A Technique for Evaluating Complex System of Systems Designs

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Stephen Blanchette, Jr.

Software Engineering Institute/Carnegie Mellon University

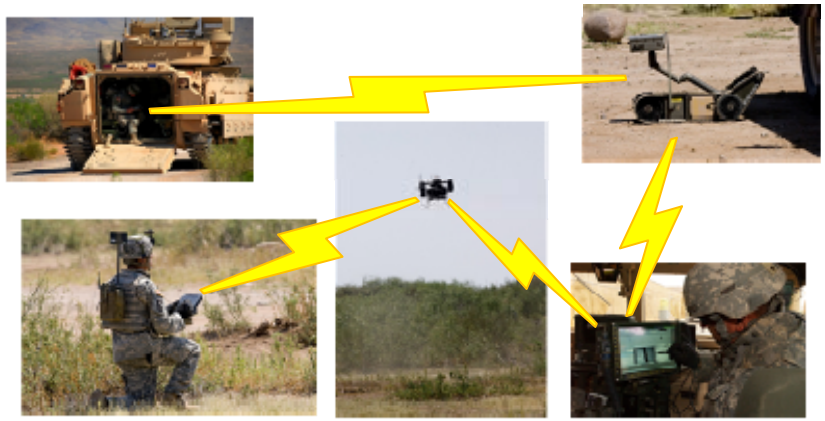
Steven Crosson

US Army – Program Executive Office Integration

Complexity Challenges Our Understanding

DoD Systems are Increasingly Complex…

…Systems of Systems (SoS) even more so



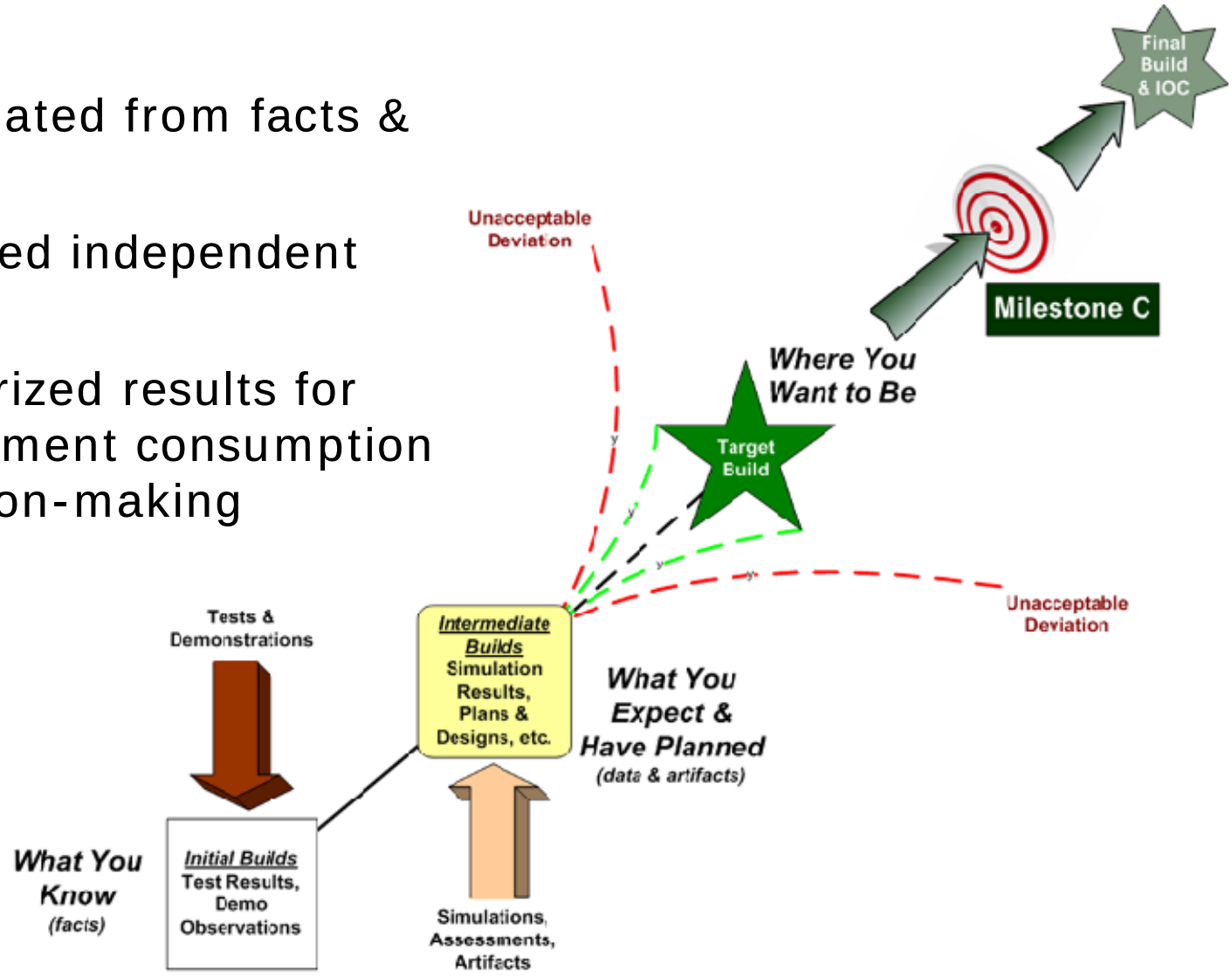
More and more, software drives system/SoS complexity and is the dominating factor in interoperability

Existing Review Types are Inadequate

- PDRs/CDRs tend to focus too narrowly
  - on a mash-up of individual system capabilities rather than true SoS capabilities
  - on functionality at the expense of suitability
  - on work to date rather than on work remaining
  - on PowerPoint artifacts rather than actual data
- Needed: an evidence-based SoS-Level evaluation looking across systems and projecting across builds
- Solution: Lifecycle Architecture (LCA) evaluation
  - LCA demonstrates feasibility of proceeding to construction phase of development
  - Originally a software notion for single systems, had to adapt to SoS
    - Detailed analyses in critical, cross-cutting, technical focus areas
    - Capstones: End State Design & Producibility Analyses

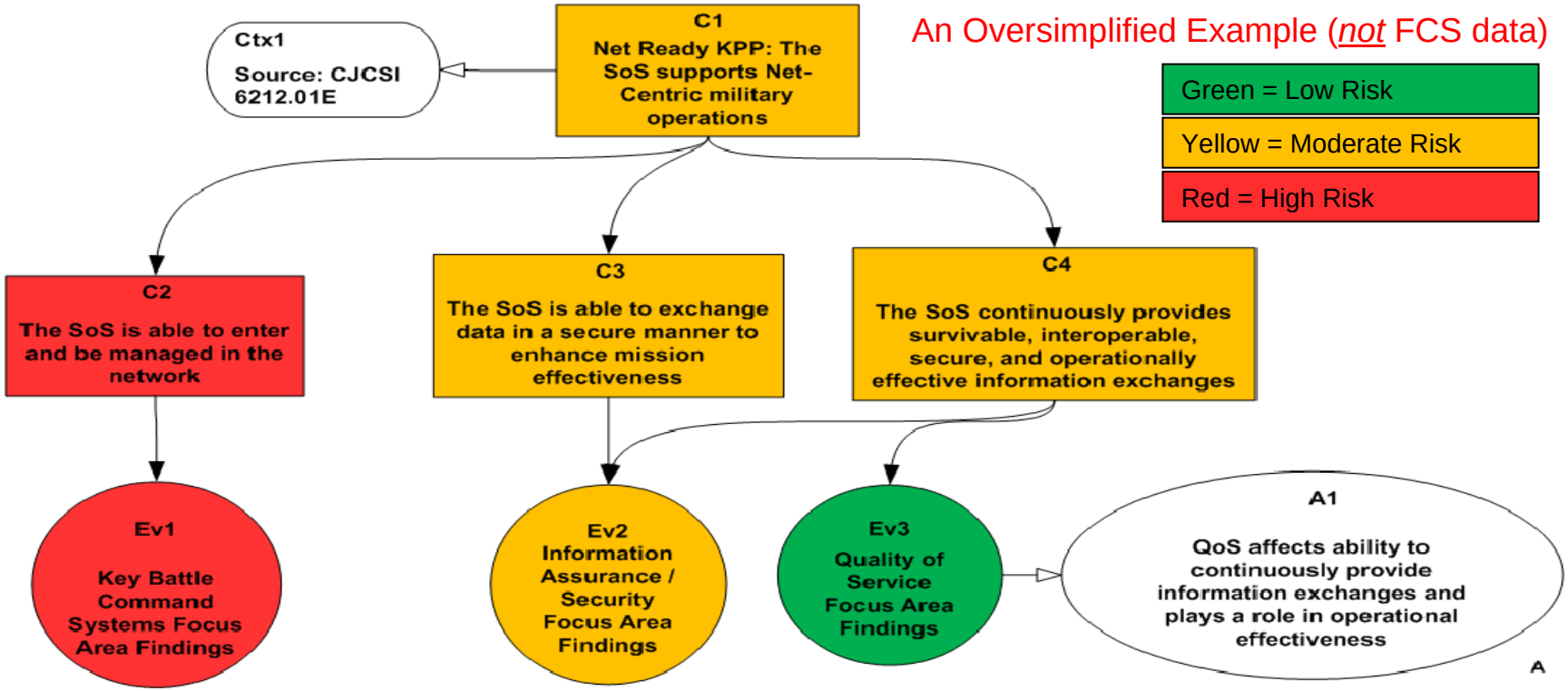
SoS LCA Provided a Better Perspective

- Extrapolated from facts & data
- Leveraged independent experts
- Summarized results for management consumption & decision-making



End-State Design Analysis Made Findings Relevant

- *Assurance Cases* tied technical findings in software to program KPPs
  - Related findings to operational needs
  - Expressed results to aid management decision-making



Producibility Analysis Completed the Picture

- Showed feasibility of developing SoS software within cost and schedule targets
  - Factored in Incremental Development Productivity Decline (IDPD)
    - Assuming constant productivity levels would have led to severe underestimation
  - Calibrated estimates based on early builds of SOSCOE and data from other large programs
- Related technical risks to cost & schedule risks

Rework from previous builds…

IDPD Says…

…increases workload & decreases productivity in future builds

SoS LCA is a Useful Tool

- SoS LCA depth/breadth of analysis exceeded other reviews
  - Provided excellent assessment of FCS software development and its potential for achieving program objectives
  - Provided insight into areas of the software development program that had never had an in-depth review
  - Provided management with a previously unseen perspective through use of actual data and fact-based projections rather than confident assertions
- Key was ability to report technical/cost/schedule risks relative to program goals at appropriate level of detail
  - Facilitated management understanding and decision-making
  - Allowed for in-stride program adjustments
- It should be possible to apply the SoS LCA technique to examine hardware/system issues from SoS perspective
  - As a practical matter, these issues are nearly impossible to ignore even with restricted focus on software

The SoS LCA is a means for evaluating and understanding complex Systems of Systems