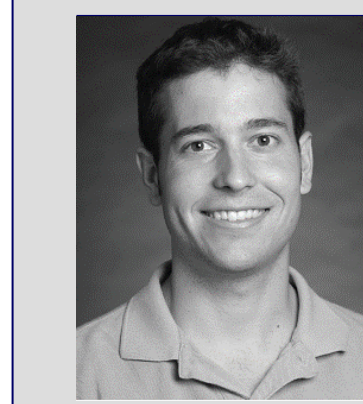


Design for Survivability: Concept Generation and Evaluation in Dynamic Tradespace Exploration

Matthew Richards, PhD in Engineering Systems (expected in 2009)

Committee: Prof. Daniel Hastings, chair; Dr. Donna Rhodes; Dr. Adam Ross; Prof. Annalisa Weigel

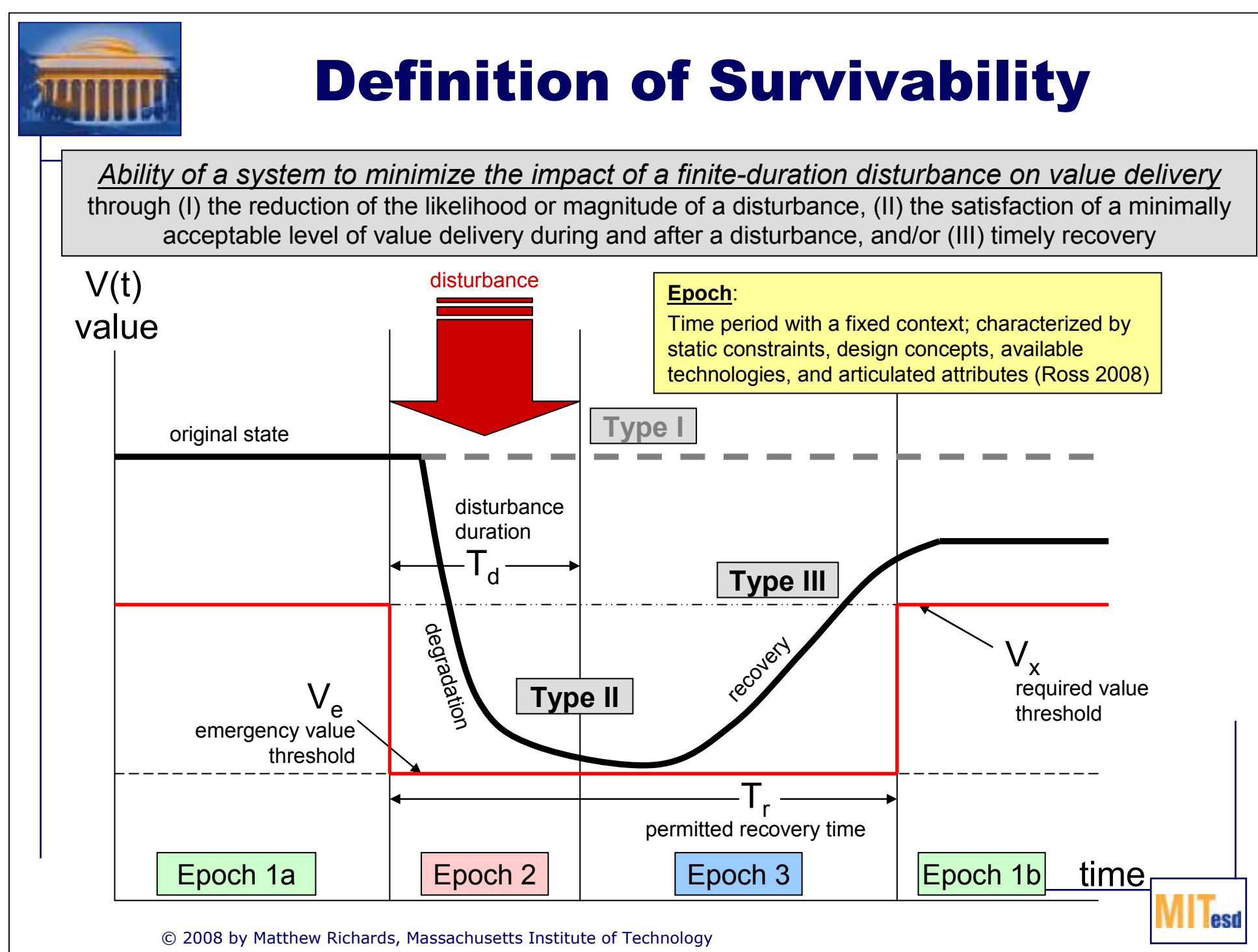


Biography

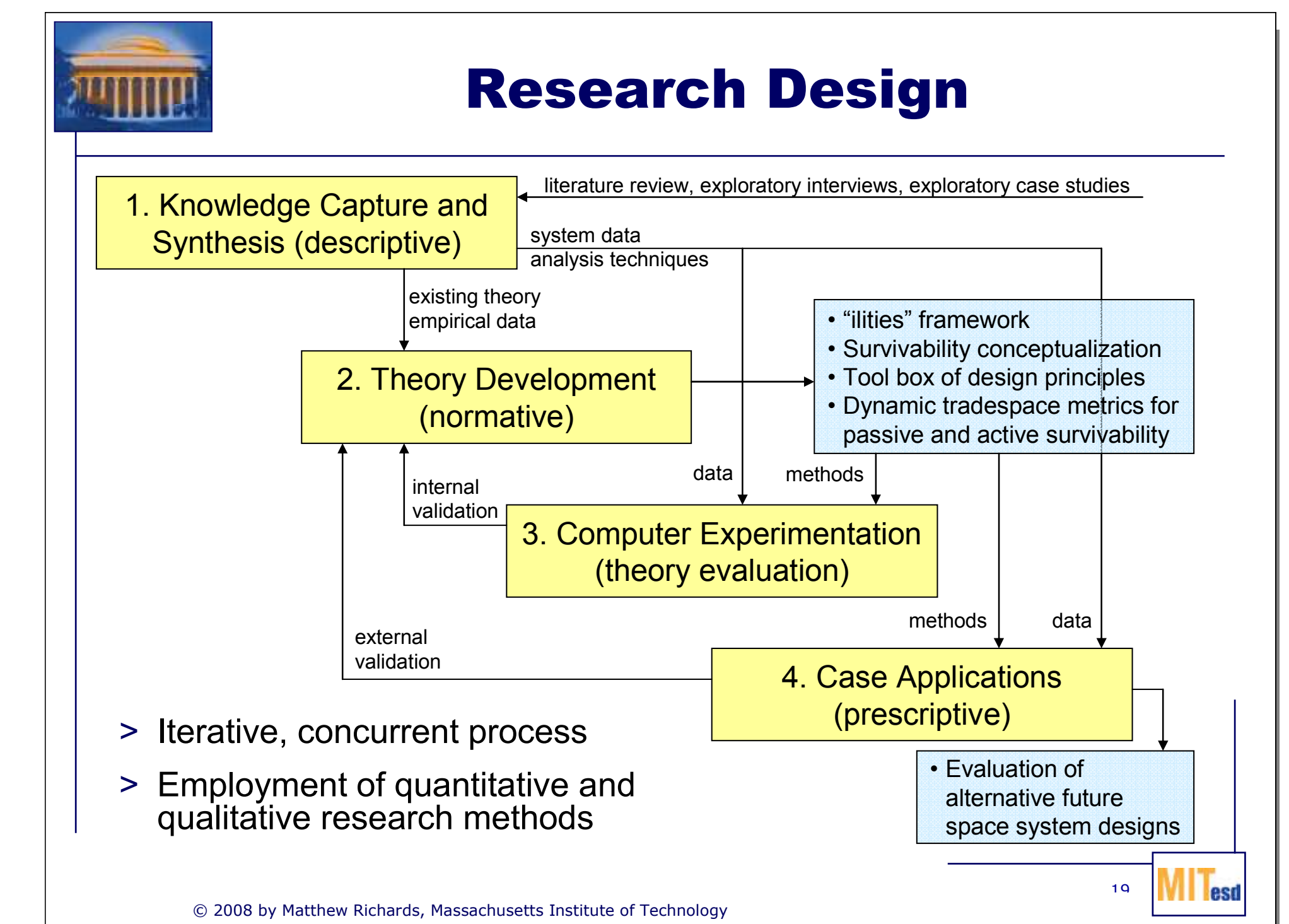
Matthew Richards is a graduate student at MIT pursuing a Ph.D. in Engineering Systems. Matt's work experience includes Mars rover mission design at the Jet Propulsion Laboratory (JPL) and systems engineering support on two autonomous vehicle programs for the Defense Advanced Research Projects Agency. From MIT, Matt has B.S. and M.S. degrees in Aerospace Engineering (2004, 2006) and an M.S. degree in Technology and Policy (2006).

Related Publications

Richards, M., Hastings, D., Rhodes, D., and Weigel, A., "Defining Survivability for Engineering Systems," 5th Conference on Systems Engineering Research, Hoboken, NJ, March 2007.
Richards, M., Ross, A., Hastings, D., and Rhodes, D., "Design Principles for Survivable System Architecture," 1st IEEE Systems Conference, Honolulu, HI, April 2007.
Richards, M., Ross, A., Shah, N., and Hastings, D., "Metrics for Incorporating Survivability in Dynamic Multi-Attribute Tradespace Exploration," AIAA Space 2008, San Diego, CA, September 2008.



- ### Research Questions
1. What is a dynamic, operational, and value-centric **definition** of survivability for engineering systems?
 2. What general **design principles** enable survivability?
 3. How can survivability be quantified and used as a **decision metric in exploring tradespaces** during conceptual design of aerospace systems?
 4. For a given space mission, how to **evaluate the survivability of alternative system architectures** in dynamic disturbance environments?
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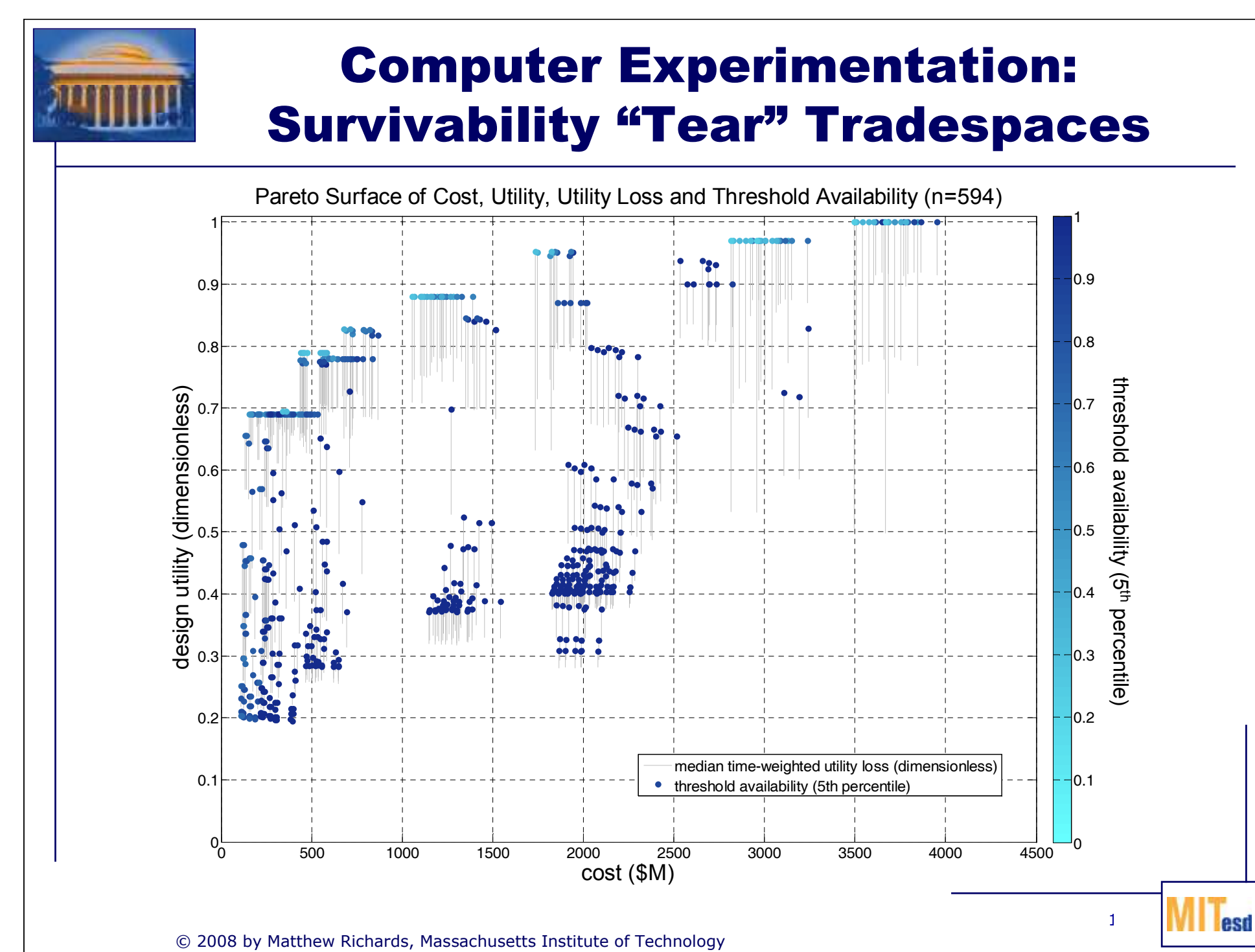
Theory Development: Empirical Testing of Design Principles

Methodology

1. Deduce design principles from generic system-disturbance representation
2. Select operational systems with survivability requirements
3. Trace design specifications to design principles
4. Revise design principle set to reflect empirical observation

Best Paper Award
Source: Richards, M., Ross, A., Hastings, D., and Rhodes, D., "Two Empirical Tests of Design Principles for Survivable System Architecture," 19th INCOSE Symposium, Utrecht, Netherlands, June 2008.

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- ### Conclusion
- > **General contributions**
 - **Theoretical**
 - General design principles to improve survivable concept generation
 - **Methodological**
 - Articulation of dynamic aspects of survivability in system design
 - Tradespace methodology to improve survivable concept evaluation and selection
 - > **Specific contributions**
 1. Dynamic, value-centric conceptualization of survivability
 2. Extensions of dynamic tradespace exploration to incorporate hostile and natural disturbances
 3. Evaluation of performance, cost, and survivability of alternative space radar constellations
- Developing and testing methodology to improve front-end system analysis of systems across disturbances, integrating cost, performance, and survivability trades*
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