25th anniversary
annual INCOSE
international symposium
Seattle, WA
July 13 - 16, 2015

Applicability of Industrial Test and Evaluation Practices to Future Nuclear Weapons

Sharissa Young
Sandia National Laboratories

Introduction

- What do you mean by “future nuclear weapons”?
- What are the “industrial test and evaluation practices”?
- How do those apply to nuclear weapons?
- What does this have to do with Systems Engineering?

Desire to Improve

- How can we do our business better in the current climate?
  - What are we doing now?
  - Where do those practices fall short?
  - What has changed in the current business environment?
  - What are other people doing that we can learn from?

Options Analysis

Methodology to study Alternative Approaches

1. Identify Characteristics of your system
2. ID other Products that Share one or more of those characteristics
3. Look for companies that make specific products
   a. Literature search
   b. Interview company reps
4. Develop list of strategies from similar products
5. Decision support
   1. What is the problem to solve
   2. Criteria or attributes that you desire to influence (without introducing other problems)
6. Decision

Developing Alternatives

http://cdn4.dogomedia.com/images/0ca439fe-7d33-4585-83e2-a977f0ffa192/berlin09-1.jpg

Characteristics of Nuclear Weapons

- Small production quantities
- High reliability
- Long periods of dormancy
- Combination of legacy and new parts
- Use commercially available parts, materials
- Can cause mass casualties, emotional response

Products that Share Characteristics

- Space Craft (satellites, space probes, etc.)
- Rocket motors (solid and liquid fueled)
- Air traffic control systems (FAA)
- Airplanes
- Electronics
- Dams
- Backup generators
- Torpedoes/missiles
- Canned foods and drugs

	NASA space craft	Rocket motors	FAA	Aircraft	Electronics	Dams	Emergency Generators	Torpedo /missile	Canned foods, drugs
Small production quantity	X	X						X	
High reliability	X	X	X	X	X	X			
Dormancy	X	X	X		X		X	X	X
Use of new with legacy parts	X		X	X					
New (current) materials and COTS parts	X	X	X	X	X		X		X
Use or failure can cause mass casualties	X	X	X	X	X	X	X	X	X

Look for companies that make specific products

- Space Craft
  - APL: New Horizons
- Rocket Motors
  - Tinker AFB: air launched cruise missiles
  - ATK: solid rocket motors
- Air traffic Control
  - Albuquerque FAA tower radars and back-up transmitters
- Aircraft
  - Boeing: TBD

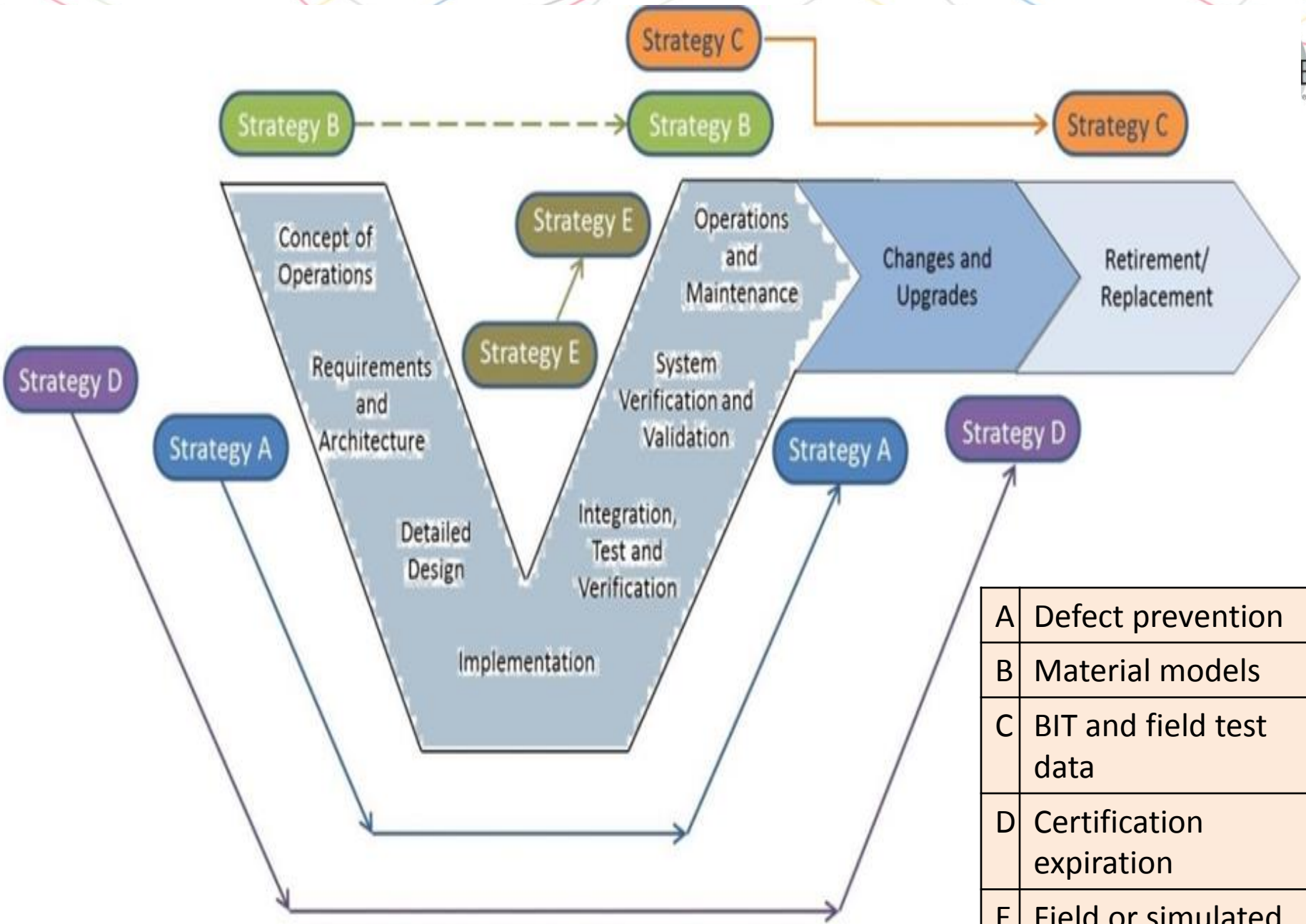
Look for companies that make specific products

- Electronics
  - TBD
- Dams
  - TBD
- Emergency Generators
  - TBD (hospitals?)
- Torpedoes/missiles
  - Historical literature
  - Raytheon: Sidewinder, Patriot missiles
  - Lockheed Martin: Fleet ballistic missiles (Navy D5)
- Canned foods, drugs
  - TBD

Develop list of strategies

- Defect prevention, 100% production and acceptance testing, no T&E
- Mechanistic prediction, sparse empirical data for model validation, and unknowns discovery
- Collect large volumes of data from BIT, monitors, predict failure from empirical data curves, and Repair and Replace/maintenance
- Make best product given affordability constraints; limit liability with warrantees, expiration dates, certifications
- Empirical test in exact test environments using operations and test SMEs

		Industry/Agency								
	T&E Strategy	NASA	SRMs	FAA	Aircraft	Electronics	Dams	Emergency Generators	Torpedoes	Canned food, drugs
A	Defect prevention, 100% production and acceptance testing, no T&E	X								
B	Mechanistic prediction, sparse empirical data for model validation, and unknowns discovery	X	X				X			
C	Collect large volumes of data from BIT, monitors, predict failure from empirical data curves, and Repair and Replace/maintenance			X	X	X		X		
D	Make best product given affordability constraints; limit liability with warrantees, expiration dates, certifications									X
E	Empirical test in exact test environments using operations and test SMEs	X				X			X	



A	Defect prevention
B	Material models
C	BIT and field test data
D	Certification expiration
E	Field or simulated field tests

Example Pugh Matrix that could be generated during a discussion

	T&E Strategy	Evaluation Criteria: Lower Cost	Data Diversity	Data Schedule	Other Criteria (specify)
0	No change	o	o	o	o
A	Defect prevention, 100% production and acceptance testing, no T&E	+	-	+	-
B	Mechanistic prediction, sparse empirical data for model validation, and unknowns discovery	+	-	-	+
C	Collect large volumes of data from BIT, monitors, predict failure from empirical data curves, and Repair and Replace/maintenance	-	+	+	-
D	Make best product given affordability constraints; limit liability with warrantees, expiration dates, certifications	+	o	-	+
E	Empirical test in exact test environments using operations and test SMEs	-	+	o	-

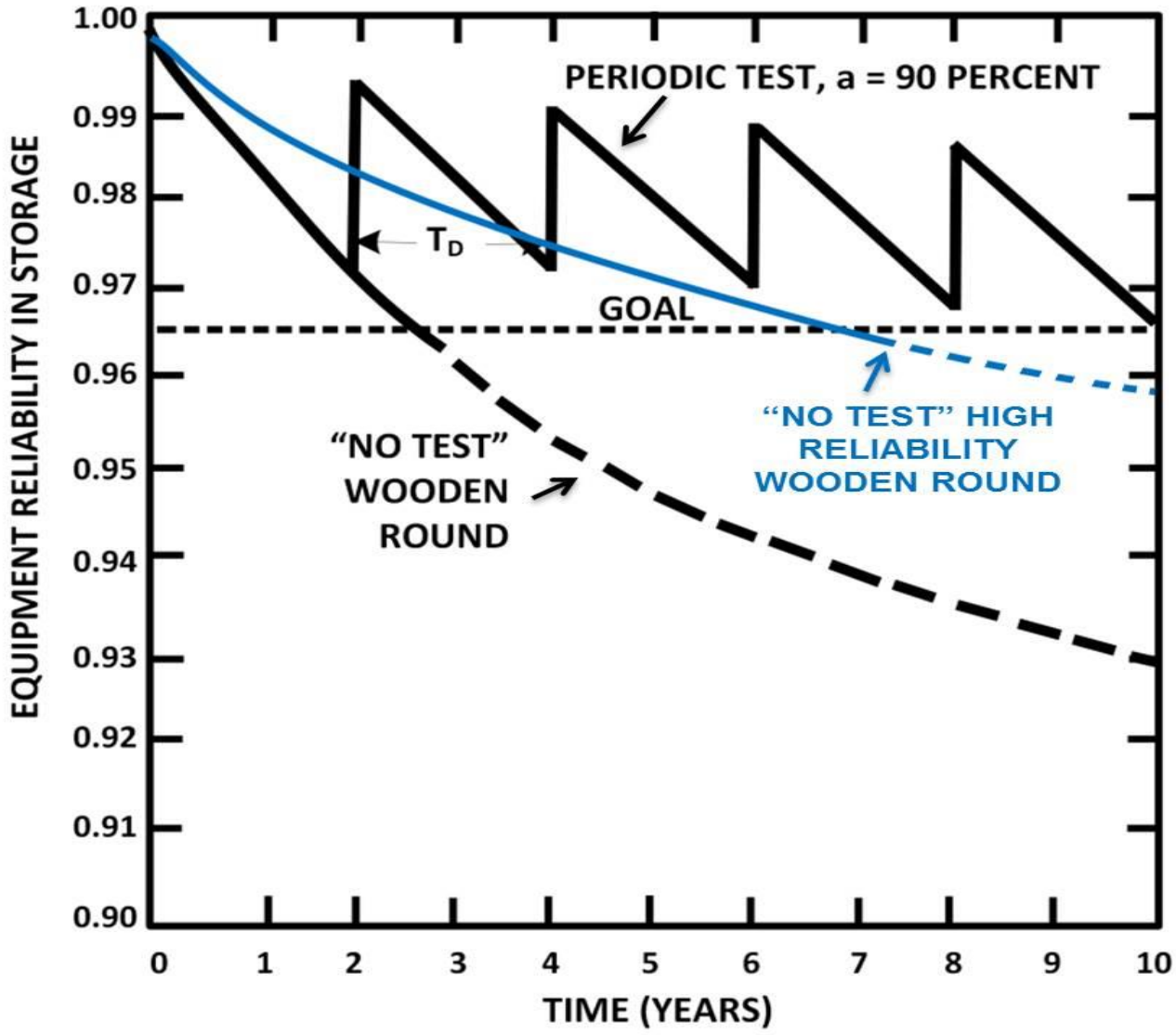
Summary

1. Identify Characteristics of your system
2. ID other Products that Share one or more of those characteristics
3. Look for companies that make specific products
   a. Literature search
   b. Interview company reps
4. Develop list of strategies from similar products
5. Decision support
   1. What is the problem to solve
   2. Criteria or attributes that you desire to influence (without introducing other problems)
6. Decision

Questions/Discussion?

Backup

Reliability Approaches for Aircraft



Develop Alternatives to Study