Production and Logistics Modeling Challenge Team

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Overview

- Purpose?
- Challenges: why do we exist?
- Collaboration Paradigm
- Making Models and MBSE Ubiquitous in Production and Logistics
Challenge Team Purpose

Increase the availability of reference models, awareness of these models and methods, and successful use of MBSE in the production, logistics, and industrial engineering communities.

Specific challenges in providing a foundation to production and logistics [systems] engineering are the lack of:

– Standard reference models
– Well-structured engineering design methodologies
– Integrated analysis models and tools available to support design and operational decision-making.
MBSE in the “Product” domain--JPL

What makes this possible?

• Almost 50 years of effort to “standardize” the specification of the product—culminating in the ability to exchange designs between CAD systems
• Similar efforts to integrate product analyses with CAD models
• Emergence of SysML, a systems modeling variant of UML
• Recognition of the potential payoff
• Resulting commitment of resources to accomplish integration
Motivation

Why don’t we apply MBSE methods and principles to Production?

There are multiple stakeholders, with discipline-specific viewpoints

The systems are large, complicated, expensive, and persistent

The contemporary decision support analyses are independent, stand alone efforts

The consequences of poorly integrated decisions can be late to market and/or cost to produce
Points of view and responsibilities
- Product requirements
- Product design
- Production system resources
- Process instructions to create
- Process time estimates
- Performance prediction
Developing the production system requires sharing a lot of technical information about the product, the intended production processes, the resources that will execute those processes, the instructions for executing those processes, the intended production schedule (or rate or ramp…), and the resulting cycle time and WIP levels.

Today, this information and the way it is shared is still largely *ad hoc*. 
Consequences of current practice

• Time to market (time to full scale production) delays while the production system “bugs” are worked out

• Cost targets missed because
  – Resource capacity additions
  – Cycle time and WIP growth
What if?

SysML Models
Product, Process, Resources, Facilities

Product Viewpoint
- Bill of Materials

Process Viewpoint
- Bill of Process

Resource Viewpoint
- Resource Req’ts

Facility Viewpoint
- Interface Req’ts

Performance Viewpoint
- Cycle Time & WIP

What if?
Production and Logistics Modeling Drivers

- Heterogenous System Integration
  - Move away from dedicated (silo’d) domains
  - Design, planning, and operational control

- “Smart” Systems
  - Cyber-physical components
  - Multi-disciplinary design

- Evolving quickly
Remember IPPD?

<table>
<thead>
<tr>
<th>Life Cycle Stages</th>
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<tbody>
<tr>
<td>Exploratory</td>
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<tr>
<td>Investigate new opportunities</td>
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<tr>
<td>Explore technology readiness</td>
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<td>Evaluate pre-concept match with users’ needs</td>
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<td>Concept</td>
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<td>Identify stakeholders needs</td>
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<td>Evaluate alternate concepts</td>
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<td>Recommend possible solutions</td>
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<td>Development</td>
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<td>Develop detailed planning</td>
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<td>Identify and manage risks</td>
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<td>and business opportunities</td>
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<td>Perform IV &amp; V activities</td>
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<td>Production</td>
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<td>Produce systems</td>
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<td>Inspect and Test</td>
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<tr>
<td>Utilization</td>
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<tr>
<td>Operate system to satisfy users' needs</td>
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<tr>
<td>Support</td>
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<td>Provide sustained system capability</td>
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<tr>
<td>Retirement</td>
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<td>Store, archive or dispose of system</td>
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Mechanisms for development collaboration

Practitioners

Reference Modelers

Create and Maintain

System Models
- SysML / Ecore
- Ontologies
- Taxonomies

Github

Design Workflow

Wiki

Provides Framework For

Library of Plug-and-Play Analysis Methods and Tools

Contribute

Practitioners

Contribute

Academic Researchers

Use

Informs

Informs
Progress to date

- “Foundations” document: fundamental concepts and abstractions (-> developers)
- “Playbook” document: how to go about creating discipline- and analysis- agnostic production models (->modelers)
- “Case studies”: central fill pharmacy; composite parts manufacturing; semiconductor manufacturing (->general interest, students, newbies)
- All with associated SysML models
Acknowledgements

- NIST
- Collins Aerospace
- McKesson High Value Solutions
- Boeing
- Physical Internet Center, GaTech
It’s (long past) time to bring the power of (model based) systems engineering to production systems and global supply chains!

What does it take to do that?

Where are we in the journey?

Challenge team:

Monday @ 1:00pm in Pier 10

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