



**2018**  
Annual **INCOSE**  
international workshop  
Jacksonville, FL, USA  
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# MBSE and Transformation Topics

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# Systems Engineering

## The Essence of the Next Industrial Revolution

“The world is entering the Fourth Industrial Revolution. Processing and storage capacities are rising exponentially, and knowledge is becoming accessible to more people than ever before in human history. The future holds an even higher potential for human development as the full effects of new technologies such as the Internet of Things, artificial intelligence, 3-D Printing, energy storage, and quantum computing unfold.”

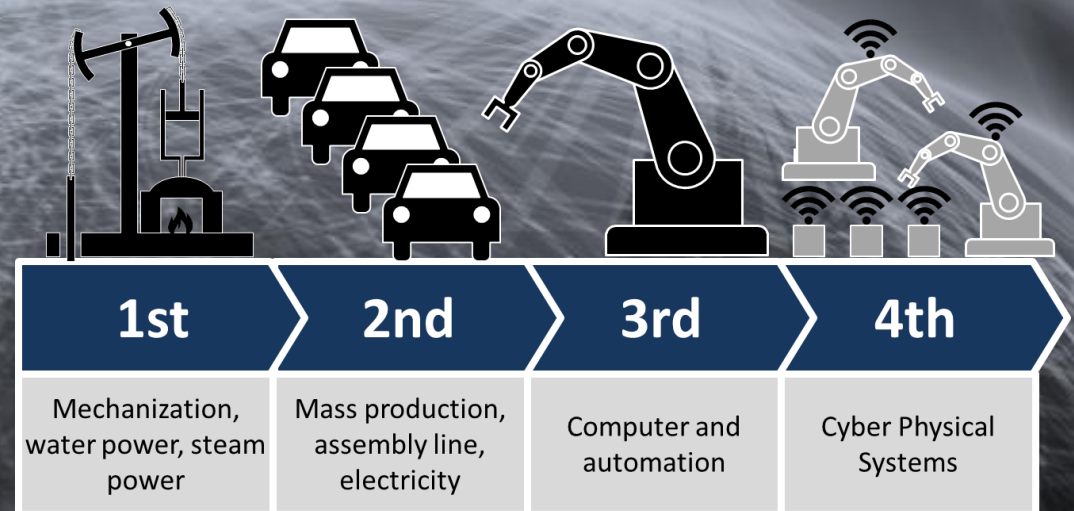
The Global Information Technology Report  
Innovating in the Digital Economy  
World Economic Forum



21 January 2018

## Digital Transformation

## Industrial Revolution





# Deep Shift

## Technology Tipping Points and Societal Impact



COMMITTED TO  
IMPROVING THE STATE  
OF THE WORLD

### The Six Megatrends

As a foundation to its work, the council sought to identify the software and services megatrends which are shaping society, and their associated opportunities and risks.

#### People and the internet

How people connect with others, information and the world around them is being transformed through a combination of technologies. Wearable and implantable technologies will enhance people's "digital presence", allowing them to interact with objects and one another in new ways.

#### Computing, communications and storage everywhere

The continued rapid decline in the size and cost of computing and connectivity technologies is driving an exponential growth in the potential to access and leverage the internet. This will lead to ubiquitous computing power being available, where everyone has access to a supercomputer in their pocket, with nearly unlimited storage capacity.

#### The Internet of Things

Smaller, cheaper and smarter sensors are being introduced – in homes, clothes and accessories, cities, transport and energy networks, as well as manufacturing processes.

#### Artificial intelligence (AI) and big data

Exponential digitization creates exponentially more data – about everything and everyone. In parallel, the sophistication of the problems software can address, and the ability for software to learn and evolve itself, is advancing rapidly. This is built on the rise of big data for decision-making, and the influence that AI and robotics are starting to have on decision-making and jobs.

#### The sharing economy and distributed trust

The internet is driving a shift towards networks and platform-based social and economic models. Assets can be shared, creating not just new efficiencies but also whole new business models and opportunities for social self-organization. The blockchain, an emerging technology, replaces the need for third-party institutions to provide trust for financial, contract and voting activities.

#### The digitization of matter

Physical objects are "printed" from raw materials via additive, or 3D, printing, a process that transforms industrial manufacturing, allows for printing products at home and creates a whole set of human health opportunities.

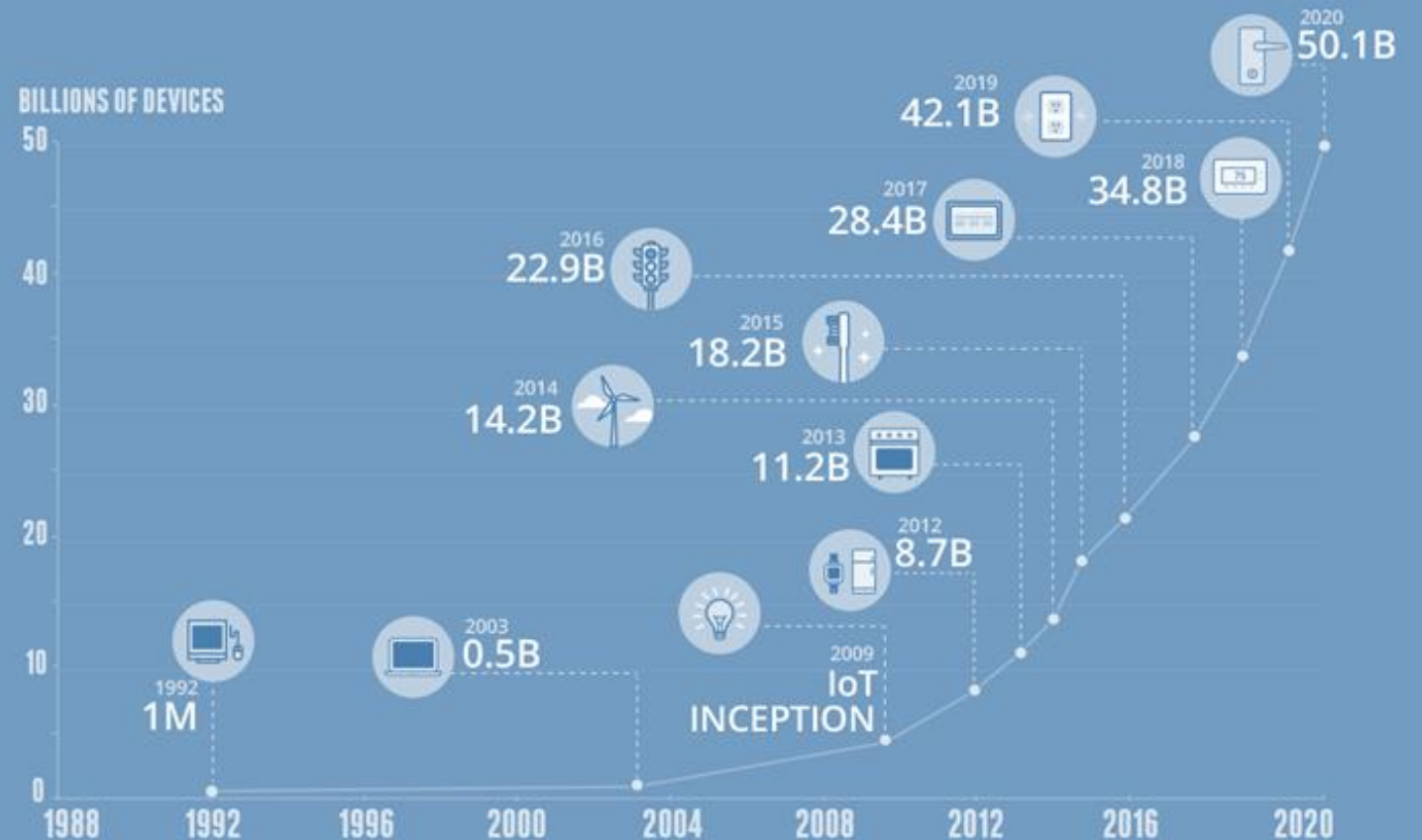


# Trends: Internet of Things and System Interactions

**The interconnection of products is ubiquitous, occurring across domains and with systems we use every day creating a complex web of interdependent systems.**

## GROWTH IN THE INTERNET OF THINGS

THE NUMBER OF CONNECTED DEVICES WILL EXCEED 50 BILLION BY 2020







# Trends: Cyber Security



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  Dance problems.
</p>
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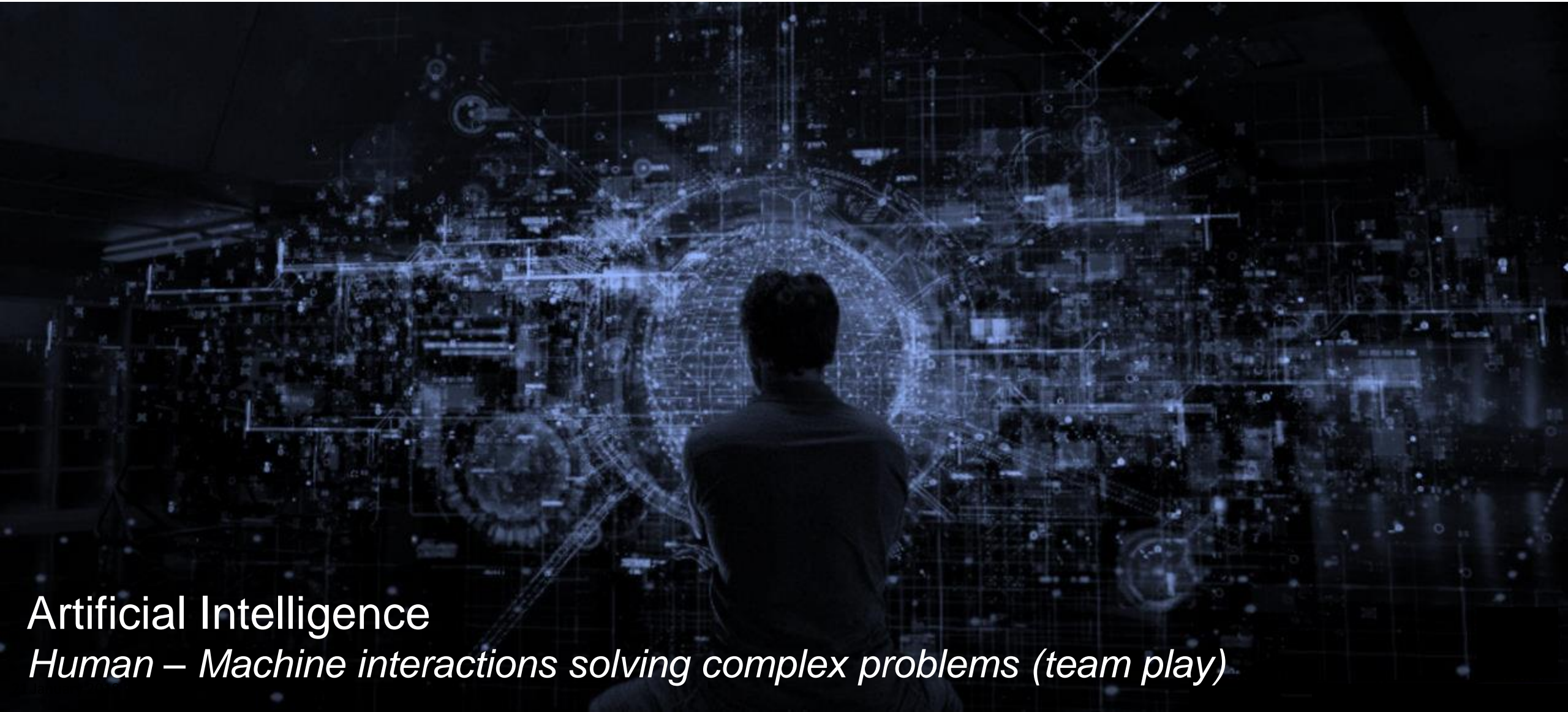
## Cyber-Physical

*Intertwined cyber and physical, vast state space, new vulnerabilities*





# Trends: Artificial Intelligence

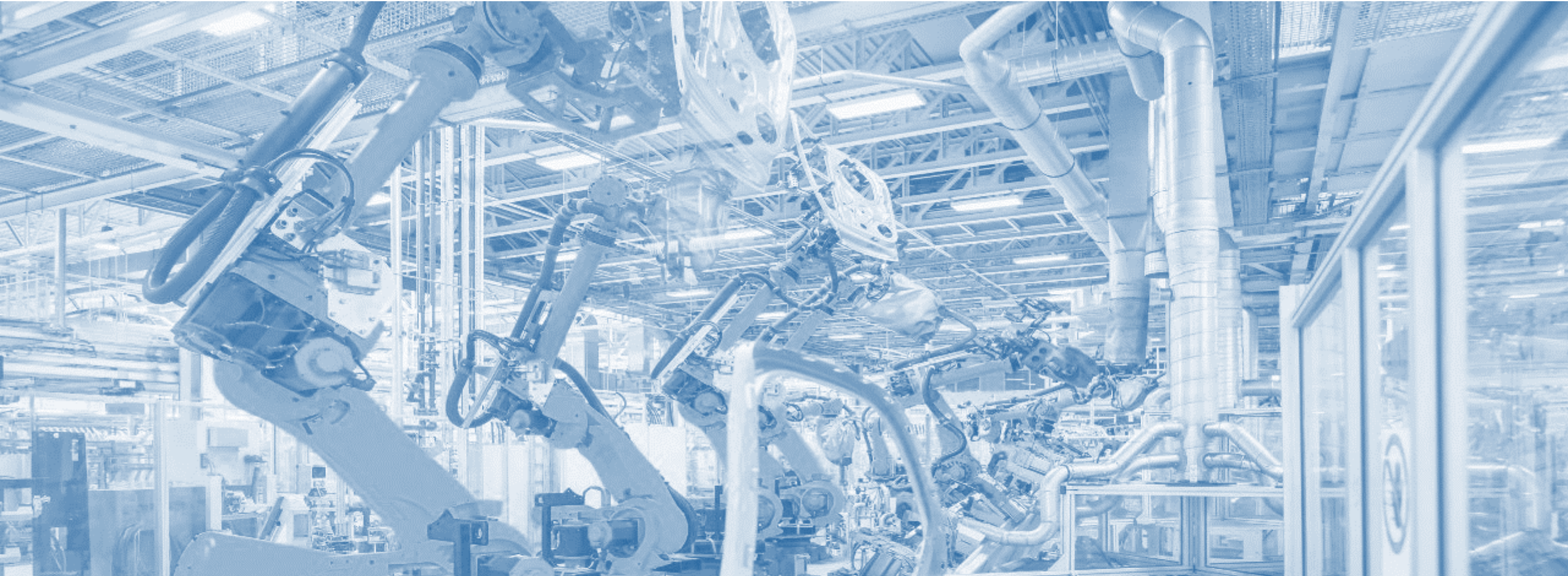


Artificial Intelligence

*Human – Machine interactions solving complex problems (team play)*



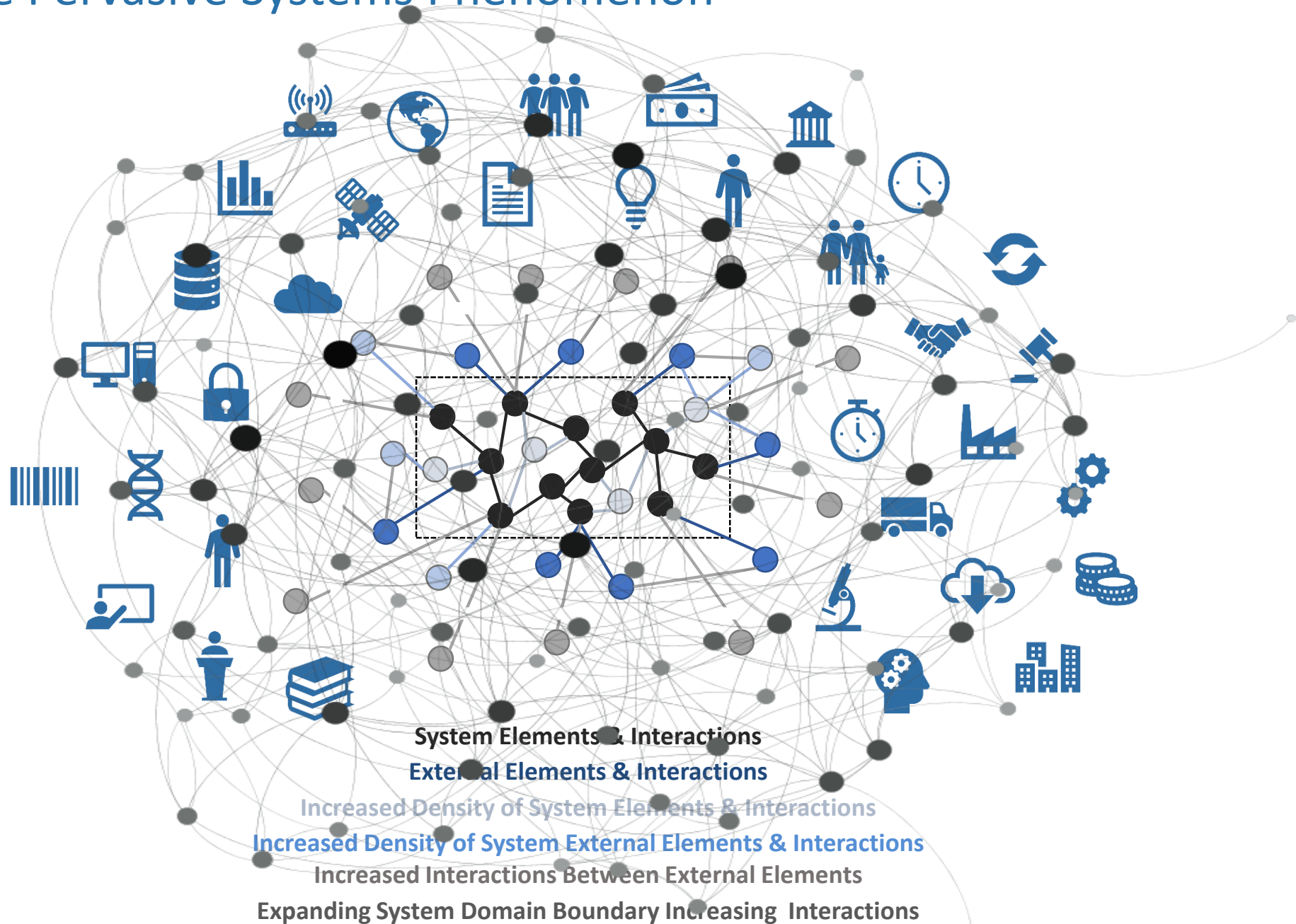
# Trends: Industrial Revolution / Industry 4.0



**Industry 4.0 / Industrial Internet**  
*Connecting models across the lifecycle*

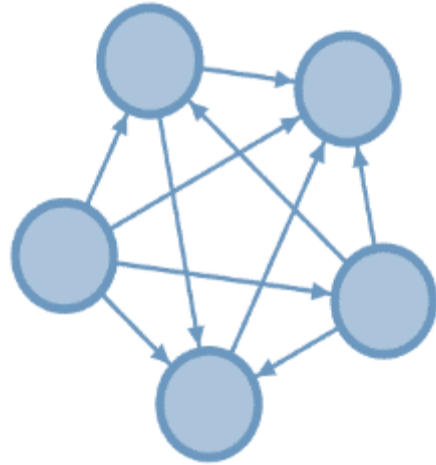


# The Pervasive Systems Phenomenon





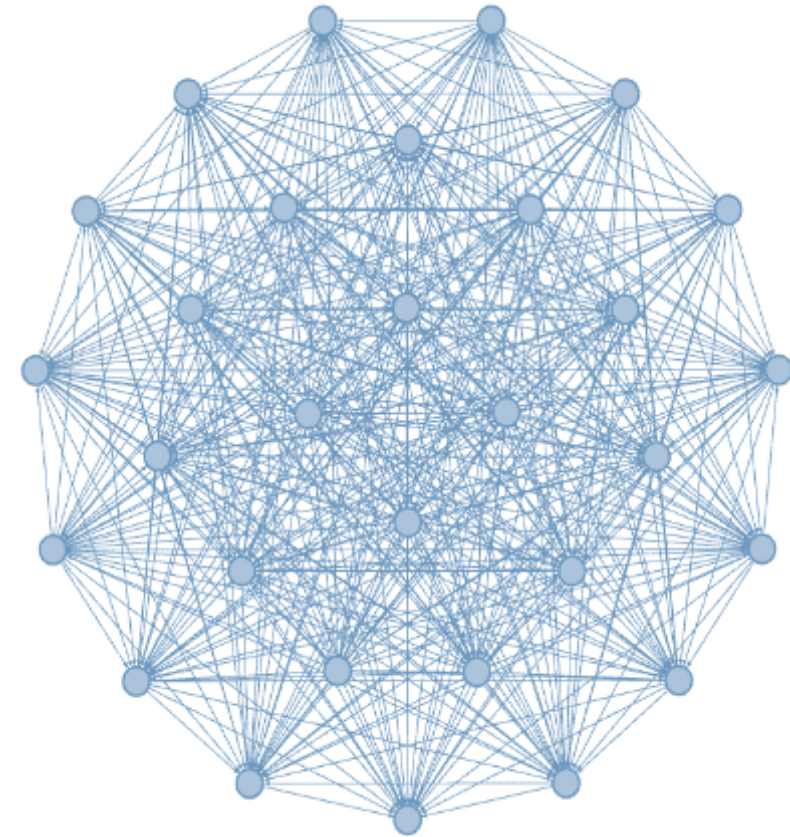
# System Phenomenon & Complexity



Nodes = 5

Potential Links = 10

Networks =  $2^{10}$  or 1024



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

***Number of known atoms in the  
universe ~  $2^{158}$  and  $2^{246}$***



## Quote on System Challenges Today

*“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*<sup>1</sup>,

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



# Rethinking Systems Conceptualization

- The rapid increase in Cyber-Physical Systems is changing the way we develop, manage and interact with systems.
- The National Science Foundation (NSF) describes Cyber-Physical Systems (CPS) as “engineered systems that are built from, and depend upon, the seamless integration of computational algorithms and physical components”
- They tightly intertwine computational elements with physical entities across domains
- The NSF notes that CPS challenges and opportunities are both significant and far-reaching.
- To address these challenges the NSF is calling for methods to conceptualize and design for the deep interdependencies inherent in Cyber-Physical Systems.





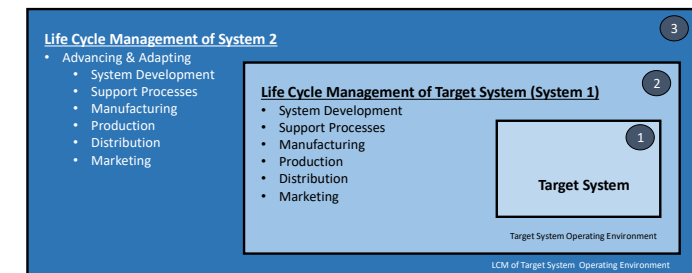
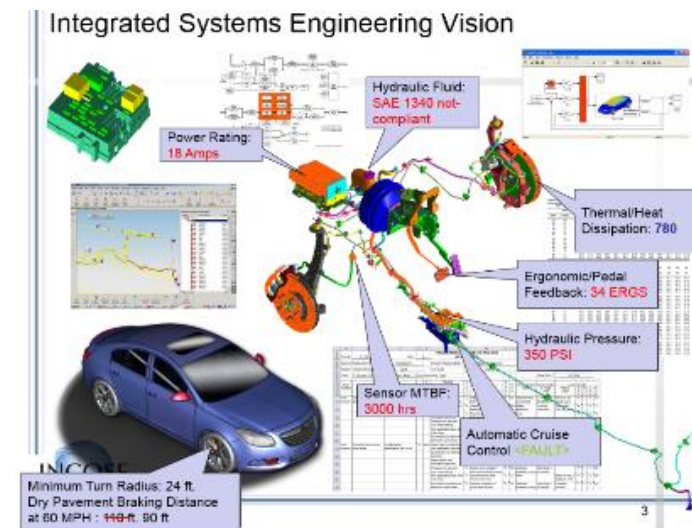
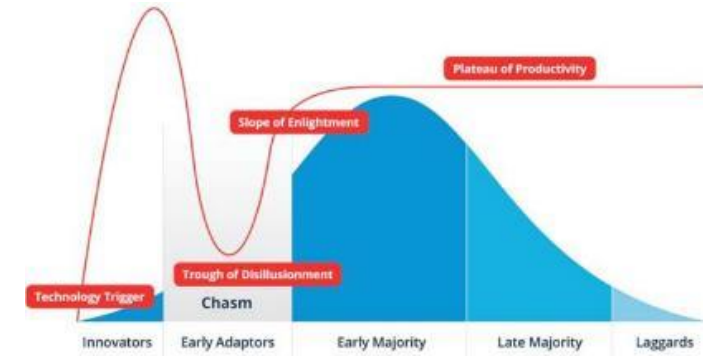
# INCOSE's Transformation Strategic Objective

## Objective:

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

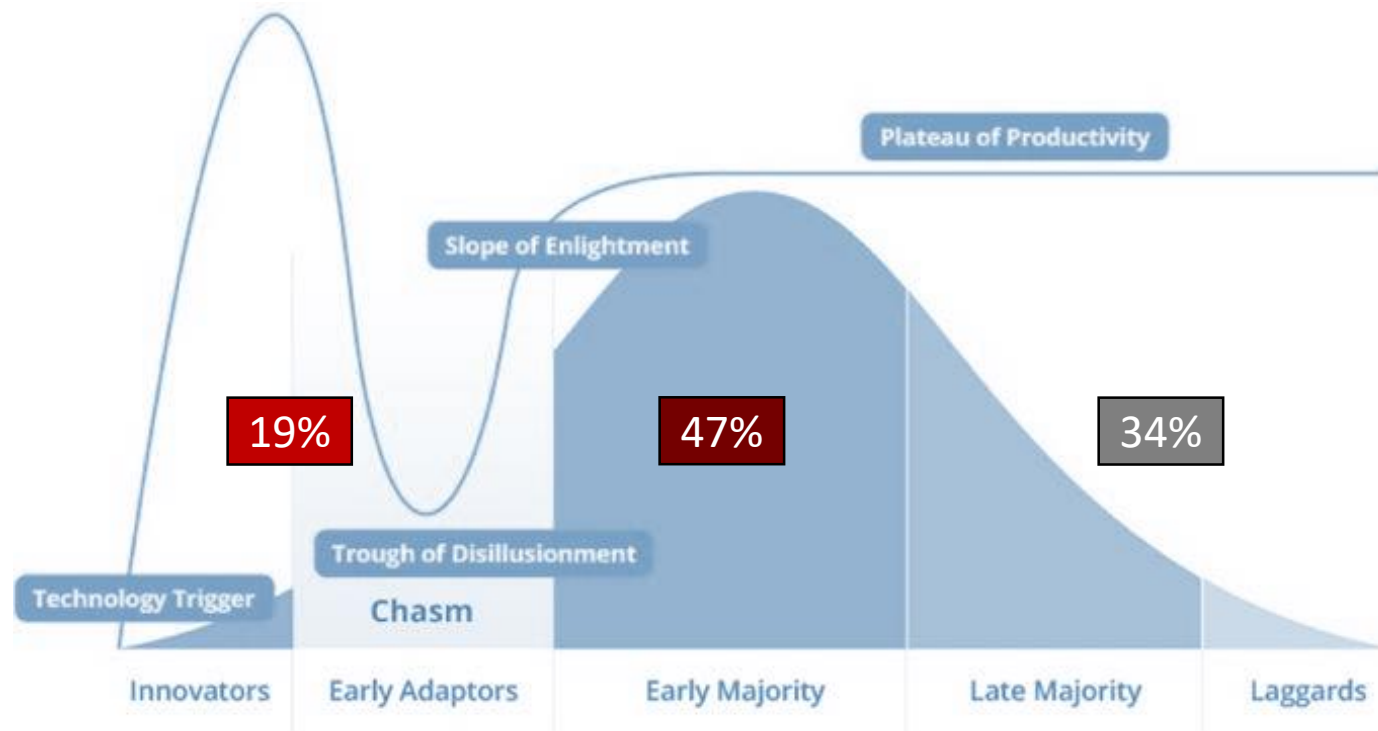
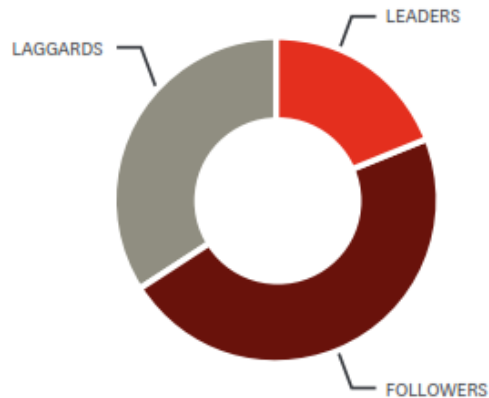
- Accelerates:
  - Understand the hype cycle<sup>1</sup> and bridge the chasm<sup>2</sup>...
  - Empower others to enlighten and influence adoption
- Transformation:
  - A marked change, as in appearance or character, usually for the better<sup>3</sup>. e.g. documents to models
  - Lead and support the 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>





# Accelerating: Technology Adoption – Hype and Chasm



**Rating of company's digital maturity in leadership and management<sup>5</sup>**

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](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



# Transformation: Change Management and Leadership

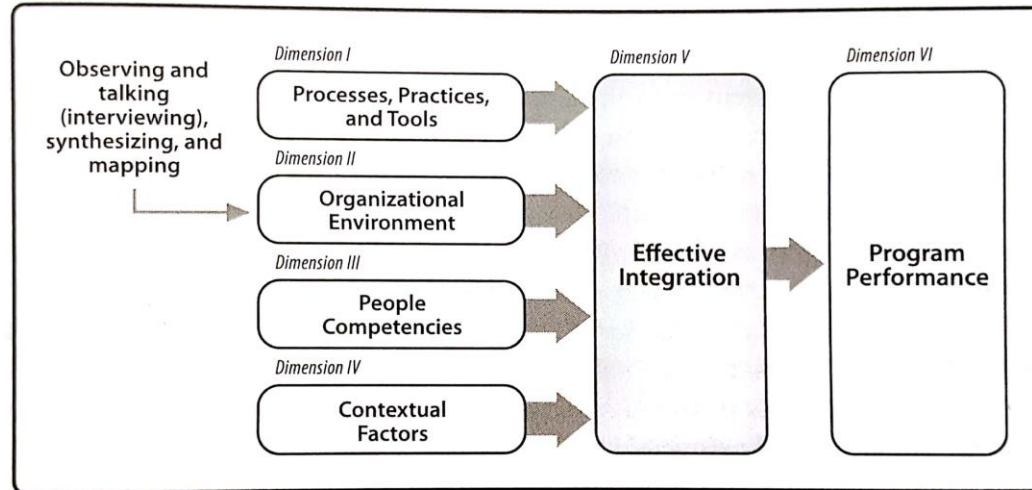


Figure 15-1: The dimension of the Integration Framework in view for initial engagement activities

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 a human  
centric endeavor.

Models should enable shared  
human understanding



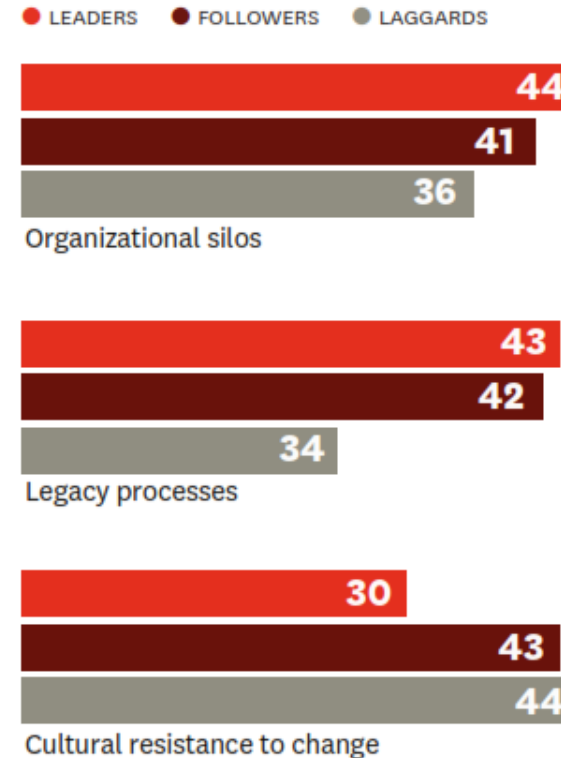
# Transformation: Driving Digital Transformation<sup>1</sup>

## Keys to Digital Transformation (HBR Report)

- Start from the customers perspective
- Digital leadership starts at the top
- Engage in a discussion of trends
- Think about agile
- Use examples to make it real
- Need a foundation of trust
- Use KPIs for sharing knowledge
- Break down walls wherever possible
- Need digital coaches or mentors
- Create appropriate learning forums

## KEY BARRIERS TO DIGITAL BUSINESS DEVELOPMENT

Percentage who said, when it comes to digital business, these are the primary issues holding their organization back. [CHECK UP TO THREE]



1. Driving Digital Transformation: New Skills for Leaders, New Role for the CIO, Harvard Business Review



# Model Based Discipline: The Next Evolutionary Step

## Model Based Discipline

- Models are not new to us
- In some ways we're going "back to the future"
- Transformation is not a wholesale change
- Model based is the next evolutionary step
- A transformation whose time has come

## 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:

- See Vision 2025, what are the business objectives, metrics, stakeholders, technologies, priorities etc.



"Make sure that those, 'Ideas whose time has come', get launched today."



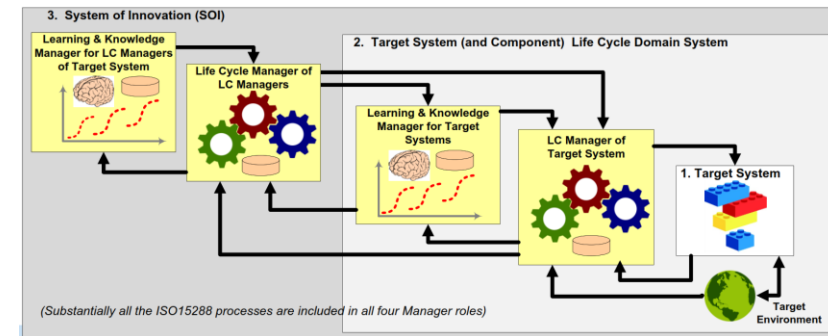
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# Systems, Boundaries and Change

## Innovation - Management of Change - Transformation



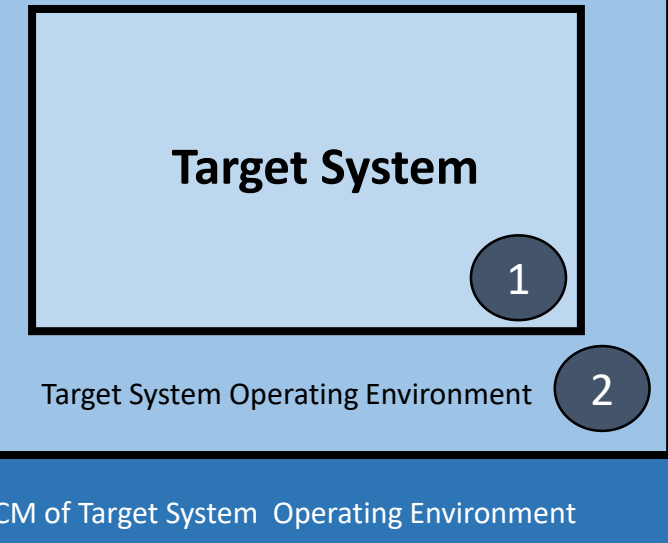
Agile Systems Engineering Life Cycle Management Pattern

### Life Cycle Management of System 2

- Advancing & Adapting
  - System Development
  - Support Processes
  - Manufacturing
  - Production
  - Distribution
  - Marketing

### Life Cycle Management of System 1(Target System)

- System Development
- Support Processes
- Manufacturing
- Production
- Distribution
- Marketing





# Transformation Strategy Overview

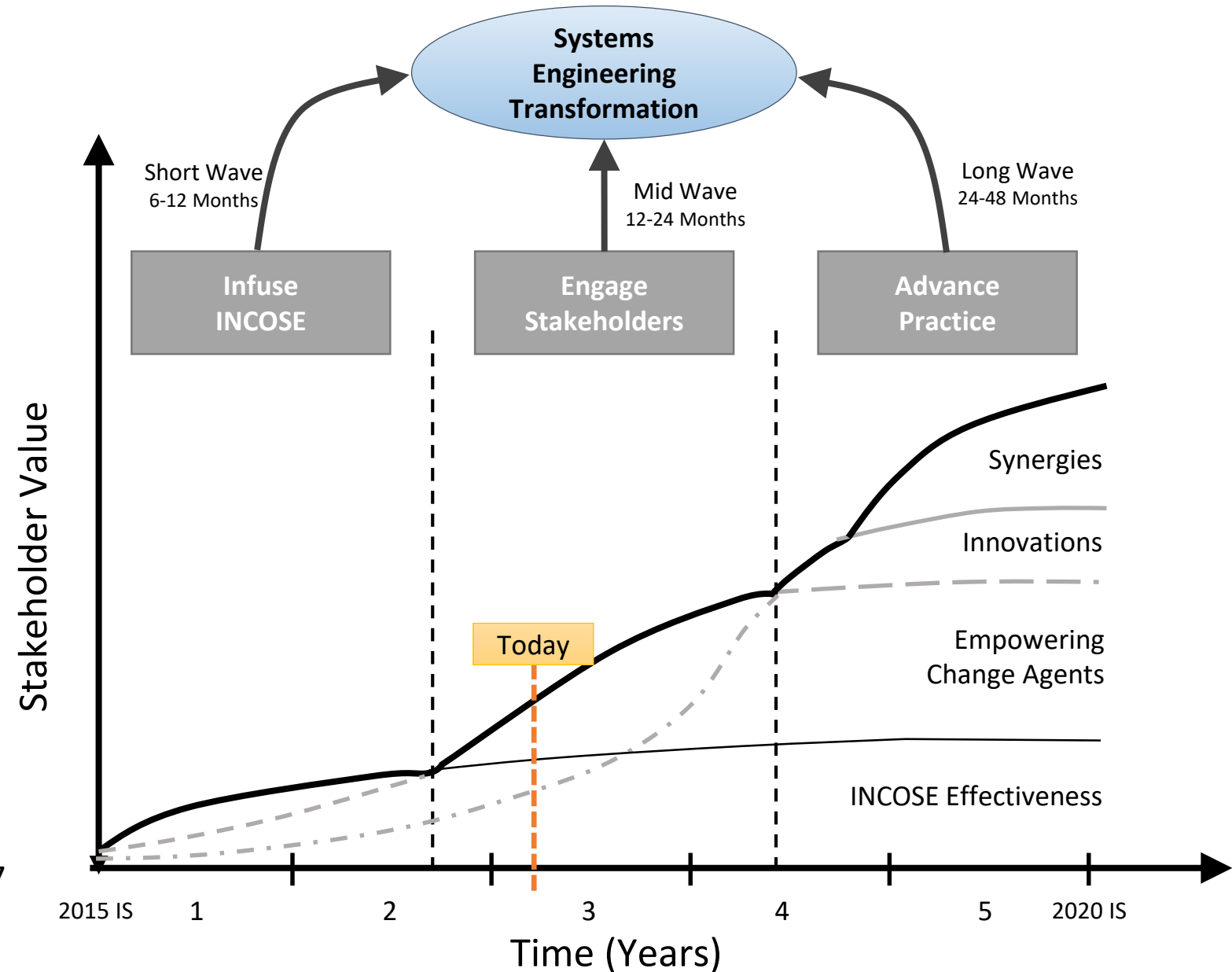
- Vision
- Mission
- Mission Areas
- Goals
- Objectives

<b>Vision</b>	<b>Systems Engineering is acknowledged as a model based discipline</b>		
<b>Mission</b>	<b>INCOSE accelerates the transformation of systems engineering to a model-based discipline</b>		
<b>Mission Area #</b>	<b>1</b>	<b>2</b>	<b>3</b>
<b>Mission Area</b>	<b>Infuse INCOSE</b>	<b>Engage Stakeholders</b>	<b>Advance Practice</b>
<b>Mission Area</b>	<b>What can INCOSE Do?</b>	<b>What is practiced and needed?</b>	<b>What is possible?</b>
<b>Goals</b>	Infuse model based methods throughout INCOSE products, activities and WGs	Engage stakeholders to assess the current state of practice, determine needs and values of model based methods	Advance stakeholder community model based application and advance model based methods.
<b>Objective 1 Foundations</b>	Inclusion of model based content in INCOSE existing/new products (Vision, Handbook, SEBoK, Certification, Competency Model, etc.)	Define scope of model based systems engineering with MBE practice and broader modeling needs	Advance foundational art and science of modeling from and best practices across academia, industry/gov. and non profit.
<b>Objective 2 Expand Reach</b>	Expand reach within INCOSE of MBSE Workshop; highlight and infuse tech ops activities with more model based content (products, WGs etc.)	Identify, categorize and engage stakeholders and characterize their current practices, enablers and obstacles	Increase awareness of and about stakeholders outside SE discipline of what is possible with model based methods across domains and disciplines (tech/mgmt)
<b>Objective 3 Collaborate</b>	Outreach: Leverage MOUs to infuse model based content into PMI, INFORMS, NAFEMS, BIM, ASME and others, sponsoring PhD Students, standardization bodies, ABET	Build a community of Stakeholder Representatives to infuse model based advances into organizations practicing systems engineering.	Initiate, identify and integrate research to advance systems engineering as a model based discipline
<b>Objective 4 Assessment/ Roadmap</b>	Assess INCOSE's efforts (WG, Objectives, Initiatives etc.) for inclusion of model based methods across the Systems Modeling Assessment/Roadmap	Engage stakeholder community with Systems Modeling Assessment/ Roadmap to better understand the state of the practice of MBSE. Push and pull content from stakeholders (change agents and the "to be convinced")	Provide baseline assessment framework, Systems Modeling Roadmap, to create a concrete measure of current state of the art of what's possible/what's the potential.



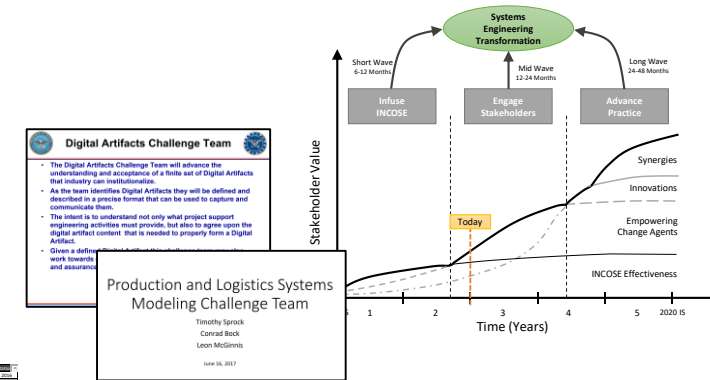
# Strategy: Notional Timeline

- Mission Areas
- Internal Short Wave
- External Mid Wave
- Advancing Long Wave
- Waves Run Concurrently
- Activities build on each other
- Important to fully engage stakeholder this next year. Pilot Assessment & Roadmap this CY and kick-off more broadly at 2017 IW.

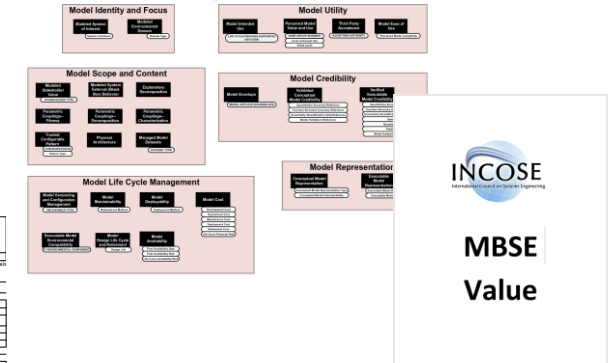
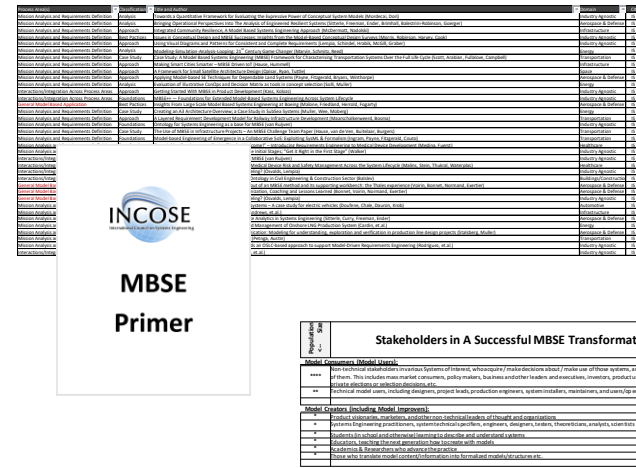




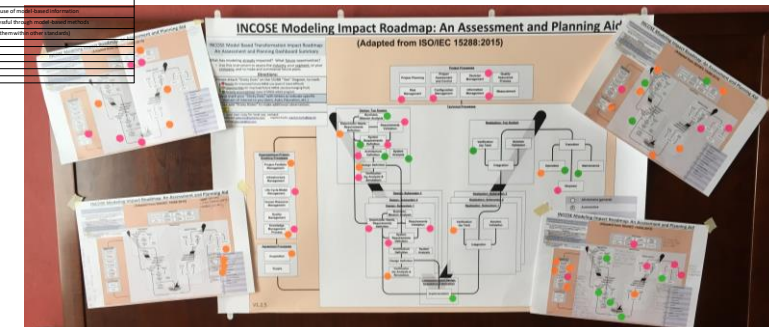
- ST4SE – SE Semantic/Ontology Effort
- New MBSE Initiative Challenge Teams and V&V
- 2018 IS MBSE Workshop “TED Talks” & Case Studies



- Model Based Exemplars
- Assessment Roadmap Model Features
- INCOSE MBSE Primer
- Value Briefing / Case Studies / ROI
- Ambassador program by sector
- Transformation FAQs



- Webinar November
- Strategy & Action Plan
- Stakeholder List
- Assessment Roadmap
- Enablers & Roadblocks
- Web search improvements
- Transformation website created
- Integration of MBSE throughout IW
- Many briefings at conferences and institutions on Systems Engineering Transformation

[illegible]



# Transformation Stakeholders

The purpose of the Vision 2025 is to *inspire and guide* the direction of systems engineering across diverse stakeholder communities, which include:

- Engineering Executives
- Policy Makers
- Academics & Researchers
- Practitioners
- Tool Vendors

This vision will continue to evolve based on stakeholder inputs and on-going collaborations with professional societies.



Population Size ↓	Stakeholders in A Successful MBSE Transformation
	<b>Model Consumers (Model Users):</b>
****	Non-technical stakeholders in various Systems of Interest, who acquire / make decisions about / make use of those systems, and are informed by models of them. This includes mass market consumers, policy makers, business and other leaders and executives, investors, product users, voters in public or private elections or selection decisions, etc.
**	Technical model users, including designers, project leads, production engineers, system installers, maintainers, and users/operators
	<b>Model Creators (including Model Improvers):</b>
*	Product visionaries, marketers and other non-technical leaders of thought and organizations
*	Systems Engineering practitioners, system technical specifiers, engineers, designers, testers, theoreticians, analysts, scientists
*	Students (in school and otherwise) learning to describe and understand systems
*	Educators, teaching the next generation how to create with models
*	Academics & Researchers who advance the practice
*	Those who translate model content/information into formalized models/structures etc.
	<b>Complex Idea Communicators:</b>
**	Marketing professionals
**	Academics/Educators, especially in complex systems areas of engineering and science, public policy, other domains, and including curriculum developers as well as teachers
**	Leaders of all kinds
**	Leaders responsible to building their organization's MBSE capabilities and enabling MBSE on their projects
	<b>Model Infrastructure Providers, Including Tooling, Language and Other Standards, Methods:</b>
*	Suppliers of modeling tools and other information systems and technologies that house or make use of model-based information
*	Methodologists, consultants, others who assist individuals and organizations in being more successful through model-based methods
*	Standards bodies (including those who establish modeling standards as well as others who apply them within other standards)
	<b>INCOSE and other Engineering Professional Societies</b>
*	As a deliverer of value to its membership
*	As seen by other technical societies and by potential members
*	As a great organization to be a part of
*	As promoter of advance and practice of systems engineering and MBSE

Model Consumers

Model Creators

Complex Idea Communicators

Model Infrastructure Providers

INCOSE and other Professional Societies



# CAB Breakout: Assessment / Roadmap Instrument:

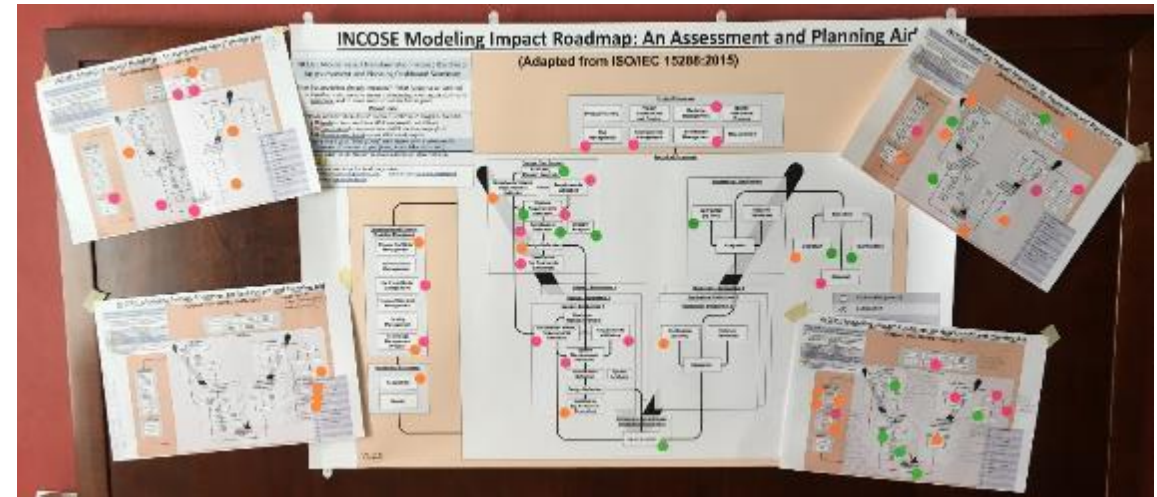
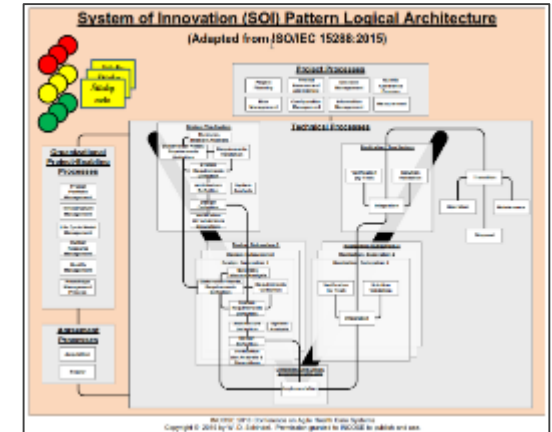
- Intentionally very simple:
  - Focused “one level down” from the intention to apply model-based methods to SE.
  - Level of detail = the individual ISO 15288 life cycle processes.
- Intended to address these important questions:
  - What are you trying to improve? (Which 15288 processes?)
  - Where are the biggest potential gains? The easiest potential gains?
  - What is already improved?
- But not:
  - How will your goals be accomplished?
  - What are the details of your plan?
  - Not a CMMI

**Break out session:  
Test Drive and Data Collection**

- Directions:
  - Break into teams and discuss the following, then . . .
  - In the domain model, identify the 5 highest cases of:
    - **Needs** for model-enabled progress (even if most difficult)
    - **Opportunities** for model-enabled progress (low-hanging fruit)
    - **Already accomplished** examples of model-enabled progress

**Sticky note:** In the same model diagram, identify any potential corrections or improvements to the model.

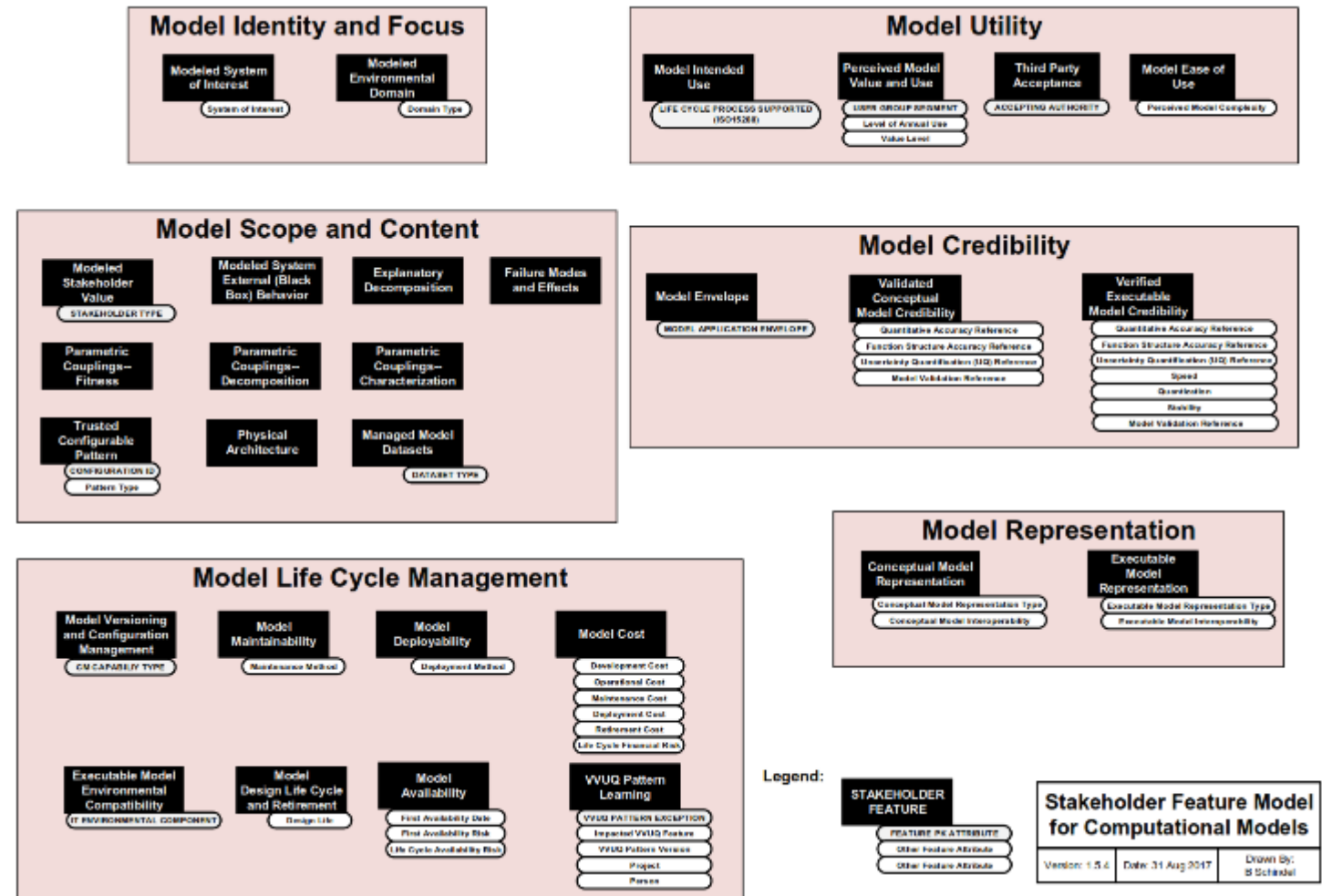
Note: This includes not just selection of life cycle processes (e.g., Architecture Definition), but also system domains (e.g., Product, Manufacturing, Distribution, Service, Enterprise, etc.)





# INCOSE/ASME Model Stakeholder Features Pattern

- Being created in the INCOSE supported ASME VV50 standards committee project, also in use in the INCOSE Transformation effort.
- Metadata in the form of a model itself, describing “what is in the model” – like a barcode which describes a product.
- 29 Model Features, spread across 6 feature groups





# MBSE Wiki and Website

**MBSE Wiki**  
WE SET THE STANDARD

Back To MRSE Initiative Wiki

## MBSE Workshop and Related Meetings at INCOSE IW 2017 (Jan. 28 - 31)

Driven by the INCOSE Board's strategic objective to become a model-based discipline, the Systems Engineering Transformation effort and Model Based Systems Engineering (MBSE) Initiative continue to expand upon the highly successful MRSE Workshop, now to the International Workshop (IW) 2017. MBSE will be at the IW. In alignment with the INCOSE's Systems Engineering focus on current practices, advancements and collaboration.

This page provides an overview of the MBSE related info. Each group is encouraged to maintain a meeting page, application, or INCOSE website. Presentations and other these pages.

### MBSE Workshop Objectives

Accelerate transformation of systems engineering to a model-based discipline.

- Advance and mature the MBSE Practice
- Mainstream Model Based Systems Engineering
- Promote and advance the role of MBSE in global
- Get authoritative information on MBSE out to practitioners
- Infuse model-based methods throughout INCOSE
- Engage stakeholders to assess the current state
- Determine needs and value of model-based methods
- Advance stakeholder community and advance the

### IW 2017 MBSE Schedule

The following PDF file contains the full IW 2017 MBSE Workshop agenda.

This agenda includes the main MBSE workshop schedule linked from the tables below as they become available.

MBSE Workshop Schedule		
All MBSE Workshop sessions are being held in Room F, with the exception of the MRSE reception on Sunday, which will be held in the Zen Garden.		
Link to presentations will be added to the agenda items below as they become available.		
Saturday, January 28, 2017		
Time	Agenda Item/Presentation Link	Presenter
10:30-11:30	MBSE Initiative	Mark Sampson (General)
11:00-12:30	Robust Design and Process Effectiveness through Model-Based Methods	Casey Medina & Kristina Puente (Terasa Medical)
13:00-13:30	Systems Engineering Transformation Strategic Objective	Troy Peterson (SSA)
13:30-14:15	Agile Model Engineering	Kristen Robinson (U.S. Coast Guard (USCG))
14:15-15:15	Model-Centric Decision Making	Diana Rhodes (MIT)
15:30-16:15	How to Make Model-Based Systems Engineering Justify It	Ed Conell (Sandia National Lab)
16:15-17:00	Future Directions for SysML v2	Sandy Proctor (MIT)
17:00-17:45	MBSE & SysML Education	Russell Peak (Google Tech)
17:45-18:00	MBSE Workshop Wrap-up & Look ahead	Mark Sampson (General) & Troy Peterson (SSA)
Other groups with MBSE-related topics on Sunday (see group section below for details)		
Time Slot	Group	
13:00-17:45	Test Integration and Model Lifecycle Management Working Group	
Sunday, January 29, 2017		
Time	Agenda Item/Presentation Link	Presenter
9:00-9:30	MBSE Initiative & SE Transformation	Mark Sampson (General) & Troy Peterson (SSA)
9:30-10:30	Closing the Design Cycle Loop with Executable Requirements and OSCL	D. Sherman (Procter & Gamble) & H. Tammescht (Modeler) & J. Larrea (The Rouse Co.)
10:30-11:00	JPL Model-Based Systems Engineering Case Study	Chris Culp (NASA JPL)
11:00-11:30	NASA Model-Based Systems Engineering Pathfinder 2016 Summary and Path Forward	K. Welland & J. Holladay (NASA)
11:30-12:00	ESA Model-Based Systems Engineering Case Study	Jana Lorenz (European Space Agency)
12:00-12:30	Systems Engineering at Ford Motor Company Case Study	Christopher Dawley (Ford Motor Company)
13:30-14:00	Model-Based Engineering at Raytheon Case Study	Stephanie Chiles (Raytheon)
14:00-14:30	MBSE Foundation Overview	Linda VanPelt (Radix)

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## Mission & Objectives

Visit the [MBSE Initiative project site](#)

Link to [SE Transformation site](#)

## Leadership

Sandy Proctor

## Challenge Team

Modeling and Interoperability

Space Systems

Telescope Model

Biomedical Data

GEOS Model

Activity Teams

MBSE Usability

Methodology

## For Further Information

See the [MBSE Initiative](#) for information pertaining to MBSE activities. Contact the IAP for SE Transformation for further information.

[Troy A. Peterson](#)

## SE Transformation

### Objective:

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

Build a broad community that promotes and advances model-based engineering, and the role that model-based systems engineering plays in it.

### 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 meet
- Connect to other MBSE cross-domain standards like Building Information Modeling (BIM)
- Get authoritative information on MBSE out to practitioners and the broader community
- Infuse MBSE into SysML
- Align with SE vision 2025 (see page 34-36)

### From:

- Model-based systems engineering has grown in popularity as a way to deal with the limitations of document-based approaches, but it is still in an early stage of maturity similar to the early days of CAD/CAM

### To:

- Formal systems modeling is standard practice for specifying, analyzing, designing, and verifying systems, and is fully integrated with other engineering models. System models are integrated to the application domain, and include a broad spectrum of models for representing all aspects of systems. The use of internet-driven knowledge representation and multimedia technologies enable highly efficient and shared human understanding of systems, the related environment, that span the full life cycle from concept through development, manufacturing, operations and support.

[http://www.omgwiki.org/MBSE/doku.php?id=mbse:incose\\_mbse\\_iw\\_2017](http://www.omgwiki.org/MBSE/doku.php?id=mbse:incose_mbse_iw_2017)

<http://www.incose.org/about/strategicobjectives/transformation>



# Accomplishments: Website / Discoverability Improvements

## Transformational Working Groups (WG)

- Agile Systems and Systems Engineering
- Lean Systems Engineering
- Model Based Systems Engineering Initiative
- Model-based Conceptual Design
- Object-Oriented SE Method
- MBSE Patterns
- Very Small Entities (VSE)
- Systems Science
- Tools Integration & Model Lifecycle Management
- INCOSE-NAFEMS Collaboration
- Ontology

## Visit site for WG charters and to learn more

<http://www.incose.org/ChaptersGroups/WorkingGroups/transformational>

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  - ▶ Analytic Enablers
  - ▶ Application Domains
  - ▶ Transformational
  - ▶ Process Enablers
- Corporate Advisory Board
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- ▶ Initiatives

## Transformational Enablers

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**Transformational Enablers - Troy Peterson**

Working Groups with public content pages managed on the INCOSE public site:

- Agile Systems & SE
- Lean Systems Engineering
- MBSE Initiative
- MBSE Patterns
- Model Based Concept Design
- Object-Oriented SE Method
- Very Small Entities (VSE)
- Systems Science
- Tool Integration and Model Lifecycle Management
- INCOSE-NAFEMS Collaboration
- Ontology

Most INCOSE Working Groups manage work in process in the INCOSE Connect library, accessible only to members and invited guests.

**Working Group Charters**

Click Download to view the Working Group Charter

File	Type	Size	Date	Download
Agile Systems and Systems Engineering	PDF	191.16 KB	30 May, 2017	<a href="#">Download</a>
Lean Systems Engineering	PDF	73.58 KB	25 Oct, 2014	<a href="#">Download</a>
Model-based Conceptual Design	PDF	210.54 KB	25 Oct, 2014	<a href="#">Download</a>
Object-Oriented SE Method	PDF	150.84 KB	25 Oct, 2014	<a href="#">Download</a>
MBSE Patterns	PDF	933.21 KB	26 Jul, 2016	<a href="#">Download</a>
Process Improvement	PDF	130.54 KB	25 Oct, 2014	<a href="#">Download</a>
Very Small Entities (VSE)	PDF	232.28 KB	07 May, 2016	<a href="#">Download</a>
Systems Science	PDF	114.51 KB	25 Oct, 2014	<a href="#">Download</a>
Tools Integration & Model Lifecycle Management	PDF	378.40 KB	07 May, 2016	<a href="#">Download</a>

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**INCOSE** INCOSE Agile Systems and Systems Engineering WG Charter

1. PURPOSE

Purpose

The purpose of this working group is to identify and develop a body of knowledge that will enhance the understanding of agile systems engineering and its application to the development of complex systems. The working group will focus on the development of agile systems engineering standards, guidelines, and best practices that will be used by the systems engineering community to improve the quality and efficiency of the systems engineering process.

Scope

The scope of this working group is to develop agile systems engineering standards, guidelines, and best practices that will be used by the systems engineering community to improve the quality and efficiency of the systems engineering process. The scope of this working group is to develop agile systems engineering standards, guidelines, and best practices that will be used by the systems engineering community to improve the quality and efficiency of the systems engineering process.

Deliverables

The deliverables of this working group are to develop agile systems engineering standards, guidelines, and best practices that will be used by the systems engineering community to improve the quality and efficiency of the systems engineering process. The deliverables of this working group are to develop agile systems engineering standards, guidelines, and best practices that will be used by the systems engineering community to improve the quality and efficiency of the systems engineering process.

Timeline

The timeline of this working group is to develop agile systems engineering standards, guidelines, and best practices that will be used by the systems engineering community to improve the quality and efficiency of the systems engineering process. The timeline of this working group is to develop agile systems engineering standards, guidelines, and best practices that will be used by the systems engineering community to improve the quality and efficiency of the systems engineering process.

Membership

The membership of this working group is to develop agile systems engineering standards, guidelines, and best practices that will be used by the systems engineering community to improve the quality and efficiency of the systems engineering process. The membership of this working group is to develop agile systems engineering standards, guidelines, and best practices that will be used by the systems engineering community to improve the quality and efficiency of the systems engineering process.

Support

The support of this working group is to develop agile systems engineering standards, guidelines, and best practices that will be used by the systems engineering community to improve the quality and efficiency of the systems engineering process. The support of this working group is to develop agile systems engineering standards, guidelines, and best practices that will be used by the systems engineering community to improve the quality and efficiency of the systems engineering process.



# MBSE Initiative as an Incubator and Transformation Agent

- Digital Artifacts Challenge Team:
  - Identifying and characterizing MBSE digital artifacts across the lifecycle
- Production and Distribution Systems Challenge Team
  - Connecting models across the lifecycle – Industry 4.0, Supply Chain, Logistics
- Standardizing V&V of models (Collaboration ASME, INCOSE, NAFEMS)
  - Verification and Validation of Models – tied to ASME VV50 standards project
- (forming) Augmented Intelligence in Systems Challenge Team / WG
  - Enhancing Systems Engineering through Man Machine Collaboration
- (forming) MBSE Roadmap Challenge Team / WG
  - Capability roadmap to enhance development of MBSE capability

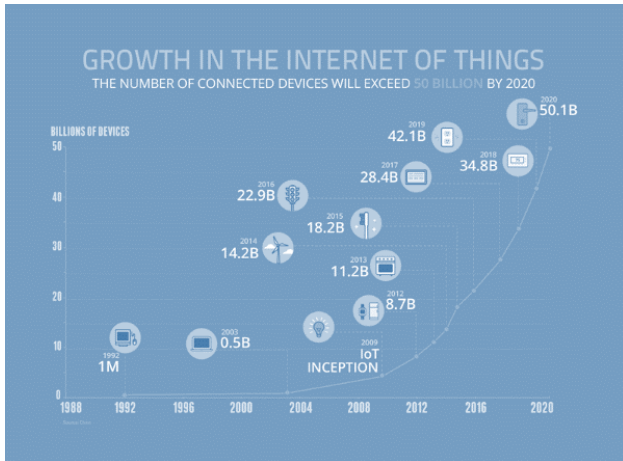
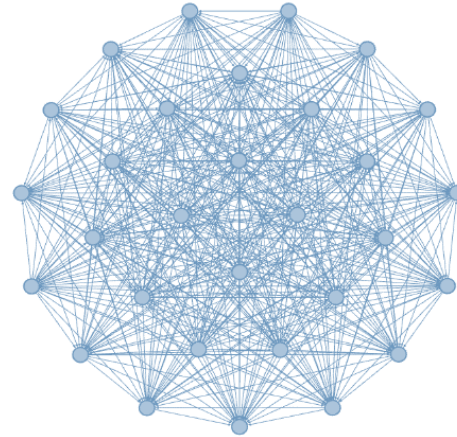
Generic life cycle (ISO/IEC/IEEE 15288:2015)

Concept stage	Development stage	Production stage	Utilization stage Support stage	Retirement stage
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# Overcoming the Challenge



...the only simplicity to be trusted is the simplicity to be found on the far side of complexity

Alfred North Whitehead (1861-1947)

***Simplicity does not precede complexity but follows it.***

Alan Perlis (1922 – 1990)

Out of intense complexities intense simplicities emerge

Winston Churchill (1874 – 1965)

***Simplicity is complexity resolved.***

Constantin Brancusi (1876-1957)

***Fools ignore complexity. Pragmatists suffer it. Some can avoid it. Geniuses remove it.***

Alan Perlis (1922 – 1990)

Any intelligent fool can make things bigger and more complex... It takes a touch of genius – and a lot of courage to move in the opposite direction.

Albert Einstein (1879 – 1955)

***A genius! For 37 years I've practiced fourteen hours a day, and now they call me a genius!***

Pablo de Sarasate (1844 – 1908)

***Lesson: Endure complexity, add tireless effort, and a touch of genius...***

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

W. Edwards Deming



“What if we don’t change at all ...  
and something magical just happens?”



**INCOSE’s Transformation Strategic Objective:**

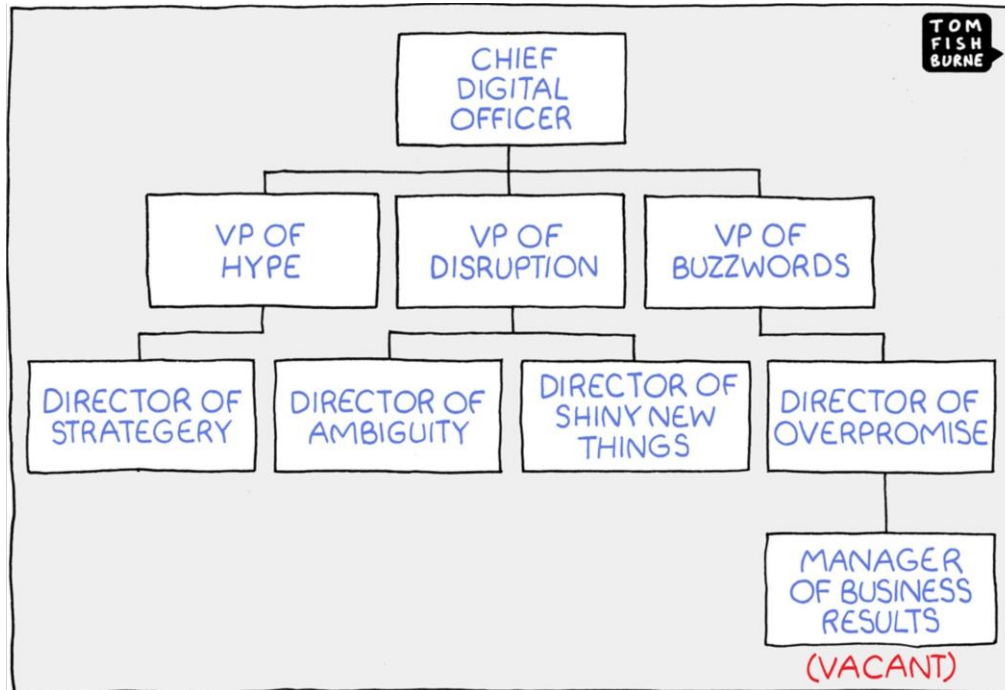
<http://www.incose.org/about/strategicobjectives/transformation>

**Engage as a Transformation Stakeholder Representative, visit:**

<http://www.incose.org/about/strategicobjectives/transformation>



# Q&A



**Digitally Zealous**



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**Digital Denial**



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