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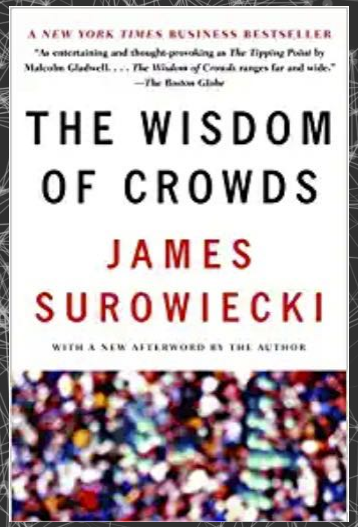
# The Power of Connections in a Digital Asset Exchange

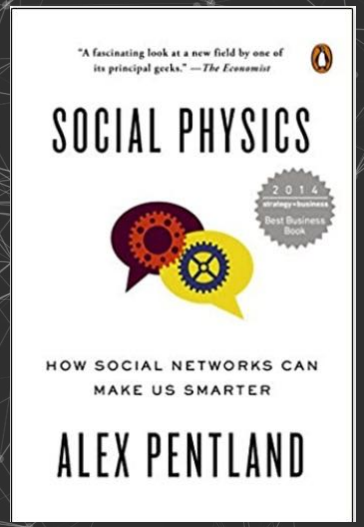
Mark Petrotta, System Strategy Inc (SSI)
Troy Peterson, System Strategy Inc (SSI)

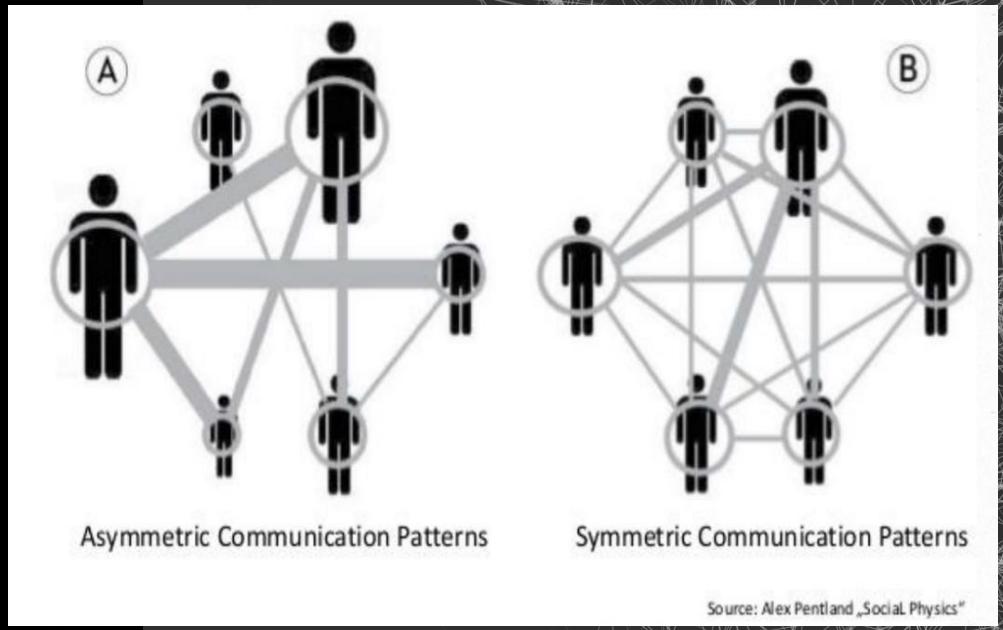
www.incose.org/symp2022

**Jarvis:**
Tell me the probability of failure on Mark 85 after 10 air combat missions?

# CONNECTIVITY



# CONNECTIVITY

We need an expansive exchange network

Connecting people and knowledge...

Engineers and digital assets...

...Internet level scalability and portability

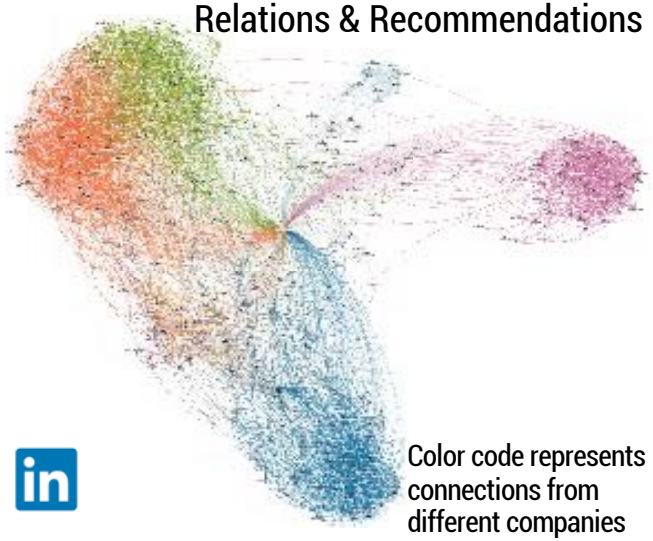
Human and machine collaboration

Appropriate contextualization for reuse

Broad stakeholder engagement...

# Connectivity in Exchange Networks

## Relations & Recommendations

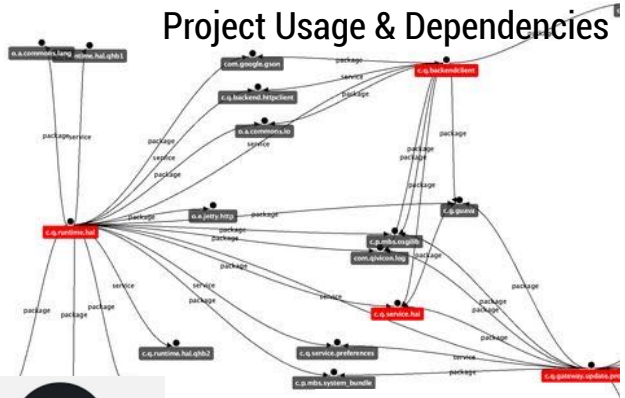


Color code represents connections from different companies

## Views, Reviews, Purchases

amazon

## Project Usage & Dependencies

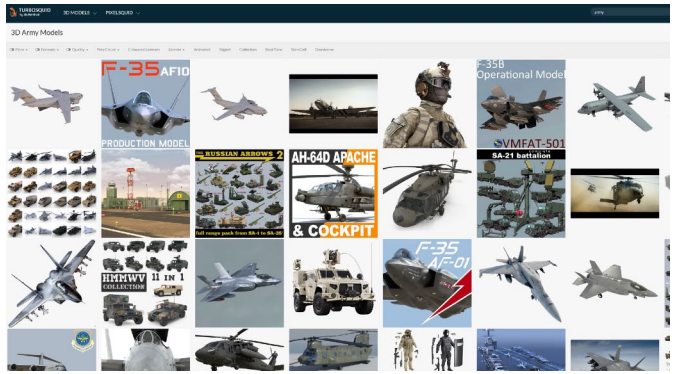


GitHub

git

## Open Source CAD Models

TURBOSQUID by shutterstock

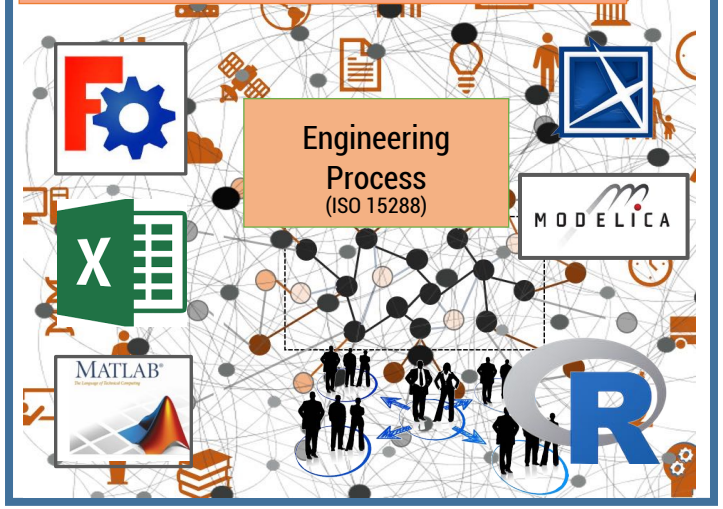


## Why participate?

## Why are these systems successful?

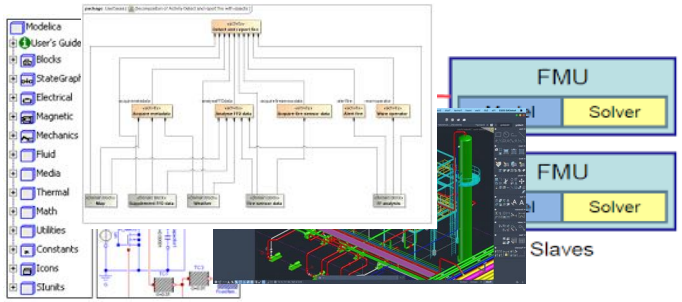
## What would this look like in the Digital Engineering community?

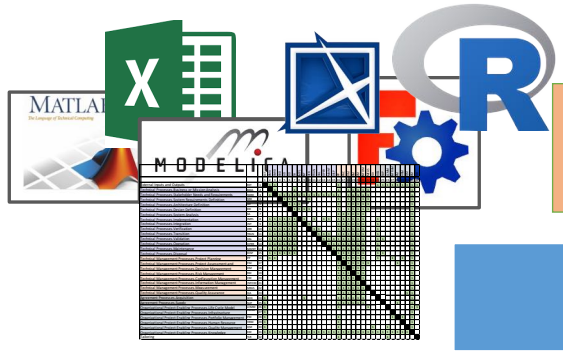
## Digital Asset Exchange (DAX)



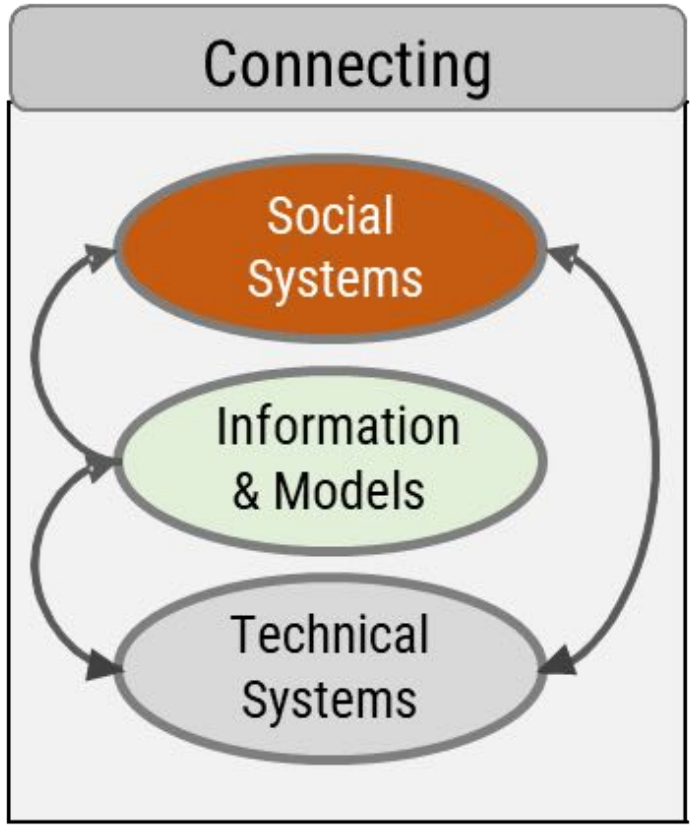
# Digital Asset Exchange (DAX)

*DAX: the reinforcing loop of an accessible model ecosystem with openly available trust, reliability, and suitability for use*




Engineering Process (ISO 15288)




Trust, cooperation, and robustness properties of the person-to-person network

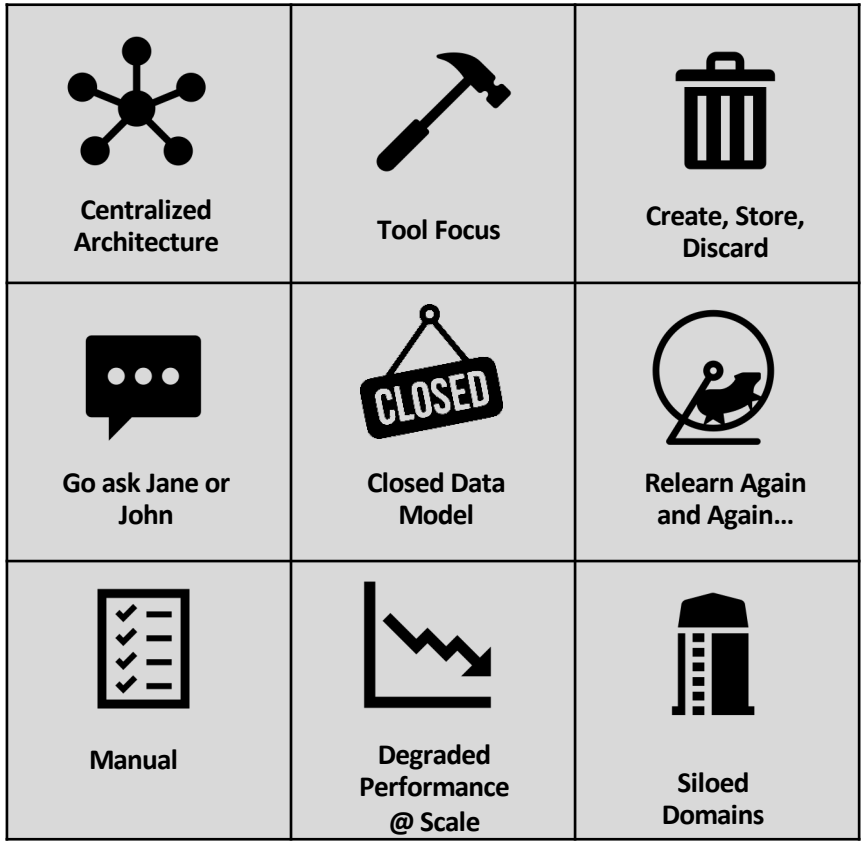
Digital assets curated for reuse and organizational benefit

Tools, processes, and technology that enable discovery and connection of reliable information

**DAX > Social + Models + Technical Systems**

# OBSTACLES

# Obstacles to Connectivity: A Brief Survey

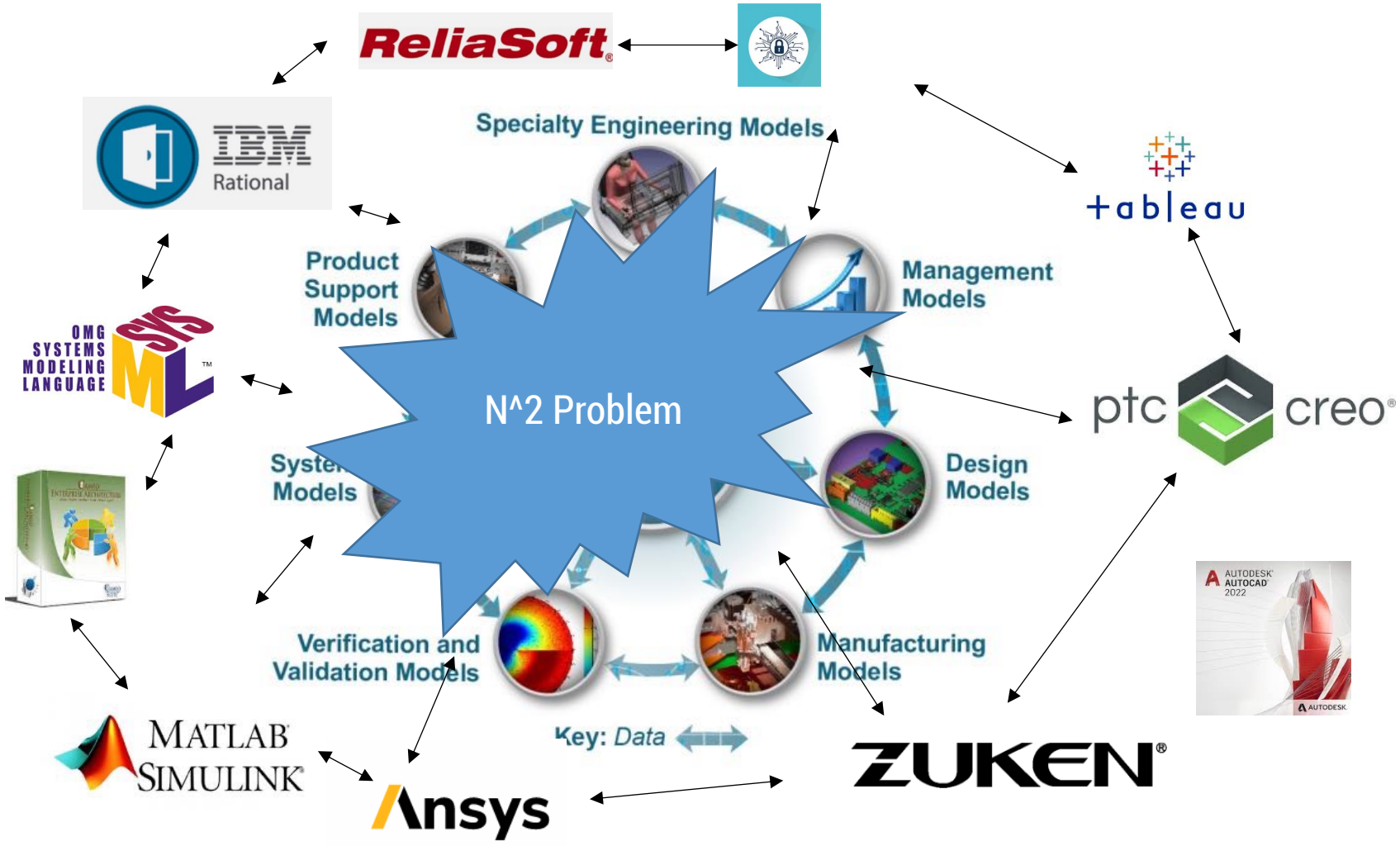



From “9 Key observations in DE implementation through our support to the DoD, industry, and academia”

SSI informal survey and assessment, 2021

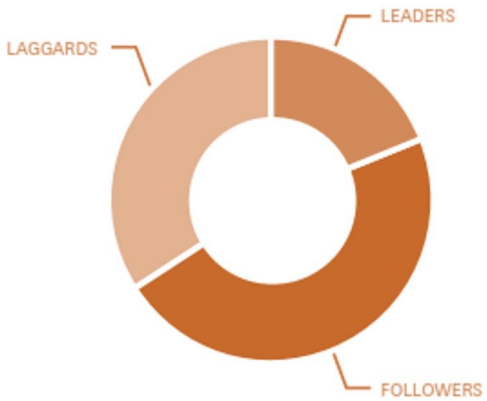
# Obstacles: Tools and Languages

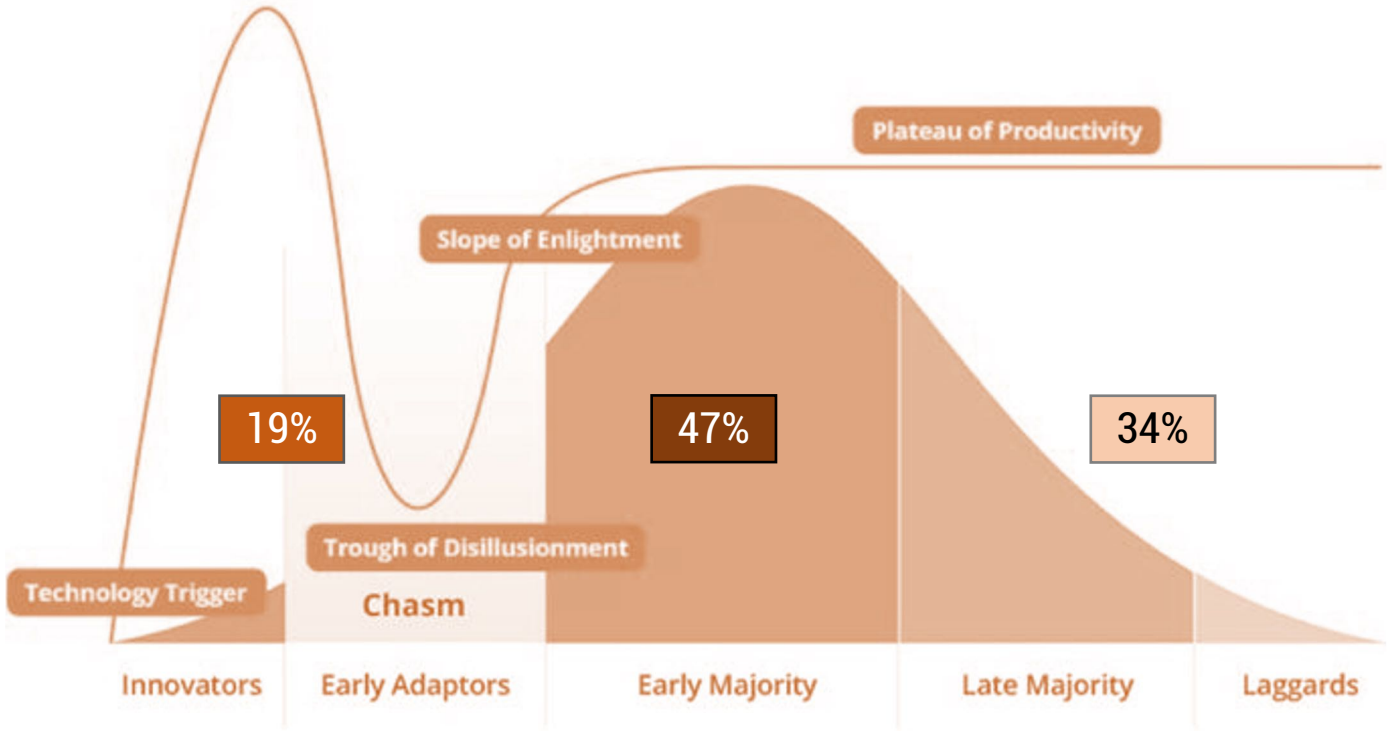
Connectivity between models in Model Based Systems Engineering (MBSE) and Digital Engineering (DE) ecosystems is most often focused on tools and languages




https://man.fas.org/eprint/digeng-2018.pdf

# Organizational Obstacles




**Rating of company's digital maturity in leadership and management[5]**

More than 80% of respondents are either followers or laggards

Acceleration is very much about sharing, communicating and learning

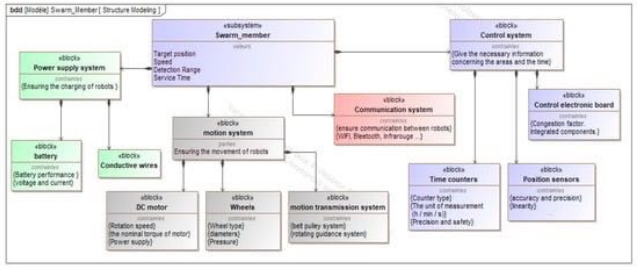
Where would you plot your organization today?

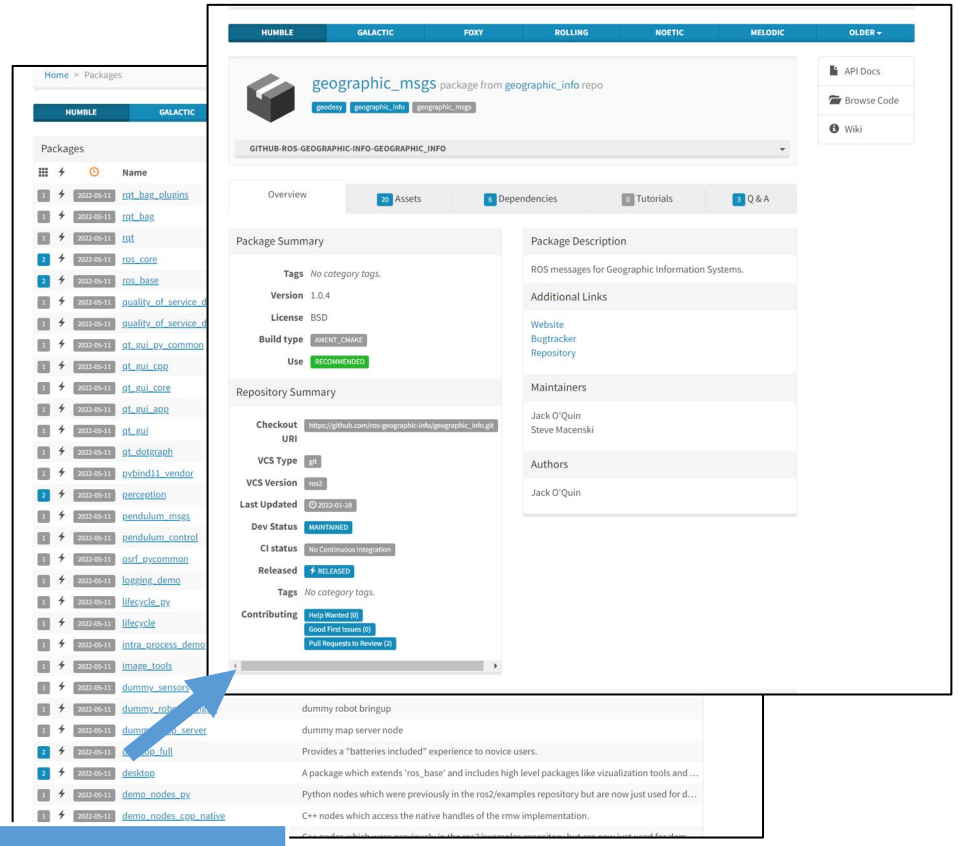
1. Hype Cycle is a branded graphical presentation developed and used by IT research and advisory firm Gartner
2. Hype Cycle Graphic: https://en.wikipedia.org/wiki/Hype_cycle
3. Moore, Geoffrey A. "Crossing the Chasm – and Beyond" Strategic Management of Technology and Innovation Third Edition 1996
4. Hype Cycle, Chasm Combined Graphic: http://www.datameer.com/blog/big-data-analytics-perspectives/big-data-crossing-the-chasm-in-2013.html
5. Driving Digital Transformation: New Skills for Leaders, New Role for the CIO, Harvard Business Review

# Enablers

# Example from Robotics

ROS = plumbing + tools + capabilities + community



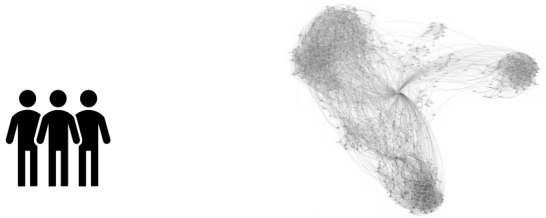


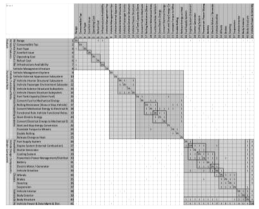

The Robot Operating System (ROS) is a set of software libraries and tools that help you build robot applications. From drivers to state-of-the-art algorithms, and with powerful developer tools, ROS has what you need for your next robotics project. And it's all open source.

Single Domain Value Based Exchange

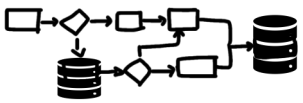
# Enabler: Sociotechnical Connections

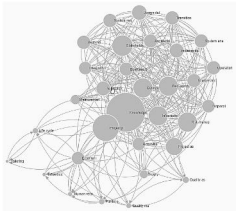
## Organizational Architectures

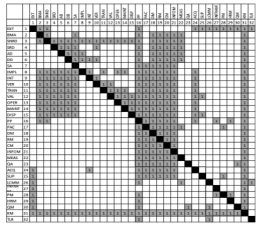




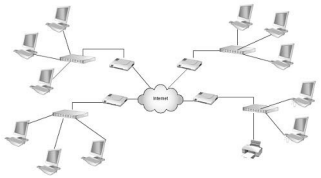
## Development Process Architectures

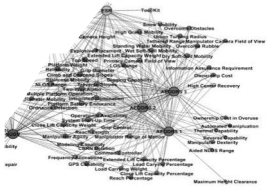


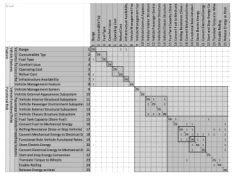




## Information System Architectures

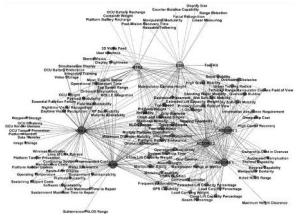


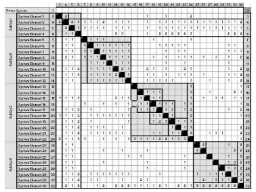


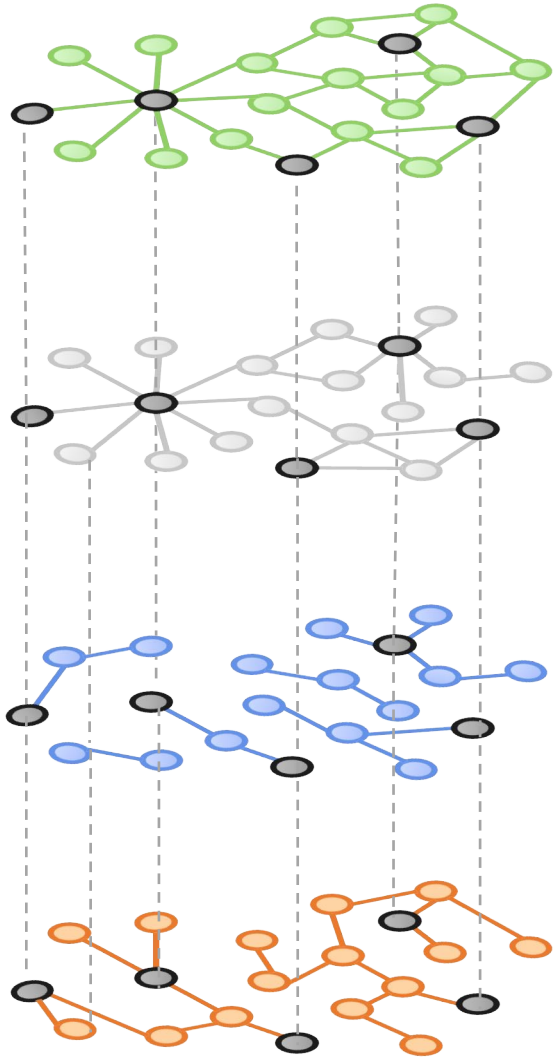


## Target System Architectures

SOI







# Enabler: Reinforcing Loops

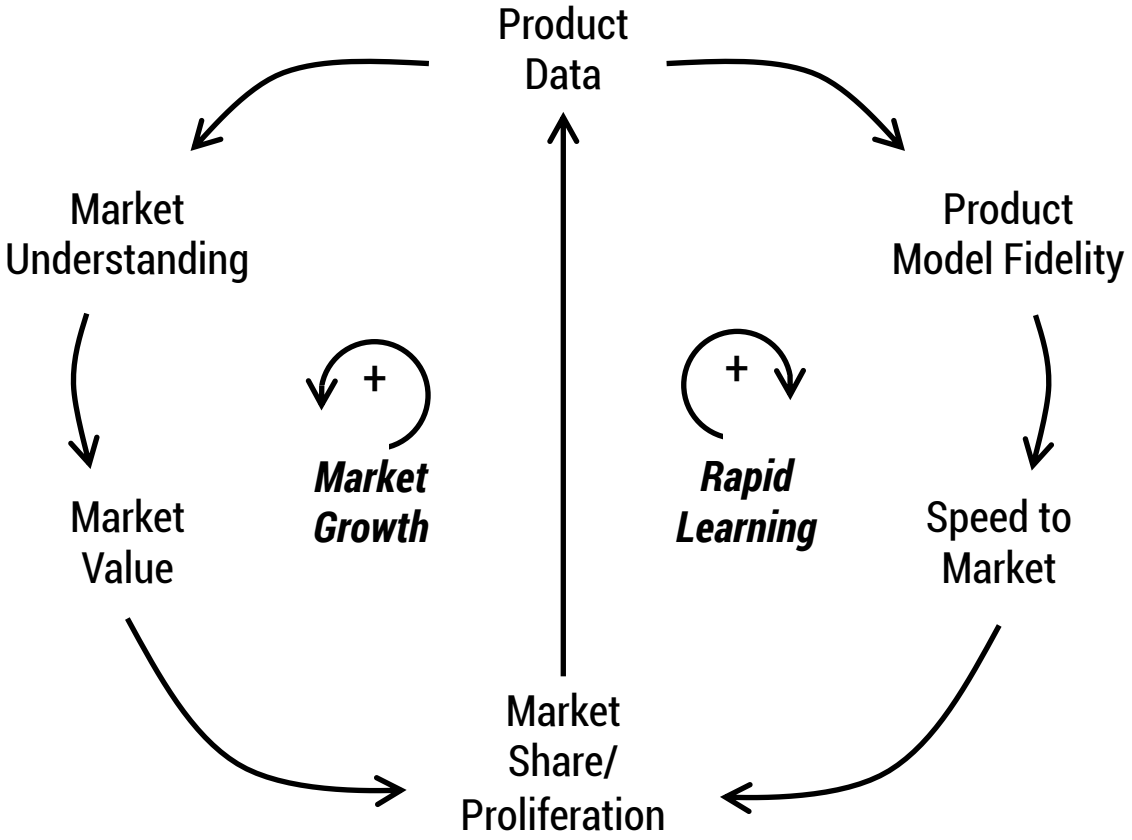
THE WALL STREET JOURNAL

## Models Will Run the World

*By Steven A. Cohen and Matthew W. Granade – August 19, 2018*

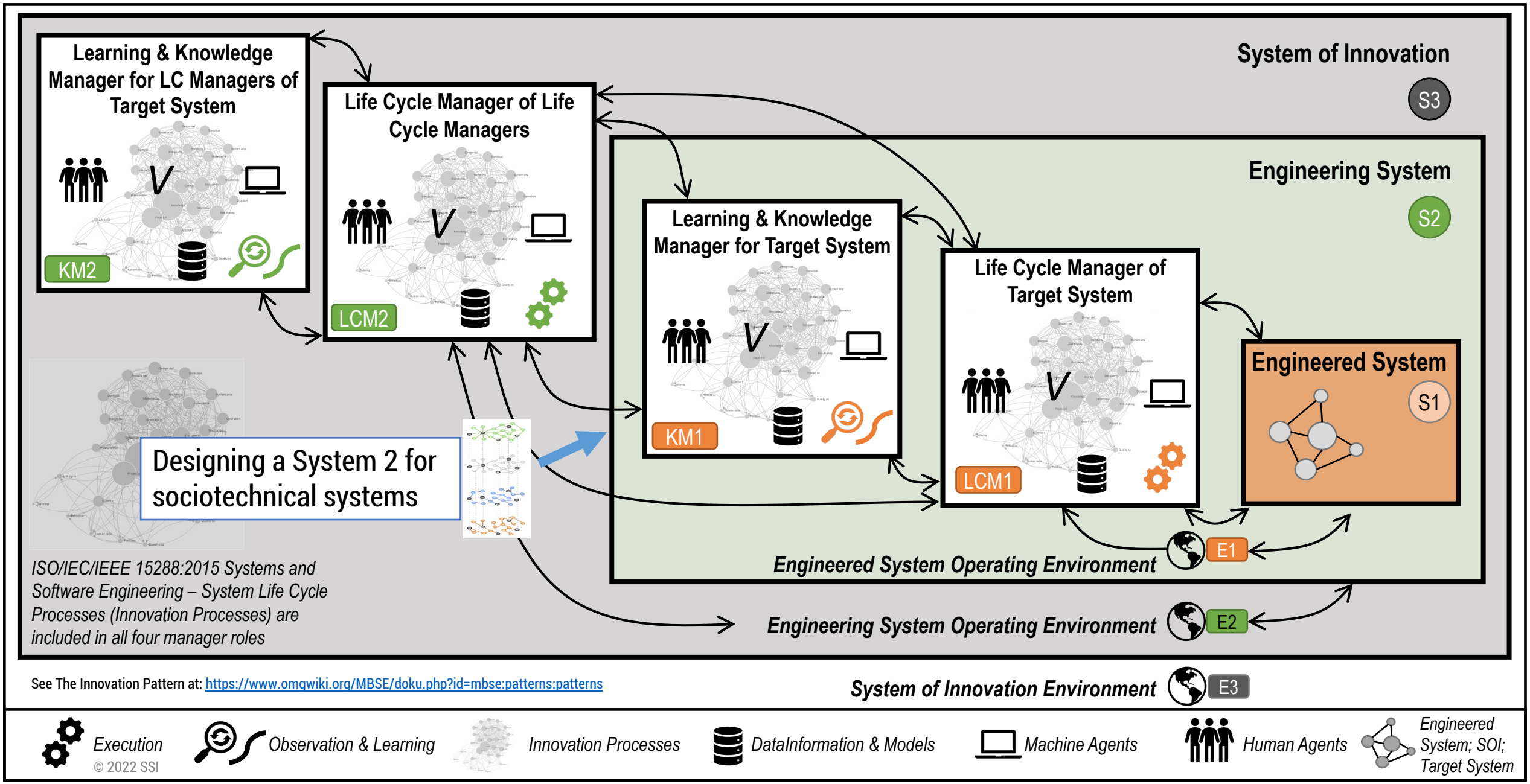
- If software ate the world, models will run it.
- There is no shortage of hype about artificial intelligence and big data, but models are the source of the real power behind these tools.
- Their products get better, allowing them to collect more data, which allows them to build better models, making their products better, and onward.
- The software revolution has transformed business. What's next? Processes that constantly improve themselves without need of human intervention.

***What happens when our models are right?***




***What happens when our models are wrong?***

# Designing a System 2 for DAX



# Enabler: Do we trust the Models?

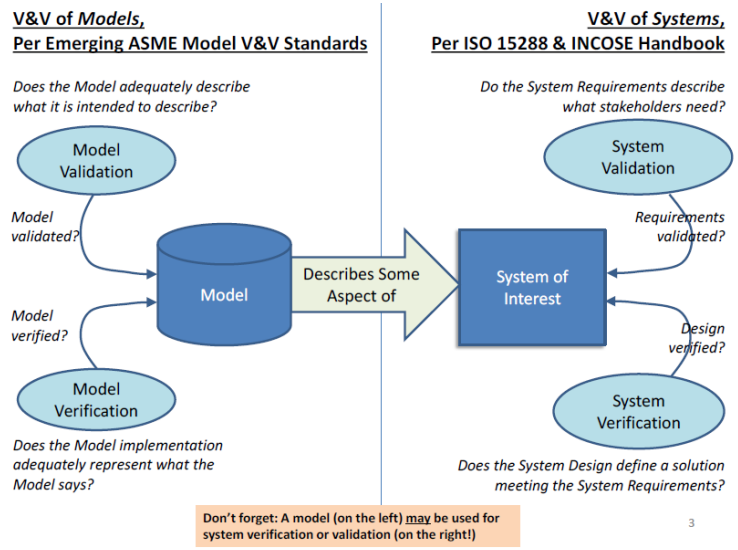
## Solutions to Validation and Verification (V&V) Questions:

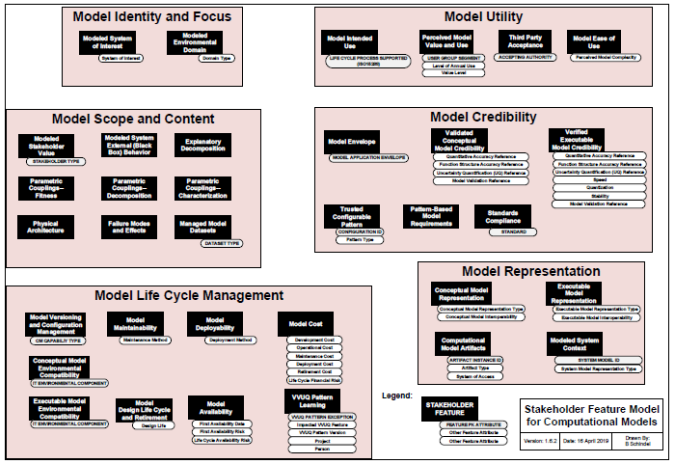
- ASME INCOSE Collaboration on VVUQ – focused on V&V of models. ASME V&V10-60.
- Expand standards to encompass VVUQ of broad ISO 15288 scope of models
- Models are contextualized carrying key information from its Model Characterization Pattern aka Model Wrapper
- Model Life Cycle Management Process: Establish, Develop, Deploy, Use, Maintain, Retire
- Model Curation

Source: Bill Schindel, ASME Collaboration, VVUQ Model Credibility Collaboration with ASME

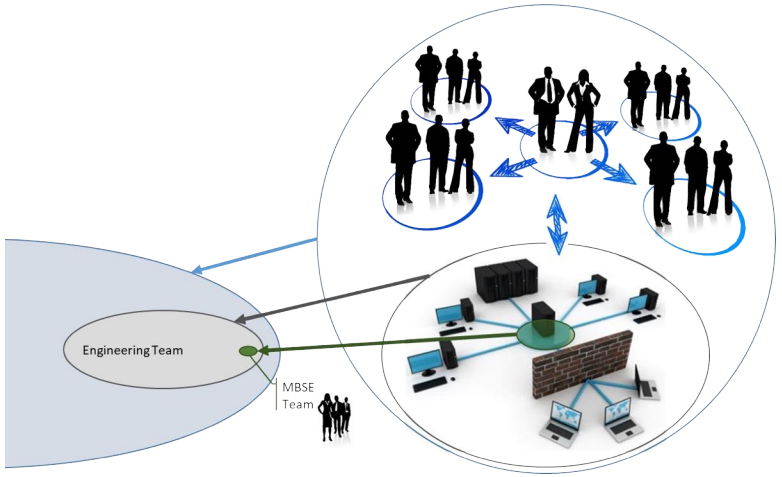
**Goals**

1. Scale up volume of models and people.
2. Manage models over entire life cycles.
3. Increase use of what was already learned.
4. Package general principles as actionable assets.
5. Prepare for a building-block world of models.
6. Unified metadata wrapper for all models.

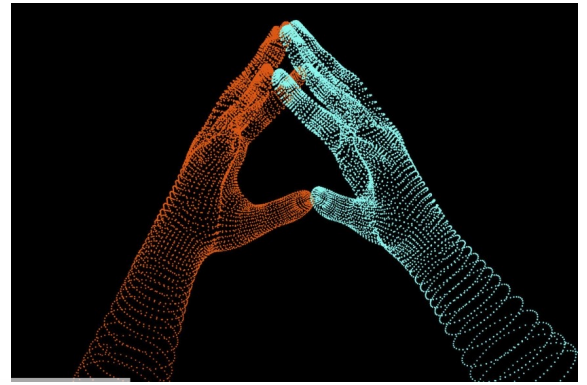


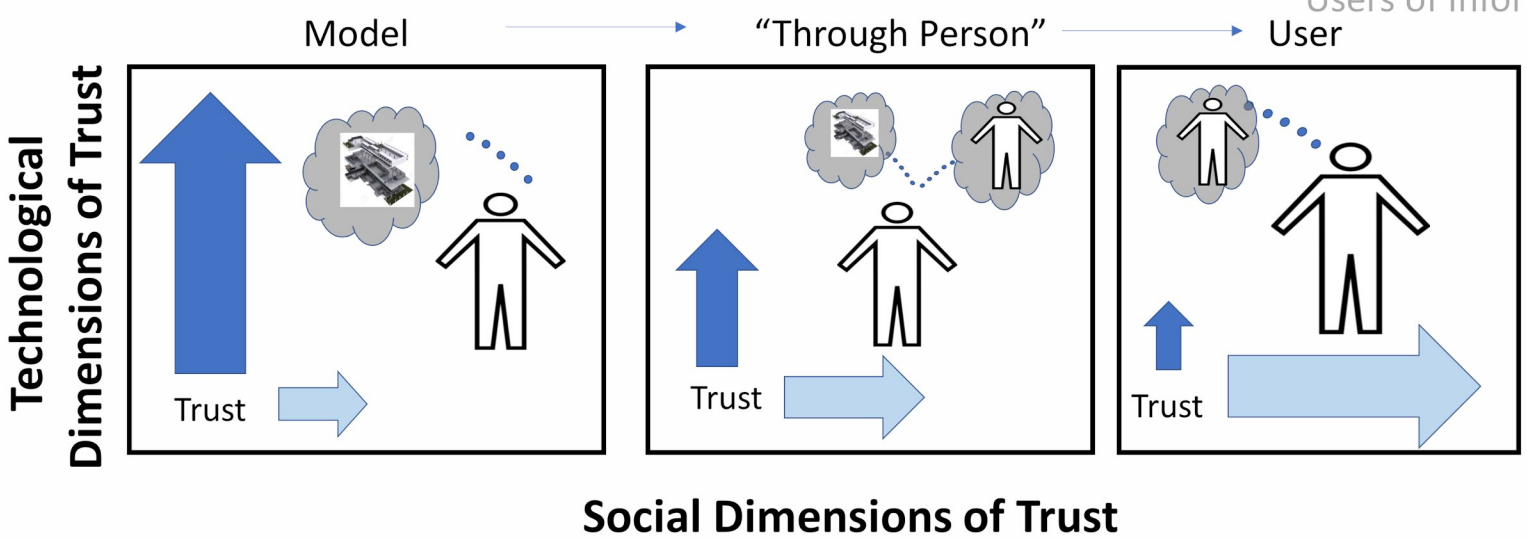
# Enabler: Trust Relationships




## How to maintain trust relationships in a Digital Engineering environment with Model to Model interactions?



Conceptual Model for "Through-Person" Trust:




**Technical Trust:**
Transparency
Code / Data Inspection
Traceability
Visualization

**Social Trust:**
Credibility
Relationships
Origin
Reputation

(2) Why is Human-Model Interactivity Important to the Future of Model-Centric Engineering?, , NASA/JPL Symposium & Workshop on Model-Based Systems Engineering, Dr. Donna H. Rhodes

# Solution Components

# Leverage the Power of Abstraction – metadata, properties and more

## Add a Unifying Metadata Layer to bridge:

- Organization Boundaries
- Inconsistencies across tools
- Networks and Security Domains
- Neutral to Modeling Languages
- Intellectual Property Barriers and Issues
- Functional Disciplines
- And more

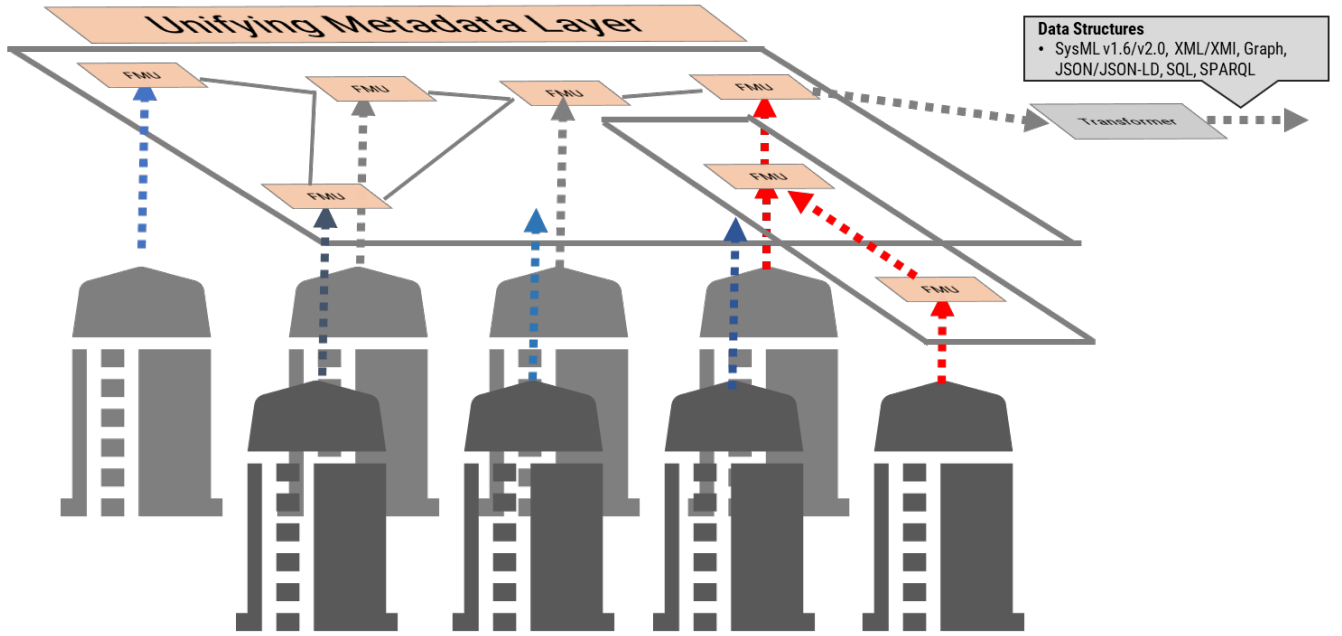
*Share information across specialized needs/purposes*

*Collect, Operate, and Curate Engineering Information at a level that enables scale, rapid response, portability, and more.*

***DAX provides a structured and effective way to package digital assets, making them both portable and immediately exploitable.***

# Working with Multidomain Metadata

## *Address the Combinatorial Silo/Domain Problem*

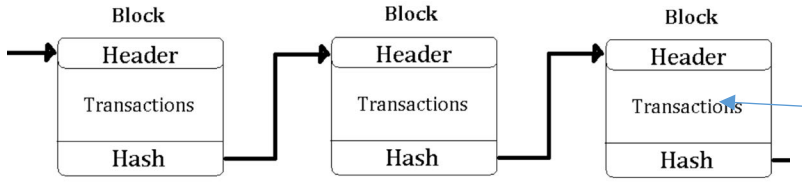



### Unifying Metadata Layer bridges

- Organization Boundaries
- Inconsistencies across tools
- Networks
- Security Domains
- Modeling Languages
- IP barriers and issues
- Functional Disciplines

***DAX provides a structured and effective way to package digital assets, making them both portable and immediately exploitable.***

# Decentralization of Digital Assets

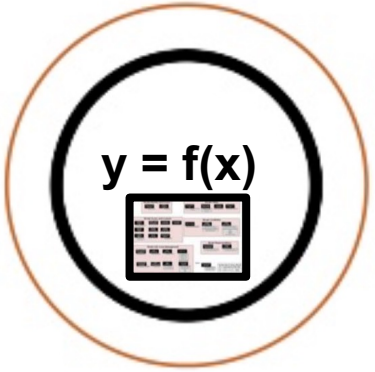



## Digital Ledger

A continually updated, network hosted database of all transactions on a blockchain. Comprised of blocks of transactions (with metadata) chained together by cryptography

## Consensus Mechanism

Programmed into each blockchain protocol, and responsible for verifying and updating transactions on the network's digital ledger




## Digital Asset

The good transacted on the blockchain.

## Network Participants

Computing nodes with access to the blockchain, able to manipulate the ledger and view past transactions; may be pre-approved or verified by a consensus mechanism





*https://www.slideshare.net/socialogilvy/understanding-blockchain-72744959/11*

## Use AuI for Systems Engineering

- Reinforce knowledge from models, model patterns, metadata, characteristics, and systems engineering methods with AuI
- Maximize Human + Machine Collaboration
- Allocate work based on strengths
- The Human + Machine combined "team" is more effective than either in isolation.

**Remember:** AuI = Human + AI
AuI > Human
AuI > AI

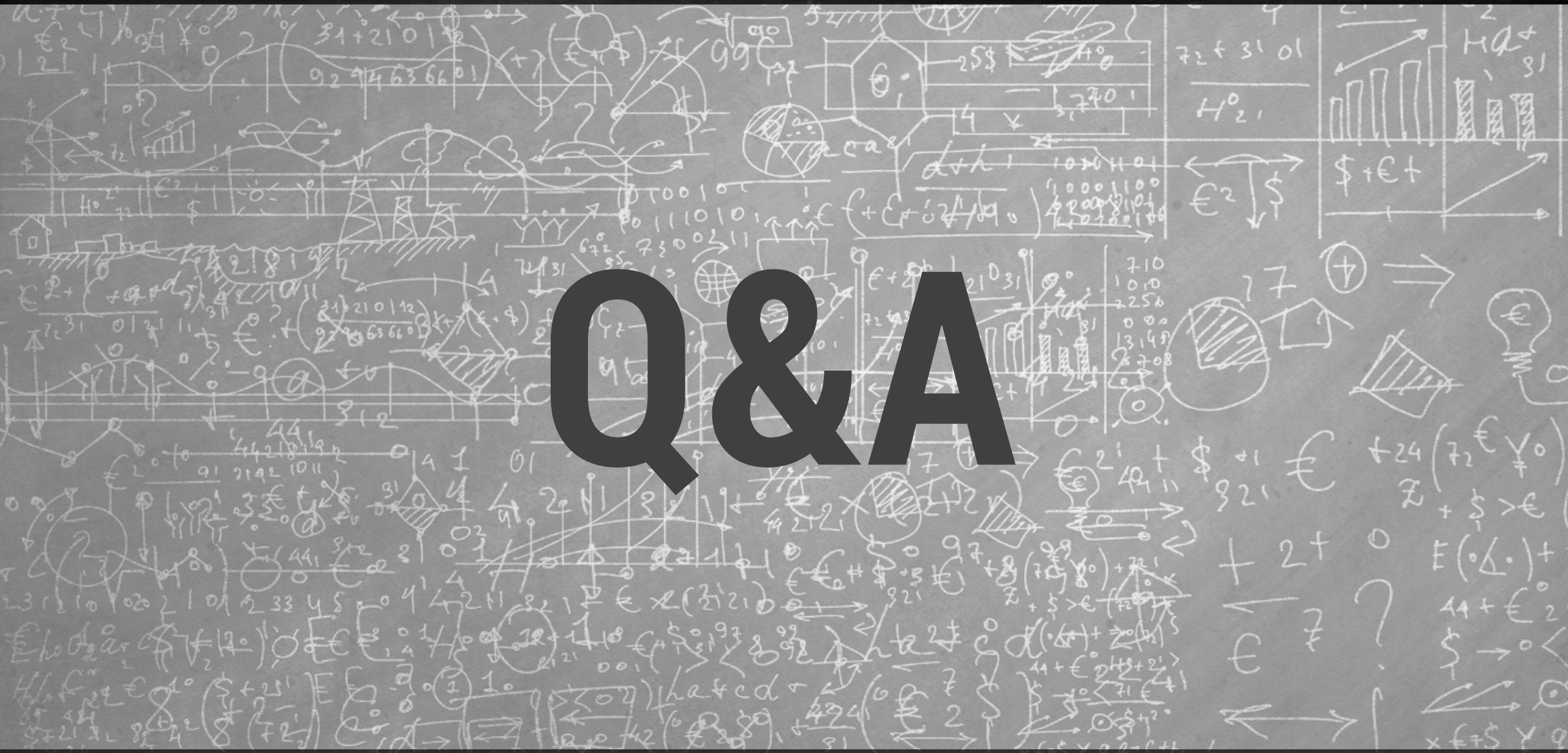
**Kasparov's Law:** weak human + machine + better process
***beats***
strong human + machine + inferior process.

# Thinking in Terms of a Digital Asset Exchange

| Go Fast, Small Teams | | |
|---|---|---|
| Centralized Architecture | Tool Focus | Create, Store, Discard |
| Go ask Jane or John | Closed Data Model | Relearn Again and Again… |
| Manual | Degraded Performance @ Scale | Siloed Domains |

| @ Scale Systems Engineering | | |
|---|---|---|
| Decentralized Architecture | Model Focus | Model Reuse |
| Model Speaks for Itself | Open Data Model | Reuse what we know |
| Augmented | Improved Performance @ Scale | Network Domain |

**Jarvis:**
Tell me the probability of failure on Mark 85 after 10 air combat missions?


Q&A

# About the Speaker

**Mark Petrotta**
Principal
System Strategy Inc (SSI)
mpetrotta@systemxi.com

Mark Petrotta is a Principal Systems Engineer at Systems Strategy Inc (SSI), supporting the US Army in model based systems engineering and digital engineering. He has more than twenty years of experience in software development and systems architecture in aerospace and defense, encompassing space, land, and sea applications. He holds a OCSMP Model Builder Advanced certification in SysML, and is a Design for Six Sigma Master Black Belt. He received his BS from University of California, Santa Barbara, and Masters in Computer Science from Cornell University, focusing on Artificial Intelligence and Machine Learning.

# About the Speaker

**Troy Peterson**
Vice President
tpeterson@systemxi.com
844.SystemXi
313.806.3929

Troy Peterson, SSI Vice President, and INCOSE Transformation lead is a recognized leader in developing model based solutions to speed innovation and solve complex systems challenges. He has led the delivery of numerous complex systems and methodologies while at SSI, Booz Allen, and Ford Motor Company. His experience spans academic, non-profit, commercial, and government environments across all lifecycle phases. Troy received a BS in Mechanical Engineering from Michigan State University, an MS in Technology Management from Rensselaer Polytechnic Institute, and a graduate certificate in Systems Design and Management from Massachusetts Institute of Technology. He also holds INCOSE CSEP, PMI PMP, and ASQ Six Sigma Black Belt Certifications.