2022 Annual INCOSE international workshop
HYBRID EVENT
Torrance, CA, USA
Jan 29 - Feb 1, 2022

Premier Systems Engineering Workshop

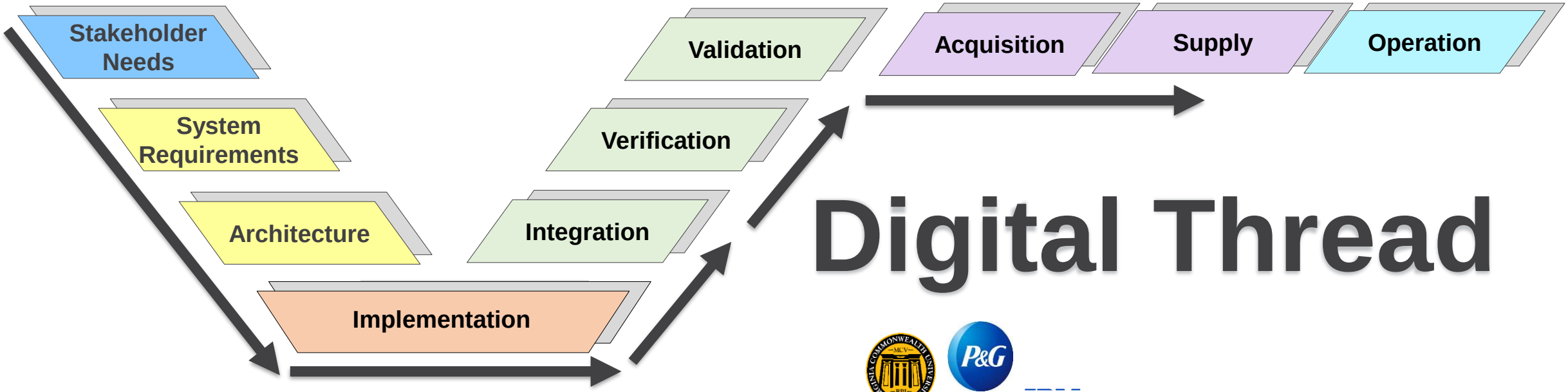
Uber for MBSE

www.incose.org/iw2022/

www.OccamSystemsInc.com / Bob@OccamSystemsInc.com

MBSE Lightning Round

Agenda:



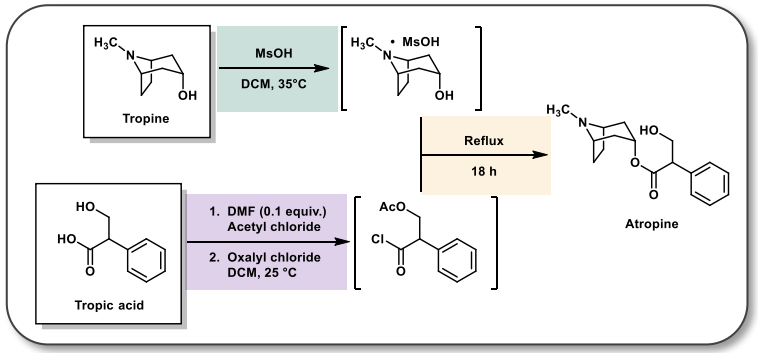
Digital Thread

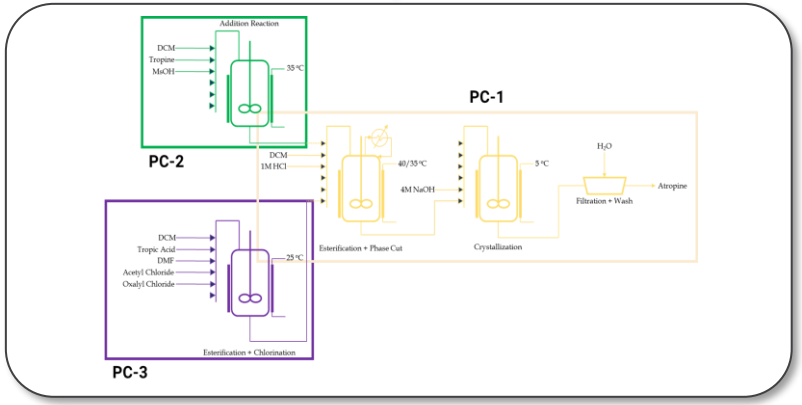
- Problem
- Solution
- Pilot

The problem…

>1300 Strategic Off-Patent API

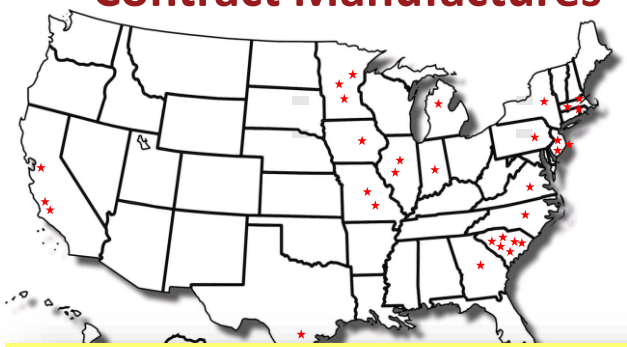
Manufacturing Requirements





?

Contract Manufactures



Contract Manufacturing Organization (CMO)
CMO = cGMP manufacturer

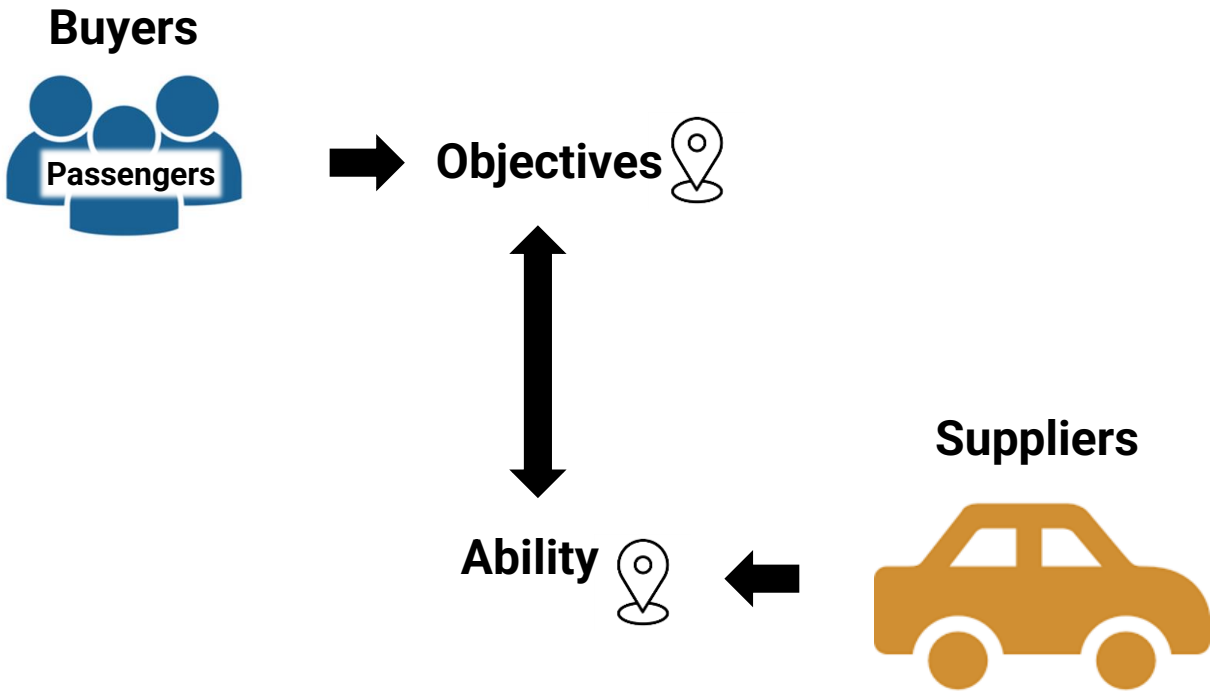
12 CMOs, 27 sites

14 Toll Manufacturers, 23 sites

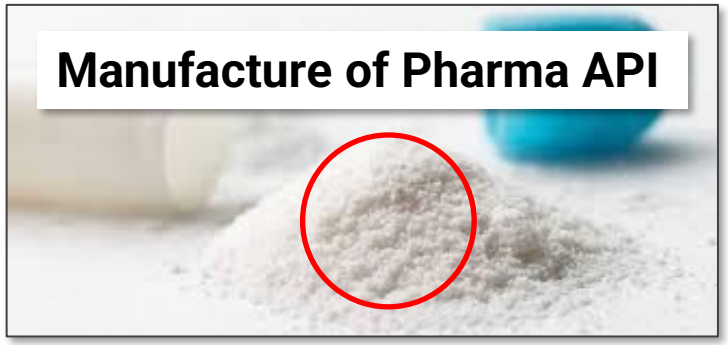
Would an Uber Approach Help?

Uber

Mission: Provide transport solutions that mutually benefit both buyers and suppliers in a rapidly changing environment.



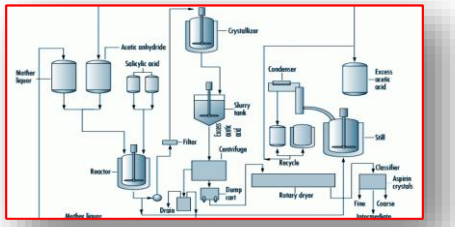
Uber for Chemical Supply Chain

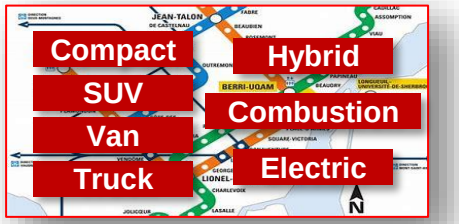


Atropine (antidote); Albuterol (bronchodialator; #10 prescription); Ciprofloxacin (antibiotic); Propofol (anesthetic); Midazolam (anesthetic); Ceftriaxone (antibiotic;part of penicillin/ceflosporin derivatives). Famotidine (antacid); Neostigmine (muscle strengthener; used with atropine); Lisinopril (ACE inhibitor; #1 prescription)

Mission: Provide ~~transport~~ manufacturing solutions that mutually benefit both buyers and suppliers in a rapidly changing environment.

API Synthesis vs **Transportation**





Buyers

DARPA, ASPR, McKESSON, FDA

Objectives

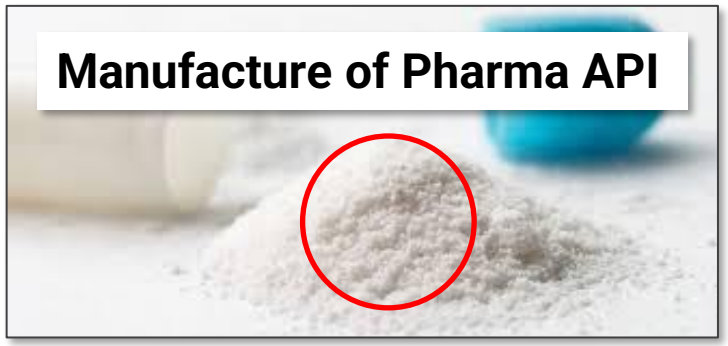
Requirements

Ability

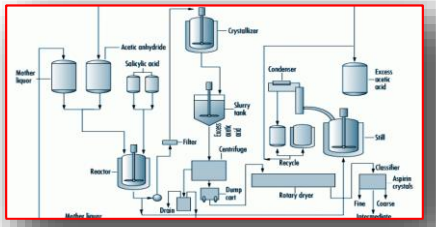
Suppliers

Patheon, JM, SNAPDRAGON CHEMISTRY, Pfizer, CentreOne Contract Manufacturing

Uber for Chemical Supply Chain



Synthetic Path



Buyers

DARPA
ASPR
McKESSON
FDA

Objectives

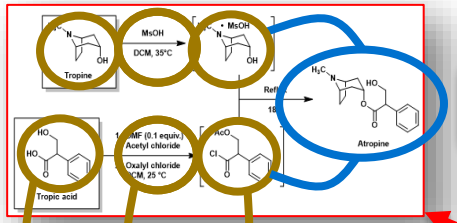
Requirements

Ability

Suppliers

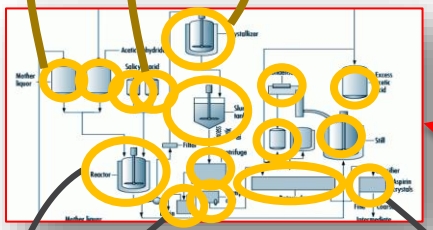
Patheon
JM
SNAPDRAGON CHEMISTRY
Pfizer
CentreOne
Contract Manufacturing

Transformations

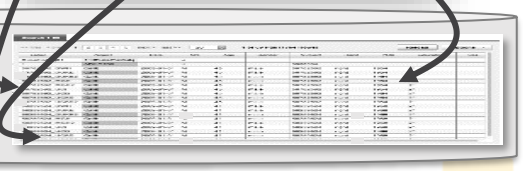


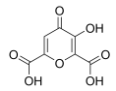
Objective

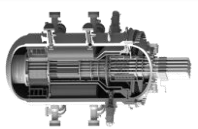
Types of Things

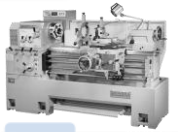


Instances of Things

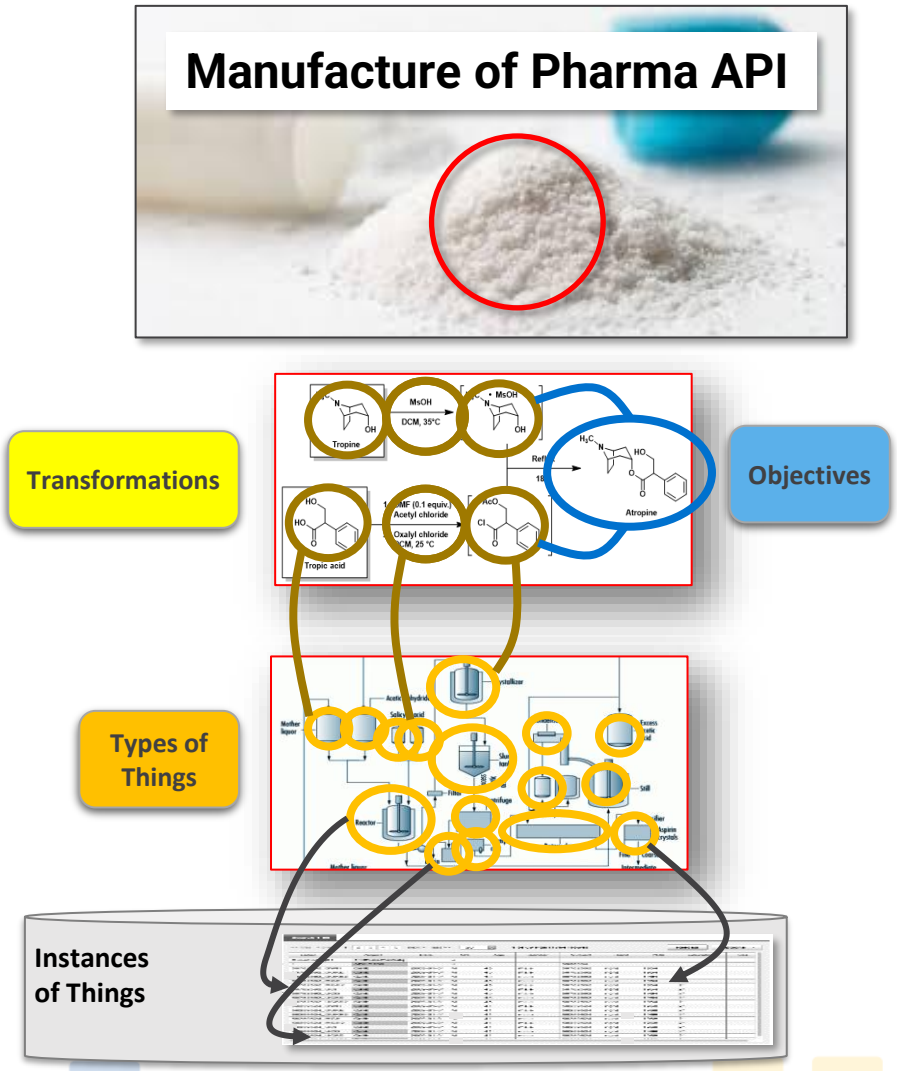






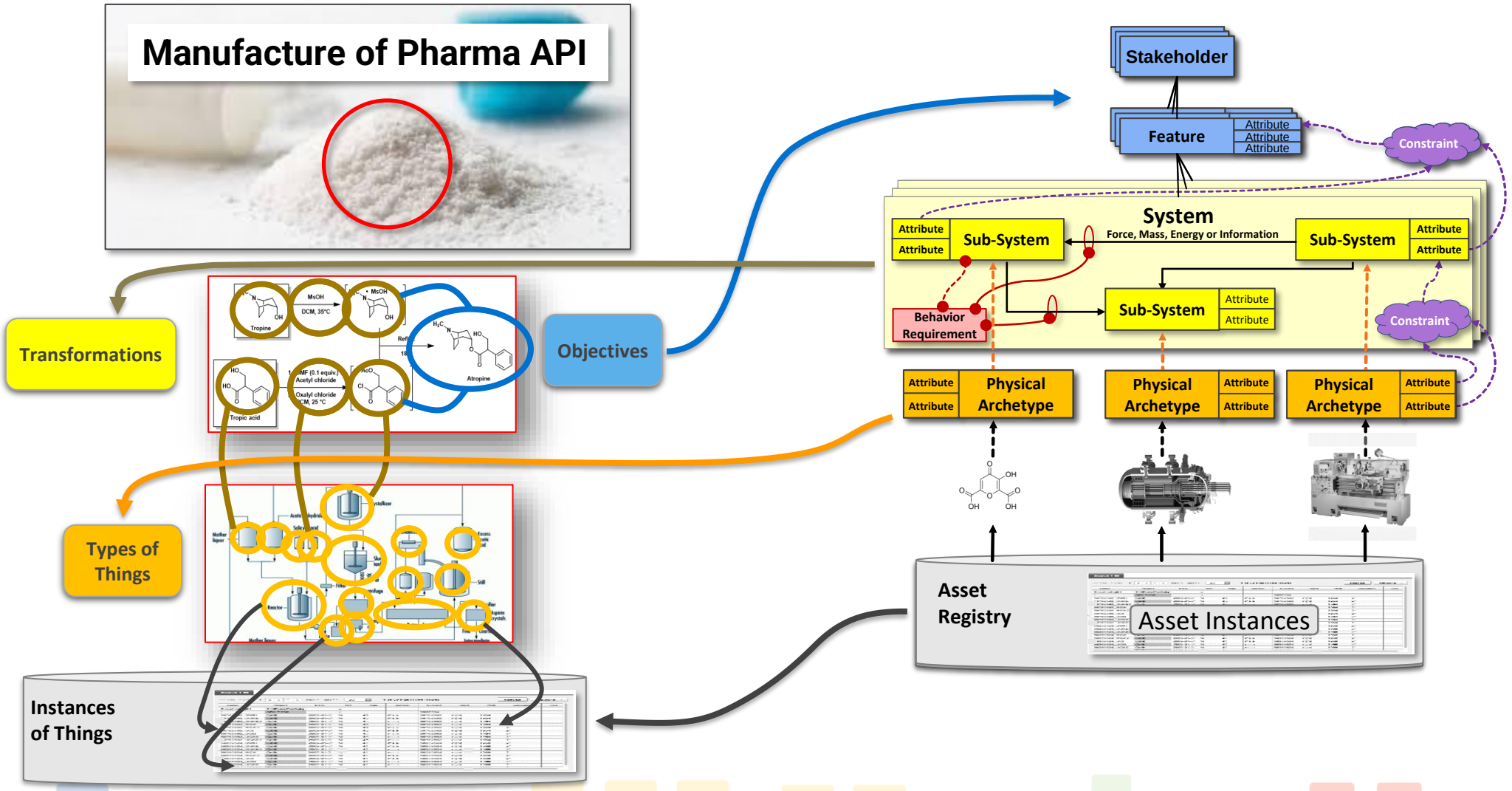


Agenda:

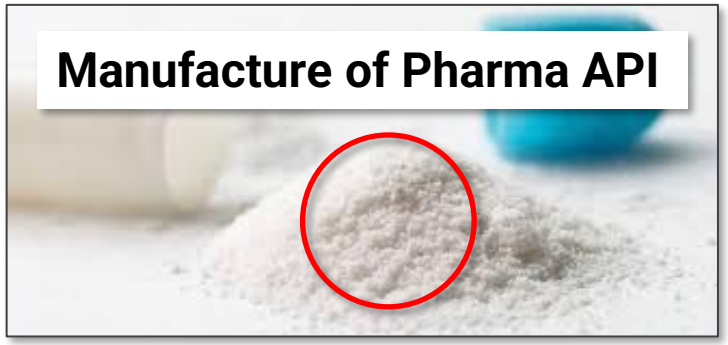


- Problem
- Solution
- Pilot

Minimalistic, Formal “Systems Model”



Minimalistic, Formal "Systems Model"



Transformations

Objectives

Types of Things

Instances of Things

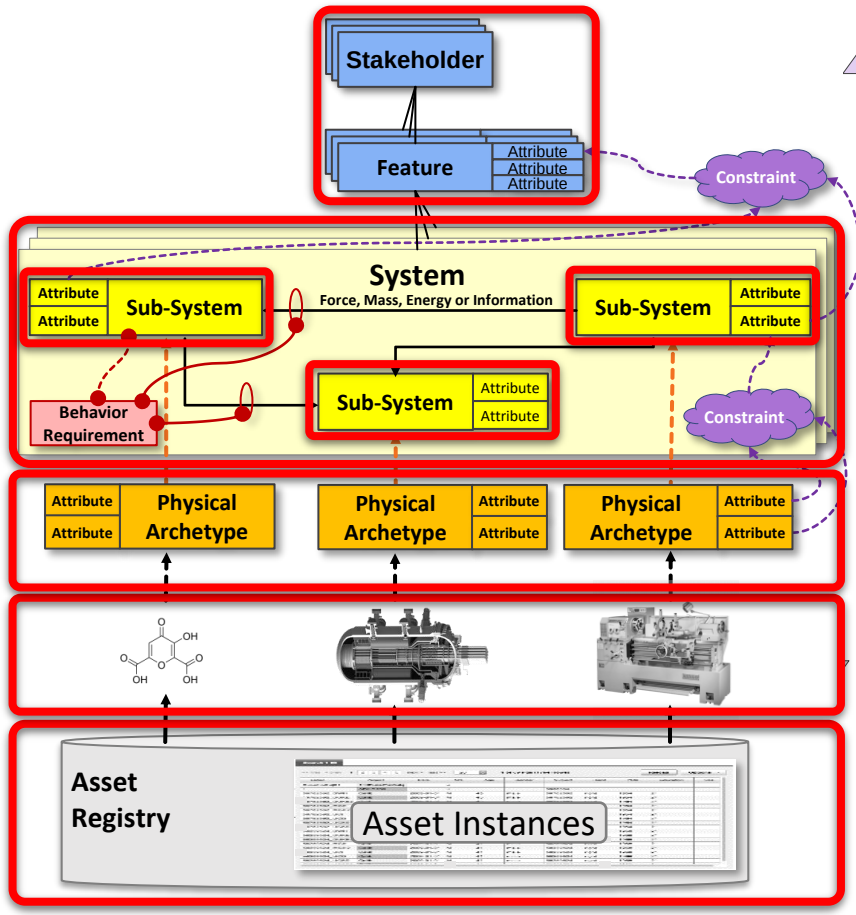
Manufacturer	U.S. Sites / Locations
Albemarle Fine Chemistry Services	2 / MI, PA
AMPAC Fine Chemicals (AFC)	3 / CA, TX, VA
Patheon	3 / SC*
Seqens PCI Synthesis	1 / MA
Sterling Pharma Solutions	2 / NC, WI
Pfizer CentreOne	Multiple / MI*
Snapdragon Chemistry	1 / MA
Johnson Matthey Ph	1 / MA
Abbvie	1 / IL
Evonik	1 / IN*
Millipore Sigma	3 / MO, WI
Lonza	1 / NJ
AMRI	5 / IL, MO, NY, WI
Bachem Americas	2 / CA
Cambrex	1 / IA
Recro Gainesville	1 / GA
Regis Technologies	1 / IL
Siegfried	1 / NJ
Ortec	3 / SC
Hovione New Jersey	1 / NJ

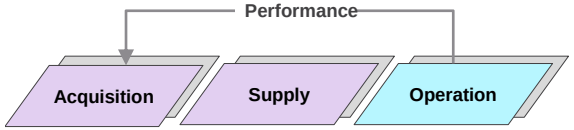
Best estimate:
50-60% of US CMO sites
(non-domestic CMOs excluded)

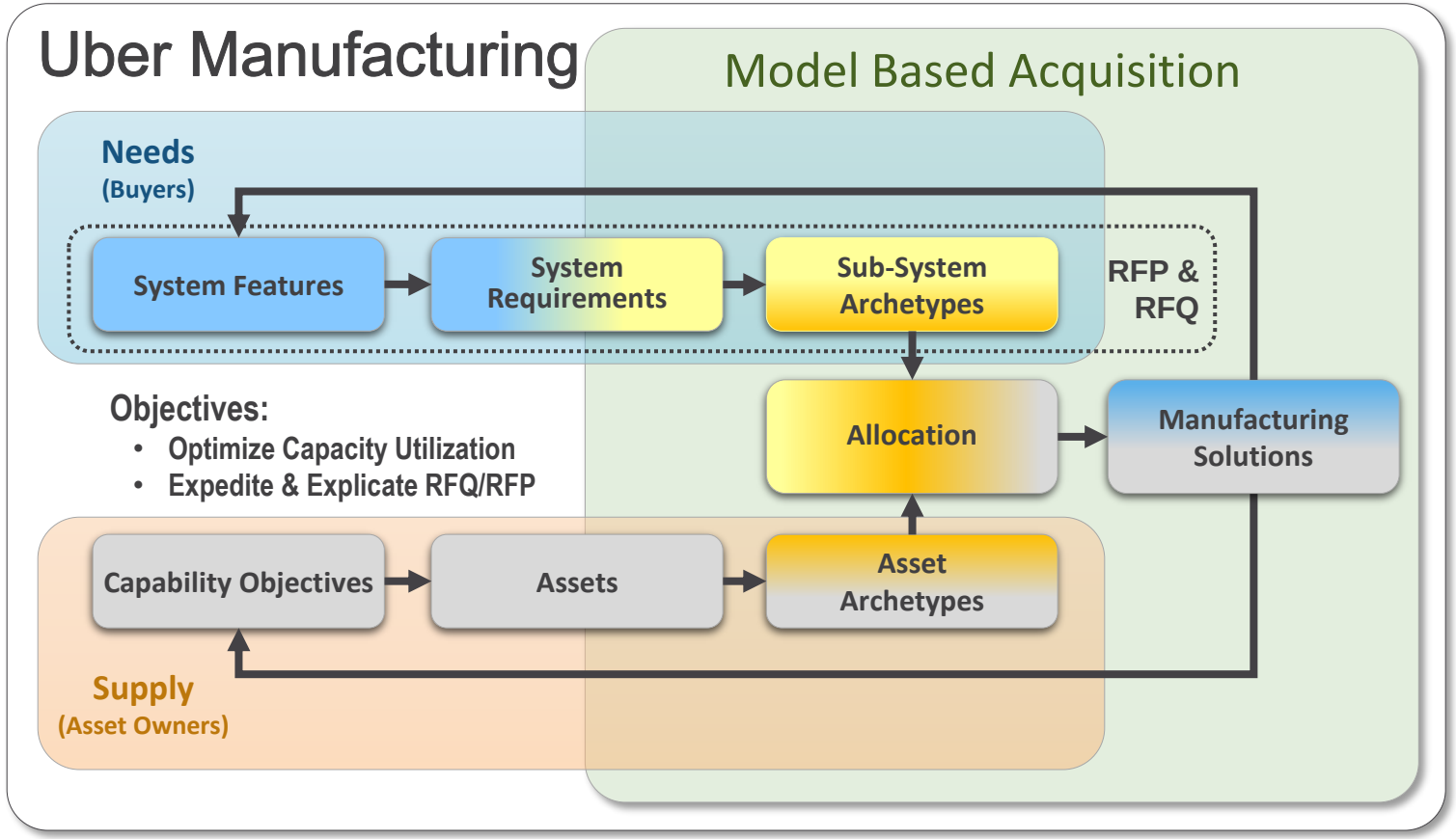
Asset Registry

Asset Instances

Minimalistic Solution “Activity System”



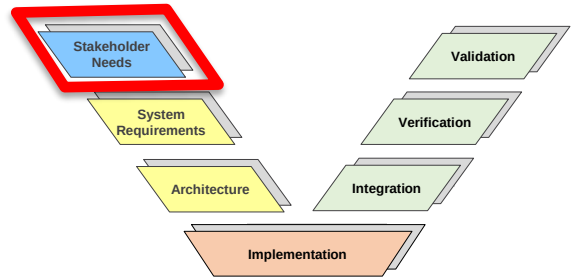




Agenda:

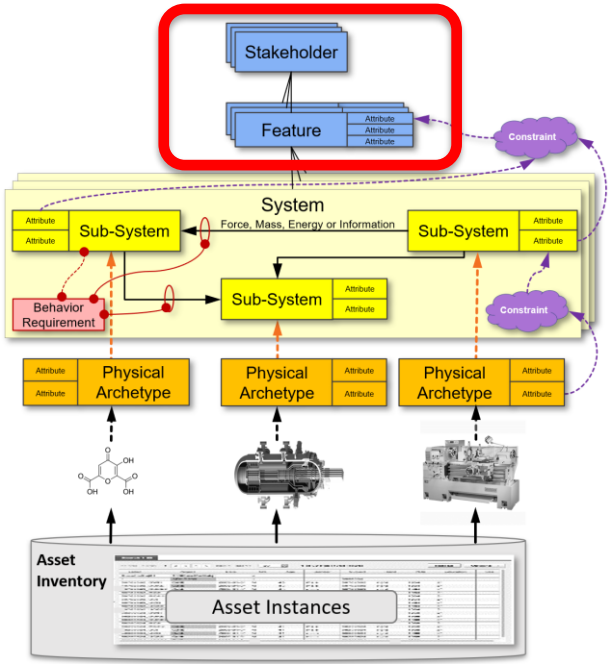
- Problem
- Solution
- Pilot

Translate Objectives to Systems Model

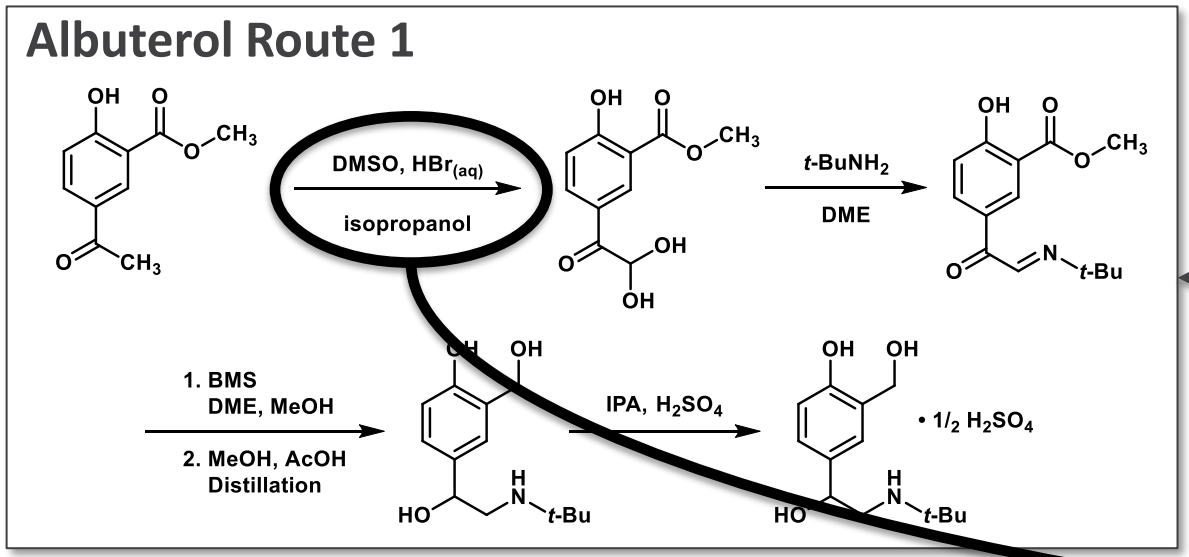


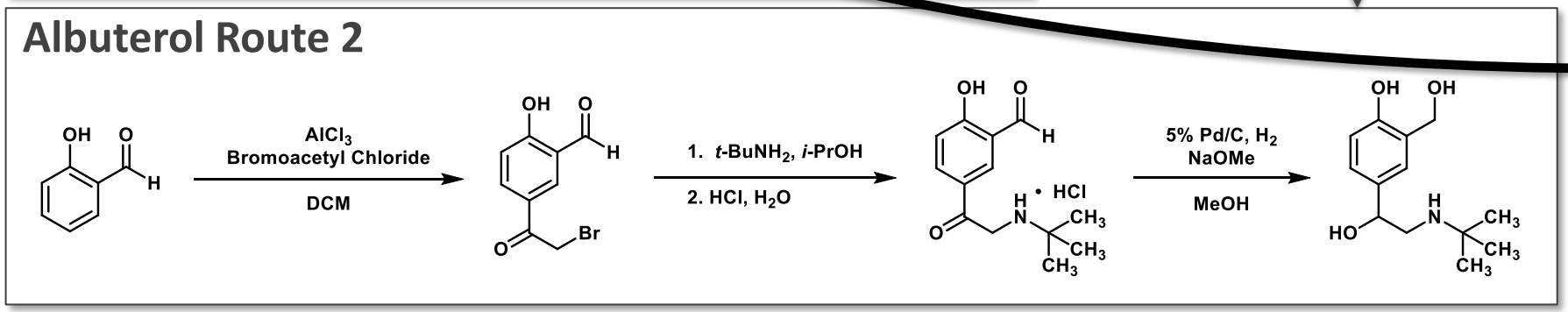
System Features:

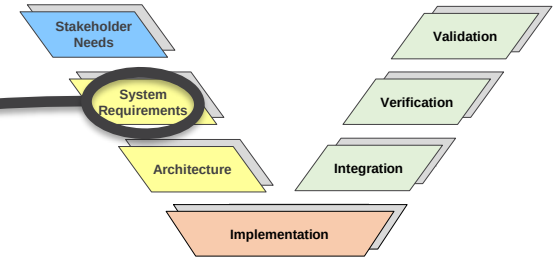
- xx,xxx KG(n) of API(n) over time(n)
- API(n) may not use manufactures in region X or Y
- Minimize cost of API(n)
- API(n) Must use “> x site” and “> y supplier”



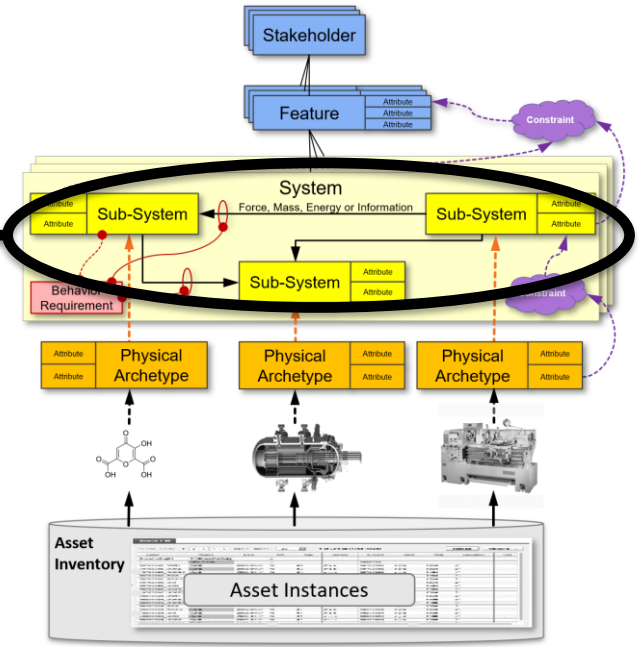
System Requirements



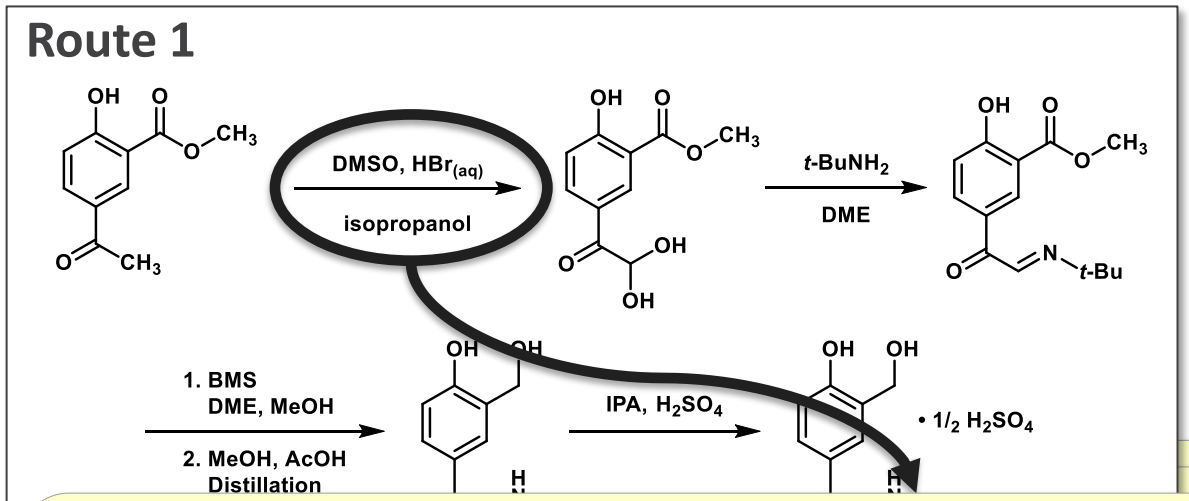


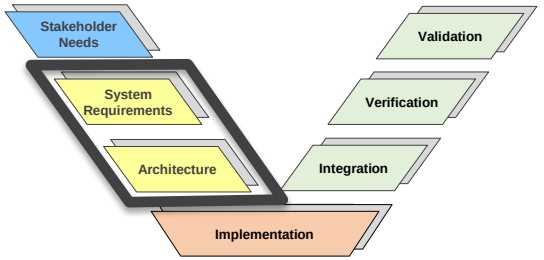


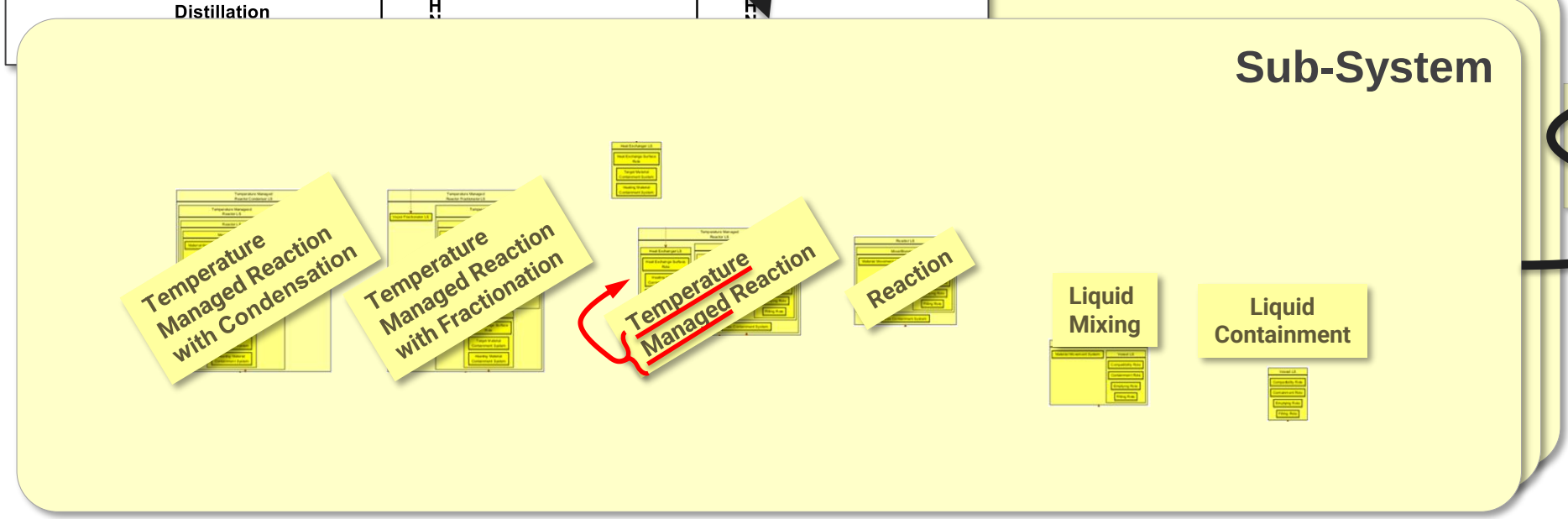
?

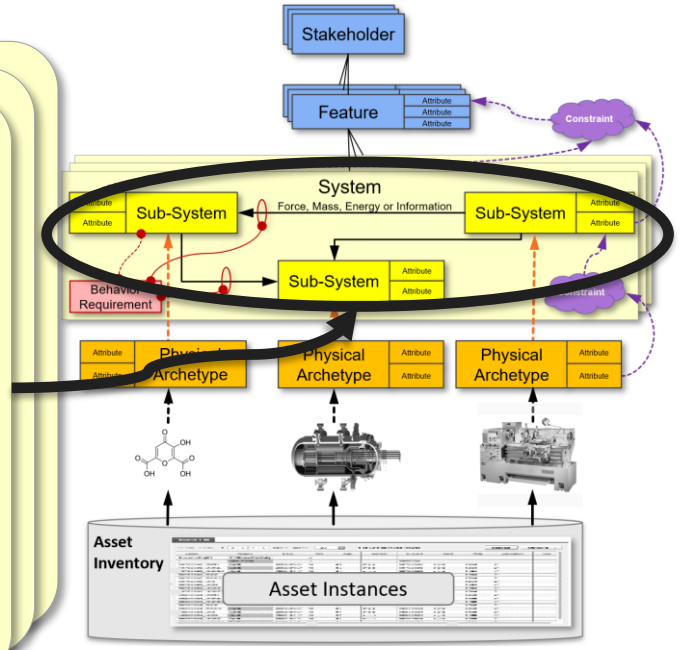


Decomposition to Functional Archetypes

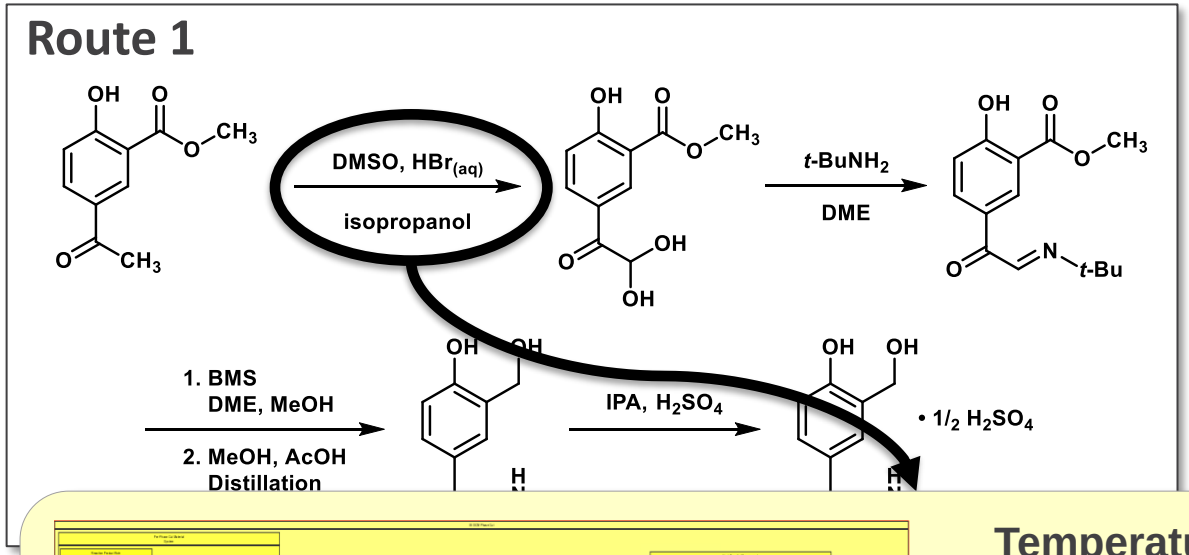


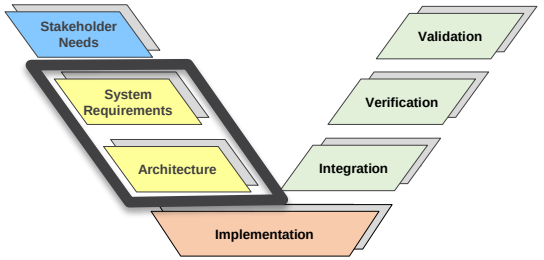


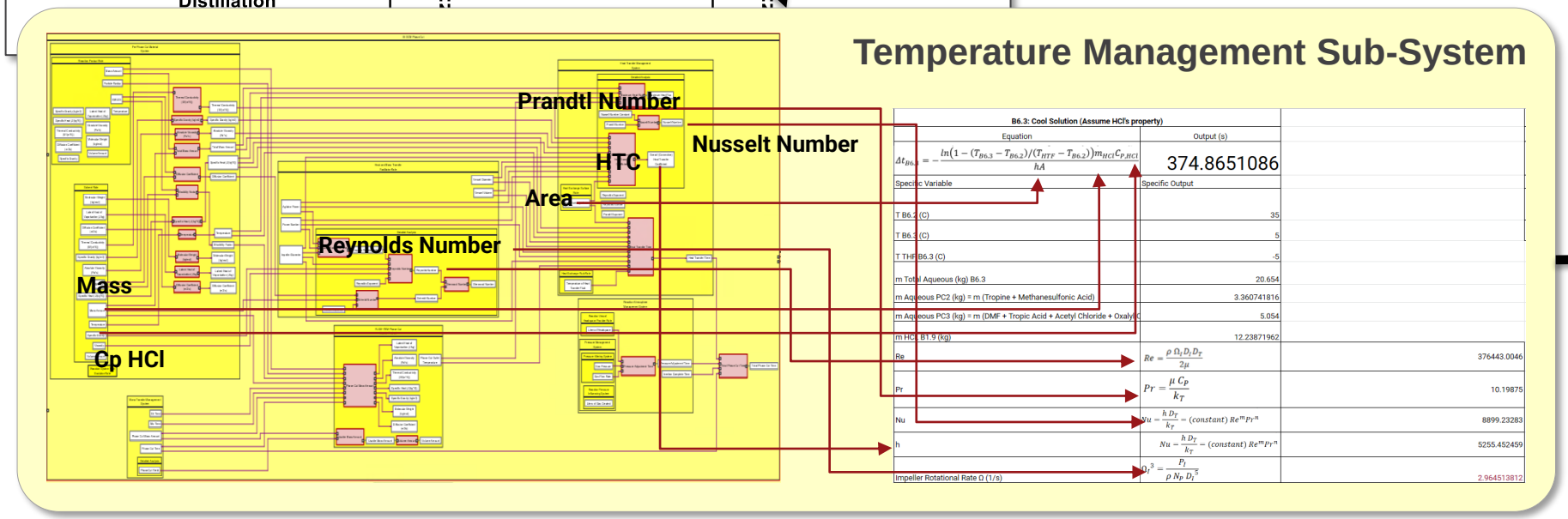


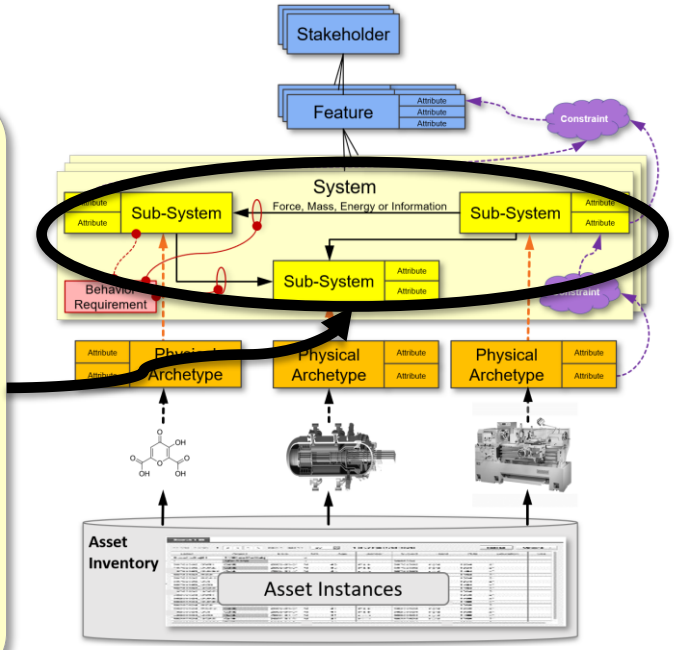


Functional Archetypes Encode Knowledge

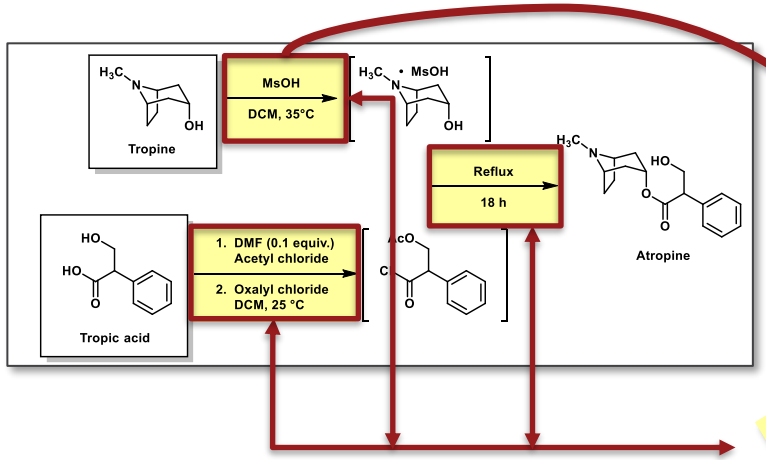


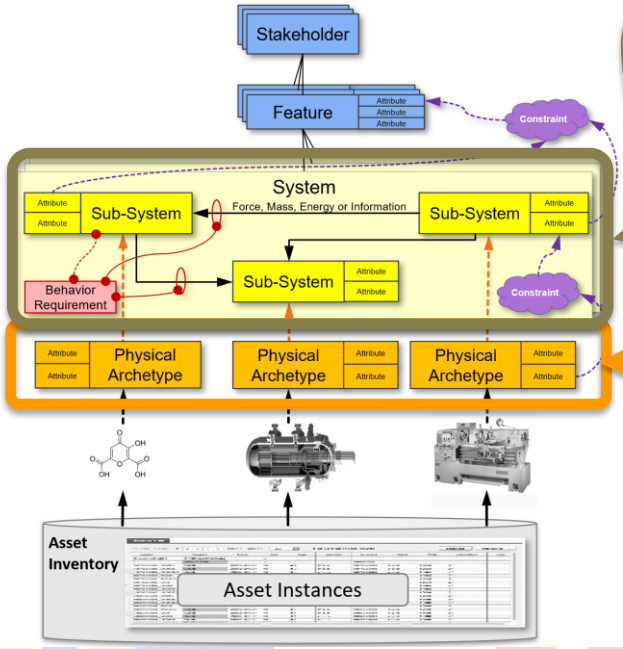


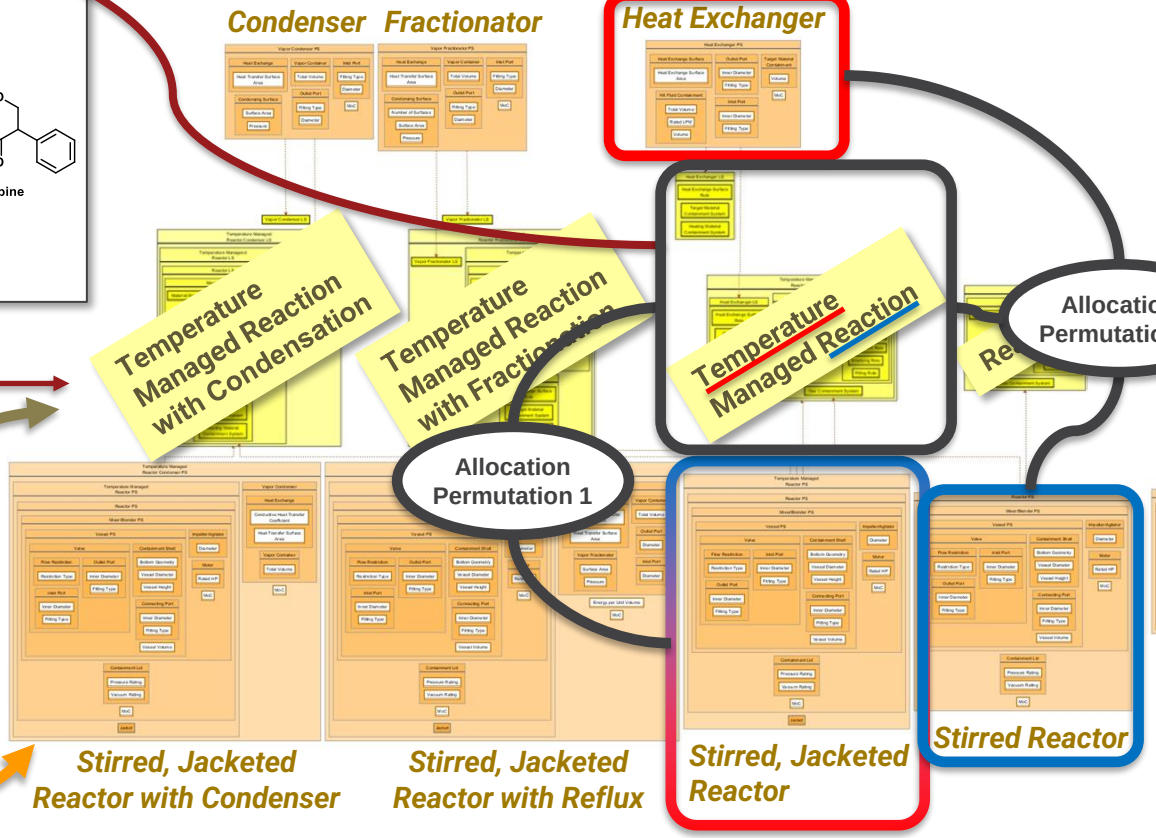


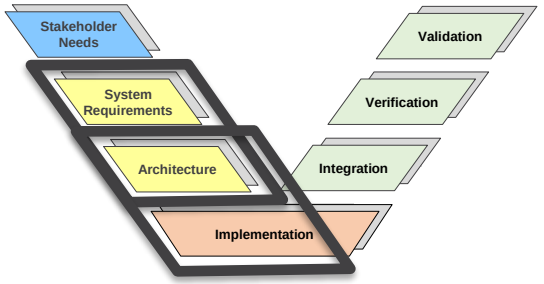


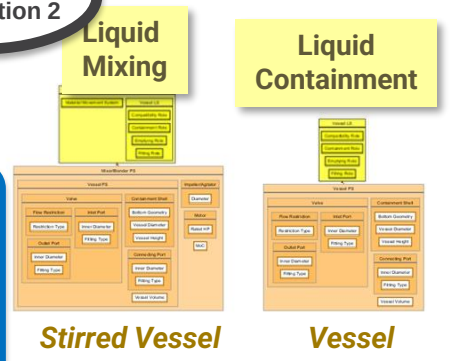
Allocatable Physical Archetypes

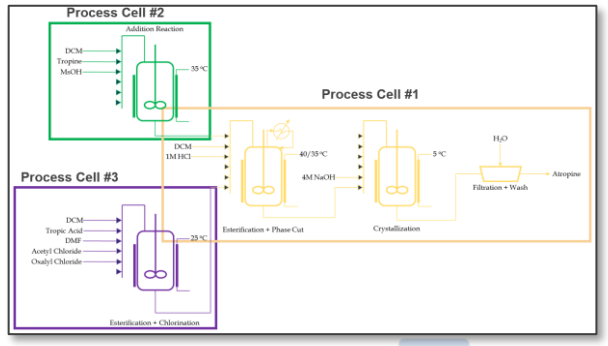




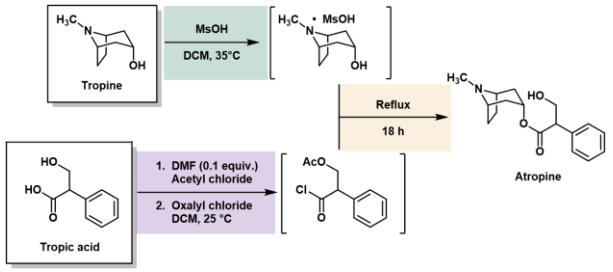




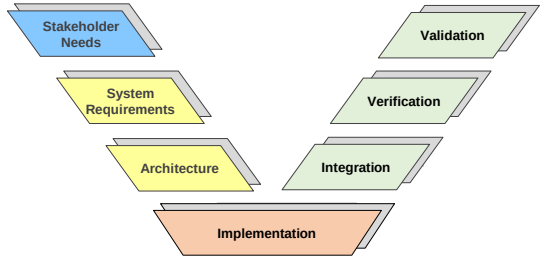


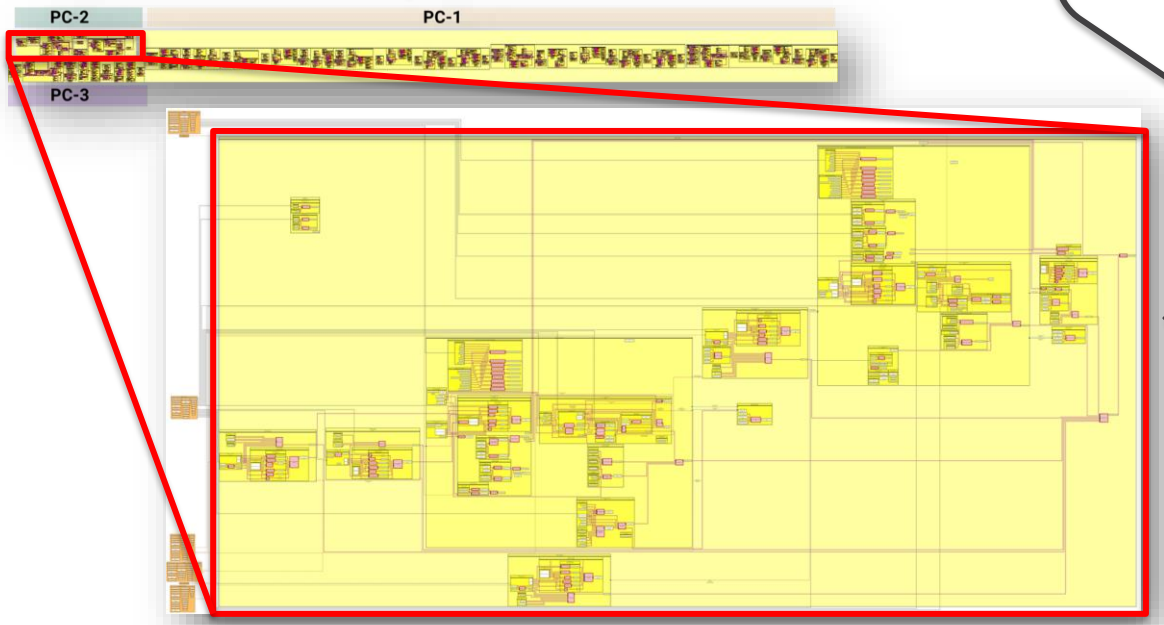


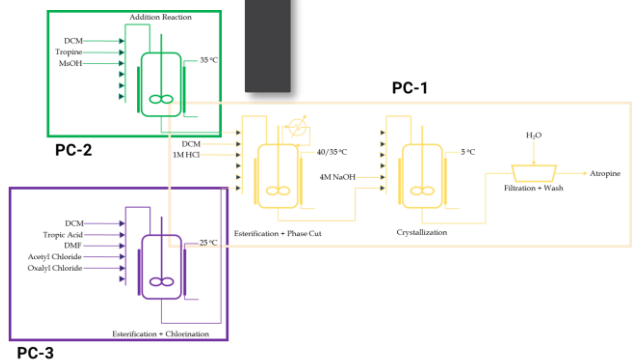
The Manufacturing System is Complex



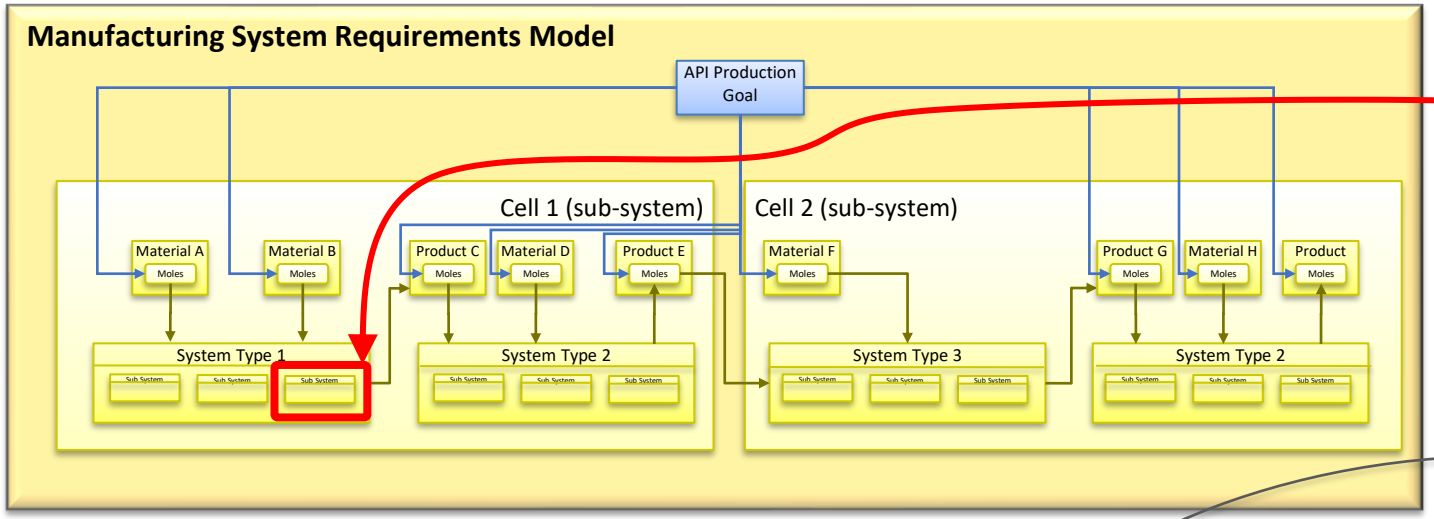
One solution:
System model size
> 5,000 nodes

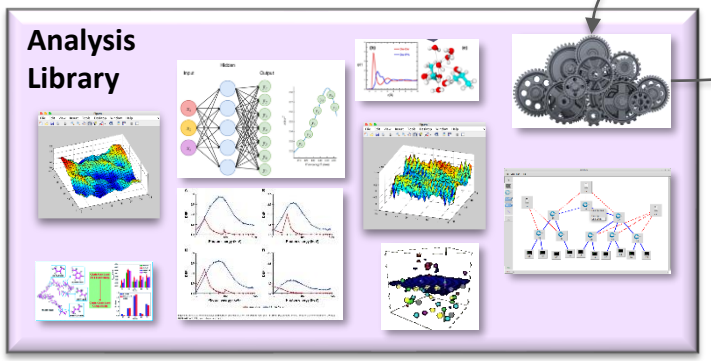


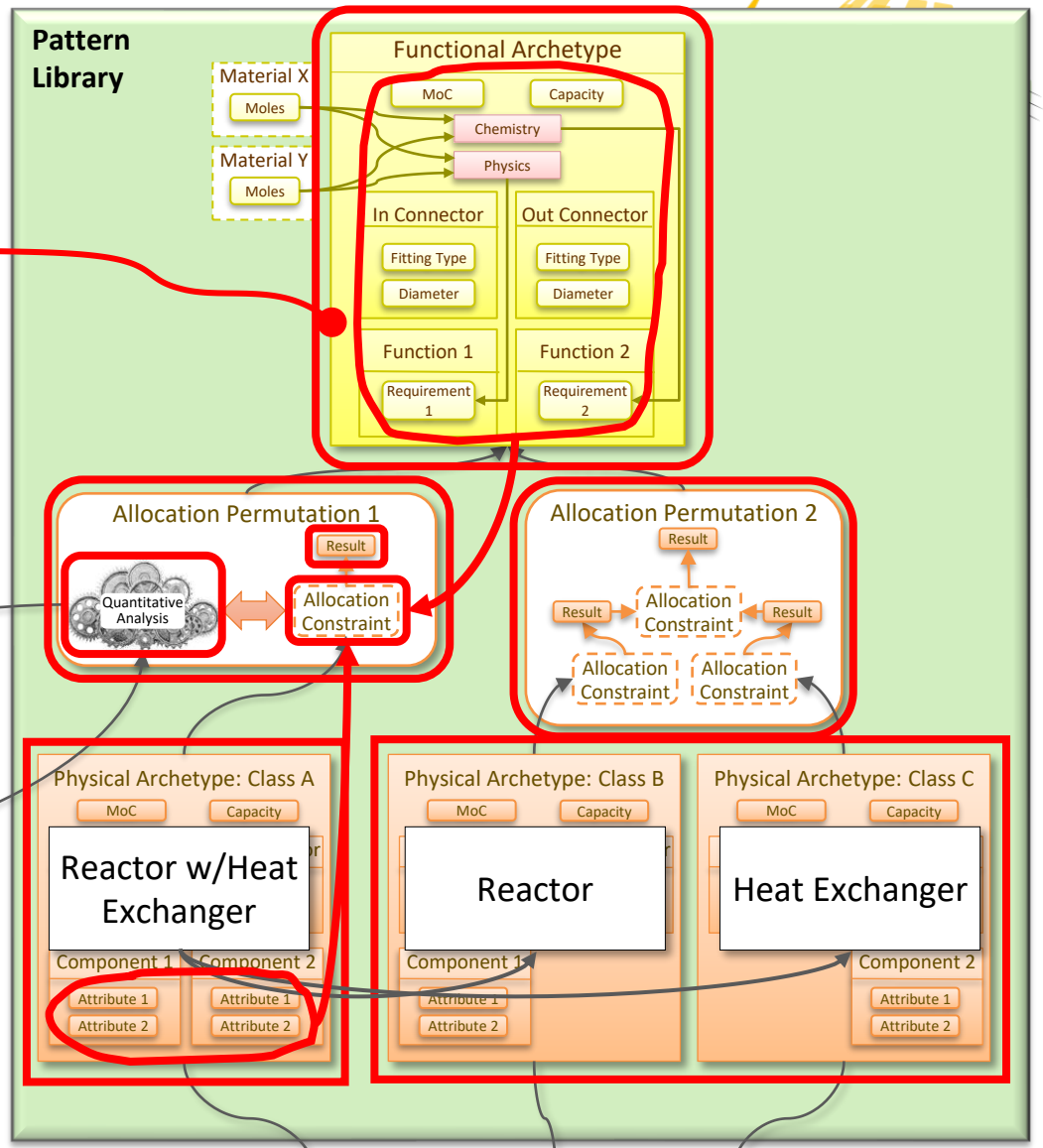


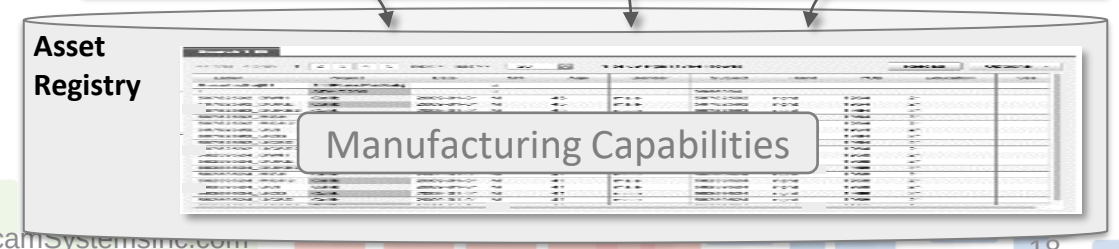


Putting it all together…

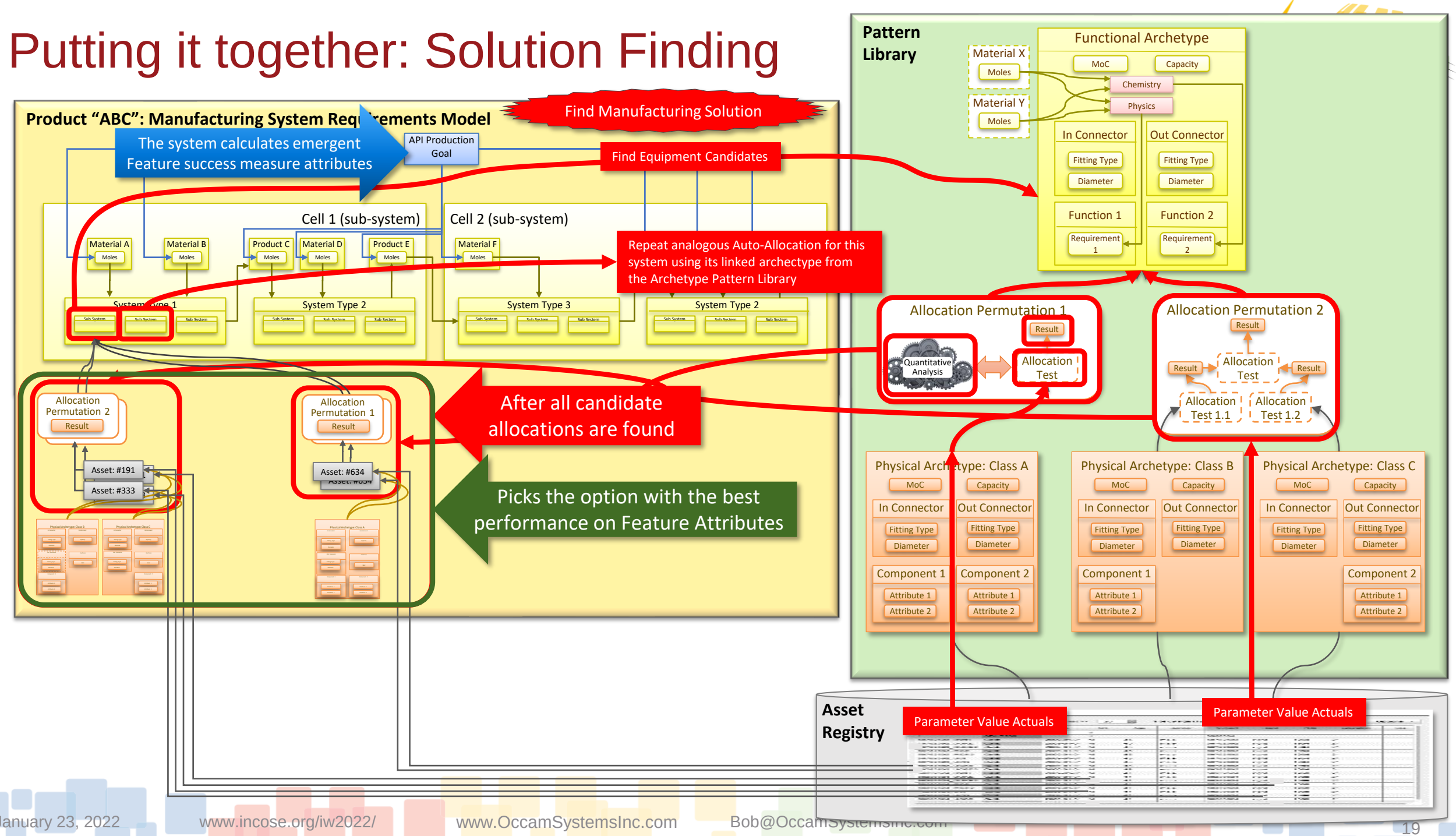




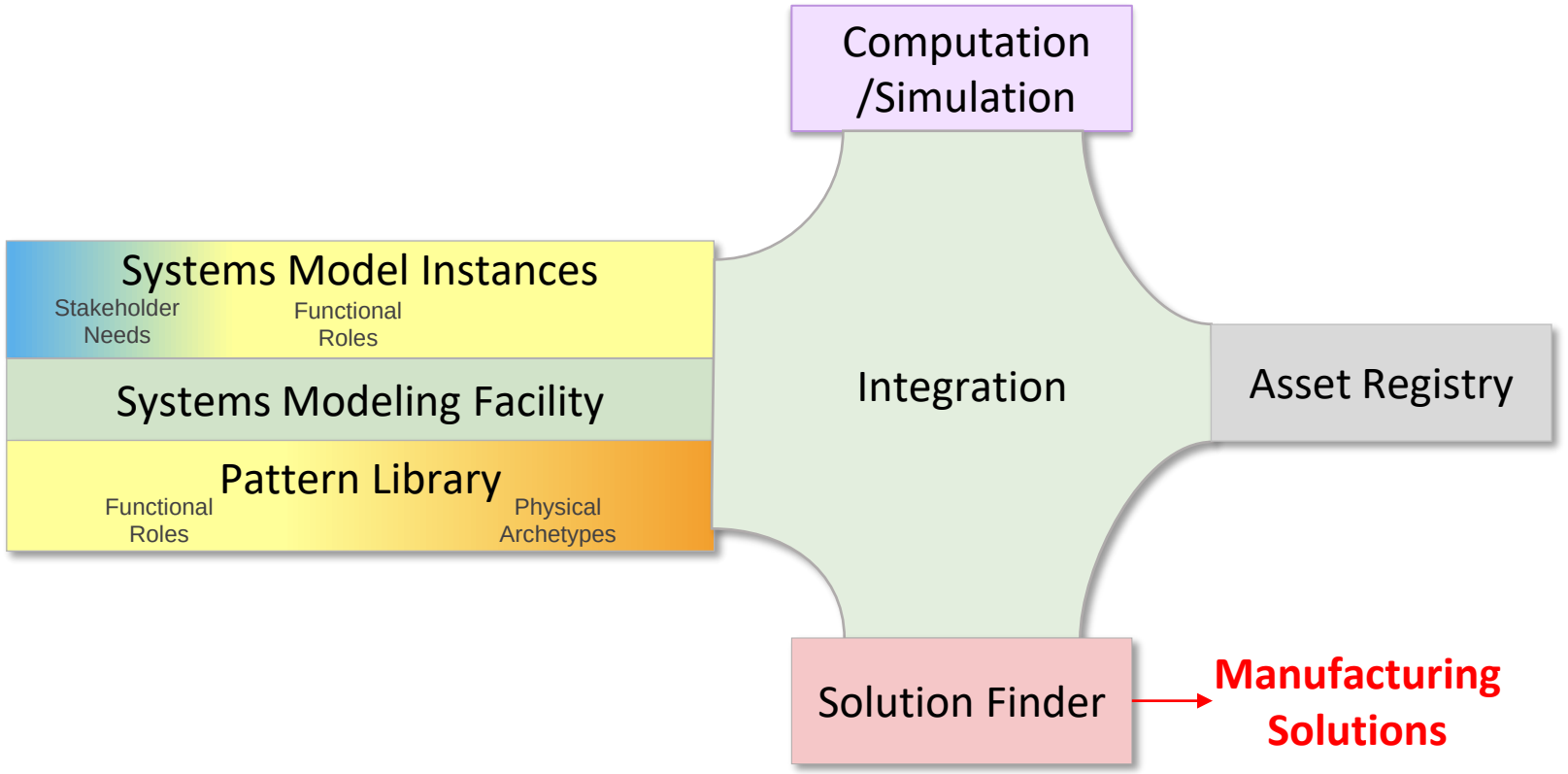




Putting it together: Solution Finding



Summary


Computation /Simulation
Systems Model Instances
Stakeholder Needs
Functional Roles
Systems Modeling Facility
Pattern Library
Functional Roles
Physical Archetypes
Integration
Asset Registry
Solution Finder
Manufacturing Solutions

Next Steps

- “Occam Systems Incorporated” to commercialize the solution
  - Simplify the modeling method
  - Improve model integrity checking
  - Re-platform to completely cloud infrastructure
- Seeking new pilots beyond chemistry
  - Verify extensibility of:
    - Business case
    - Method & automation
  - Increase the types of manufacturers in the Asset Registry

Questions?

www.incose.org/iw2022/

MBSE Lightning Round