

Empirical Investigation of System Changes and Associated Ilities

J. Clark Beesemyer, S.M. in Aeronautics and Astronautics (expected in 2012)

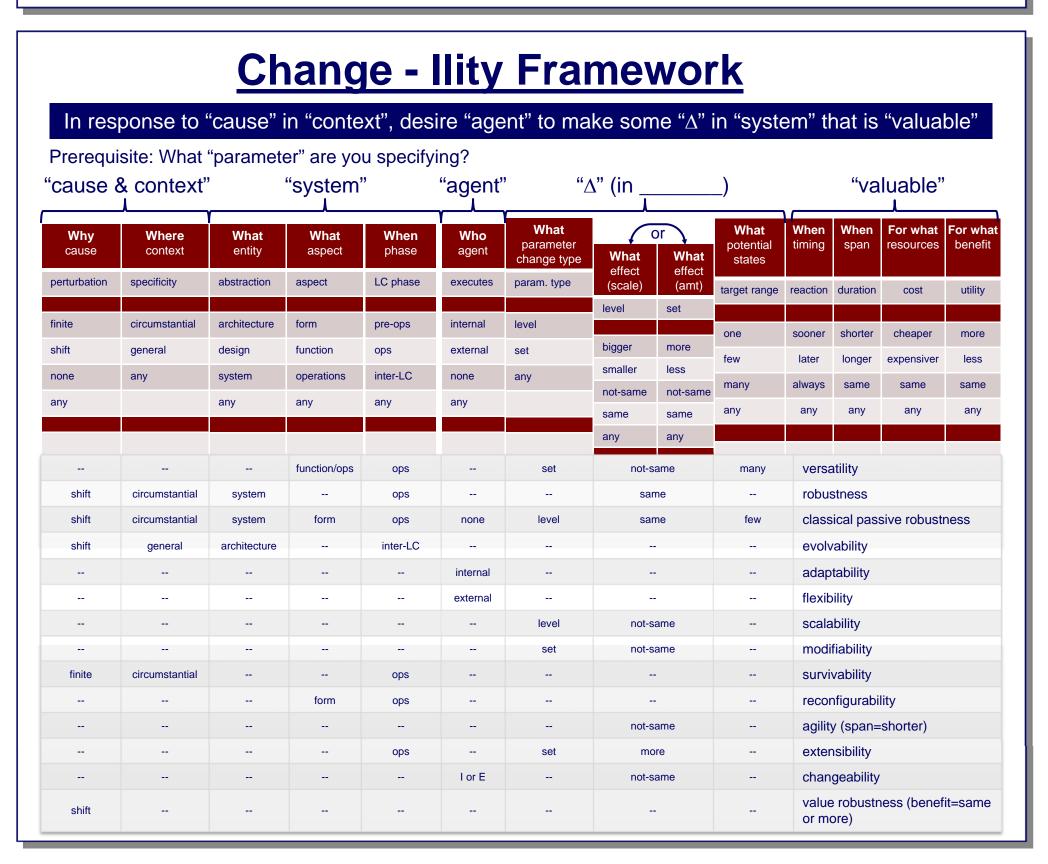
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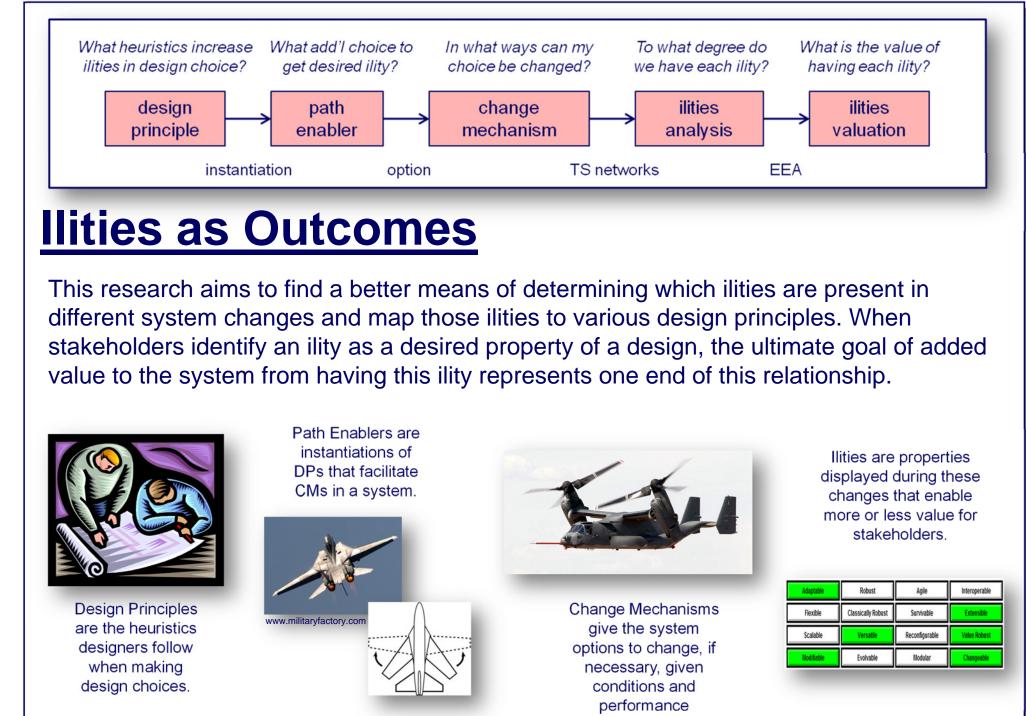
Motivation

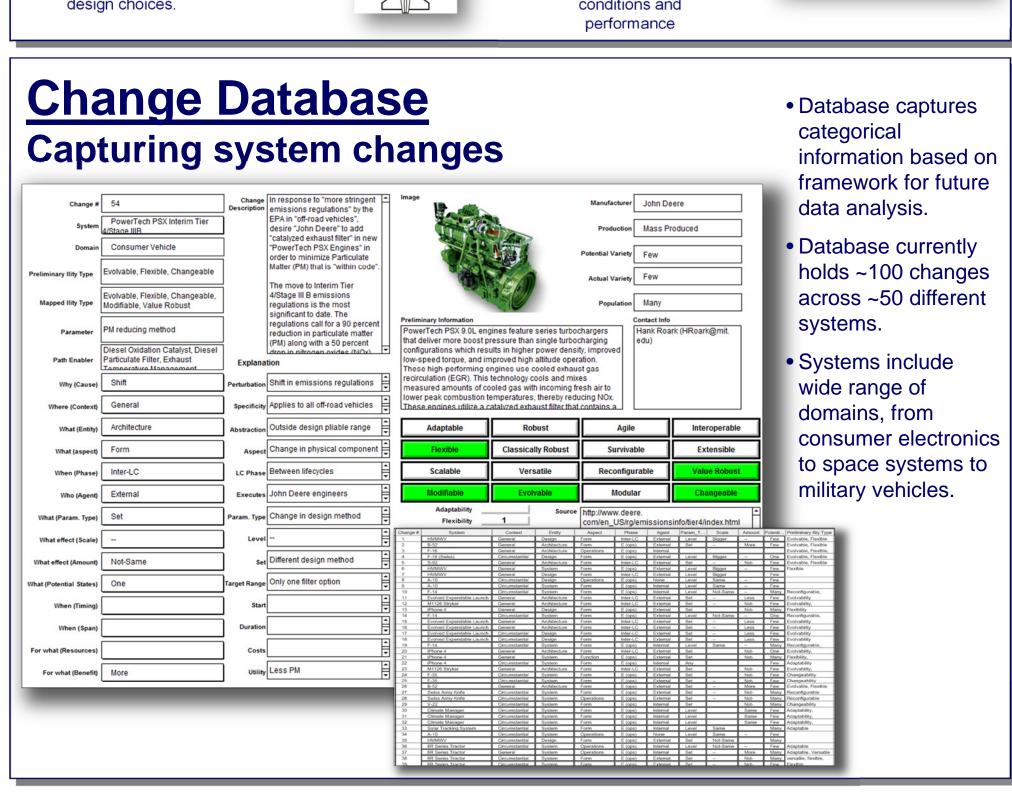
The beginning phases of system development and conceptual design require careful consideration, as these decisions will have significant influence on system lifetime performance and are usually made with incomplete system knowledge. Decision makers may improve their capacity to discriminate between system concepts and design choices, as well as hedge against lifecycle uncertainties by considering a system's "ilities" such as changeability, scalability, and survivability. These ilities may enable systems to respond to shifts in contexts and needs in order to ensure system functionality and adequate performance over time.

Goal and Approach

Characterizing system changes through empirical examples may inform research on how system ilities relate to each other across various system and domain types. This research attempts to analyze system change mechanisms that allow system changes to occur, and propose a framework for allowing system designers to map vague, yet desirable, ilities to prescriptive system design principles.









Biography

J. Clark Beesemyer is a masters student in the MIT Department of Aeronautics and Astronautics. Completing his undergraduate education at the United States Air Force Academy, he received a B.S. in Astronautical Engineering. There he served as the chief engineer for FalconSAT-5, a small satellite program exploring the effects of space weather. He now serves as a 2nd Lieutenant in the U.S. Air Force and will be attending pilot training at the conclusion of his masters program.

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Related Publications

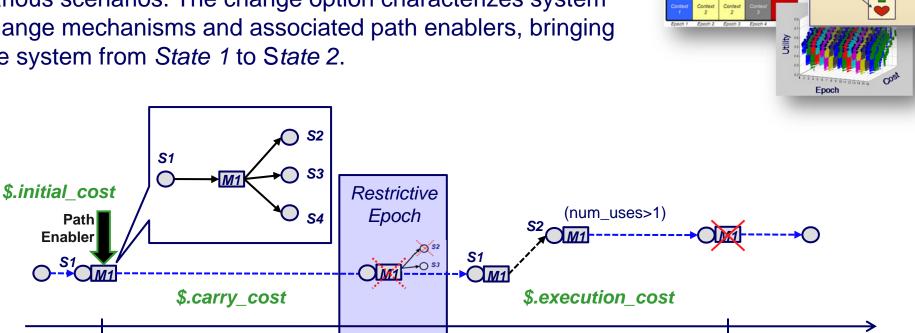
Beesemyer, J.C., Fulcoly, D., Rhodes, D.H., and Ross, A.M., "Developing methods to design for evolvability: research approach and preliminary design principles," 9th Conference on Systems Engineering Research, Los Angeles, CA, April 2011.

eesemyer, J.C., Ross, A.M, and Rhodes, D.H., "An Empirical Investigation of System Changes to Frame Links between Design Decisions and Ilities," 10th Conference on Systems Engineering Research, St. Louis. MO. March 2012. (submitted)

Ross, A.M., "Anatomy of a Change Mechanism," SEAri Working Paper WP-2011-1-1, 2011.

The Change Option

Research concentrates on outcomes of system changes in various scenarios. The change option characterizes system change mechanisms and associated path enablers, bringing the system from State 1 to State 2.



- Expiry date
- Possible end states
- Initial cost = path enabler?
- Carry cost = f(now, execution date, expiry date)
- Execution cost = f(end state, epoch)
- **Execution duration**
- Reusability = number of times it can be executed
- Valid epochs
- Valid lifecycle phase

Next Steps

Categorical Cluster Analysis

As the database grows in size, becoming more statistically viable, categorical cluster analysis will be made on the system changes. Expected clusters will give insight into how various ilities interrelate. It is possible that new ilities may be identified, or common ilities may be found. Since the system change itself is the more important for designers, this research may find that the label of "ilities" are just subjective representations of desirable system properties.

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Intended Contributions

Maintaining system performance in the presence of uncertainties in design and operating environments is both challenging and increasingly essential as system lifecycles grow longer. Ongoing research that investigates empirical examples of system changes, in order to characterize these changes, helps to develop a categorization scheme for framing and clarifying design approaches for proactively creating ilities in a system, and gives more insight into how these ilities may tradeoff or inter-relate.