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Innovate or Integrate: Controlling Schedule Risk

Dan Manuel

Ph.D. Candidate

Department of Engineering Management and Systems Engineering

School of Engineering and Applied Science

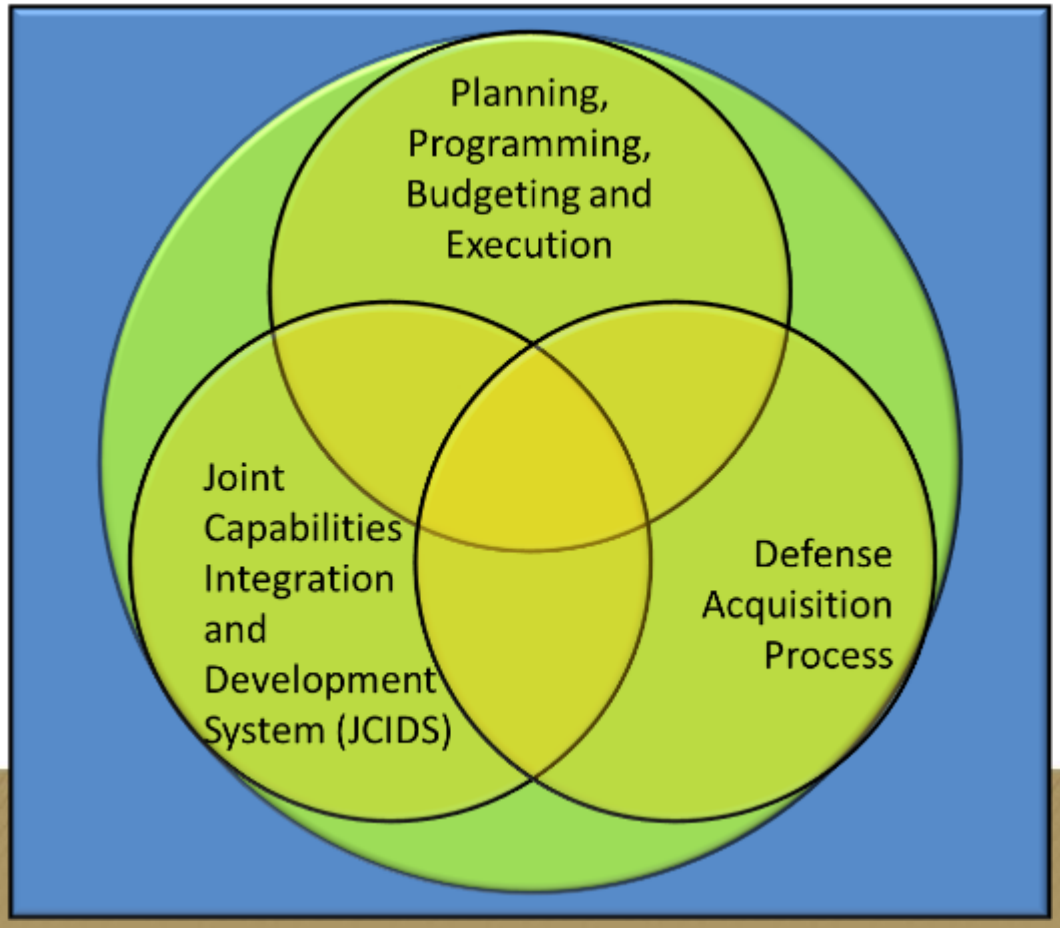
Overview

- Thesis
- Review of DoD Acquisition Process
- Analyzing the process
- Thoughts on an alternate process
- Additional area for research

Dissertation Thesis

Shorter, integration based acquisition programs provide a means to deliver capability with much lower schedule variance.

The Defense Acquisition System



DoD procures new systems through the interaction of these three primary processes

From DAU: https://dap.dau.mil/APHOME/Pages/Default.aspx

Joint Capabilities Integration and Development System (JCIDS)

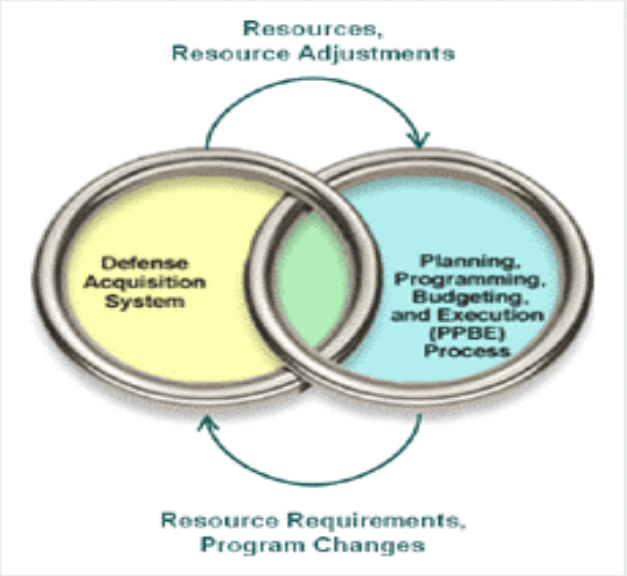
Process goal is to identify, assess and prioritize capabilities needed to fulfill DoD missions

- "The Requirements Process"—Three key documents
  - Initial Capabilities Document: Documents need for a materiel solution and summarizes supporting analysis
  - Capabilities Development Document: Documents information to develop a program and ID performance attributes
  - Capability Production Document: Address the production elements of a single increment of an acquisition program

Planning, Programming, Budgeting and Execution

Process goal: Develop the best mix of forces, equipment, manpower & support within budget

- Planning: Lays out "budget conscious" priorities for the services
- Programming: Detailed proposed budgets
- Budgeting: Detailed cost estimates and expenditures
- Execution: Reviews current effectiveness of budget, includes feedback mechanism for budget changes

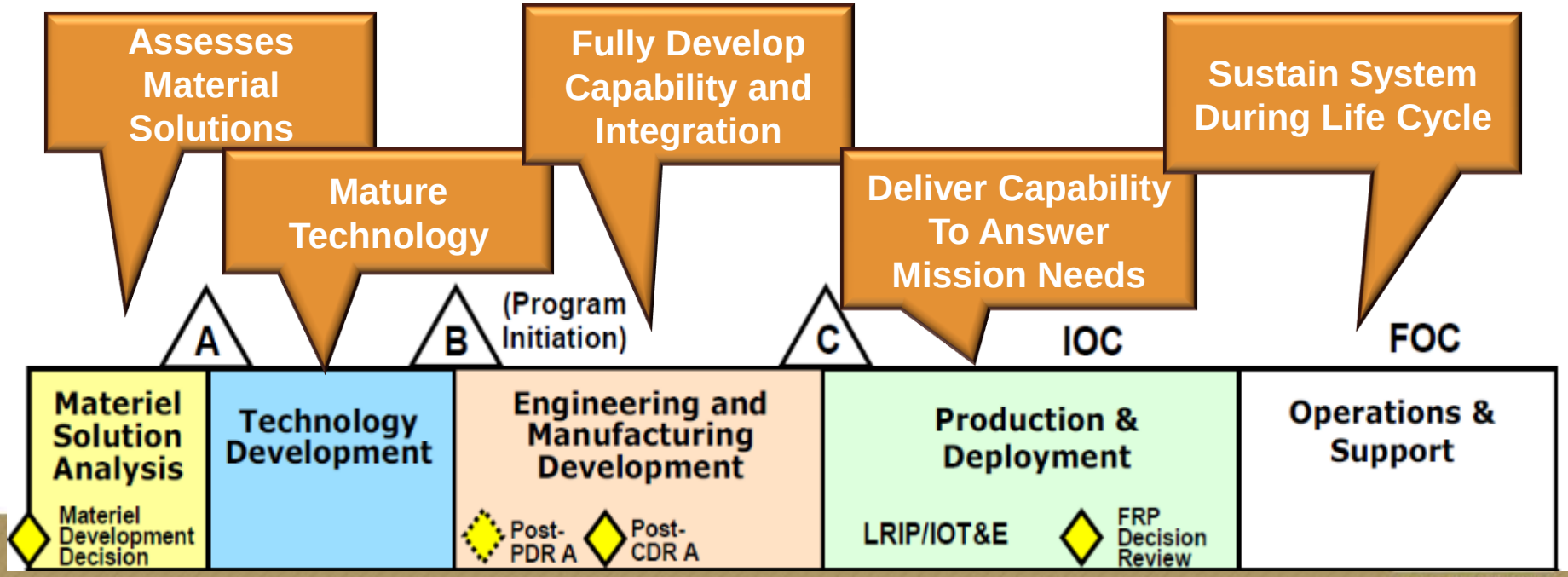


From DAU: https://dap.dau.mil/aphome/ppbe/Pages/Execution.aspx

The Defense Acquisition System

Process Goal is to develop and deliver capabilities to answer requirements within PPBE fiscal constraints

- System development phases separated by milestone decisions



From DAU: https://dap.dau.mil/aphome/das/Pages/Default.aspx

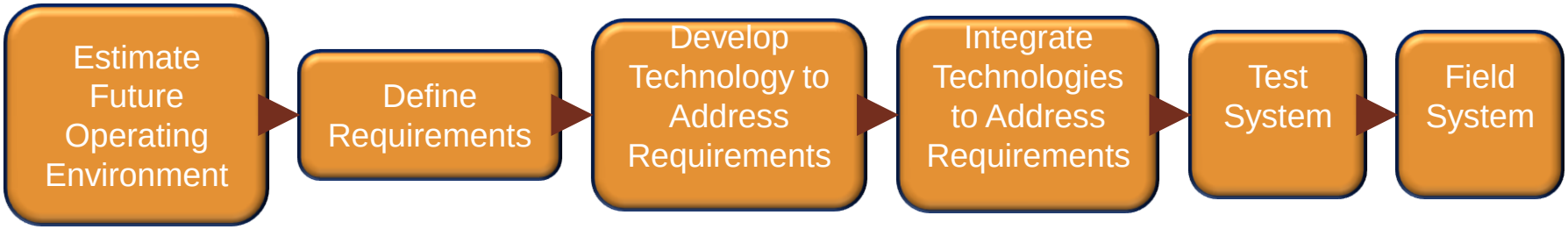
Analyzing the Process

- Process is “Broken”--quote from HASC
- Used F-22 and F-35 Examples to Assess Risk Areas and Consider Mitigation
  - JCIDS: Incorrect problem/threat definition, incorrect requirements, unstable or changing requirements
  - PPBE: Funding uncertainty, extended timelines as a result of funding cuts
  - Defense Acquisition System: Program management, changing requirements and technology development risks
- Developing an assessment model of Systems Development process

Complex System Acquisition - Conceptual Model

Program schedule and funding profiles built on planned duration

Composed of many events, each with some probability of success



- Planned duration
- High Probability of executing on time
- Some probability correctly defining environment

- Planned Duration
- High Probability of executing on time
- Some probability correctly defining requirements

- Some probability of completing on time
- Continues until success or relief from requirement

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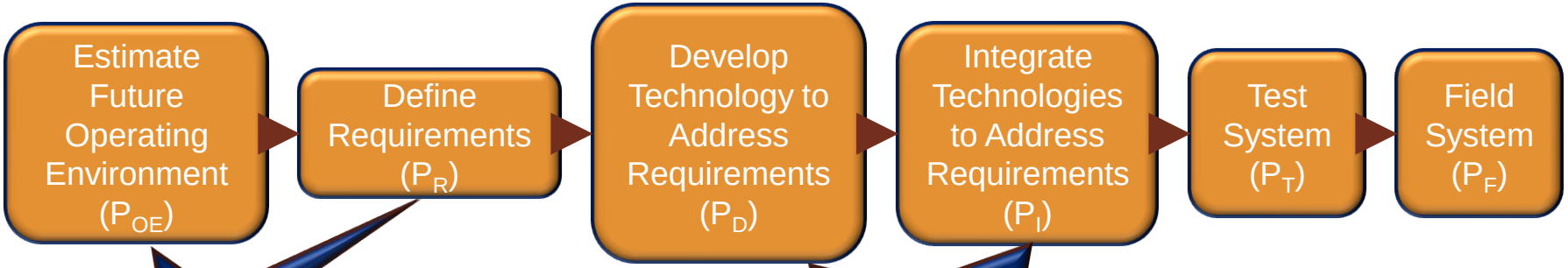
Modeling Program Execution
- Logistics Series System Reliability Model

Viewing the process as a serial system allows for application of the logistics series system reliability model

- **Each event has some probability of success**
- **External influences**

External impacts from funding cuts and requirements changes



Some events have a discrete time—event occurs and either fails or succeeds

Some events must continue until they have a success or decision is made to proceed without success—acceptance technology development or integration did not succeed

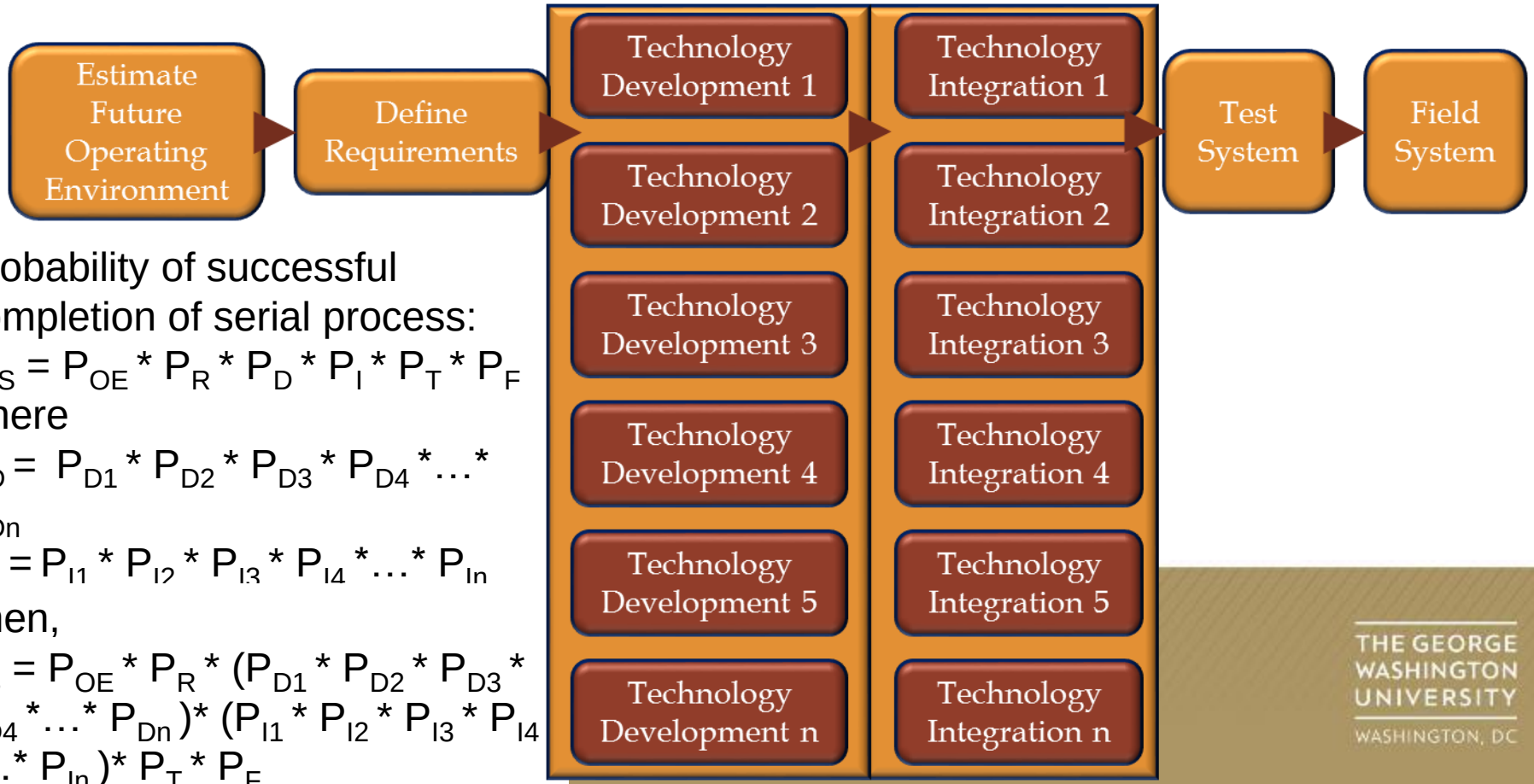
Probability of successful completion of the serial process

$$P_S = P_{OE} * P_R * P_D * P_I * P_T * P_F$$

Impact of Number of Technology Development and Integration Events

Technology development and technology integration can be decomposed into multiple technology development efforts

- **Occur at the same time**
- **Must be completed for success**



Probability of successful completion of serial process:

$P_S = P_{OE} * P_R * P_D * P_I * P_T * P_F$

where

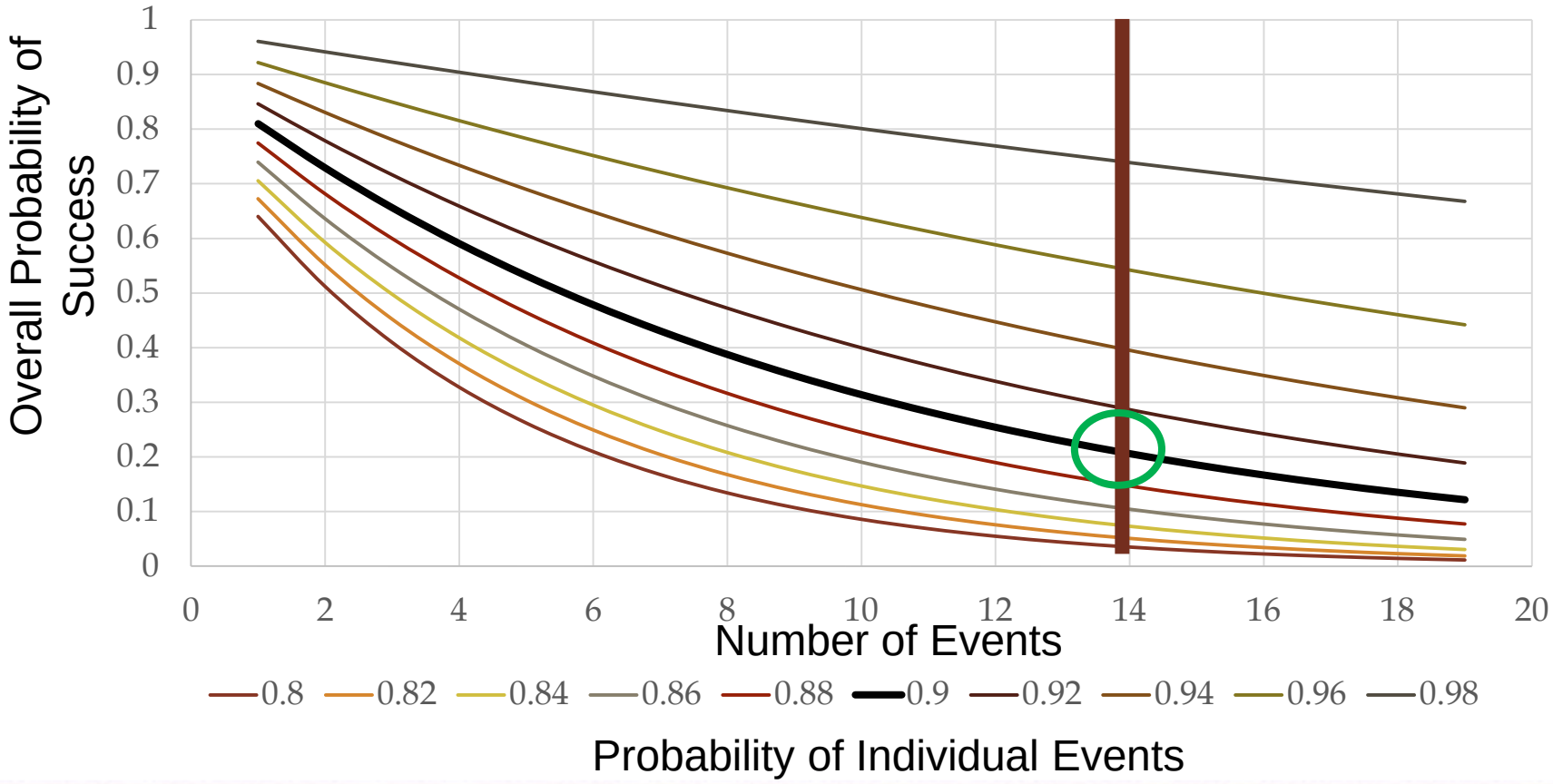
$P_D = P_{D1} * P_{D2} * P_{D3} * P_{D4} * \ldots * P_{Dn}$

$P_I = P_{I1} * P_{I2} * P_{I3} * P_{I4} * \ldots * P_{In}$

Then,

$P_S = P_{OE} * P_R * (P_{D1} * P_{D2} * P_{D3} * P_{D4} * \ldots * P_{Dn}) * (P_{I1} * P_{I2} * P_{I3} * P_{I4} * \ldots * P_{In}) * P_T * P_F$

Simple Assessment:
Impact of Number of Events v. Probability



5 technology development and subsequent integration efforts :

- 14 total events.

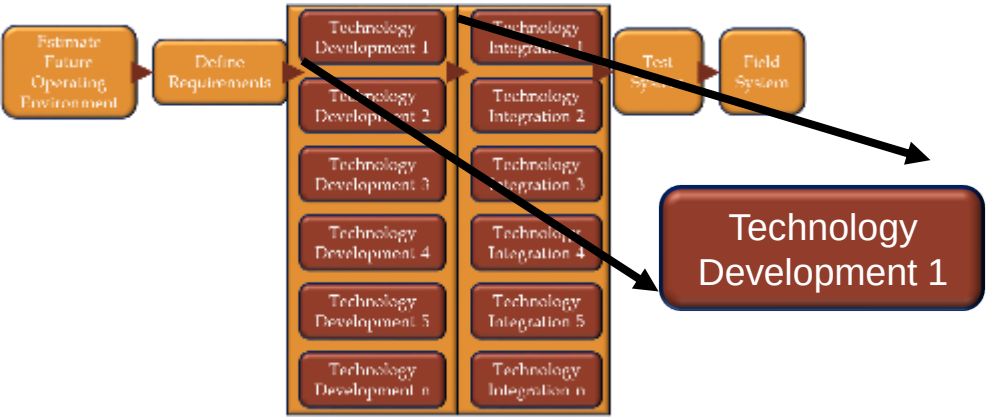
If each event has a probability of .9

- Probability of success is less than .23

Assessing the Impact of Technology Development and Integration

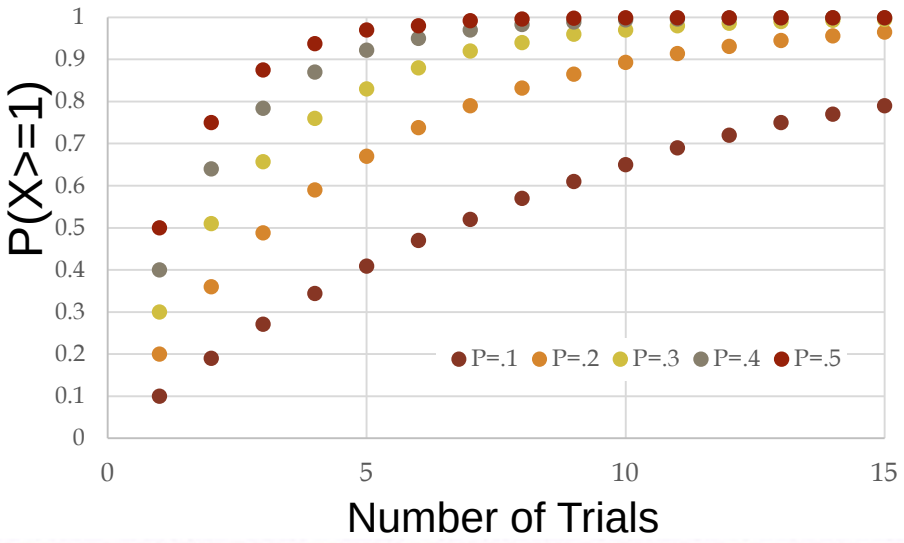
Each individual technology development and technology integration effort described with a Binomial Distribution

- **Each year of development is a Bernoulli Trial, with some probability of success**



Consider also funding impacts from budget cuts and changing requirements

Probability of at least one success in n trials:



Initial modeling and research indicate this is the largest impact to schedule (and as a result-cost)

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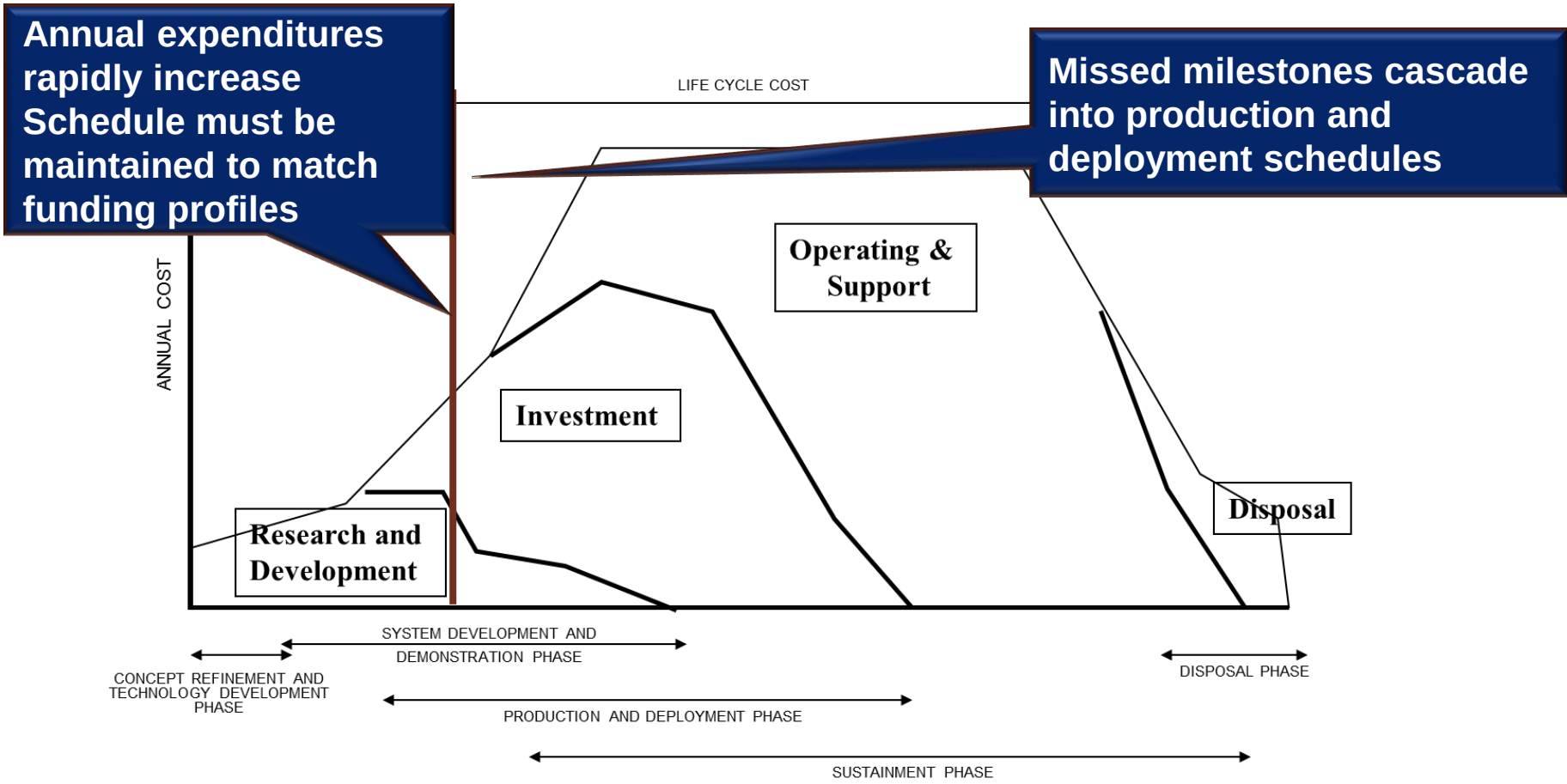
Calculation is one minus probability of zero 'successes' in n trials, calculated with excel, backed up by StatTrek

Impact of Missed Schedule



Program Life-Cycle (Illustrative)

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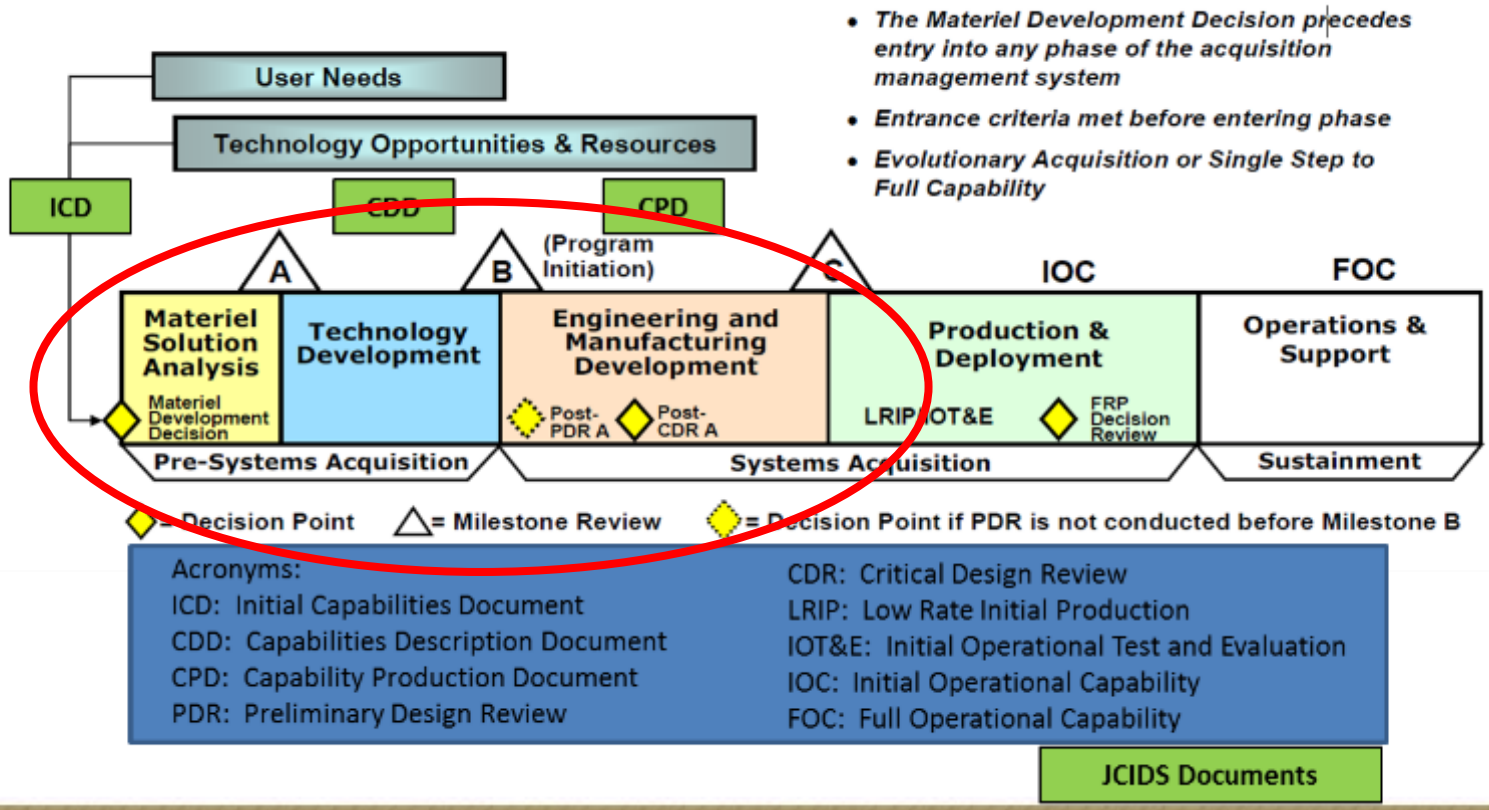
From DAU: https://acc.dau.mil/CommunityBrowser.aspx?id=488332

Process Change Focus Areas

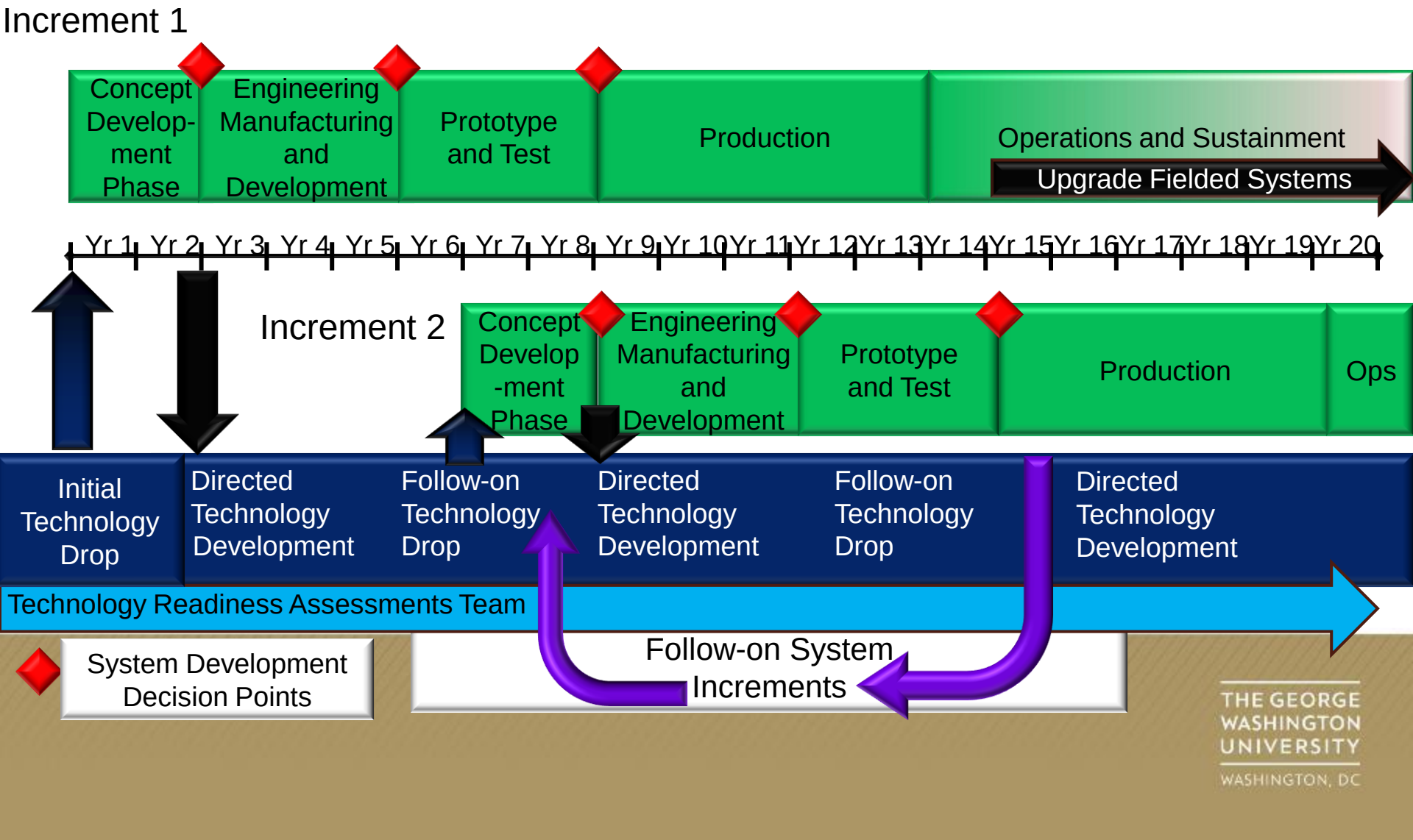
- **PPBE changes beyond the scope**
- **Focused on interaction of JCIDS and the Defense Acquisition Process**



Revising DoD Acquisitions

- Integration focused
  - Remove risk of technology development to separate process
    - Dedicated, directed technology development efforts
    - Program efforts receive mature technology
  - Shorten acquisition timeline
    - Focus on nearer term threat definition
    - Limit process to integration of mature technologies
    - Feedback technology needs to technology development portfolio
- Parallel Development Efforts
  - “Fallback” low risk system
  - Same form /fit
    - $P_S = 1 – (1-P_A)*(1-P_B)$
    - -- if $P_A = .9$ and $P_B = .6$, then $P_S = .96$

An Alternate Approach To Acquisition: Integration



Conclusion

Technology development introduces tremendous uncertainty to program

- Research indicates development risk frequently carries over into EMD
- Multiple developmental efforts appear to contribute to high probability of failing to meet schedule objectives.
- Program isolated technology development provides means to remove risk
- Integration focus offers means to accelerate development

Additional work needs to be done

- Develop probability curves for technology development
- Correlation with TRL? IRL? SRL?
- Role of professional judgement in predicting likelihood of development success
- Complete modeling of current process and alternate process(es)
- Quantify risk difference between short term threat definitions and long term threat definitions
- Is there an impact on quality of requirements
- Do short term acquisitions have a shorter shelf life?
  - If so, is the cost exchange viable?

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Thanks!

Contact Info:

Dan Manuel

703-589-3424

George Washington University

manueldgjr@gmail.com

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