MBSE Context & SE Transformation:
Accelerating transformation to a model-based discipline

Troy A. Peterson
Assistant Director
SE Transformation
troy.peterson@incose.org

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The Context – Is this all new?

"Today more and more design problems are reaching insoluble levels of complexity."

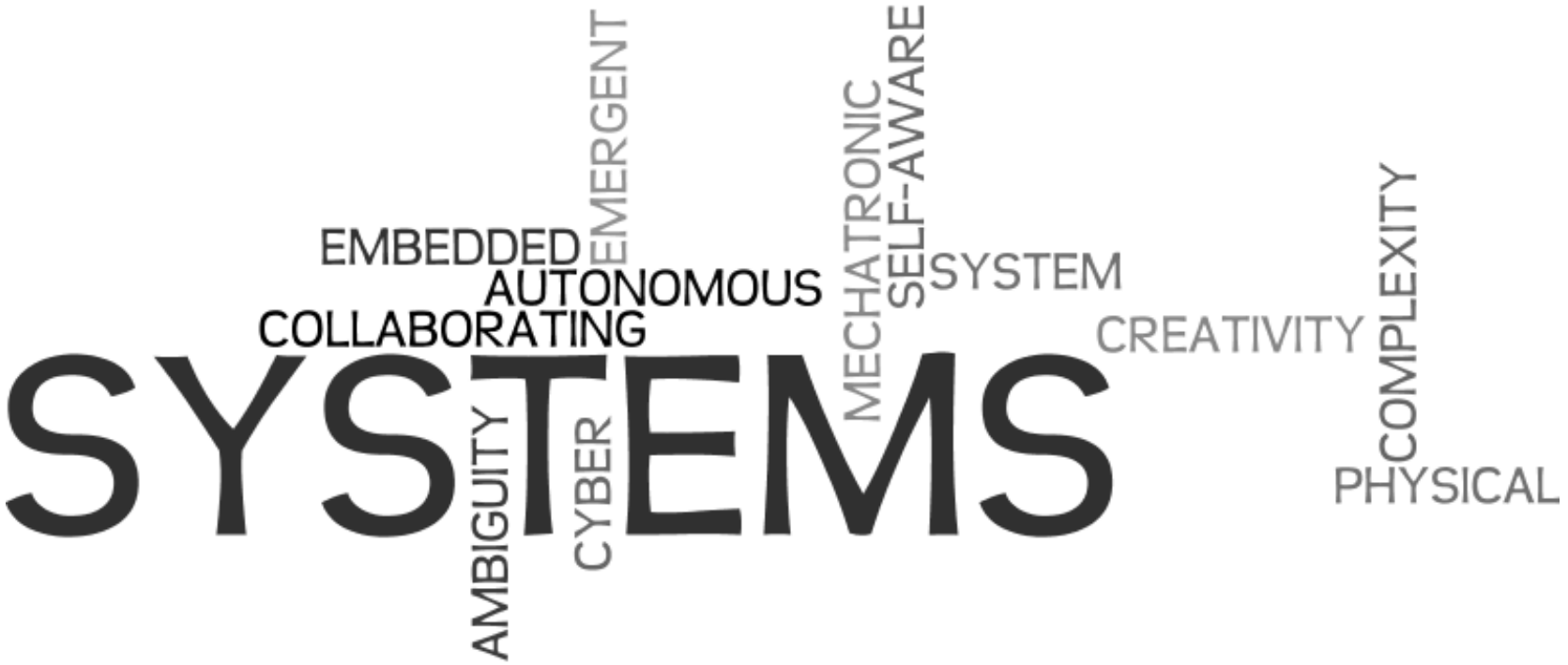
"At the same time that problems increase in quantity, complexity and difficulty, they also change faster than before."

"Trial-and-error design is an admirable method. But it is just real world trial and error which we are trying to replace by a symbolic method. Because trial and error is too expensive and too slow."

Christopher Alexander,
Notes on the Synthesis of Form[1],

1. Christopher Alexander, "Notes on the Synthesis of Form" Harvard University Press, Cambridge Massachusetts, 1964

Characterization of System Complexity



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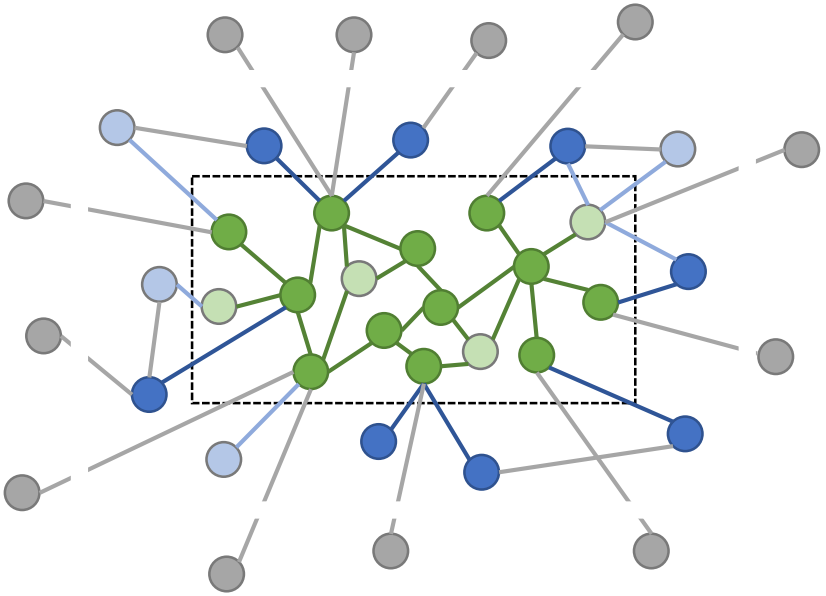
The Pervasive Systems Phenomenon

Interactions

Complexity



System Elements & Interactions

External Elements & Interactions

Increased Density of System Elements & Interactions

Increased Density of System External Elements & Interactions

Increased Interactions Between External Elements

Expanding System Domain Boundary Increasing Interactions

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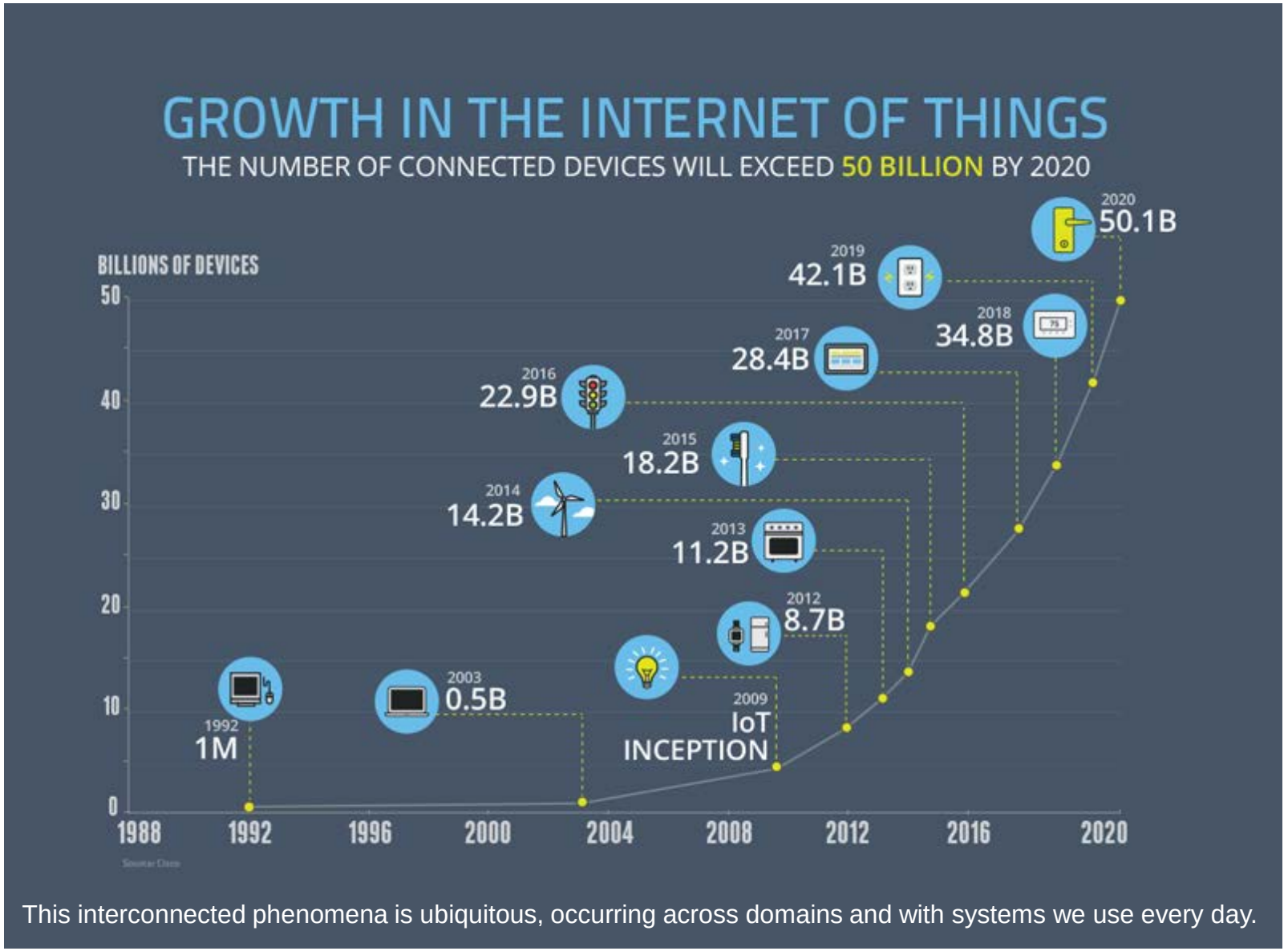
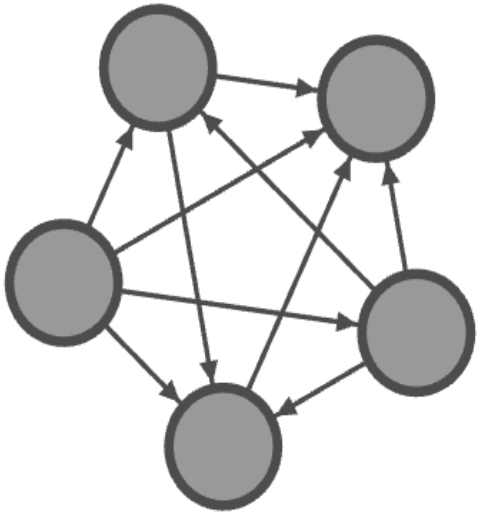
Internet of Things



This interconnected phenomena is ubiquitous, occurring across domains and with systems we use every day.

Interactions Drive Complexity



Nodes = 5
Potential Links = 10
Networks = 2^{10} or 1024

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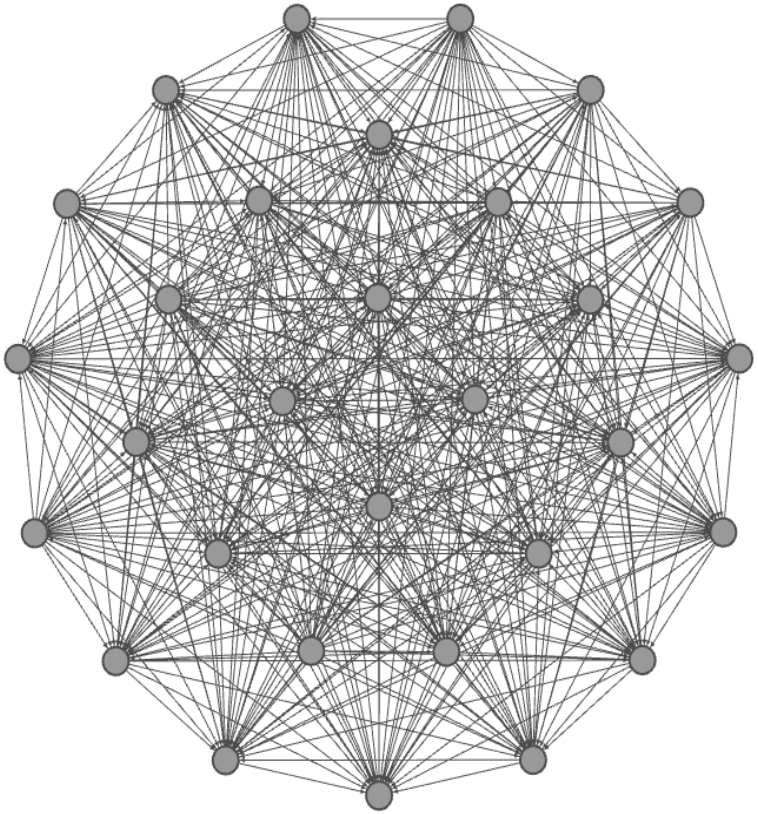
Putting Complexity into Perspective



Nodes = 30, potential links = 435, unique configurations = 2^{435}

Number of known atoms in the universe estimated between 2^{158} and 2^{246}

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Transformation

- While complex systems transform the landscape, the Systems Engineering discipline is also experiencing a transformation - to a model-based discipline.
- Within INCOSE we've see a strong trend toward increased interest and application of systems modeling
- Our surveys show interest and growth as well as attendance at MBSE related activities
- What about the larger stakeholder community?

Search Trends

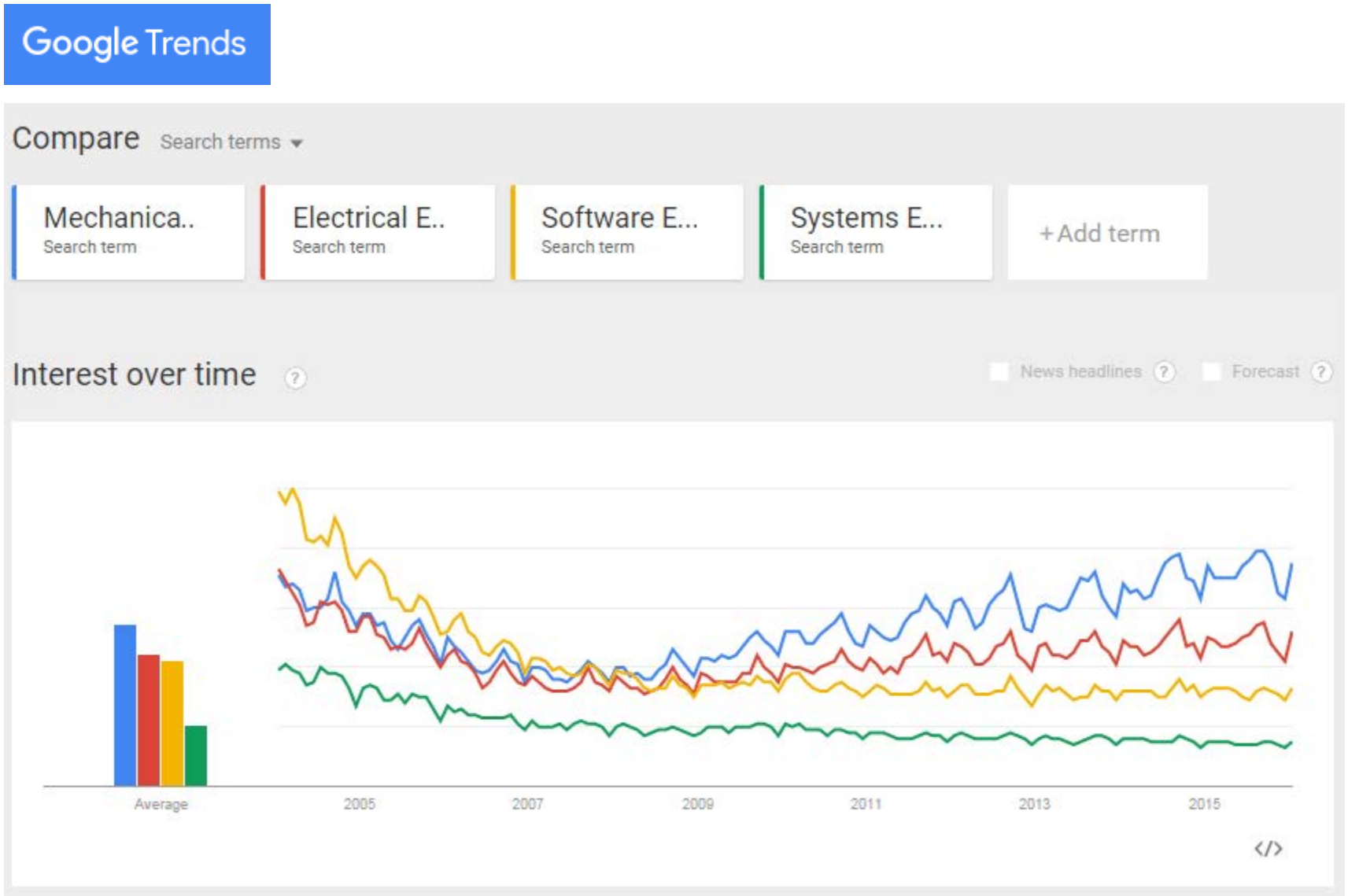
Google Trends

Google Trends analyzes a percentage of Google web searches to figure out how many searches were done over a certain period of time.

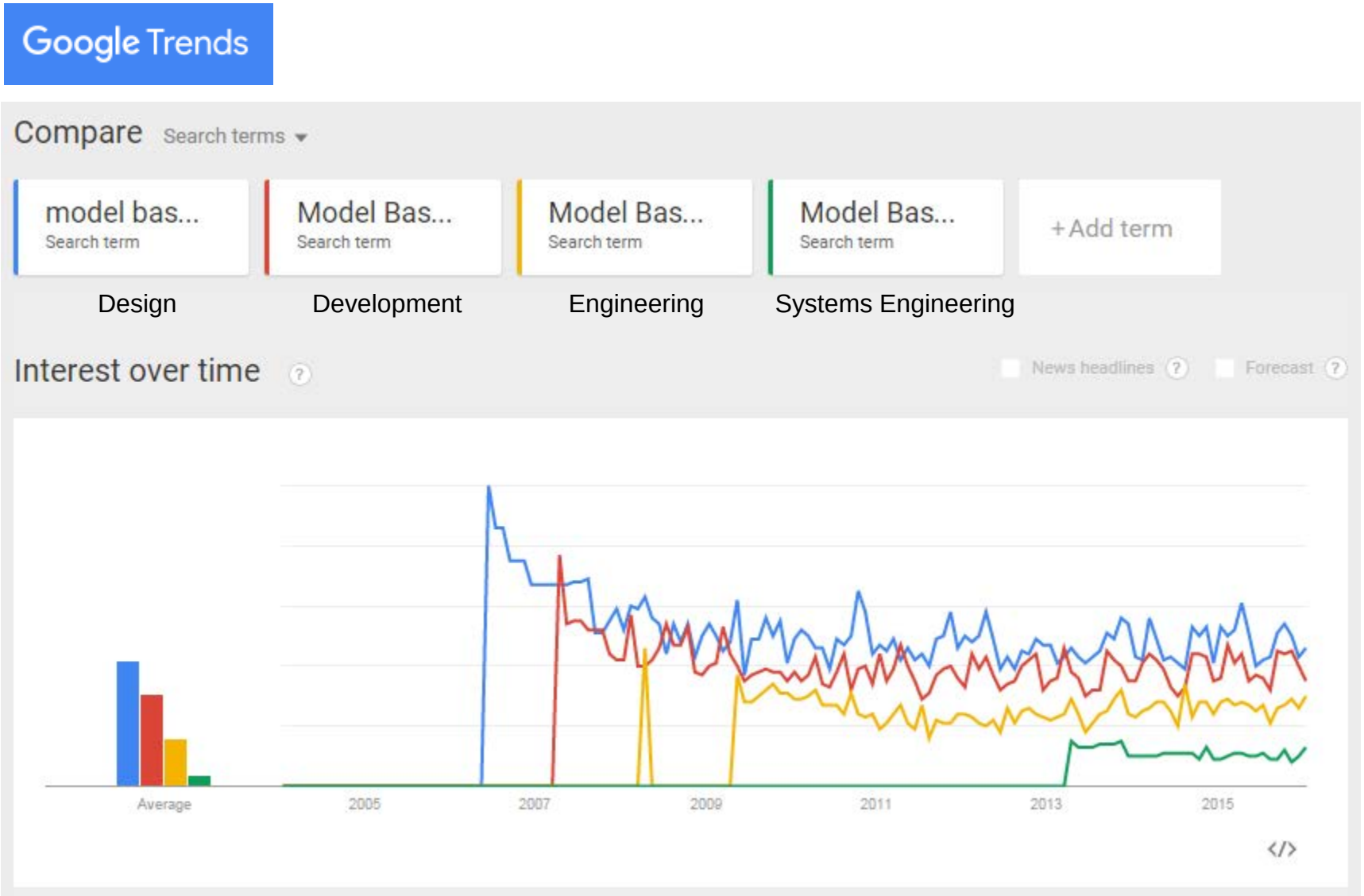
Data that is excluded:

- **Searches made by very few people**: Trends only analyzes data for popular terms, so search terms with low volume appear as 0.
- **Duplicate searches**: Trends eliminates repeated searches from the same person over a short period of time.
- **Special characters**: Trends filters out queries with apostrophes and other special characters.

Search Interest in Systems Engineering



Search Interest in Model Based…



Model Value and Momentum

Model Based trend is positive and growing

System model value is reinforced by growth in:

- Product complexity
- Contextual uncertainty, requirements change and volatility
- Complexity and number of alternatives
- Level and speed of model reuse…

We can gain momentum by showing ongoing and increasing value from modeling activities

- Risk Identification and Avoidance
- Opportunity Identification and Capture

Achieving Value from Model Based Methods

"…All models are wrong, but some are useful"

"Since all models are wrong the scientist ***cannot obtain a "correct" one by excessive elaboration***. On the contrary following William of Occam he should ***seek an economical description*** of natural phenomena. Just as the ability to devise ***simple but evocative models is the signature of the great scientist*** so ***overelaboration and over parameterization is often the mark of mediocrity***."

George E. P. Box

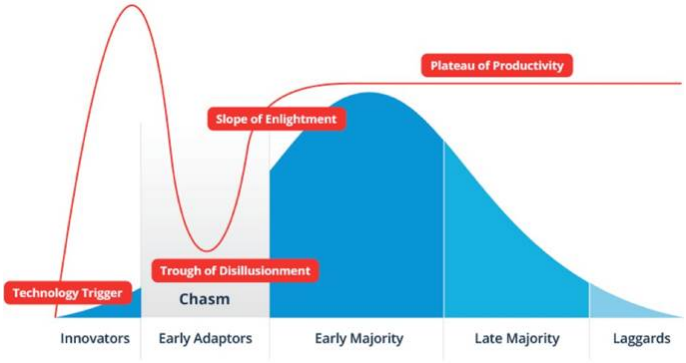
Some Contextual Conclusions

- Given the scale of complexity system models are essential.
- We need:
  - Integrated and federated system models which span across traditional boundaries
  - System model expressions which deepen human understanding
  - To make the business case and add value with our modeling efforts
  - To reach the larger community of stakeholders

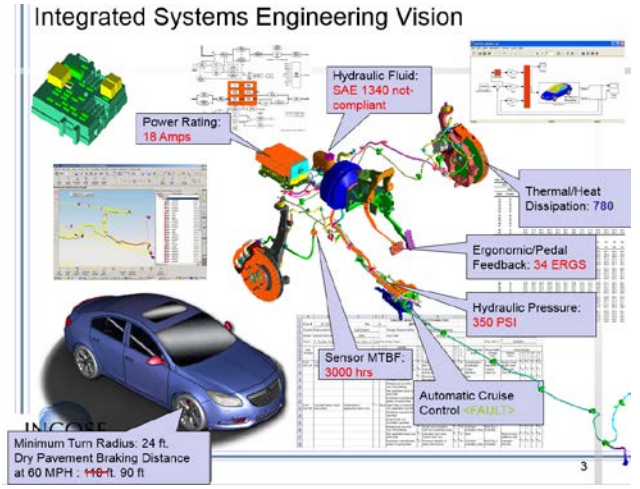
SE Transformation Overview

Objective:

INCOSE accelerates the transformation of systems engineering to a model-based discipline.

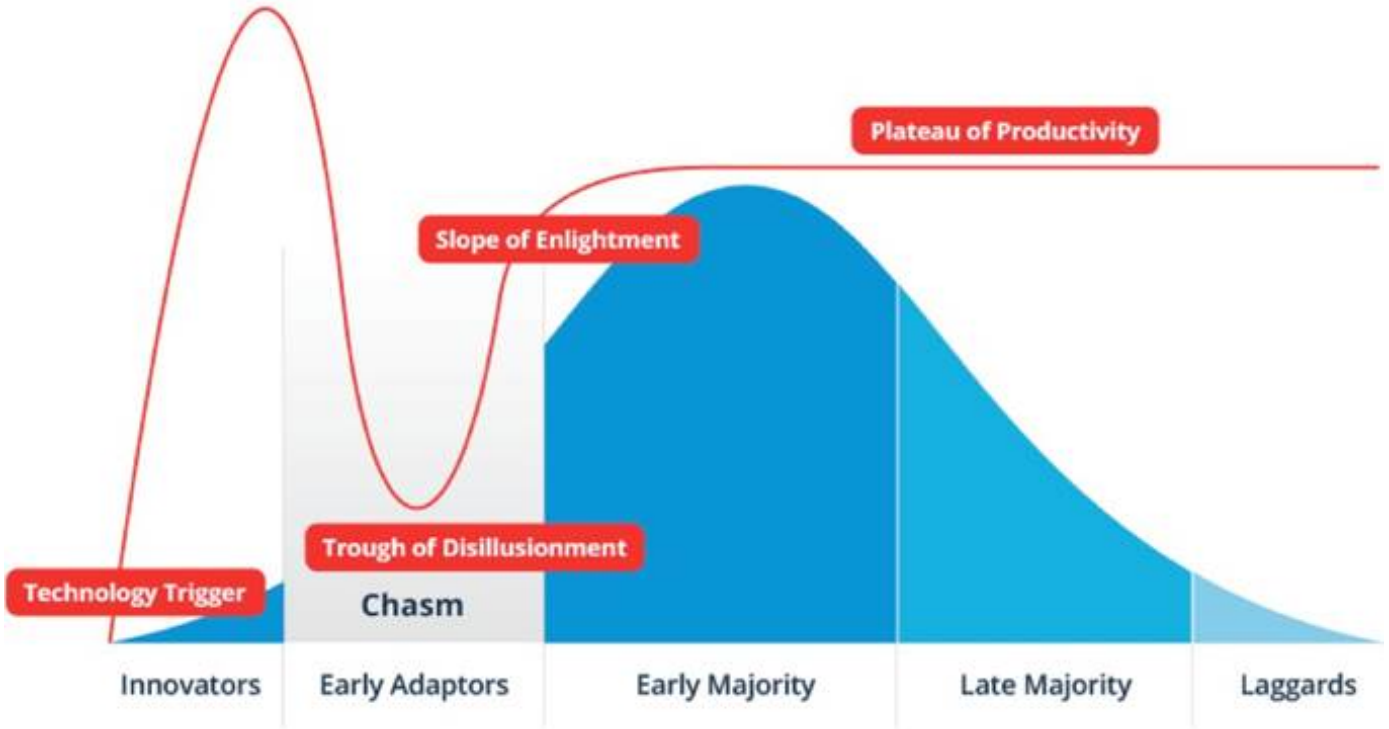


- Accelerates:
  - Understand the hype cycle[1] and bridge the chasm[2]…
  - Empower others to enlighten and influence adoption
- Transformation:
  - A marked change, as in appearance or character, usually for the better[3]. e.g. documents to models
  - Lead and support the community in crossing the chasm
- Model Based Discipline
  - System models of all types
  - Modeler Collaboration and Model Integration



1. Hype Cycle is a branded graphical presentation developed and used by IT research and advisory firm Gartner
2. Moore, Geoffrey A. “Crossing the Chasm – and Beyond” Strategic Management of Technology and Innovation Third Edition 1996
3. Excerpted from The American Heritage Dictionary of the English Language, Third Edition 1996 by Houghton Mifflin Company
4. Friedenthal, Sandy and Sampson, Mark - MBSE Initiative Overview - http://www.omgwiki.org/MBSE/doku.php

Accelerates: Hype Cycle and Chasm

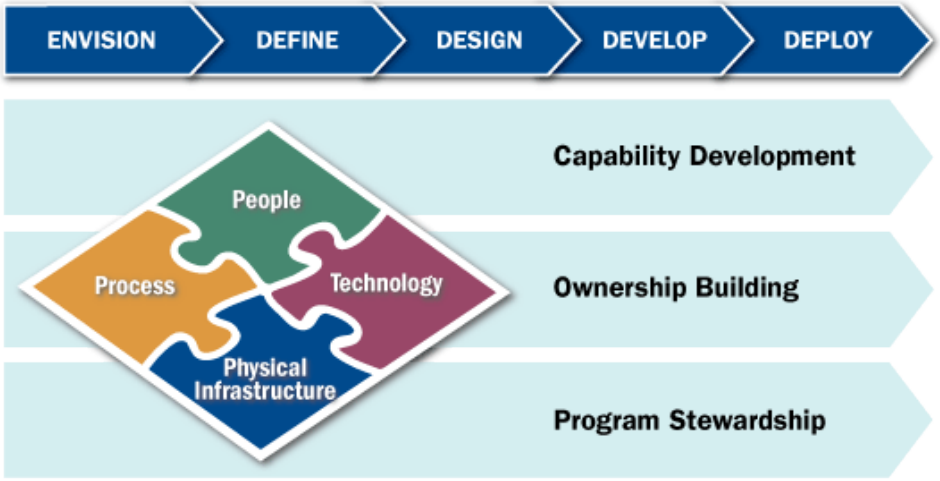


Acceleration is very much about sharing, communicating and learning

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 Combind Graphic: http://www.datameer.com/blog/big-data-analytics-perspectives/big-data-crossing-the-chasm-in-2013.html

Transformation: Change Management and Leadership



Transformation Life Cycle™ (TLC): Booz Allen Hamilton

Consider key dimensions of change

- People, Process, Technology, and Physical Infrastructure
  - Integrate dimensions of change
  - Addresses dimensions in parallel
  - Leverage concurrency to encourage cross dimension trades
  - Build ownership at the grass-root level

Consider:

ABP = CM(OE + BPR + IT)

- ABP = Achieving Breakthrough Performance
- OE = Organizational Environment
- BPR = Business Process Reengineering
- IT = Information Technology
- CM = Change Management

Transformation is very much a people focused endeavor.

Transformation & Change Management

There is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success, than to take the lead in the introduction of a new order of things.

Niccolo Machiavelli

If you want to truly understand something – try to change it.

Kurt Lewin

The best way to mange change is to create it.

Peter Drucker

Model Based Discipline: The Next Evolutionary Step

- Model based is the next evolutionary step
- Not a wholesale change
- In some ways we're going "back to the future"
- Sometimes its not so much starting something new but stopping something old… or in our case complementing our processes and documents
- Understand the Current State
  - Take inventory of current state of transition and progress toward becoming a model based discipline
- Envision and define the future state of SE:
  - Vision 2025,what are the business objectives, associated metrics, stakeholders, technology and transition needs, typical what if questions, priorities etc.
- Leverage Transformation and Change Management methods and frameworks

Transformation to a Model-Based Discipline

Objective: Accelerate the transformation to a model-based discipline

- Advance and mature the MBSE Practice
- Mainstream Model Based Systems Engineering
- Evolve to a cohesive MBSE language, applicable to multiple domains
- Promote and advance the role of MBSE in global Model Based Engineering (MBE)
- Connect to other MBE cross domain standards like Building Information Modeling (BIM)
- Get authoritative information on MBSE out to practitioners and the broader community
- Align with SE Vision 2025 (see page 38-39)

Team

Assistant Director for Transforming SE to a Model Based Discipline

- Troy Peterson

Core team of experts supporting the effort – Meet one or two times a month…

- Jeff Bergenthal
- Sandy Friedenthal
- Joachim Fuchs
- John Gill
- Mark Sampson
- Bill Schindel

Adding stakeholder representatives to obtain diverse perspectives

- INCOSE CAB, IOB, Working Groups etc.
- Strong connection to the INCOSE MBSE Initiative
- Representatives from targeted MBE applications (NAFEMS, BIM, ….)
- Domain representatives

Please let me know if you are interested

Anticipated Products & Interactions

- Strategy and Plan for Transformation
  - Vision, mission, goals, objectives, tasks and associated metrics
- Transformation Business Case / ROI Briefing
  - Collection of works to help make the case for transformation
  - Compelling Storylines / Success Stories / Case Studies
  - SE Transformation Principles (heuristics, lessons learned, best practices)
- Model Foundations Types / Taxonomy
  - Ontology
  - Model Types/Taxonomy
- Strategic Collaboration and Communication
  - Who all should INCOSE collaboration from a Transformation perspective
  - How do we better reach and communicate with stakeholders

Motivation for Transformation

“When the rate of external change exceeds the rate of internal change, the end of your business is in sight.”

Jack Welch

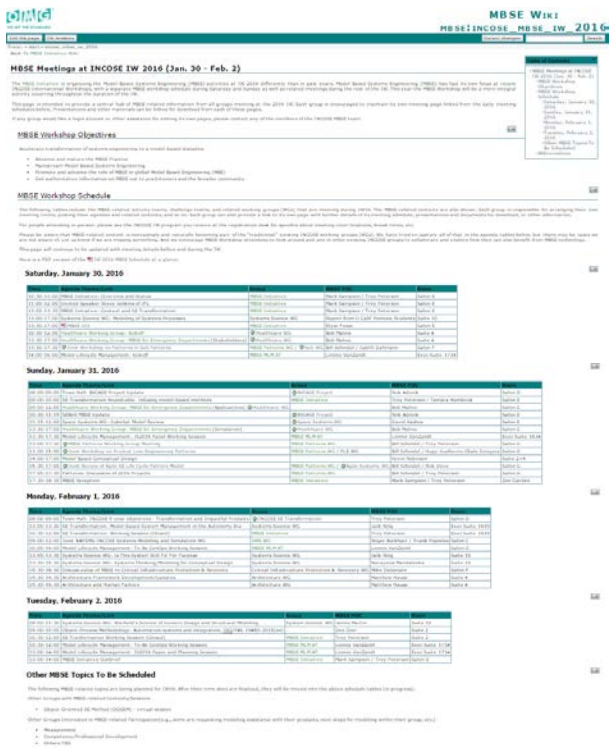
“It is not necessary to change. Survival is not mandatory.”

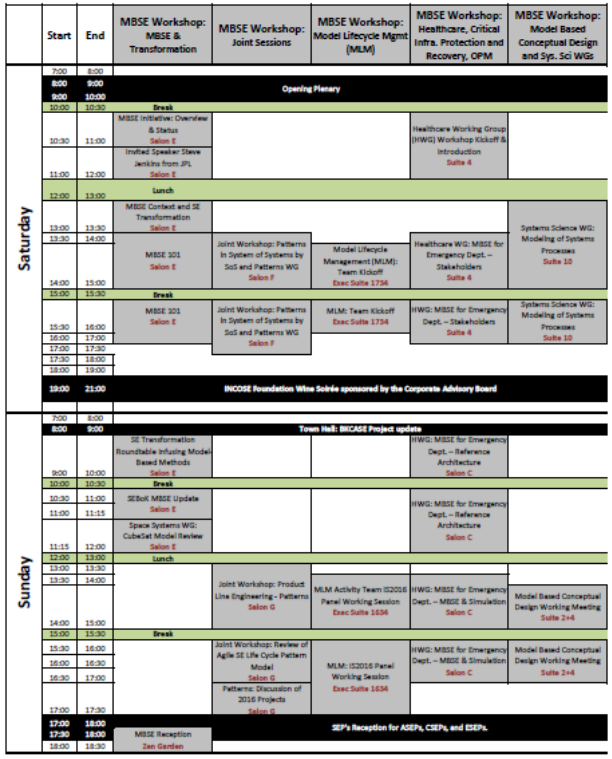
W. Edwards Deming

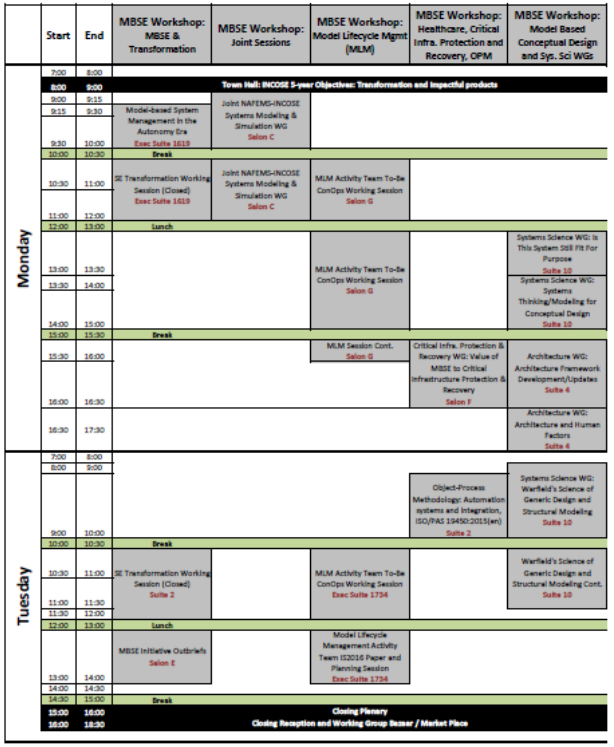
MBSE Workshop Agenda & Logistics

Sources of Information for IW MBSE Related Content

- MBSE wiki
- IW 2016 Website
- IW 2016 App







Metrics on the new MBSE Workshop format

- 30+ model based related sessions in MBSE Workshop
- 4 joint sessions (Patterns, SoS, PLE, Agile and NAFEMS)
- Almost half the present WGs have model content (15/34)
- Half of those with model content are new to the workshop
- Receive an additional 8 commitments for next year