



2019
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Production and Logistics Modeling Challenge Team

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www.incose.org/IW2019



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.



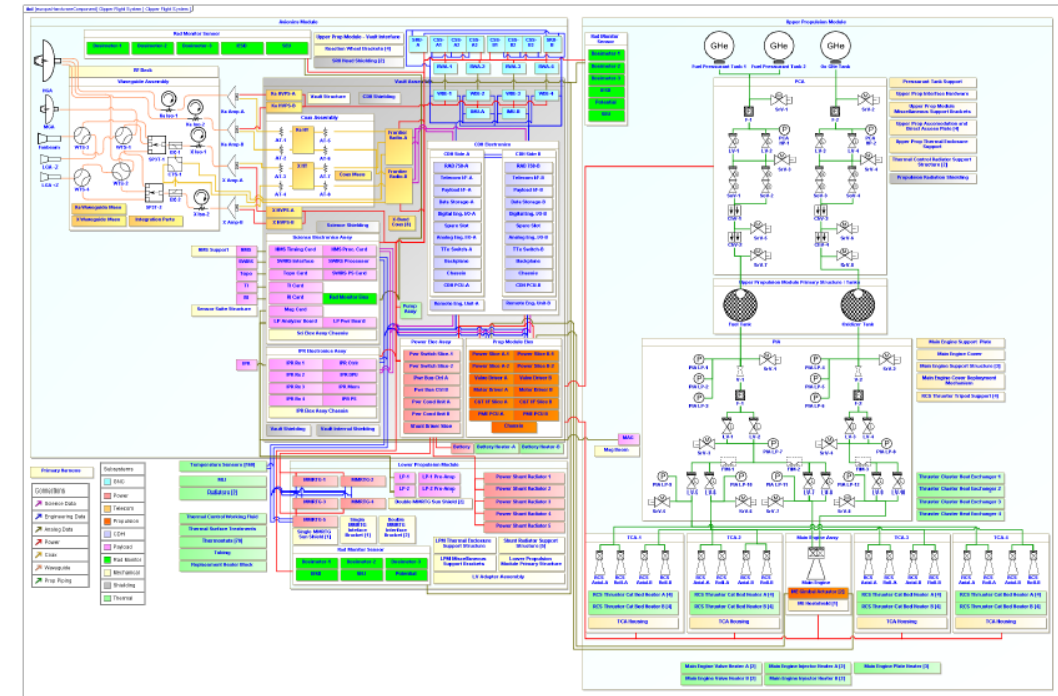
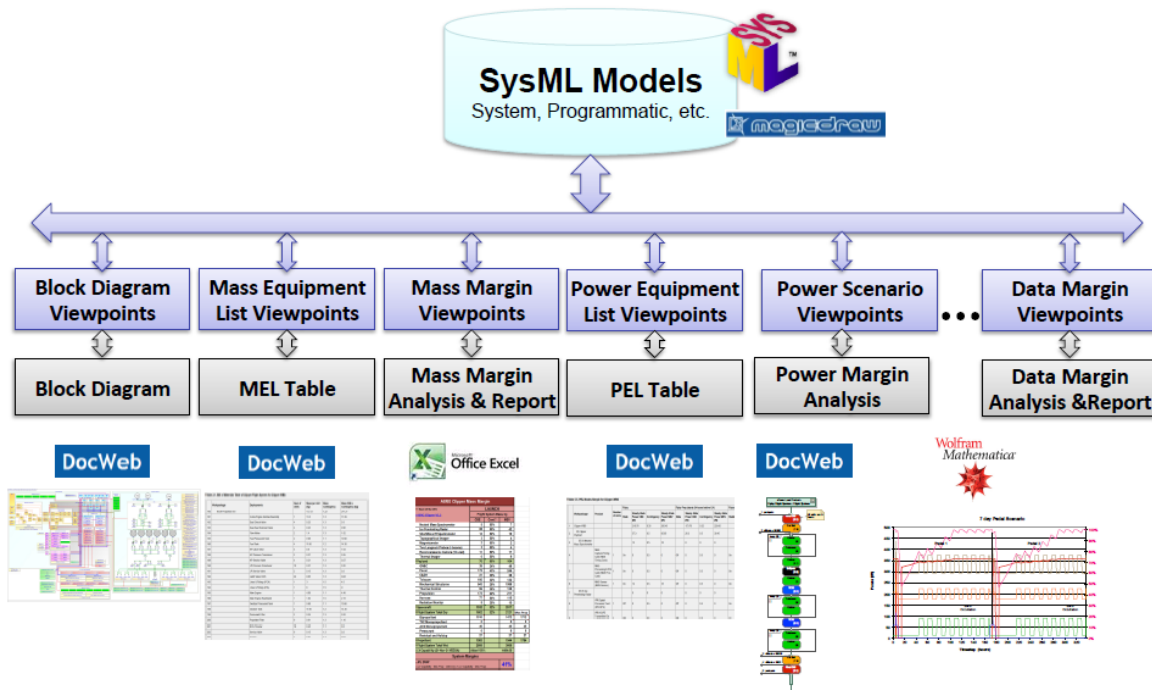
MBSE in the “Product” domain--JPL

NASA National Aeronautics and Space Administration Jet Propulsion Laboratory California Institute of Technology

Europa System Model Framework

NASA National Aeronautics and Space Administration Jet Propulsion Laboratory California Institute of Technology

More Meaningful System Diagrams



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Dave Nichols & Chi Lin, “Integrated Model-Centric Engineering: The Application of MBSE at JPL Through the Life Cycle,” INCOSE IW 2014



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



There are multiple stakeholders, with discipline-specific viewpoints

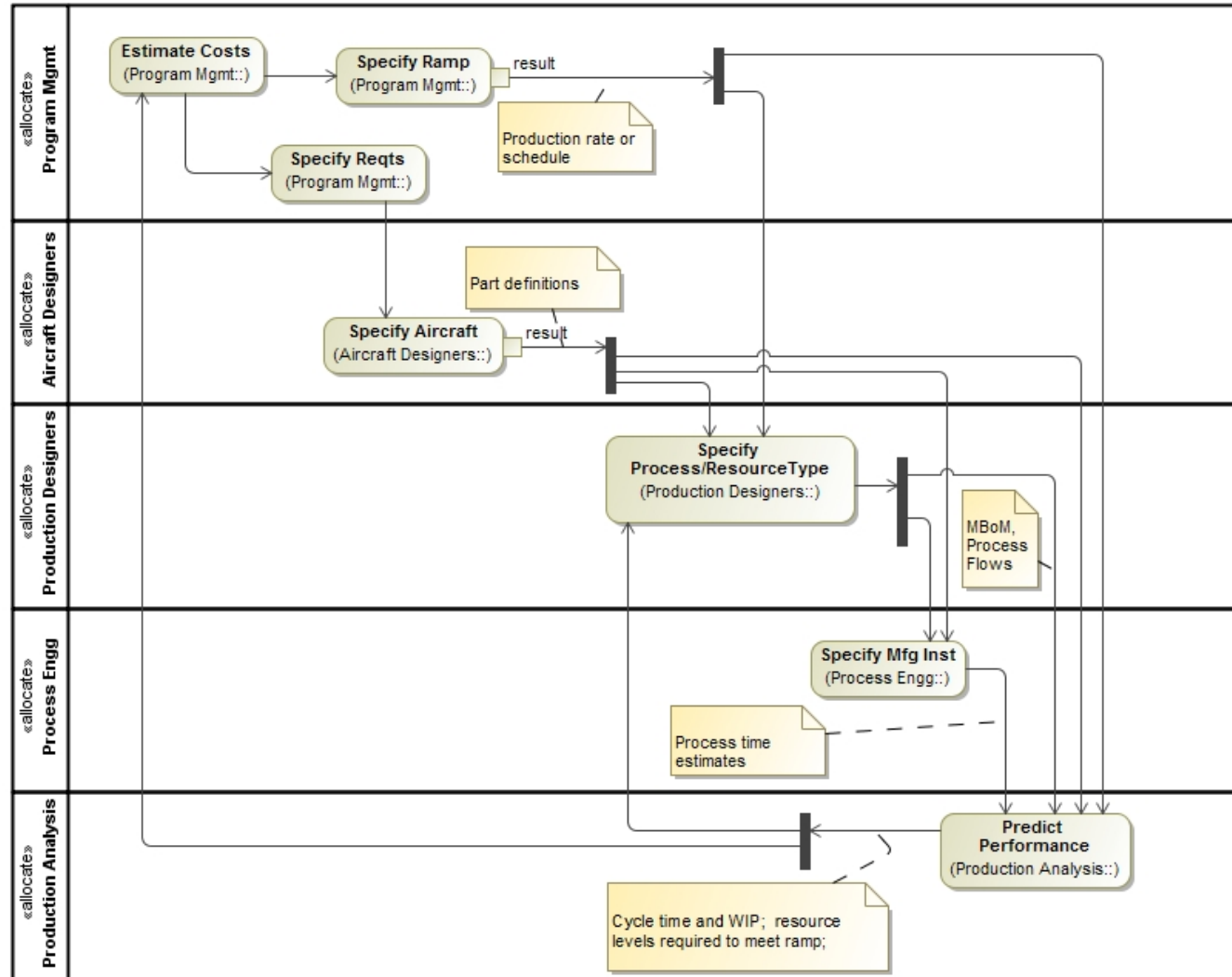
The systems are large, complicated, expensive, and persistent

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

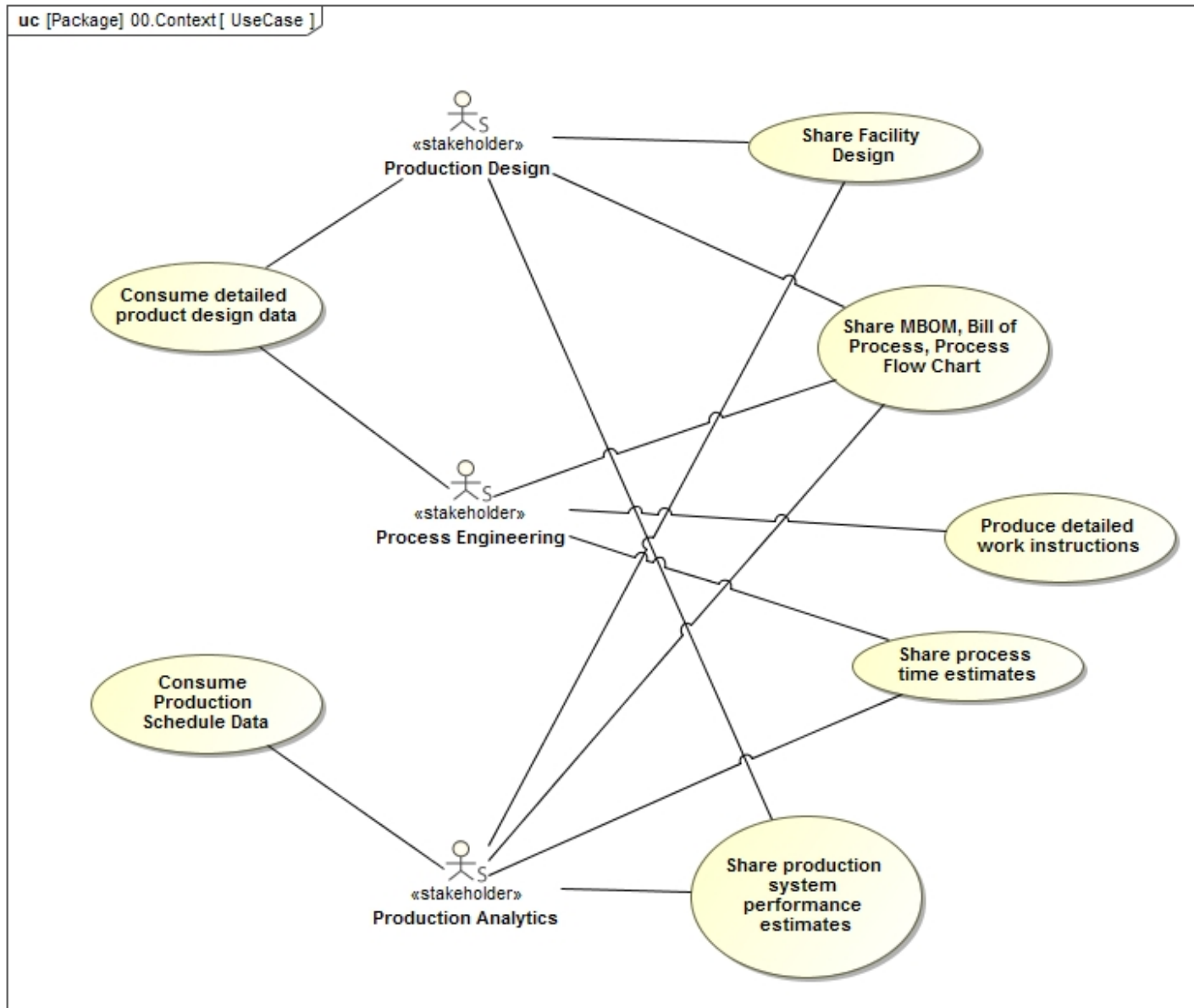


Stakeholders and interactions in Production



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.

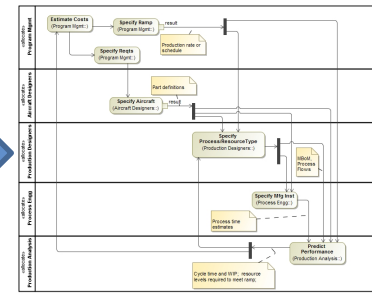
Today, this information and the way it is shared is still largely *ad hoc*.



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?



Product Viewpoint

Process Viewpoint

Resource Viewpoint

Facility Viewpoint

Performance Viewpoint

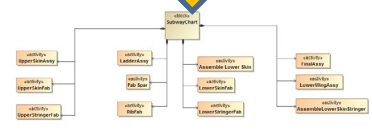
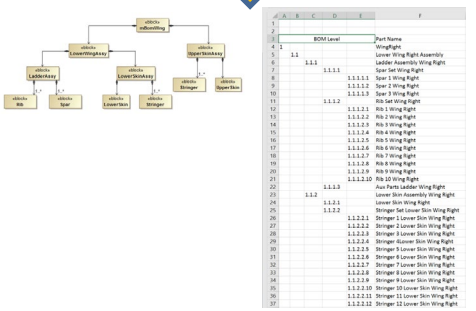
Bill of Materials

Bill of Process

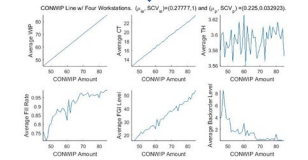
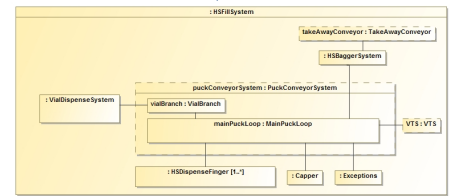
Resource Req'ts

Interface Req'ts

Cycle Time & WIP



| | A | B | C | D | E | F |
|---|----------|------------|-----------|-----------|-----------|----|
| 1 | | | | | | |
| 2 | Part | Rib1starb | Rib2starb | Rib3starb | Rib4starb | Ri |
| 3 | Process | Technology | | | | |
| 4 | Laminate | AFP | | | | |
| 5 | Bag | Manual | | | | |
| 6 | Cure | Autoclave | | | | |
| 7 | DeBag | Manual | | | | |





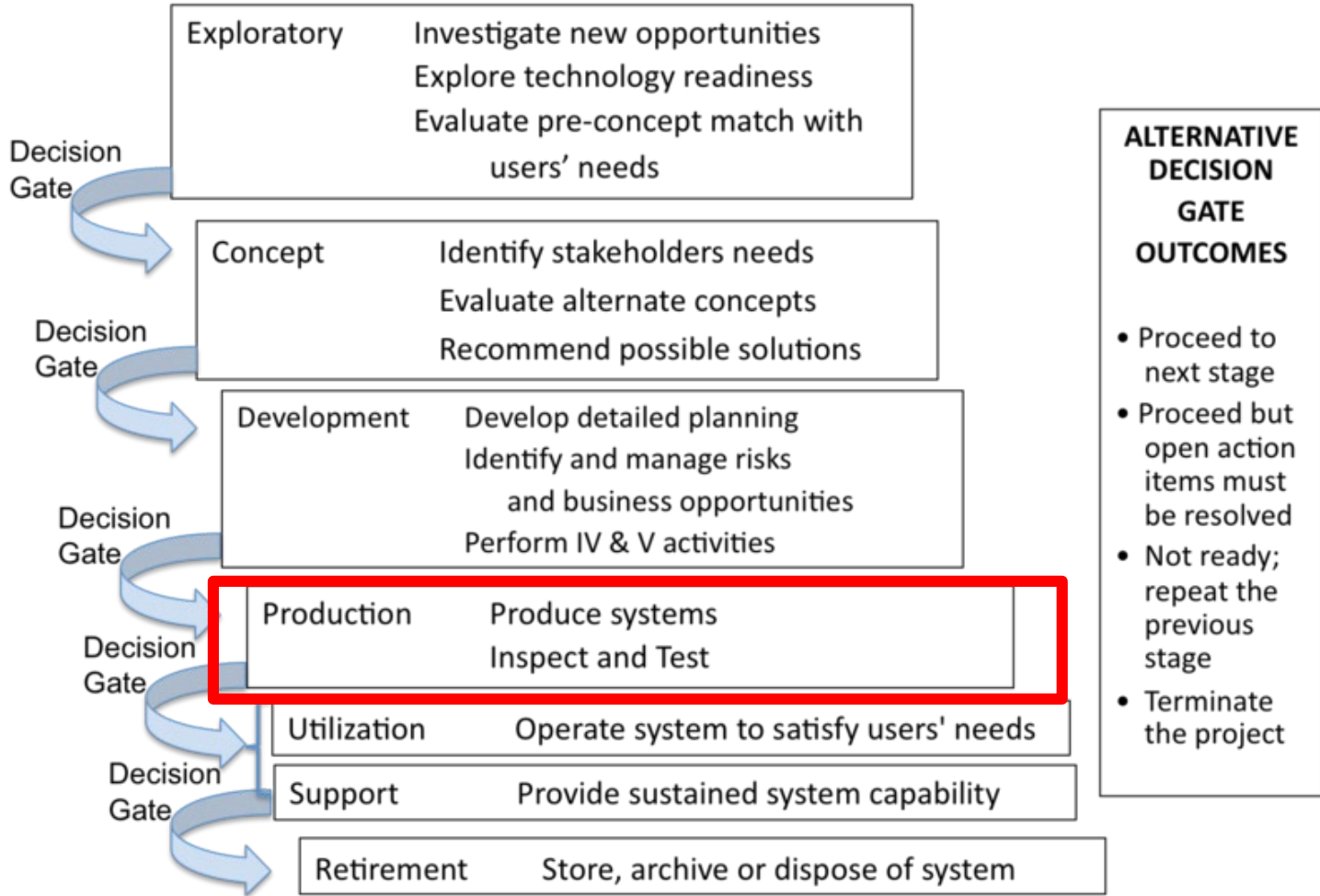
Production and Logistics Modeling Drivers

- 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?

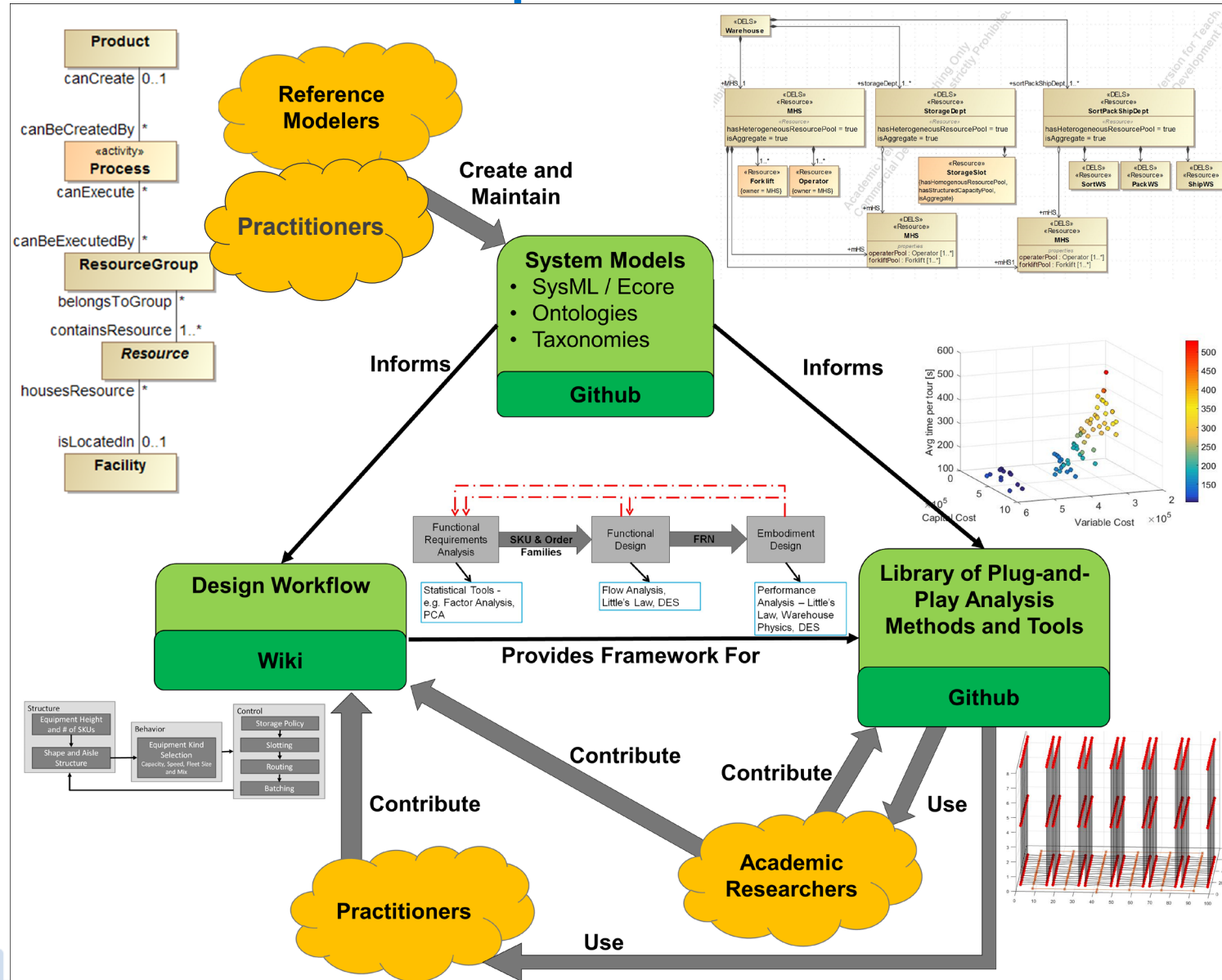
Life Cycle Stages



http://sebokwiki.org/wiki/System_Life_Cycle_Process_Models:_Vee



Mechanisms for development collaboration





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:

<http://www.omgwiki.org/MBSE/doku.php?id=mbse:prodlog>

Monday @ 1:00pm in Pier 10

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