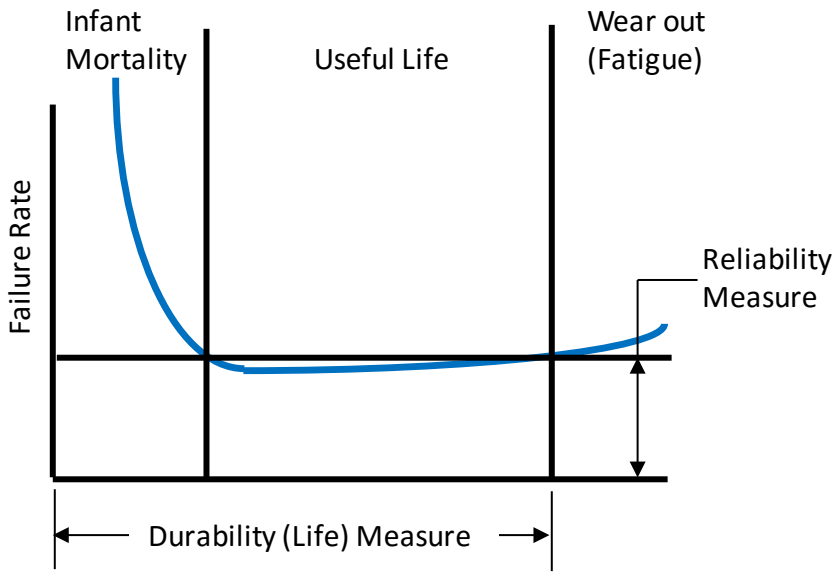
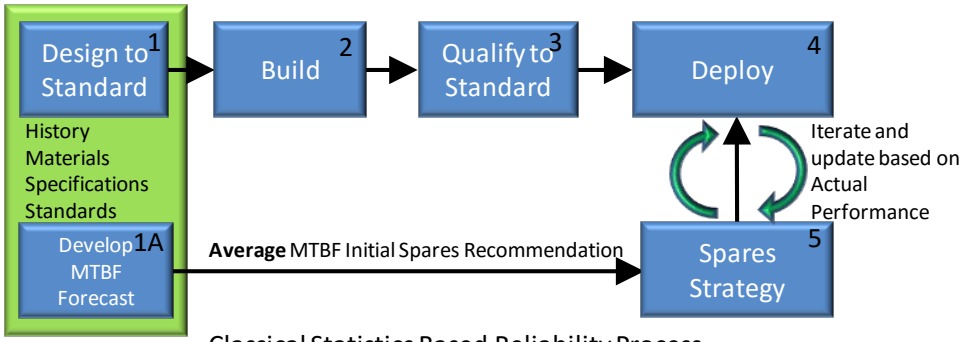
Physics Based Reliability - Introduction

- Physics Based Reliability
  - Science-based approach to reliability
    - Uses modeling and simulation to design-in reliability
    - It helps to reduce decision risk during design
    - Evaluates root causes of failure
  - Provides a Reliability Forecast with minimal information
- Life Cycle Cost/Total Ownership Cost
  - Cost models use reliability as a key driver
    - To forecast O&S costs
    - When augmented with PoF/PBR data, provides decision makers opportunities to reduce TOC
  - Provide cost sensitivity to TOC

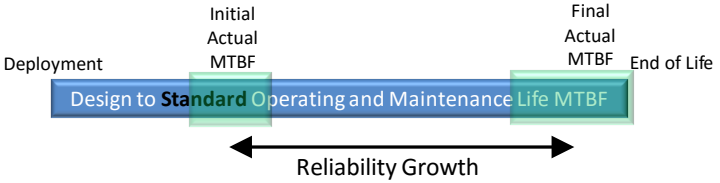


History and Contrast - Processes

- Classical

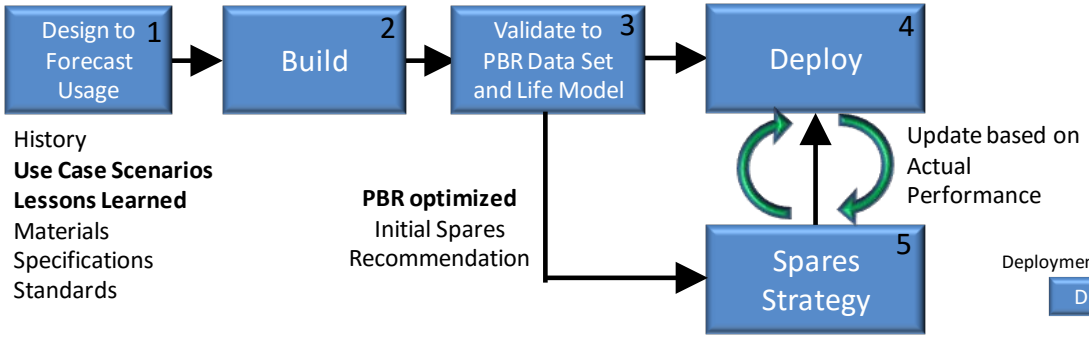


Classical Statistics Based Reliability Process

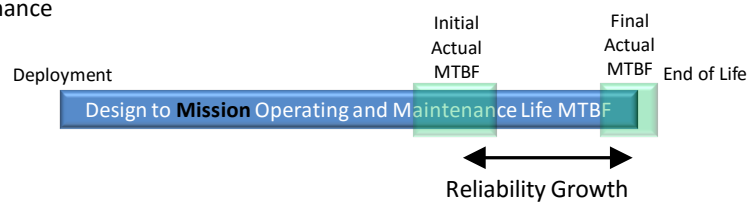


Classical Statistics Based Reliability Evaluation

- PB Reliability



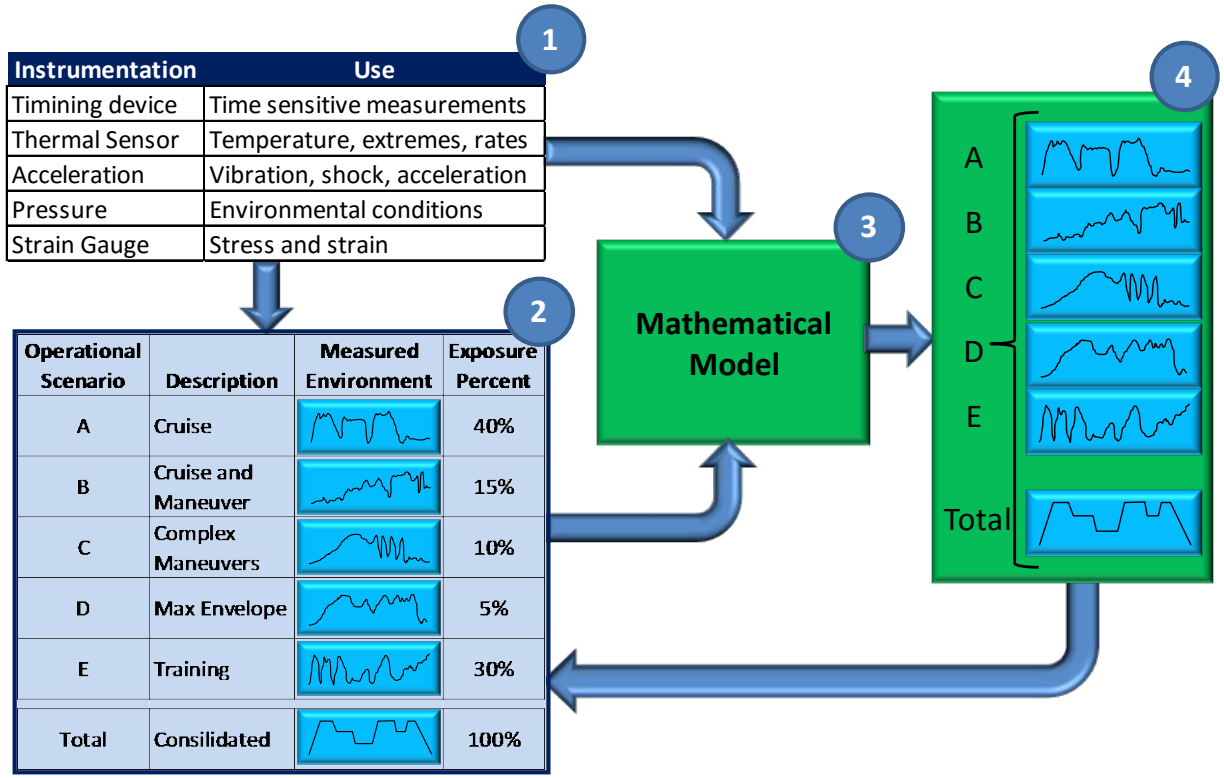
Physics of Failure/Physics Base Reliability Process



Physics of Failure/Physics Base Reliability Evaluation

Life Model is the PBR Enabler

- (1) Design/Test Specification
  - Use Cases
  - Instrumentation
  - Test Plan
- (2) Testing
  - Execute to Plan
  - Evaluate for Model
- (3) Modeling and Simulation
  - Integrate actual results
  - Update
- (4) Life (model) Management
  - Emulate Use Case
  - Look forward
  - Support Spares Management/O&S

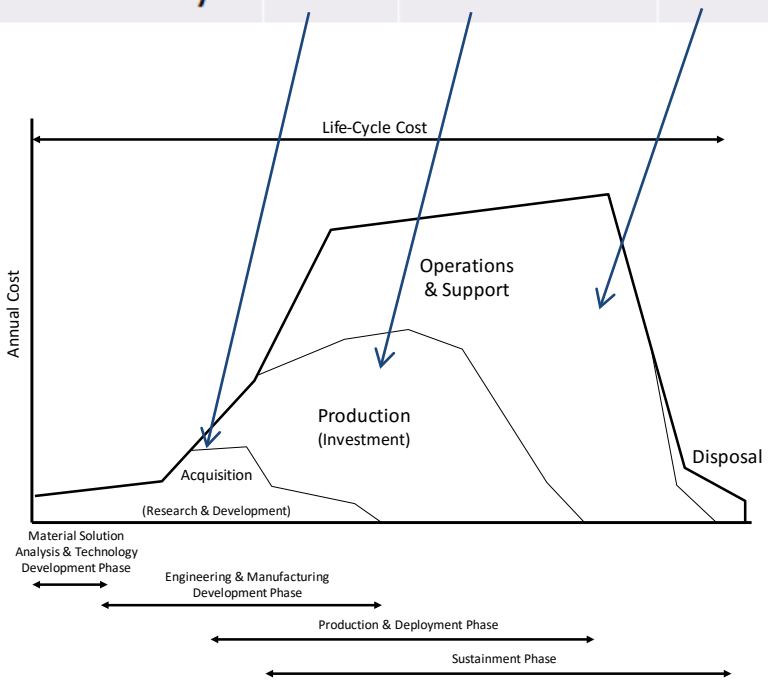


Life Model

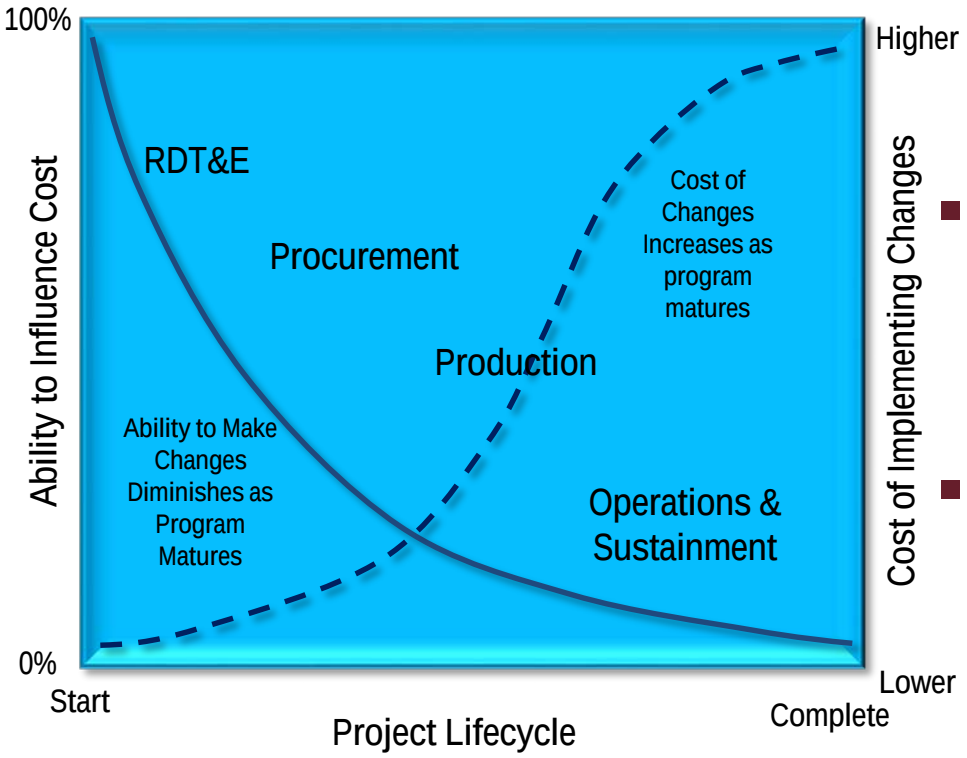
Why Look at PBR? - Some Examples

- Significant Costs during O&S drive TOC
- Reliability Drives Cost
  - Parts life
  - Performance
  - Replacement prior to design life
- Reliability Confidence Early Supports
  - Smaller Logistics footprint
  - R-TOC

Program	R&D	Production	O&S
F-16 Fighter	2%	20%	78%
M-2 Bradley	2%	14%	84%



PBR Decisions Can Impact TOC

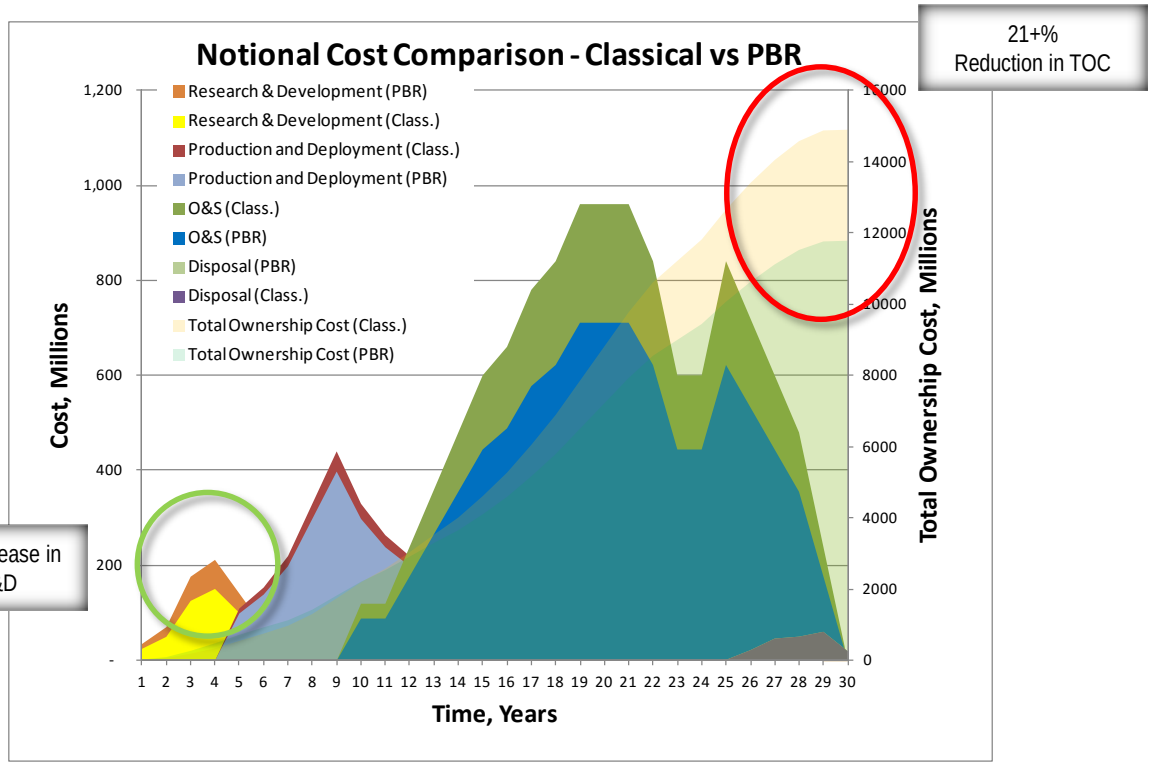


- Implement PBR early in the Project Lifecycle
  - Small investment
  - Big payoff later
- Often not considered until
  - Late Procurement
  - Production
- Impacts
  - Early – economic advantage
  - Later – costly till disposal

PBR Methodologies and Implementation

- Early Adoption of PBR can Save
- Advantages
  - Benchmarking
  - Root Cause
  - Reduction of TOC – Notional Solution 3% up front yields 21% TOC Savings

Phase	Benchmark		PR Implementation		Change	
	$, Millions	Percent	$, Millions	Percent	$, Millions	Percent
Research & Development	$ 500	3%	$ 700	6%	$ 200	40%
Production and Deployment	$ 2,200	15%	$ 1,980	17%	$ (220)	-10%
O&S	$ 12,000	81%	$ 8,880	76%	$ (3,120)	-26%
Disposal	$ 200	1%	$ 200	2%	$ -	0%
Total	$ 14,900	100%	$ 11,760	100%	$ 11,760	**-21%**



Success Stories

Surveillance System

$1.2M Saved

Analysis showed commercial CCA OK

Tri-Service Radio

$27M Cost Avoidance

Identified weak link in design & verified

Army Vehicle

$1M Cost Avoidance

Fix confirmed through low-level test and M&S instead of full-up testing

Mobile Bridge

$1.5M Savings

Reduced testing

- PBR supports reduction in TOC
- Cost
  - Avoidance
  - Savings
- Program Efficiency
- Smaller O&S Footprint
- Start PBR Early

Future Work

- Develop Process to implement PBR techniques pre-MS A
- Enhance the discrete activities to realize SC savings and cost avoidance

Questions?

Thank You