# Fail-Fast Rapid Innovation Concepts

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Bill is president of ICTT System Sciences, where he has pioneered the strengthening of Model-Based Systems Engineering (MBSE), and its extension to Pattern-Based Systems Engineering (PBSE), applying it across automotive, communications, mil/aero, health care, construction, consumer product, and advanced manufacturing domains. Bill co-led a project on Systems of Innovation in the INCOSE System Science Working Group, co-leads the Patterns Working Group, and is a member of the lead team of the INCOSE Agile Systems Engineering Life Cycle Discovery Project. In addition to founding several systems enterprises, he has been active in advancement of engineering education for over thirty years, including collegiate engineering faculty and board of trustees service. Bill is an INCOSE CSEP, an INCOSE Fellow, and the current president of the INCOSE Crossroads of America Chapter.

**Day-2 Workshop Participants**

| | | |
|---|---|---|
| **Ed Carroll** | **Sandia National Laboratories** | **ercarro@sandia.gov** |
| **Adam Hamm** | **NMTech** | **adam.hamm@student.nmt.edu** |
| **Bill Schindel** | **ICTT System Sciences** | **schindel@ictt.com** |
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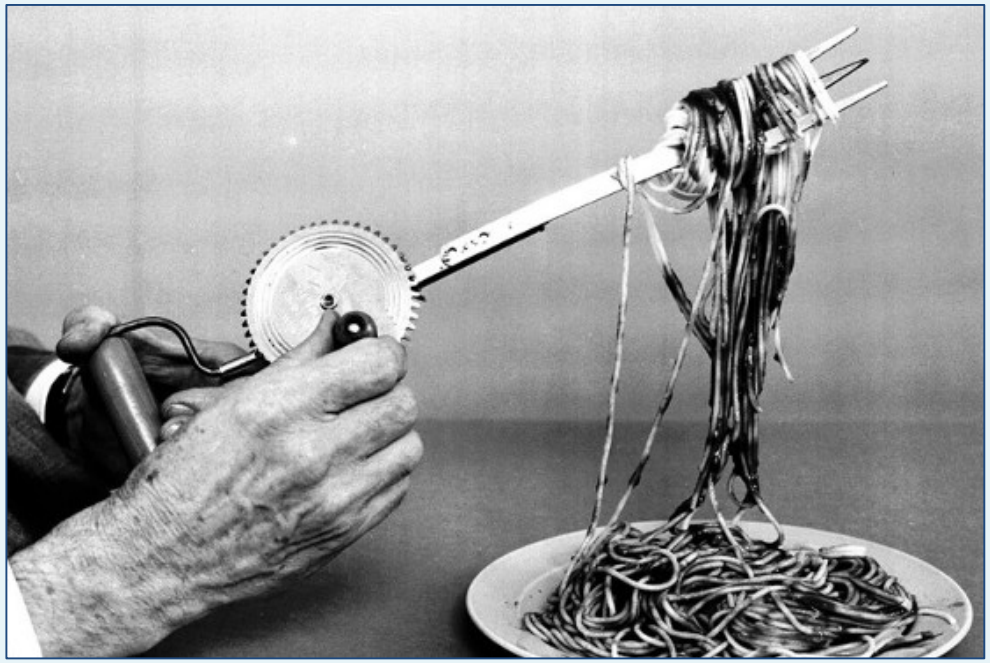
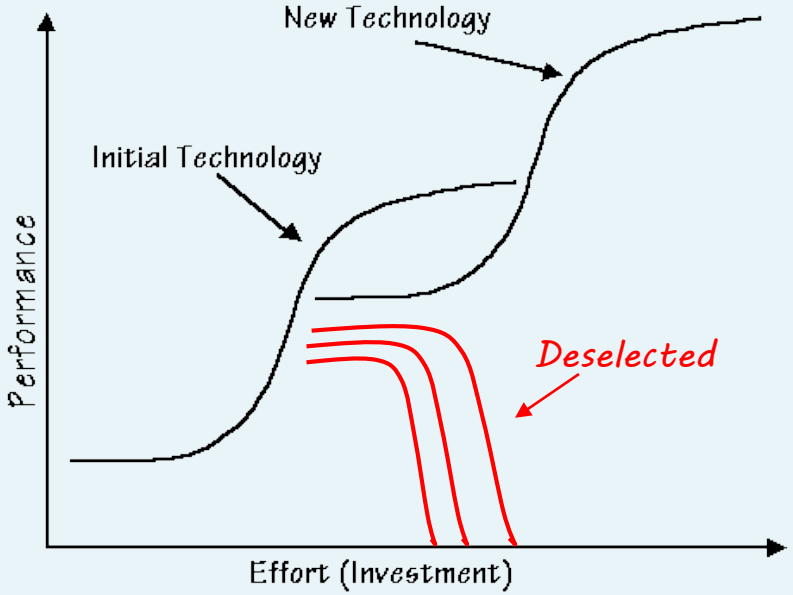
# Day-1 Intro and Results Poster

# ***Fail-Fast*** Rapid Innovation Concepts



From: Richardson, A., "Prototyping That's Less Prone to Failure", *Harvard Business Review*, Dec 7, 2015.

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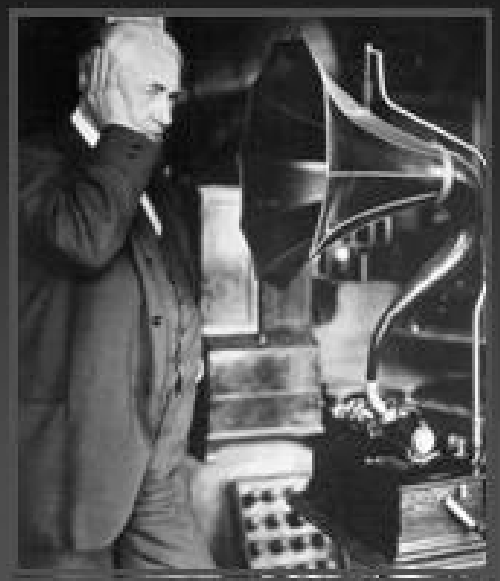
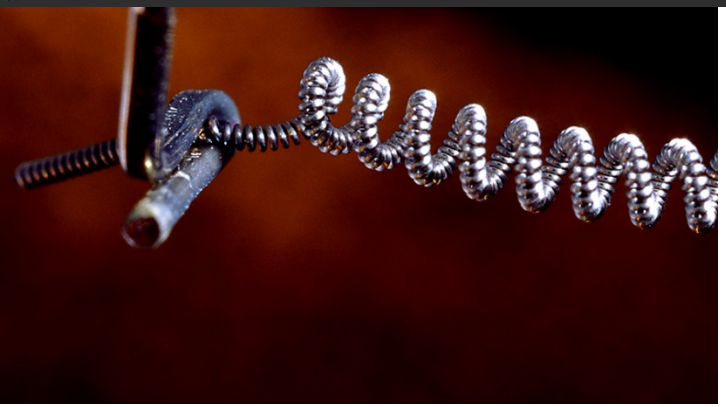
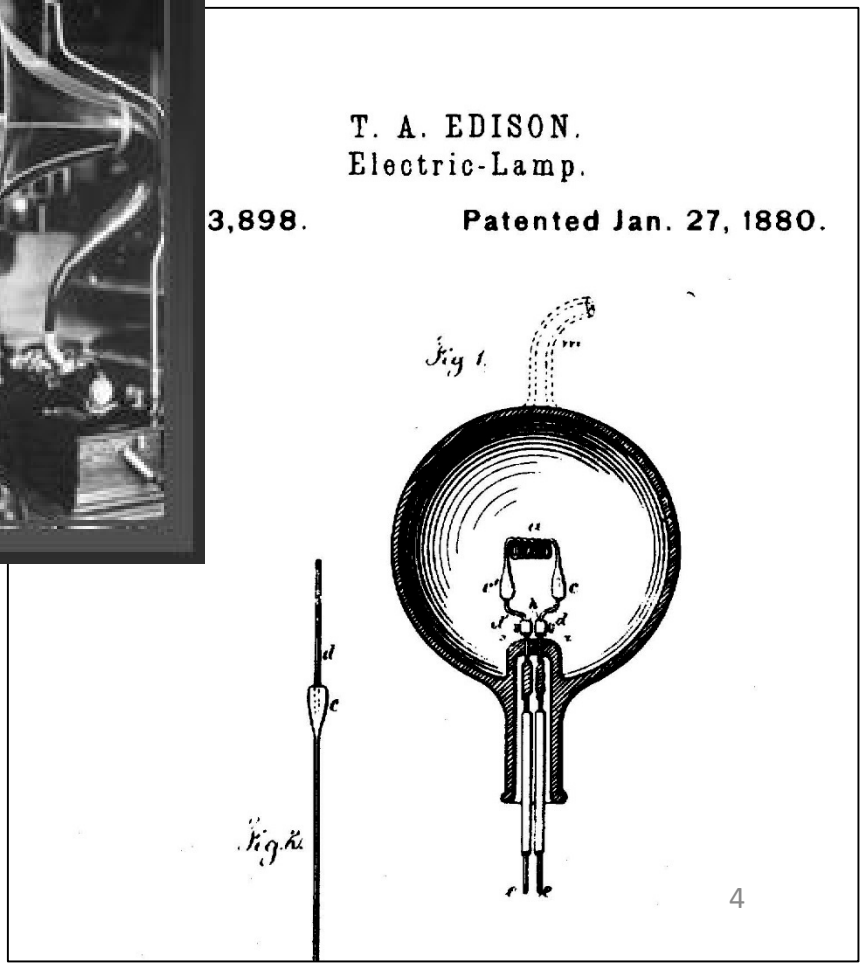
# What do we mean by “fail fast”?

**I have not failed.**
**I’ve just found 10,000 ways that won’t work.**
*~ Thomas Edison*







# Examples of late stage "surprises"

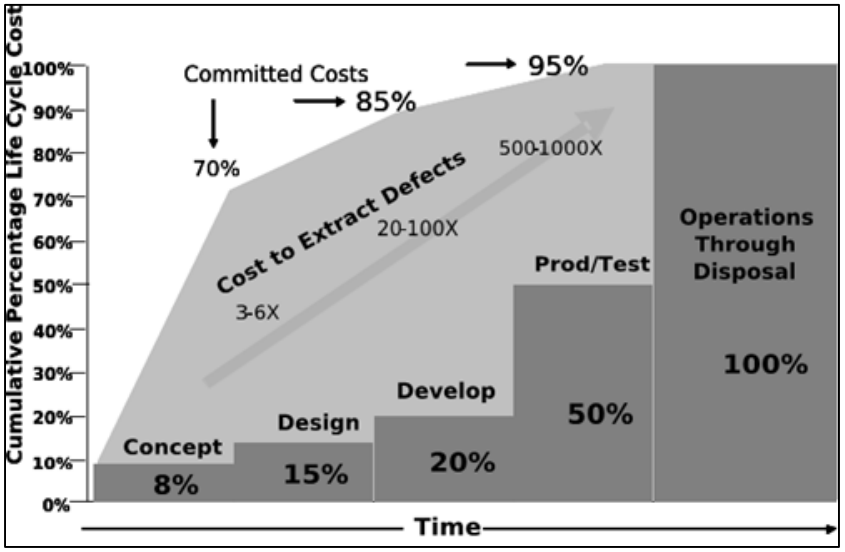
Pfizer Exubera Inhaled Insulin
(Withdrawn after factory built)

**There may be such a thing as "too late to fail".**

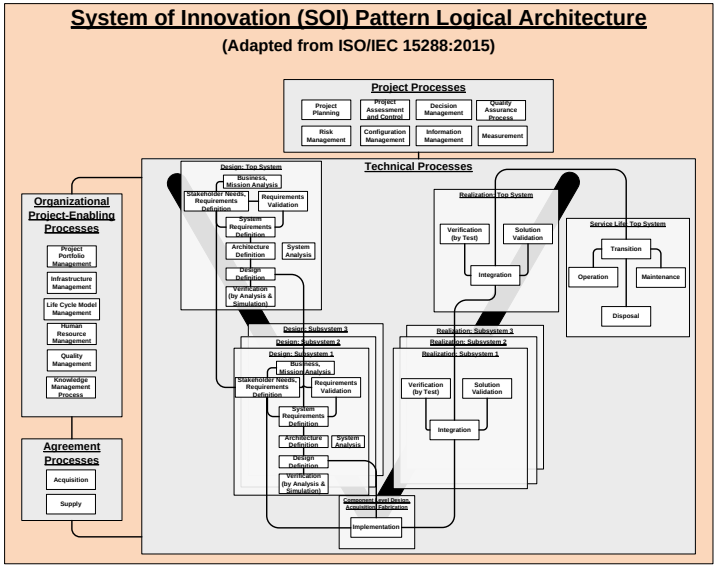

Keurig Kold Platform
(Withdrawn from market)

ACA Enrollment Web Site
(Rebuilt after public rollout)

# Traditional Perspectives




**INCOSE SE Handbook**

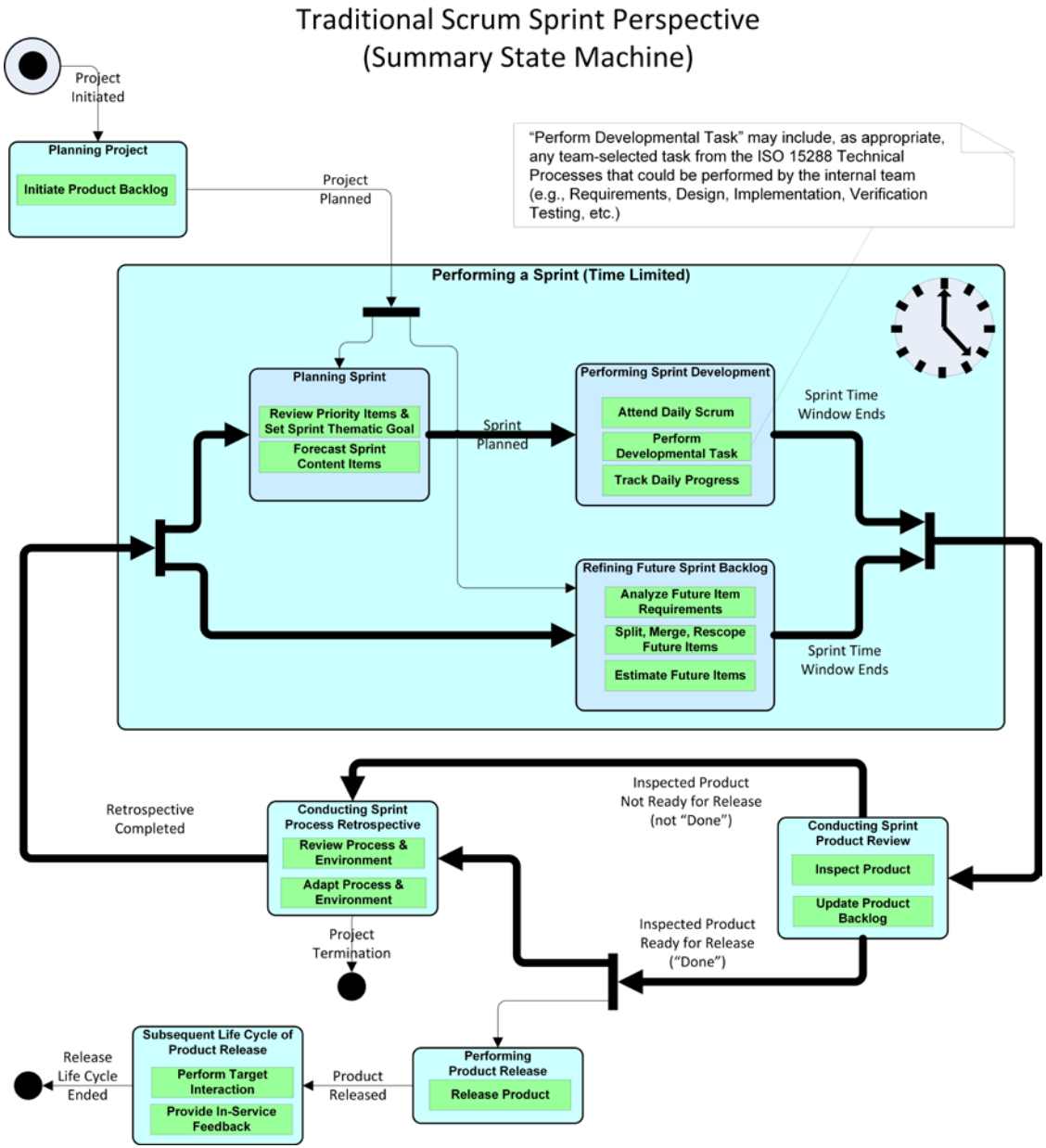



**ISO 15288 Processes**

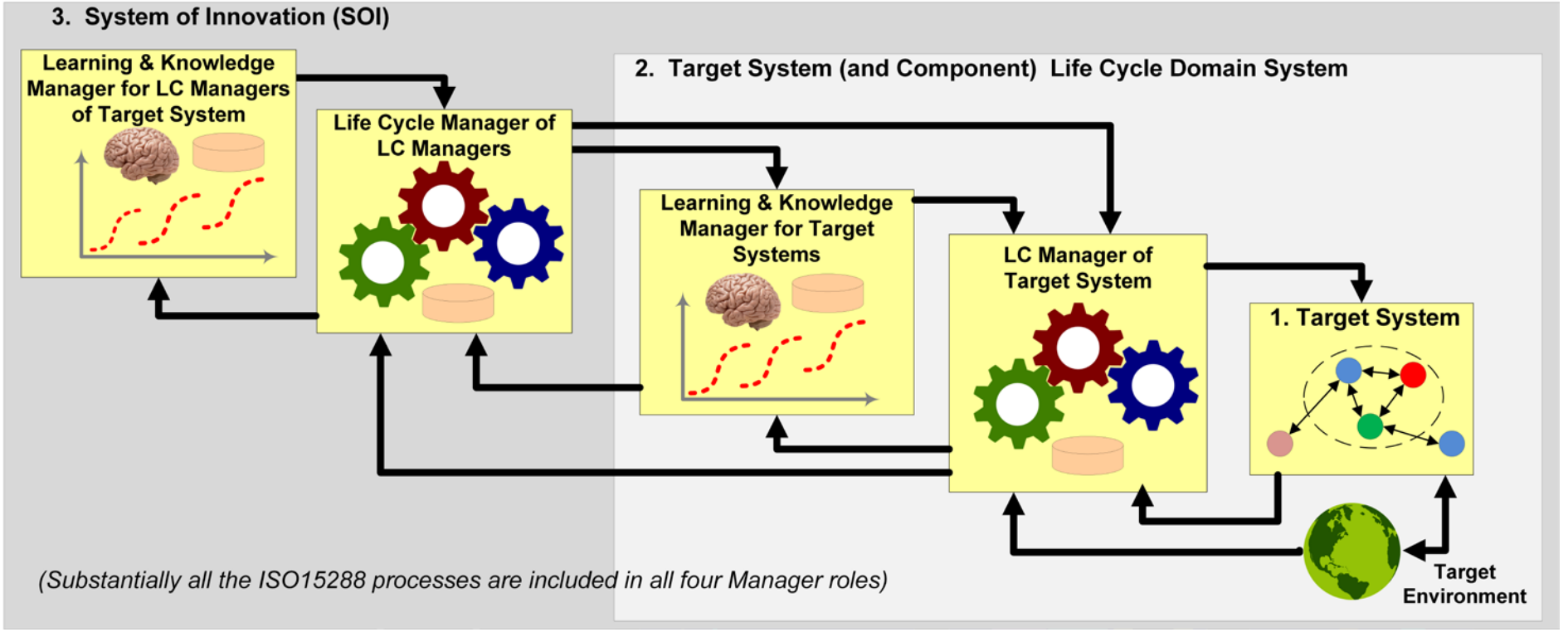
- Emphases on managed life cycle processes
- Early decisions are known to have most impact on later cost, schedule, performance—but can we know enough early to optimize those?
- Where in these pictures is what we <u>already</u> knew?

# Agile Perspectives

Incremental discovery, experiments, learning, through short "sprints"



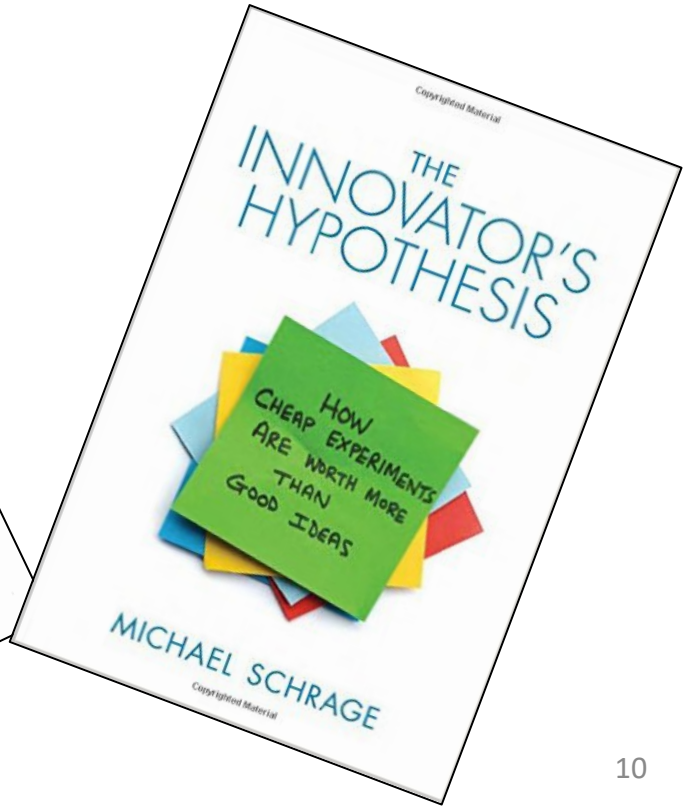
# Learning




ASELCM Pattern

# Planned experiments

- Fisher: Mathematics of experiment design
  - First published 1935
  - Now in 9th edition

# How many experiments?

- Remember Fisher's Design of Experiments (DOE) spaces, to find smallest number of experiments?
- Schrage: 5 x 5 framework
- "Today, the most innovative businesses run thousands—Intuit: 1,300, P&G: 7,000–10,000, Google: 7,000, Amazon: 1,976, and Netflix: 1,000
  - Instead of making ideas trickle up through a long process of approvals, meetings, egos, and politics, junior level decision makers can perform low risk, low cost experiments." - Ben Clark, *Fast Company*

# Fear vs. Incentives

- Regina Dugan, discouraging fear of failure, retrieved from:

https://www.ted.com/talks/regina_dugan_from_mach_20_glider_to_humming_bird_drone?language=en

# Challenges to “fail fast”

- How to budget, schedule, plan?
- How to justify failing?
- What balance of failures to successes?
- Whose failure? Who owns the loop?
- What do we reward?
- Signals and hype—are we hearing the data?
- Can we always afford to fail? When not?
- Your experiences and interests?

# References Sampler


1. Ronald A. Fisher, *The Design of Experiments*, Ninth Edition, Macmillan, 1971.
2. Michael Schrage, *The Innovator's Hypothesis: How Cheap Experiments Are Worth More Than Good Ideas*, MIT Press, 2014.
3. Clarke, Ben, "Why These Tech Companies Keep Running Thousands of Failed Experiments", *Fast Company,* Sep 26, 2016.
4. Ronny Kohavi, Thomas Crook, Roger Longbotham, Brian Frasca, Randy Henne, Juan Lavista Ferres, Tamir Melamed, "Online Experimentation at Microsoft", retrieved from: http://www.exp-platform.com/documents/expthinkweek2009public.pdf
5. Ted Talk by Astro Teller, Alphabet X, retrieved from: www.ted.com/talks/astro_teller_the_unexpected_benefit_of_celebrating_failure
6. Ted Talk by Regina Dugan, DARPA, on discouraging fear of failure, retrieved from: https://www.ted.com/talks/regina_dugan_from_mach_20_glider_to_humming_bird_drone?language=en
7. J Dyer, C Christensen, and H. Gregersen, *The Innovators DNA: Mastering the Five Skills of Disruptive Innovators,* HBR Press, 2011.
8. Schindel, W.D., S.N. Peffers, J.H. Hanson, J. Ahmed, and W.A. Kline, "All Innovation is Innovation of Systems: An Integrated 3-D Model of Innovation Competencies," in *Proc. of American Society for Engineering Education Annual Conference and Exposition*, Vancouver, Canada, 2011.
9. Sorvino, C., "The Reinvention Factory, *Forbes Magazine*, September 13, 2016
10. Johnson, A., "Insulin Flop Costs Pfizer $2.8 Billion," *The Wall Street Journal*, October 19, 2007.
11. Walden, D. et al, eds., *Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities*, Fourth Edition, INCOSE, 2015.
12. Schindel, W., and Dove, R., "Introduction to the Agile Systems Engineering Life Cycle MBSE Pattern", in *Proc. of INCOSE 2016 International Symposium*, Edinburgh, UK, 2016.

# Fail Fast, Learn, Recover Early
# Day-1 Brief Out Poster

- **Need/Problem Statement:**
  - Reduce risk
  - Accelerate results
    - While managing expectations/cost throughout lifecycle
- **Customers**:
  - Program/project manager
  - Chief executives
  - Empowered teams
  - Enterprise process owner
- **Impediments to focus on**
  - Organizational risk aversion/perception of failure
    - Addiction to success
  - Culture
    - Development
    - Public appearance
  - Cost justification
    - Cost avoidance
  - Knowledge of judicious application and experimental technique
  - Knowledge management/transfer

# Day-2 Workshop

# Day 2 Participants

- Ed Carroll, Sandia National Laboratories, ercarro@sandia.gov
- Adam Hamm, New Mexico Tech, adam.hamm@student.nmt.edu
- Bill Schindel, ICTT System Sciences, schindel@ictt.com
- Eric Smith, UTEP, esmith2@utep.edu
- Neale Smith, UTEP, nealess@hotmail.com

# Fast/Fail Requirements

1) The system shall identify the right problems to use Fail/Fast experiments for exploration tests, subject to constraints to optimize risk vs. resources.
2) The system/methodology shall provide a means to enforce knowledge and data retention and sharing (forward and backwards).
3) The system shall educate, encourage and provide incentives to ingrain Fast/Fail as a mindset for test exploration.
4) The system shall provided metrics to justify Fast/Fail value.

# Supplemental Information

- Day 2 discussion points
- Day 2 diagramming

# Day 2 Discussions

- Identify Fail/Fast innovations toward technology
- Tools to help with the process of Fail/Fast Technology
- Methodology of starting with new technology
- Succeed fast opportunity cost to Fail/Fast Methods (comparison to other techniques)
- Identify target points to problems through Fail/Fast Methodology (application of using Fail/Fast Methods for creative procedures)
- Describing Fail/Fast in experimental testing
- Accommodations in focus groups for requirements testing (Consumers requirements for the technology)
- Test harness description (understanding the requirements)
- Stages of requirements in Fail/Fast ideas
- Flow chart to Fail/Fast ideas
- Application in ideas testing using Fail/Fast techniques
- Funding for the Fail/Fast process
- Driving force for Fail/Fast systems
- Fail/Fast as many times needed to produce a result
- Graphing iterations of Fail/Fast Systems process
- Maximizing the final outcome (trial/error)
- Management and staff culture willingness to allow failure
- Long term cost savings outweighs short term failure costs
- Engineering staff needs to knowledgeable in testing to failure
- Methods of testing to failure such as FMEA
- Overall application in Fail/Fast techniques in stages of experimental testing
- Knowledge and data gained should be retained and shared
- Training individuals for forward and backward sharing in the experimental process (teaching and informing others on updated testing)

# Fail Fast = Test Exploration?