety

- …the capacity to respond to challenges. (Woods, Hollnagell)
- …the presence of defenses. (Conklin, et. al.)
- …the operation of a system architecture which supports viability or persistence. (Balkin, Woods, and Gantt)
- …the ability to successfully manage risk (Mitchel and Harris, 2012)

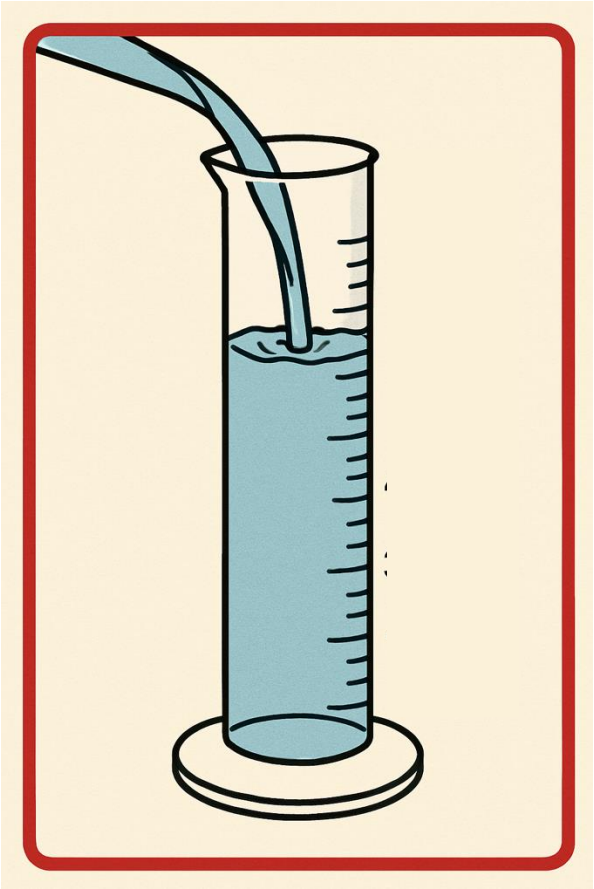
How Systems Do Work

- Capacity
- Performance Envelopes

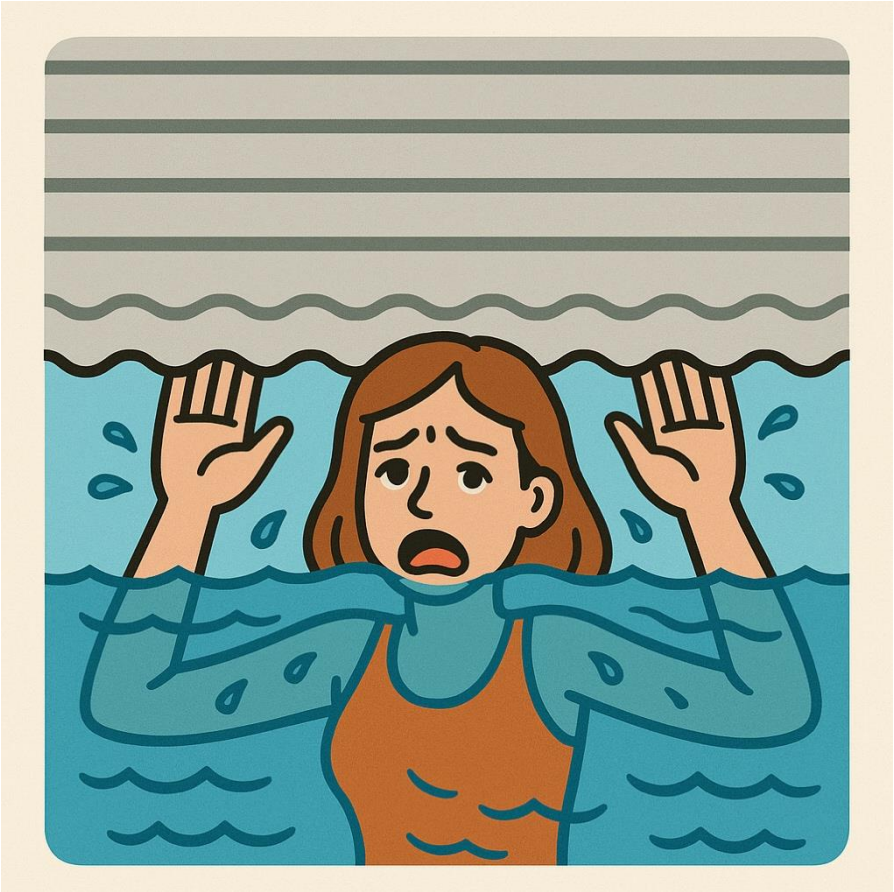


Capacity and Saturation

Capacity and Saturation



Capacity and Saturation



Resilience—The Bottom Line

- Resilience is about changing faster than the situation changes.
- Safety is about changing faster than the situation changes.
- The ability of the system to successfully deal with challenging events to allow continued viability.
- Safety accidents are failures to manage production capacity, adaptive capacity, or both.

See D.D. Woods, 2016 as well as Balkin, Maguire, and Woods, 2025

Common Themes…

- Work systems fail (in general) when they run out of capacity to act and loose margin for maneuver.

- Work systems experience safety accidents when…

they run out of capacity to act and loose margin for maneuver.

Resilience—The Bottom Line

- You can’t operate safely at the boundary forever;

- You need capacity to do work or you get “pinched between the demands of work and the limits of the system’s ability to get it done.

See D.D. Woods, 2016 as well as Balkin, Maguire, and Woods, 2025

- Being able manage and use a system’s capabilities and capacities to adapt to variability without incurring an injury event, is a demonstration of resilient performance in action!

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