NATIONAL DEFENSE INDUSTRIAL ASSOCIATION
STRENGTH THROUGH INDUSTRY & TECHNOLOGY

JCSEM Producibility M&S Sub-Committee Mid-Year Progress

Dr. Al Sanders, Chairman

June 11, 2009

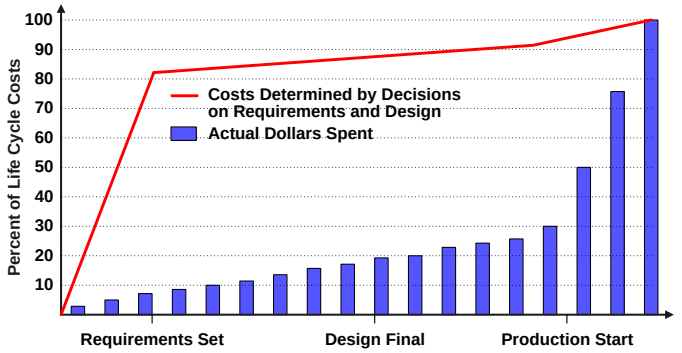
JCSEM M&S Sub-Committee Core Team (Active Participants)

- Al Sanders - Chair (Honeywell)
- John Allen (Honeywell)
- Kevin Fischer (Rockwell Collins
- Greg Pollari (Rockwell Collins)
- Charlie Stirk (Cost Vision)
- Gary Belie (LMCO)
- Simon Frechette (NIST)
- Tim Comerford (Missouri University)
- Scott Frost (Anser)

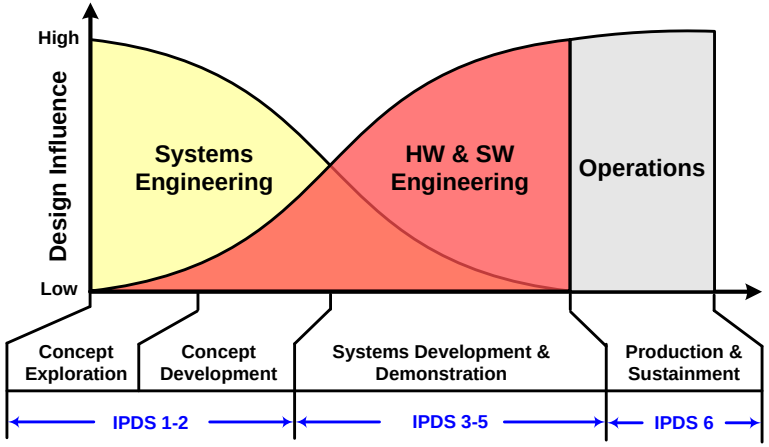
* 17 members on initial roster

JCSEM M&S Sub-Committee Example Producibility Issues

- Avionics RF transponder
  - Circuit architecture drives trial & error tuning of each individual card
- Display graphics card
  - Functionality upgrade for a dense design drove yield into single digits
- Engine controller chassis
  - Size & functionality drove compact design which cannot be assembled
- Composite engine bypass duct
  - Weight drove selection of composite material for use in a metallic design
- Advanced heat exchanger
  - Weight drove non-optimal joint design susceptible to braze erosion



GAO-03-57: "Setting Requirements Differently Could Reduce Weapon Systems' Total Ownership Costs", February 2003

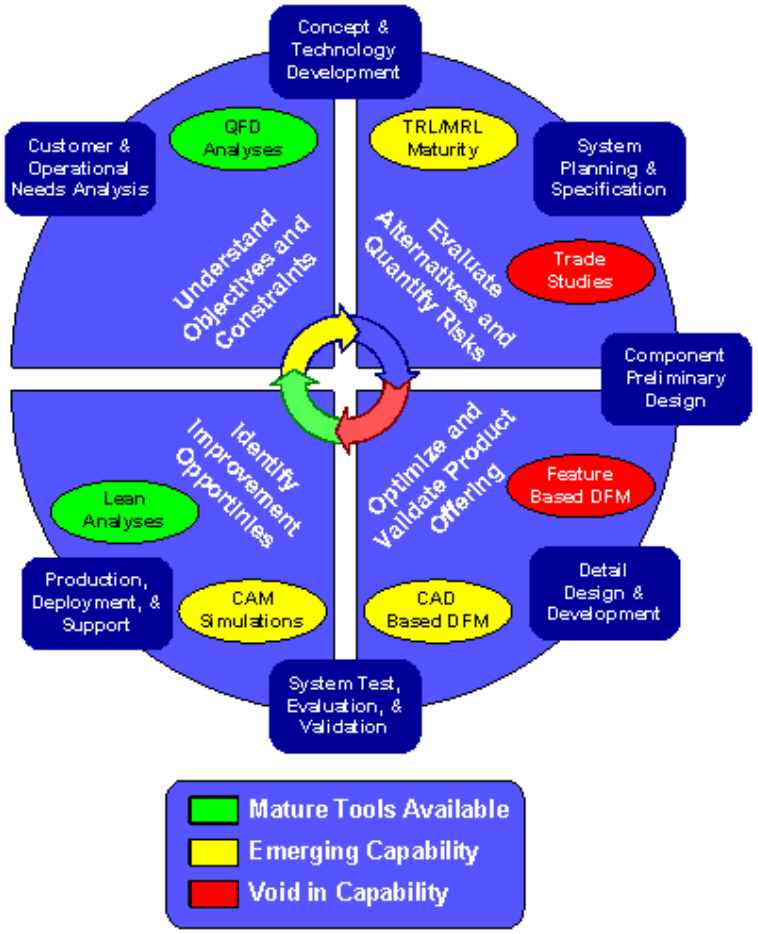


*** Examples from "Modeling & Simulation Approaches for Conceptual Design Producibility Trades", A. Sanders, Presented at 2008 DMC**

Most Producibility Issues Driven by Early Decisions

JCSEM M&S Sub-Committee
Motivation for Up-Front M&S

- Most producibility issues driven by architecture shortfalls not identified until late in design
- Current producibility analyses are rule-based CAD plug-ins that drive late risk identification
- Low-fidelity M&S capabilities needed to guide up-front SE trades to identify risk early on
- Quantitative analysis capability needed to enable balanced performance/producibility trades



Void in Producibility M&S Capability Exists Today

JCSEM M&S Sub-Committee Charter and Scope Statement

"Identify industry M&S ***analysis*** needs to facilitate the integration of producibility concerns into the earliest phases of the system engineering process"

In-Scope:

- Validated models to help answer early MRL 1-6 questions
- Product/process centric producibility analyses for trade studies
- Factory and supply chain analyses to guide industrial base design
- Cost modeling analyses and approaches that enable CAIV trades
- Methodologies to enable SE performance/producibility trade studies

Out-of-Scope:

- Virtual collaboration tools and existing SW enhancements
- Data standards and interoperability requirements
- Digital/IT type solutions to facilitate information sharing

JCSEM M&S Sub-Committee Objectives & 2009 Deliverables

Objectives and Focus Areas:

1. *Identification of **product/process centric analysis needs***
2. *Development of **methodology for SE trade study integration***
3. *Identification of **industrial base war gaming analysis needs***

2009 Deliverables:

1. *Development of a matrix describing product/process centric producibility analysis needs that maps to both the MRL criteria and the DoD 5001 systems engineering process*
2. *White paper describing product/process centric producibility analysis needs and a proposed framework and guidance document for system engineering trade study integration*
3. *White paper describing top supply chain risk drivers and enterprise "system-of-systems" analysis needs for defense industrial base war gaming applications*

JCSEM M&S Sub-Committee Progress & Next Steps

What's been done to date:

1. *Draft industrial base war gaming white paper completed*
2. *Product/process centric analysis needs matrix complete*

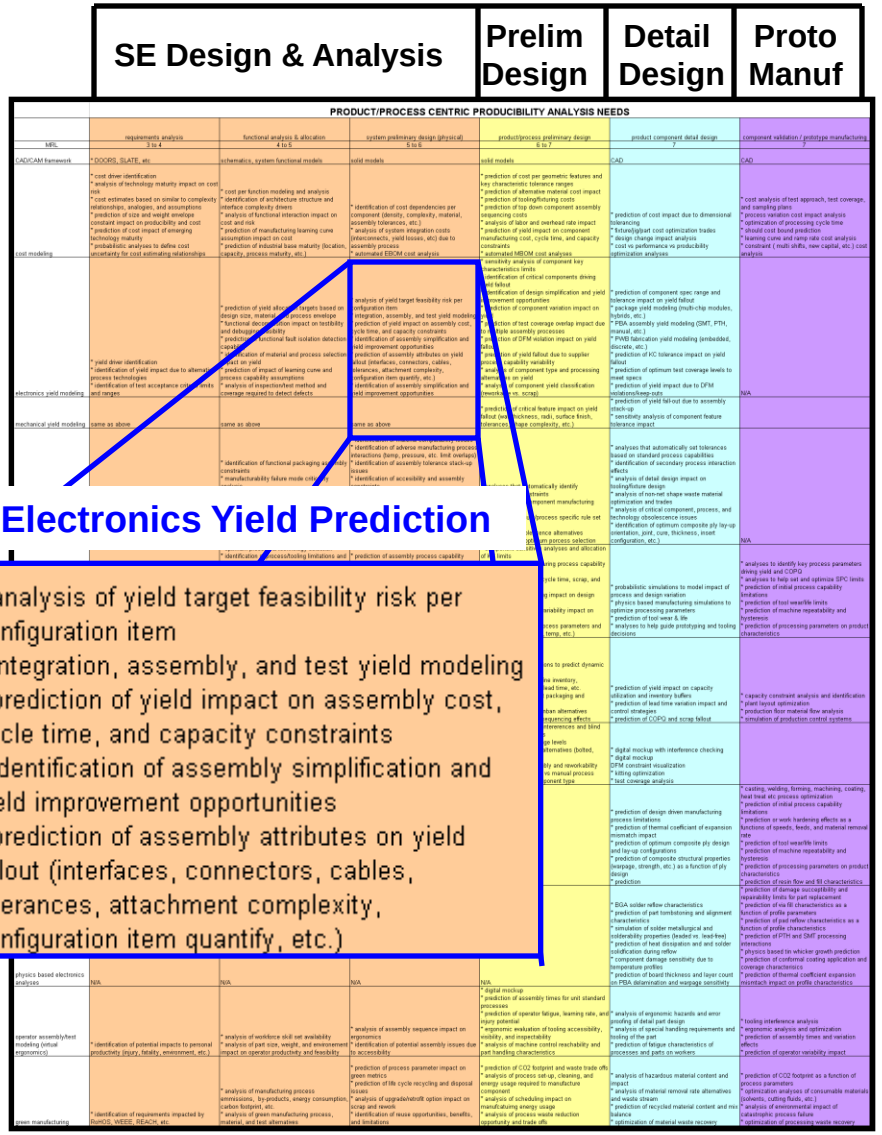
Next steps:

1. *Develop methodology for M&S-based performance/producibility trade study integration into the SE process (currently performance based)*
2. *Develop white paper describing product/process centric producibility analysis needs and guidance document for SE trade study integration*
3. *Finalize white paper for industrial base war gaming based on ManTech feedback to help define future investment focus areas*

JCSEM M&S Sub-Committee Analysis Need Focus Areas

Matrix Focus Areas:

- *Cost analyses*
- *Mechanical yield prediction*
- *Electronics yield prediction*
- *DFX analyses*
- *Process modeling*
- *Production line modeling*
- *Physics based mechanical analyses, e.g., casting*
- *Physics based electronics analyses, e.g., solder flow*
- *Ergonomics modeling*
- *"Green" manufacturing*



JCSEM M&S Sub-Committee Industrial Base War Gaming

Analysis Focus Areas:

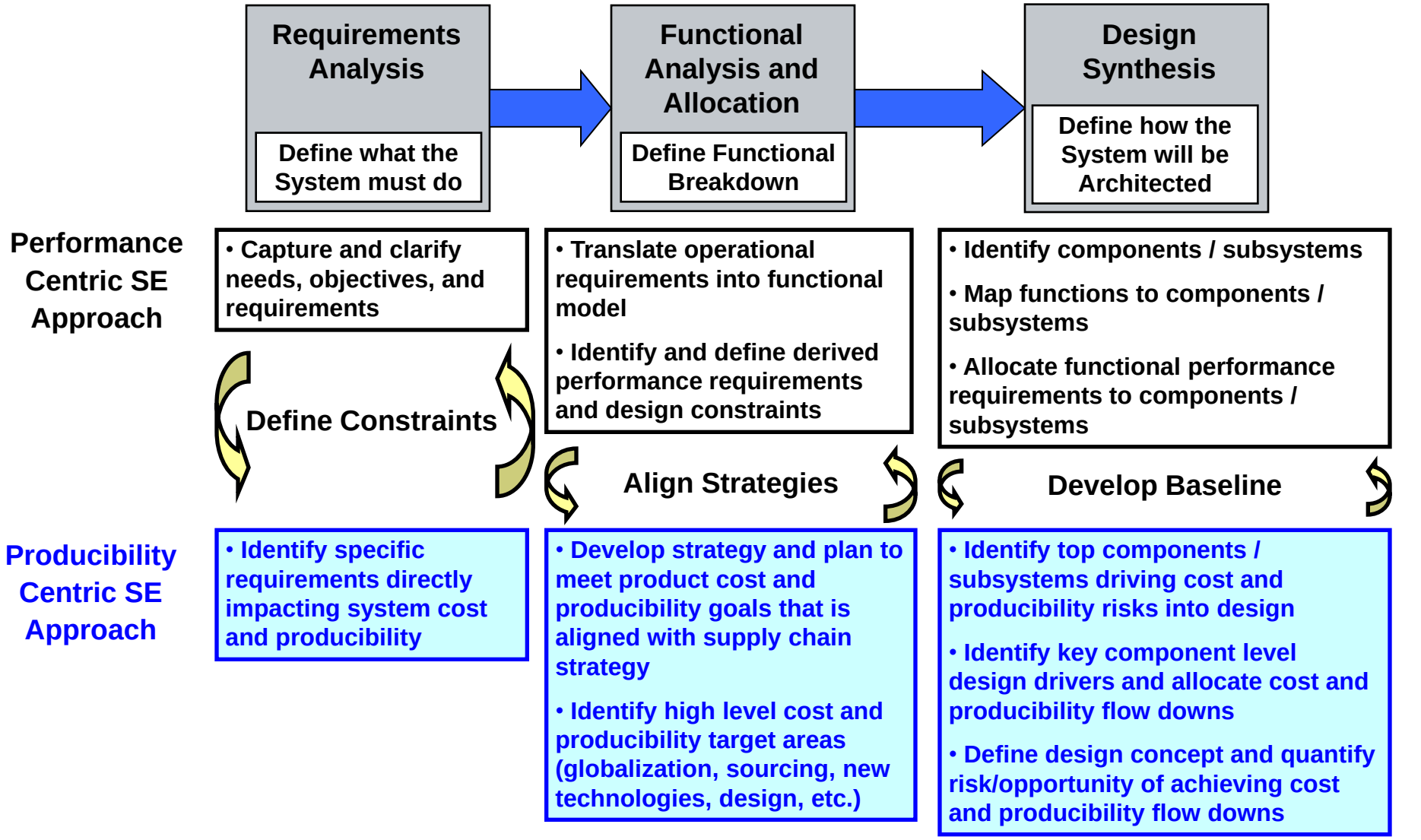
- *Logistics factors*
- *Environmental factors*
- *Strategy factors*
- *Sustainability factors*
- *Product design factors*
- *Material factors*
- *Process factors*
- *Technology maturity factors*
- *Infrastructure factors*
- *Policy factors*
- *Work force factors*

Black: currently modeled
Blue: currently not modeled

Proposed Approach:

- *Extend proven SE M&S approaches to facilitate supply chain analyses*
- *Develop standard supply chain architecture definitions and behavioral models*
- *Model transient and dynamic response of "system" due to disruptions and rate changes*
- *Three application areas:*
  - ***R&D and technology demonstration segment***
  - ***New product introduction segment***
  - ***Legacy product sustainment segment***

JCSEM M&S Sub-Committee Integration into SE Process



JCSEM M&S Sub-Committee Issues/Concerns

Deliverable Progress:

- *Product/process producibility analysis need matrix complete*
- *On-track to finalize industrial base war gaming white paper*
- *On-track to complete SE-based producibility analysis white paper*

Issues/Concerns/Challenges:

- *Challenge has been to maintain in-scope focus, i.e, identify next-generation analysis needs rather than use of existing software apps*
- *Aggressive year one deliverables require shifting focus away from analysis needs to developing a methodology to perform SE trades*

Areas for Help:

- *Need a few strong SE "engineers" on sub-committee to complete remaining deliverables, i.e., develop methodology and framework to integrate new producibility M&S analysis output into SE trade process*