

Modeling Hardware Development Cost in a Low TRL / Pre-Acquisition Environment



International Cost Estimating and Analysis Association
Professional Development and Training Workshop
Portland, OR



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THE ADVANCED MILITARY TECHNOLOGY THAT WILL WIN FUTURE WARS

The West is searching for a new edge on the battlefield through advanced military technology. Benjamin Sutherland goes inside the quest...



US Air Force names new stealth bomber as B-21 "Raider"

Line Spacing + -

S): The US Air Force's stealth bomber has been



NEWS MAGAZINE BLOG NEWSLETTER

Home / Technology / U.S. Military Successfully Demonstrates Microdrone Swarm



Perdix microdrones launched from F/A-18 Super Hornets demonstrate advanced decision making, adaptive formation flying and self-healing.

Blog: U.S. Military Successfully Demonstrates Microdrone Swarm

January 9, 2017

Super laser weapons are coming to Navy ships

FROM **vocativ**

Jennings Brown



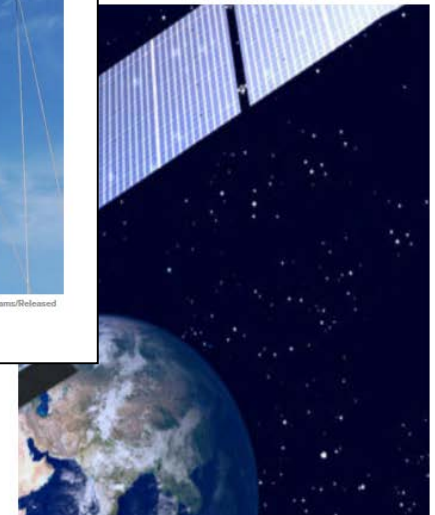
U.S. Navy photo by John F. Williams/Released

February 17, 2017

The United States military has been working on laser weapons

Laser comms from space gets another test

BY GEORGE LEOPOLD • FEB 17, 2017



Agenda

Presented at the ICEAA 2017 Professional Development & Training Workshop - www.iceaaonline.com/portland2017



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- Background
- Challenge
- Case Study
- Potential Solutions
- Future Research
- Discussion



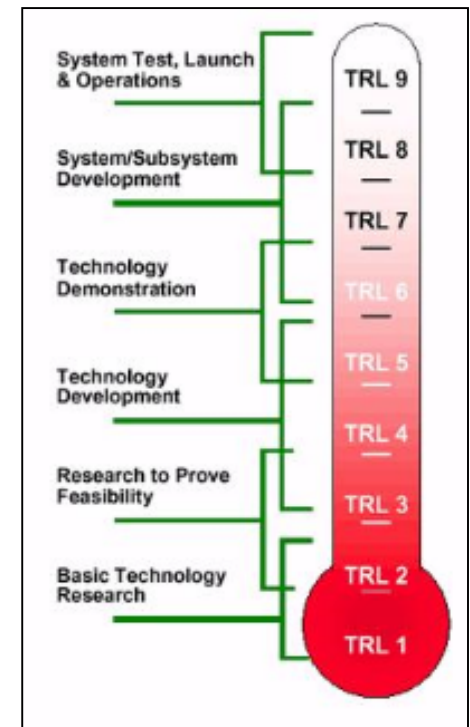
- Some technology must be matured prior to acquisition
- Research lab objective: Discover, Develop and Integrate
- Comparison to traditional acquisition programs

– Similarities

- *Cost estimation, Sys Eng, Prog Mgmt still occur*
- *Proposal eval, contracting functions required*
- *Development activities similar to acquisition program*

– Differences

- *“End State” is not necessarily a fielded system*
- *Production not a consideration; affordability may be*
- *Iterative development may take longer*
- *Testing, scaled prototyping, demonstration is key*
- *New norm: lack of analogies, schedules, requirements*



Challenge

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- Apply cost estimation “tool kit” to novel programs
- TRL cost drivers
- Forecast effort for acquisition transition
- Identify affordability early
- Define requirements
- Budget constrained, vice requirement driven

AFRL Unique Challenges

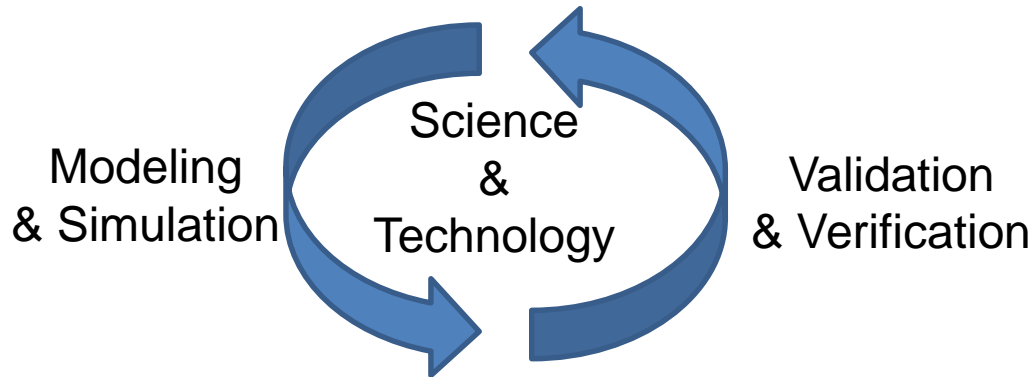
- **Identity**
 - Science & Technology vs. Integration & Demonstration
- Unique “never been done before” mentality
- Requirements not always shared within program
- Lack of DoD 5000.02 rigor
- Potentially substantial follow-on EMD program to deliver
- Engineer & program management estimates
- Internally funded

Pre-Acquisition Environment

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Problem Statement



Research
Lab Reality

Scaled / Demo Testing

Requirements Definition

System Design

Development Engineering

Development Mfg.

Test and Evaluation

Traditional
Acq Reality

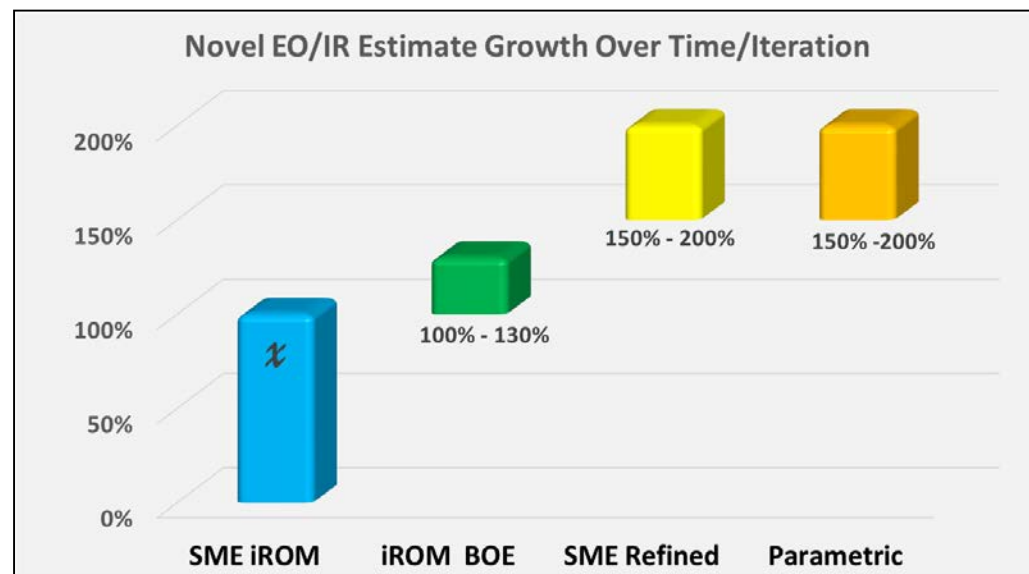
Case Study – Novel EO/IR Device

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- Demonstrate novel concept
- SME initial ROM χ
- Devil is in the details
- iROM excluded
 - Inflation
 - Lab overheads
 - Uncertainty
 - Applicable wrap rates



Novel EO/IR Device Analogy

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- Possible Analogies
 - EO/IR sensors
 - FLIR
- Data Sources
 - CSDR / 1921s
 - EVM and SAR data
 - Tribal knowledge





- Commercially available cost estimating framework
- Cost drivers
 - Hardware functionality
 - Operating environment
 - Weight
- Calibrate for low TRL environment
 - Requirements instability
 - Iterative development
 - Partial prototyping
 - Less rugged end item
 - Less stringent operating environment, i.e. brass boarding

Case Study – Novel Ordnance

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- Discover & develop new warhead technologies
- SME initial ROM: Y
- iROM BOE: 140%·Y
- Parametric crosscheck: 130%·Y
- iROM excluded
 - Inflation
 - Lab overheads
 - Uncertainty
 - Applicable wrap rates





- Analogous Programs
 - SDB
 - FLM
 - SEM
- Skepticism comparing old programs to “novel” programs
- Normalize content & complexity





- **Commercially available cost estimating framework**
- **Cost drivers**
 - Hardware functionality
 - Operating environment
 - Weight
- **Calibrate tools for low TRL environment**
 - Requirements instability
 - Iterative development
 - Partial prototyping
 - Less rugged end item
 - Less stringent operating environment

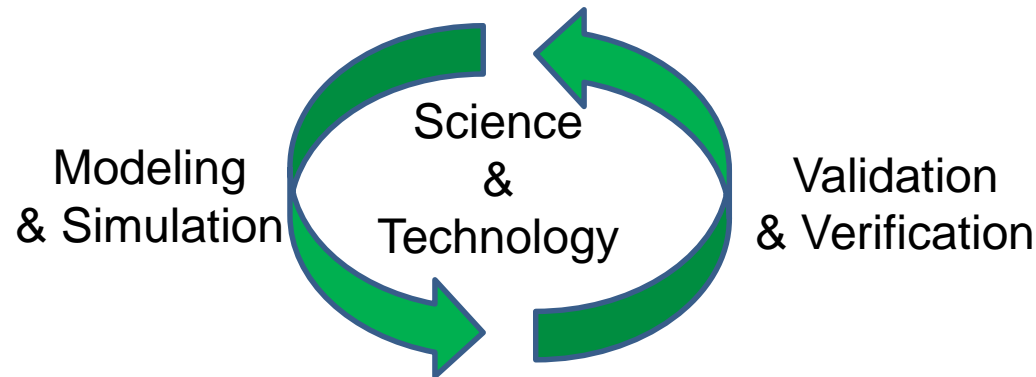
Novel Ordnance Technology Discovery

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Problem Statement



Scaled / Demo Testing

- Unique effort
- Rigorous design of experiments
- Continual model validation & test/verification

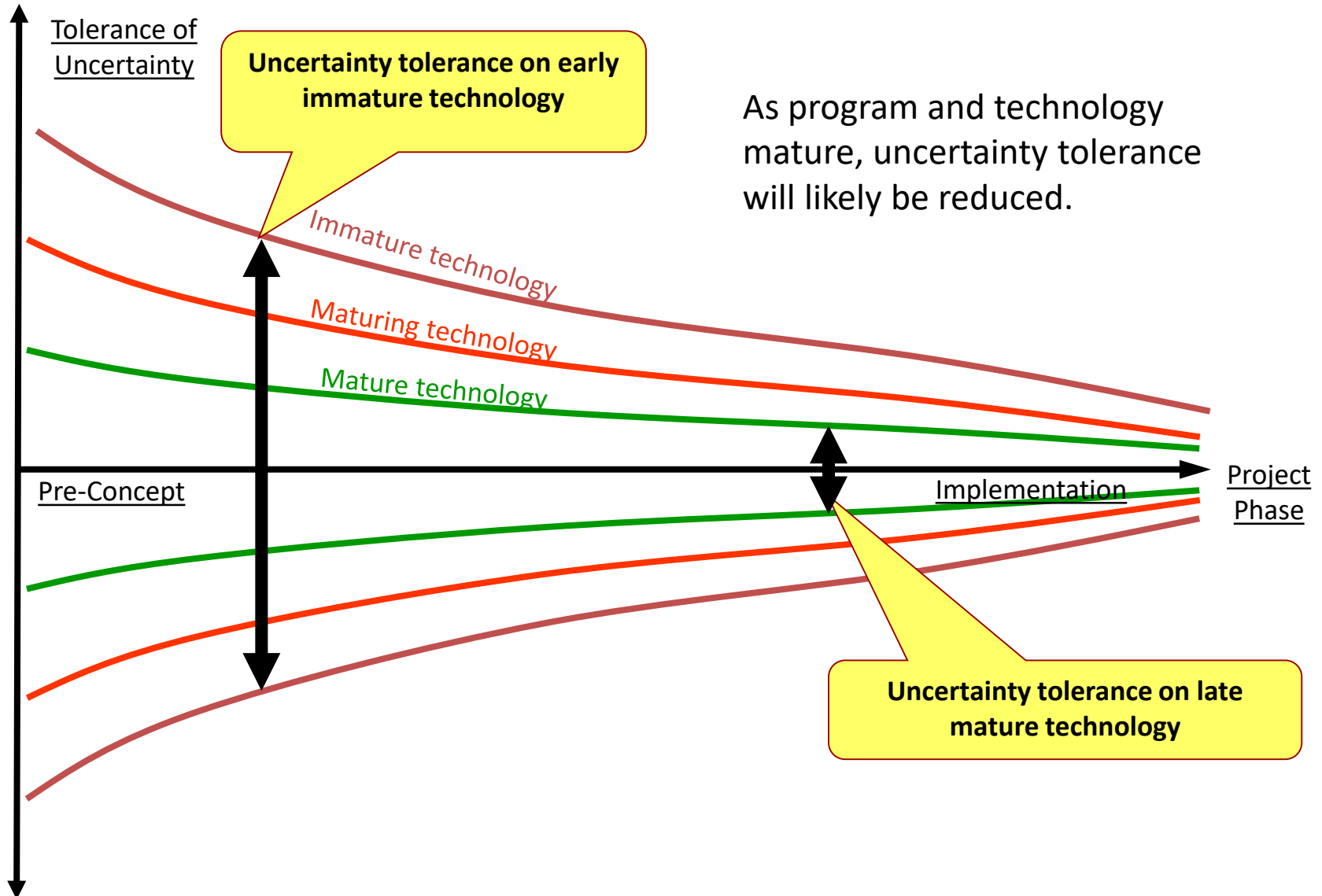
Challenges of Case Studies

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- Normalizing between SDD and pre-EMD
- Analogous small programs “fly under radar”
- Mix resources between programs
- Classified or proprietary programs
- Developing S&T cost data bases

Cone of Uncertainty





- **Piecing together analogies**
 - Development testing from Program A
 - Integration estimating from Program B
 - Scaled prototyping from Program C

- **Parametric modeling**
 - Cost drivers for immature technology
 - Differences in development time frames
 - Extrapolating affordability from lab / demo programs



- Can TRL transition be accurately modeled TRL 1 to 4?
- How do typical S&T programs mature over time?
- Identify unique S&T characteristics for modeling?
- At what stage can accurate estimate affordability be established?
- Analyzing AFLCMC EMD following AFRL tech maturation



Questions?

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The Authors



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Mr. Joe Bauer joined PRICE Systems after twenty years of service in the US Air Force. Joe is the primary Solutions Consultant for US Air Force and Canadian government customers, providing training, mentoring, and consulting. Prior to joining PRICE Systems, Joe was the lead hardware estimator for the F-22 Raptor program office. Joe earned a Master of Science degree in Cost Analysis from the Air Force Institute of Technology in 2009. He earned an MBA from the University of Phoenix in 2005. Joe is also a Certified Cost Estimator / Analyst (CCEA) with the International Cost Estimating and Analysis Association (ICEAA). He can be contacted at Joe.Bauer2@pricesystems.com