



Talking about Resilience

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Resilience in Common Parlance



- ⦿ Weather the storm – perseverance
- ⦿ Bend not break – flexibility
- ⦿ Bounce back – ability to recover
- ⦿ Roll with the punches – withstand adversary
- ⦿ Stay the course – stamina



Resilience in the thesaurus

- ◎ Major categories in thesaurus.com
 - Bounce
 - Elasticity
 - Flexibility
 - Springiness
 - Stamina
 - Staying power
 - Tolerance
 - Plasticity
 - Buoyancy
 - Malleability
 - Pliancy
 - Suppleness

Resilience – Google definition



- re·sil·ience
- rə'zilyəns/*noun*
- **1.**the ability of a substance or object to spring back into shape; **elasticity.**

"nylon is excellent in wearability and resilience"
- **2.** the capacity to recover quickly from difficulties; **toughness.**

"the often remarkable resilience of so many British institutions"

Resilience – Medical definition



- ◎ **1:** the capability of a strained body to **recover** its size and shape **after** deformation caused especially by compressive **stress**
- ◎ **2:** an ability to recover from or **adjust** easily to misfortune or **change** <emotional *resilience*>

<http://www.merriam-webster.com/medical/resilience>



Resilience – Ecological definition

- In ecology, **resilience** is the capacity of an ecosystem to **respond** to a perturbation or disturbance by **resisting damage** and **recovering** quickly. Such perturbations and disturbances can include stochastic events
- https://en.wikipedia.org/wiki/Ecological_resilience



Resilience – Emotional definition

- Resilience is the capacity to **withstand stress and catastrophe**. Psychologists have long recognized the capabilities of humans to **adapt and overcome risk and adversity**. Individuals and communities are able to rebuild their lives even after devastating tragedies.

Resilience is also not something that you're either born with or not. **Resilience develops** as people grow up and gain **better thinking and self-management skills** and more knowledge. Resilience also comes from supportive relationships with parents, peers and others, as well as cultural beliefs and traditions that help people **cope with the inevitable bumps** in life. Resilience is found in a variety of behaviors, thoughts, and actions that can be learned and developed across the life span.

<http://www.pbs.org/thisemotionallife/topic/resilience/what-resilience>



Engineering vs. biological definitions

- Resilience has been defined in two different ways in the ecological literature, each reflecting different aspects of stability. One definition focuses on **efficiency, constancy and predictability** – all attributes of engineers' desire for **failsafe** design. The other focuses on **persistence, change and unpredictability** – all attributes embraced and celebrated by evolutionary biologists and by those who search for **safefail** designs.

http://eusoils.jrc.ec.europa.eu/projects/scape/uploads/81/holling_resilience.pdf



Resilience – PPD definition

- PPD-21 defines resilience as the ability to **prepare for and adapt to** changing conditions, and withstand and recover rapidly from disruptions. Resilience includes the ability to withstand and recover from deliberate attacks, accidents, or naturally occurring threats or incidents.

<http://www.dhs.gov/what-security-and-resilience>

Resilience – Cyber Definition



- ◎ Cyber resiliency – the ability of cyber systems and cyber-dependent missions to **anticipate, continue to operate correctly** in the face of, **recover** from, and **evolve** to better adapt to advanced cyber threats.
- ◎ <http://www.mitre.org/sites/default/files/publications/pr-15-1334-cyber-resiliency-engineering-aid-framework-update.pdf>



Progression in resilience

- ⦿ Resilience in Engineered Systems
- ⦿ Cyber Resiliency

OR

- ⦿ Resilience in Biological Systems
- ⦿ Cyber Resiliency

Resilience in Engineered Systems



- ⦿ Sustain operations under expected and unexpected conditions
- ⦿ Correct response to faults; fault tolerance
- ⦿ Redundancy
- ⦿ Buffering capacity
- ⦿ Margin
- ⦿ Tolerance



Cyber Resiliency

- ⦿ Fight through attack
- ⦿ Sustain mission critical operations
- ⦿ Respond to threat
- ⦿ Moving target
- ⦿ Deterrence



OR

Resilience in biologic systems



- Survival of the fittest
- Adaptation
- Immune system
- Immunization – an ounce of prevention is worth a pound of cure
- Healing
- Learning



Cyber Resiliency

- Autonomic systems – self healing and self protecting
- Preventative measures
- Good hygiene
- Smarts
- Sound system management



Are these different?

- ◎ How do solutions designed with one metaphor in mind differ from solutions designed under the other metaphor with respect to:
 - Severity of threat addressed
 - Range of threats addressed
 - Effect of unintended consequences of response (collateral damage, side-effects)
 - Ability to ward off attacks
 - Operations when not under attack
 - Long term prospects for system operations
- ◎ Is there value in mixing metaphors?