The Systems Engineering Vision 2035 - Towards the Future of Systems Engineering

Model Based Space Systems and Software Engineering Conference - MBSE2022

Toulouse, 22 – 24 November 2022

Ralf Hartmann, INCOSE President-Elect

International Council on Systems Engineering

A better world through a systems approach

INCOSE is the premier choice of systems engineers for professional development. With over 30 years of experience, we are shaping the future of systems engineering. We interact with systems engineers across the globe on a daily basis to set standards.

21,000

Members and CAB Associates

126

Corporate Members

52

Working Groups

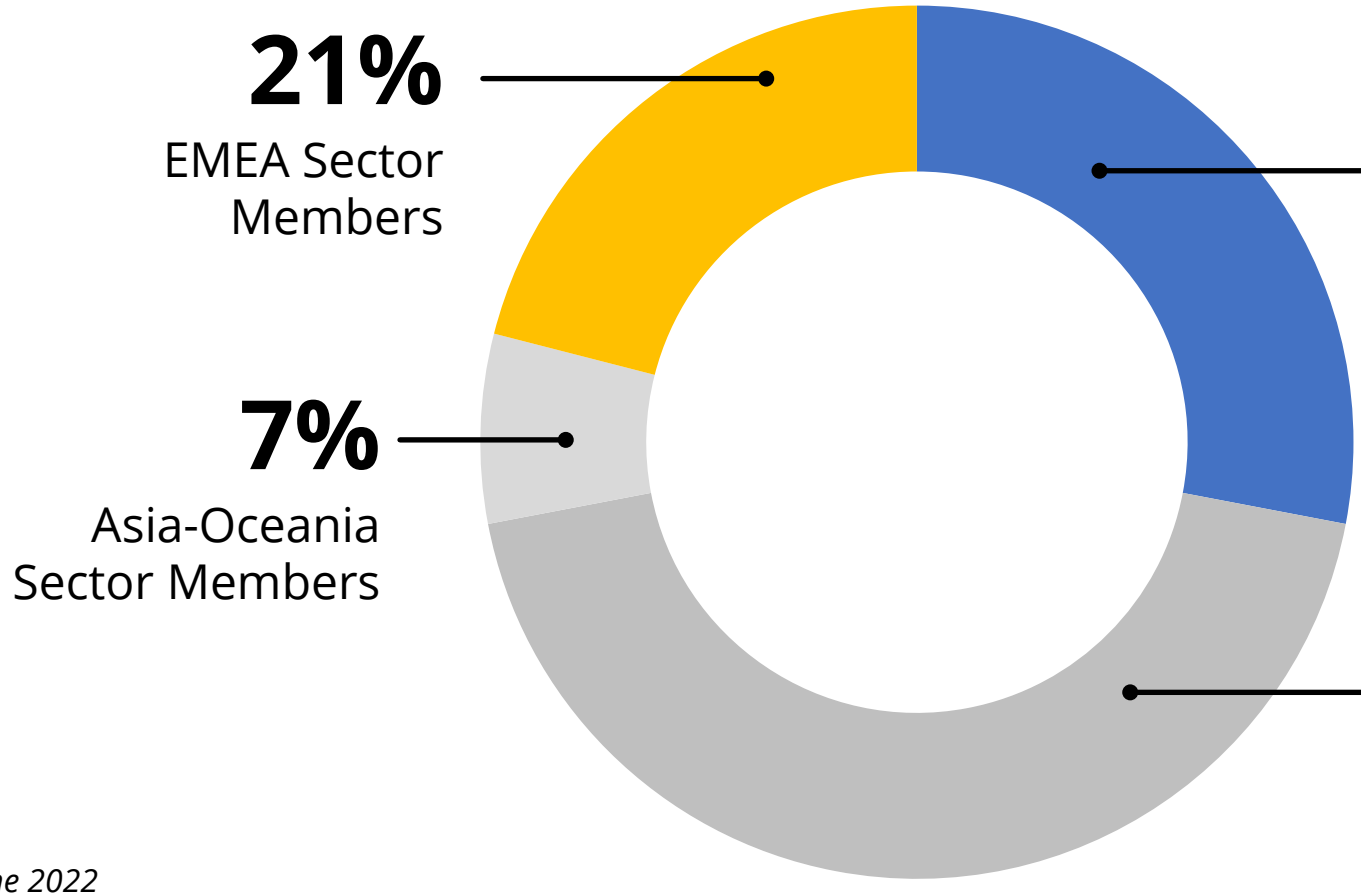
65

Chapters Worldwide

75

Countries with Active Members

INCOSE Member Breakdown



21%
EMEA Sector Members

28%
Americas Sector Members

7%
Asia-Oceania Sector Members

44%
CAB Associates

Stats from June 2022

INCOSE Members per ESA Member State


Austria
32


Belgium
19*


Canada
296*


Czech Republic
2


Denmark
98*


Estonia
1


Finland
20*


France
932*


Germany
1314*


Greece
3


Hungary
1


Ireland
23


Italy
245*


Luxembourg
1


Netherlands
698 *


Norway
36*


Poland
18*


Portugal
4*


Romania
13


Spain
193*


Sweden
355*


Switzerland
126*


United Kingdom
1542*

MEMBERS & ASSOCIATES **5972**

**for countries with chapters*

Working Groups

INCOSE has over 50 active Working Groups. Some of the WGs are:

- Space Systems
- Artificial Intelligence Systems
- Agile Systems & Systems Engineering
- Lean Systems Engineering
- MBSE Initiative
- MBSE Patterns
- Object Oriented Systems Engineering Method
- Complex Systems
- Systems of Systems
- PM-SE Integration
- Digital Engineering Information Exchange
- Tools Integration & Model Lifecycle Management
- Systems and Software Interface
- NAFEMS/INCOSE Systems Modelling & Simulation

Working groups are the resource practitioners need.

Discuss, collaborate, share in person, and online with a wide diversity of interests.

Create products to advance the state, art and practice of systems engineering.

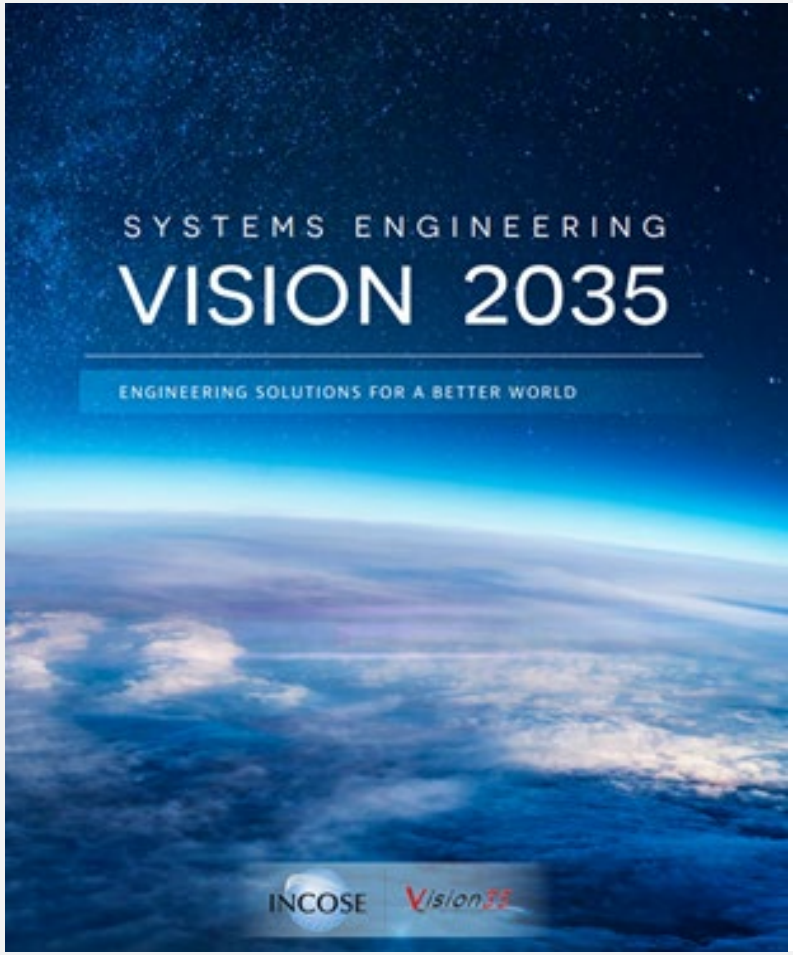
Help develop and review international standards

Bring value to other INCOSE stakeholders in your interest area

WGs run events, workshops, panels and much more

LEARN MORE: incose.org/workinggroups

Systems Engineering Vision 2035



This Systems Engineering Vision was sponsored by INCOSE and produced by a team of leaders from the systems community, with inputs from across industry, academia, and government. The Systems Engineering Vision 2035 addresses:

- The **Global Context for Systems** Engineering
- The **Current State of Systems Engineering**
- The **Future State of Systems Engineering**
- **Realizing the Vision**

We encourage you to work with INCOSE to help realize this vision.

The complete **Systems Engineering Vision 2035** is available as a **web version**, a **detailed version PDF** and an **executive summary PDF**

LEARN MORE: incose.org/sevision

Published in January 2022

The Global Context

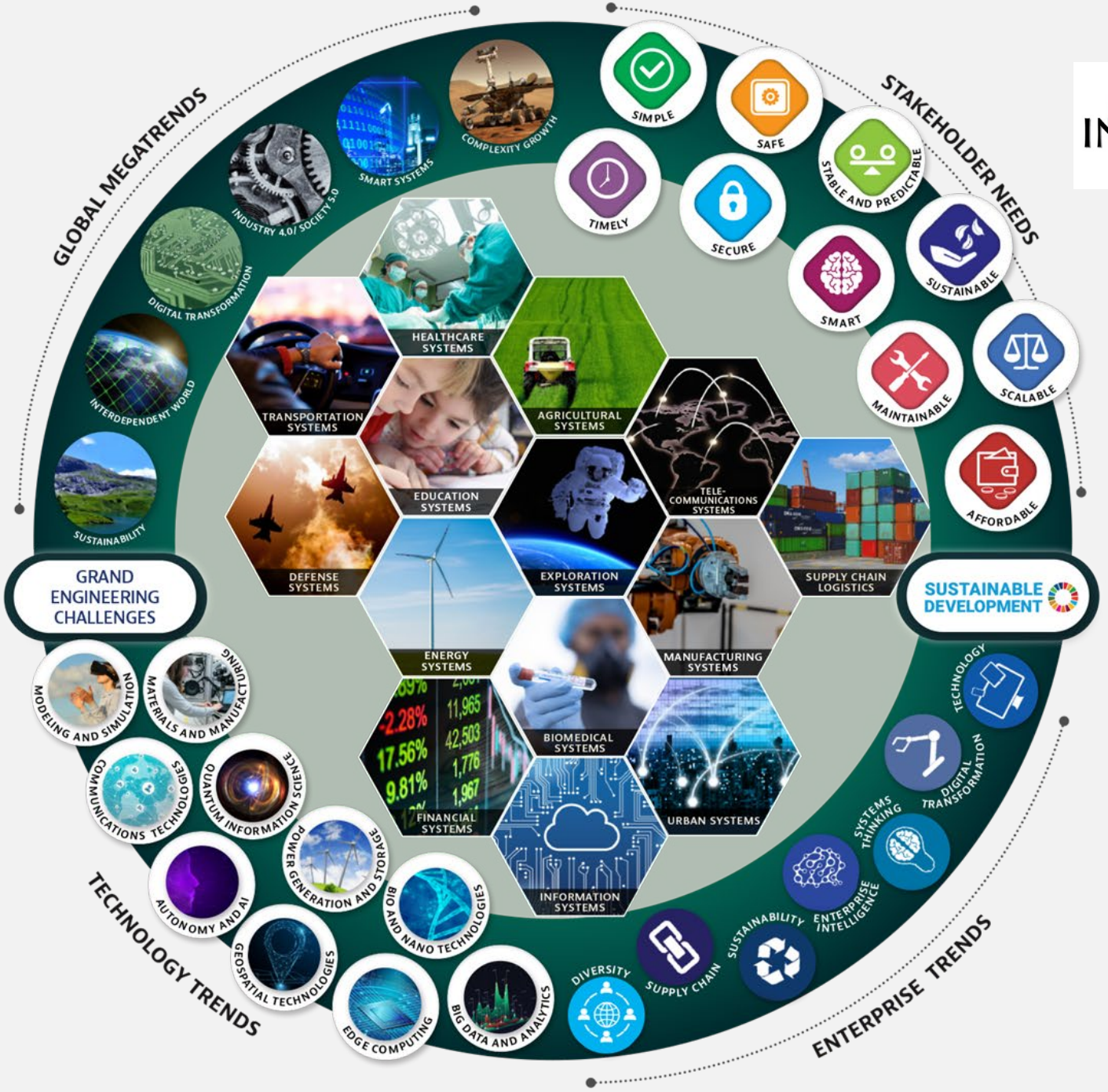
United Nations Sustainable Development Goals – a Proxy for Human Needs

All of these Goals require comprehensive System Solutions!

The Global Context

Systems adress a wide variety of domains

The Global Context



The Future State

Major Trends

The future of systems engineering is model-based, leveraging next generation modeling, simulation, and visualization environments.

Artificial Intelligence will assist the systems engineer be more efficient and effective to deliver solutions.

Data science techniques will be infused into the systems engineering practice to help make sense of large-scale data sets and assess complex systems.

Ongoing education and training will meet the demands for a growing number of systems engineers with the necessary technical and leadership competencies.

Systems engineering will be embraced by a greater number and broader range of small and medium enterprises to manage systems complexity and drive.

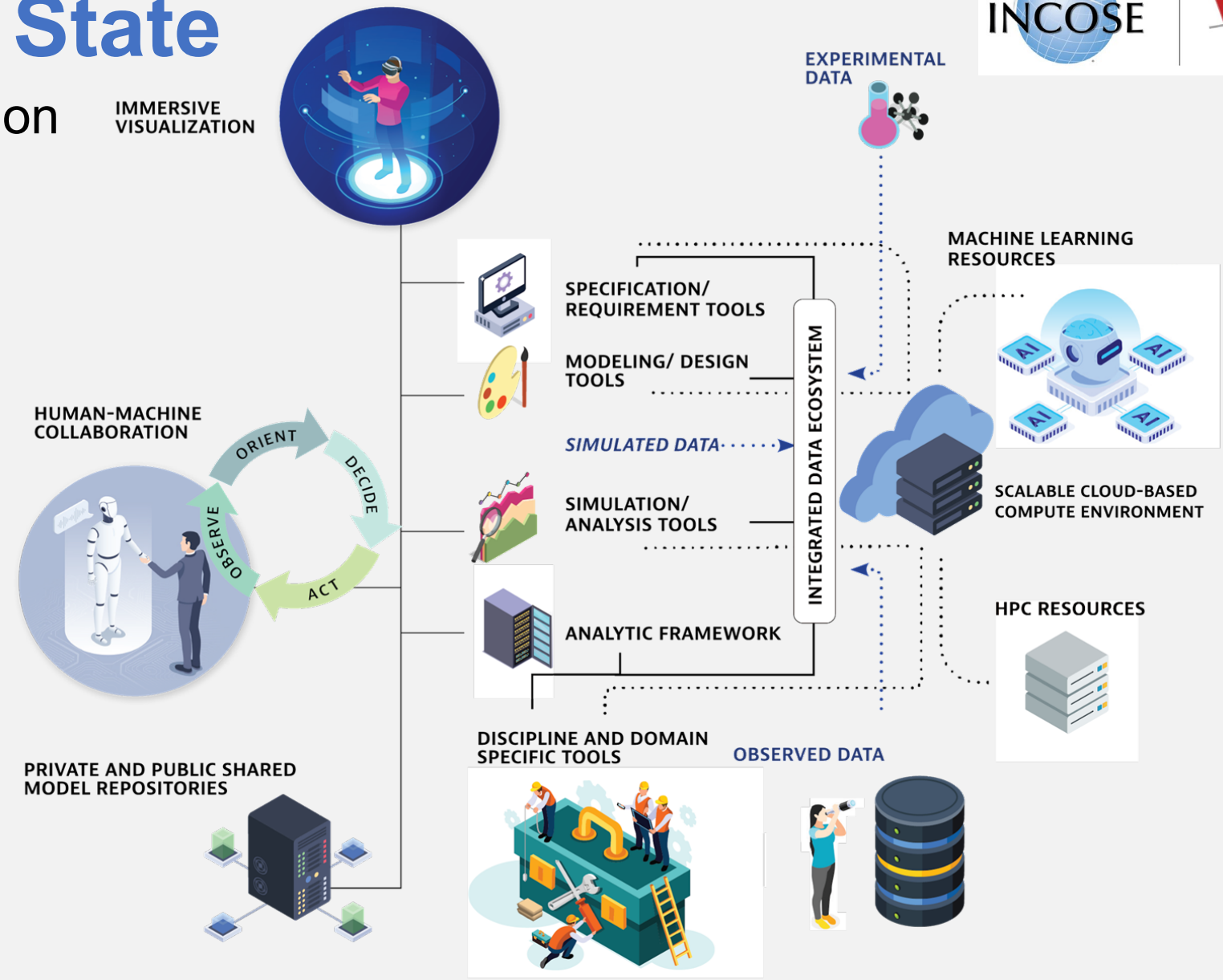
The Future State

From – To Scenarios

- **Digital Transformation**
- **Model-Based Practices**
- Architecting Flexible and Resilient Systems
- Engineering Trusted Systems
- **Infusing Data Science Methods into Practice to understand the Behavior**
- **Model Based Systems-of-Systems Practices**
- Understanding the Socio-technical Complex System with Human Systems Integration Methods
- Shifts in Acquisition Towards Collaborative Processes
- Theoretical Foundation
- Building the SE Workforce of the Future

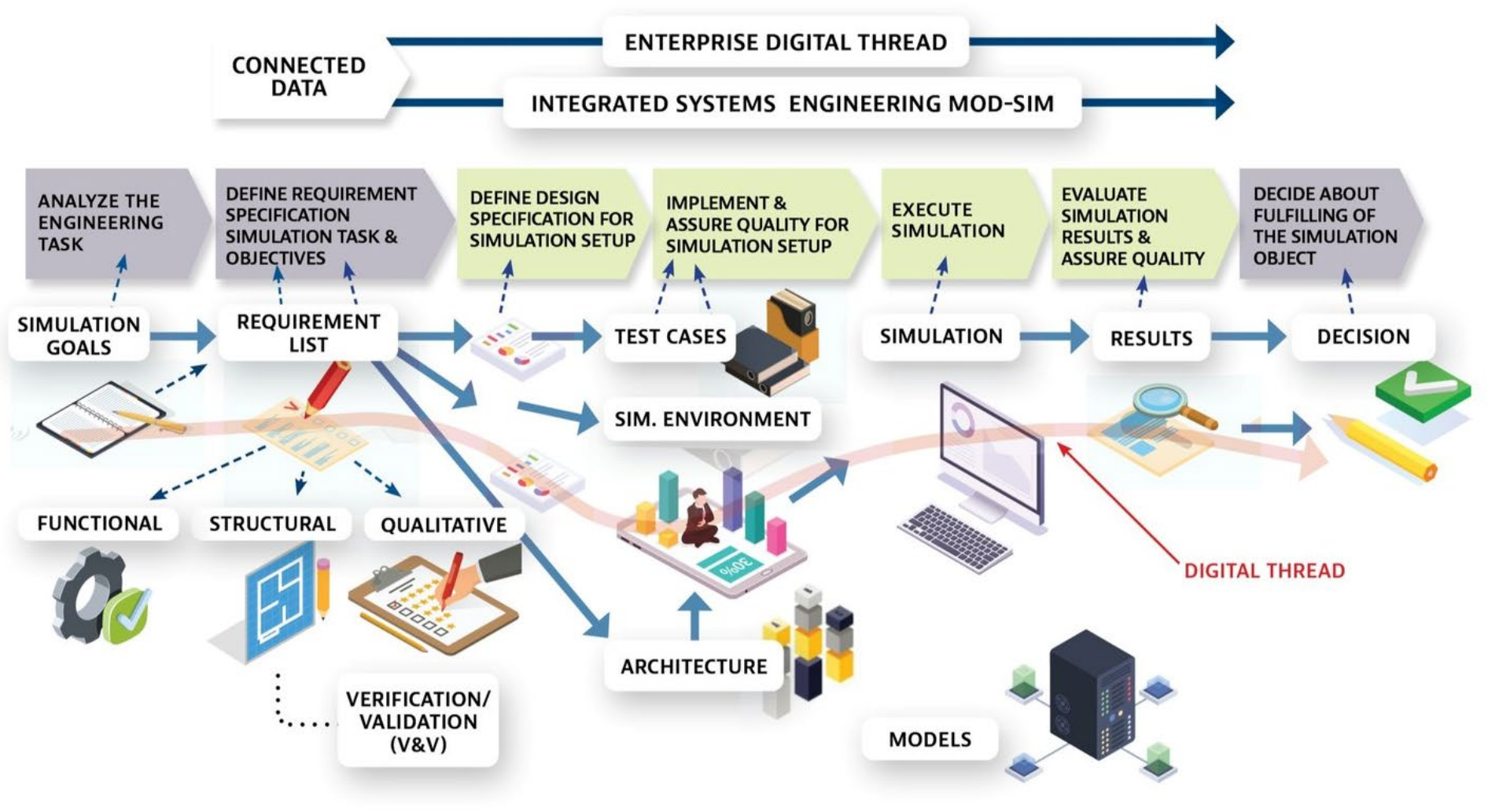
The Future State

Digital Transformation Impact on SE



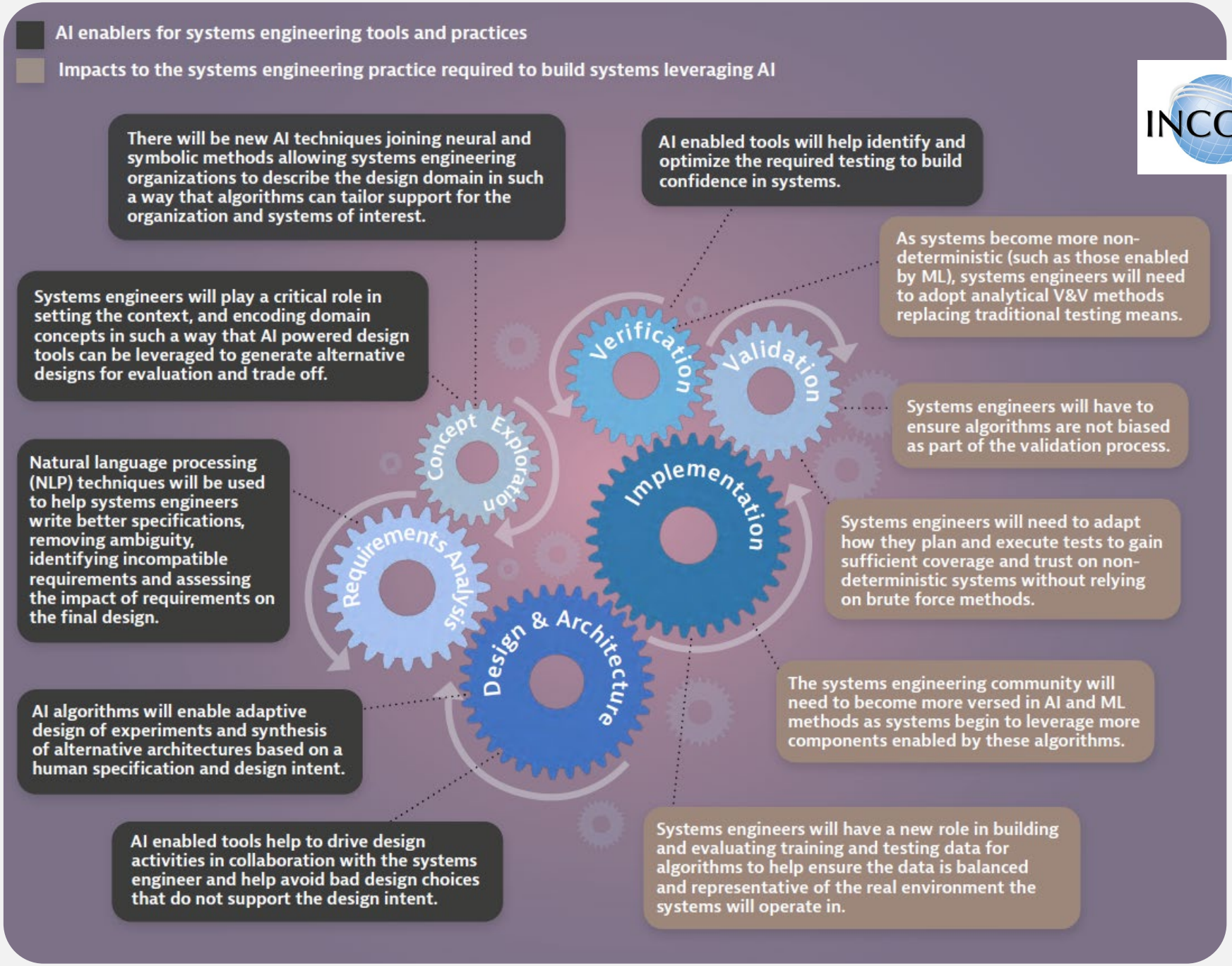
The Future State

The Future of Systems Engineering Is Predominantly Model-Based



The Future State

Impact of AI on Systems Engineering



The SE Challenges

(To address Gaps between Current and Future State)

Applications

1. Systems engineering contributes innovative solutions to major societal challenges.

2. Systems engineering demonstrates value for projects and enterprises of all scales, and applies across an increasing number of domains.

Practices

3. Systems engineering anticipates and effectively responds to an increasingly dynamic and uncertain environment.

4. Model-based systems engineering, integrated with simulation, multi-disciplinary analysis, and immersive visualization environments is standard practice.

5. Systems engineering provides the analytic framework to define, realize, and sustain increasingly complex systems.

6. Systems engineering has widely adopted reuse practices such as product-line engineering, patterns, and composable design practices.

Tools & Environments

7. Systems engineering tools and environments enable seamless, trusted collaboration and interactions as part of the digital ecosystem.

Research

8. Systems engineering practices are based on accepted theoretical foundations and taught as part of the systems engineering curriculum.

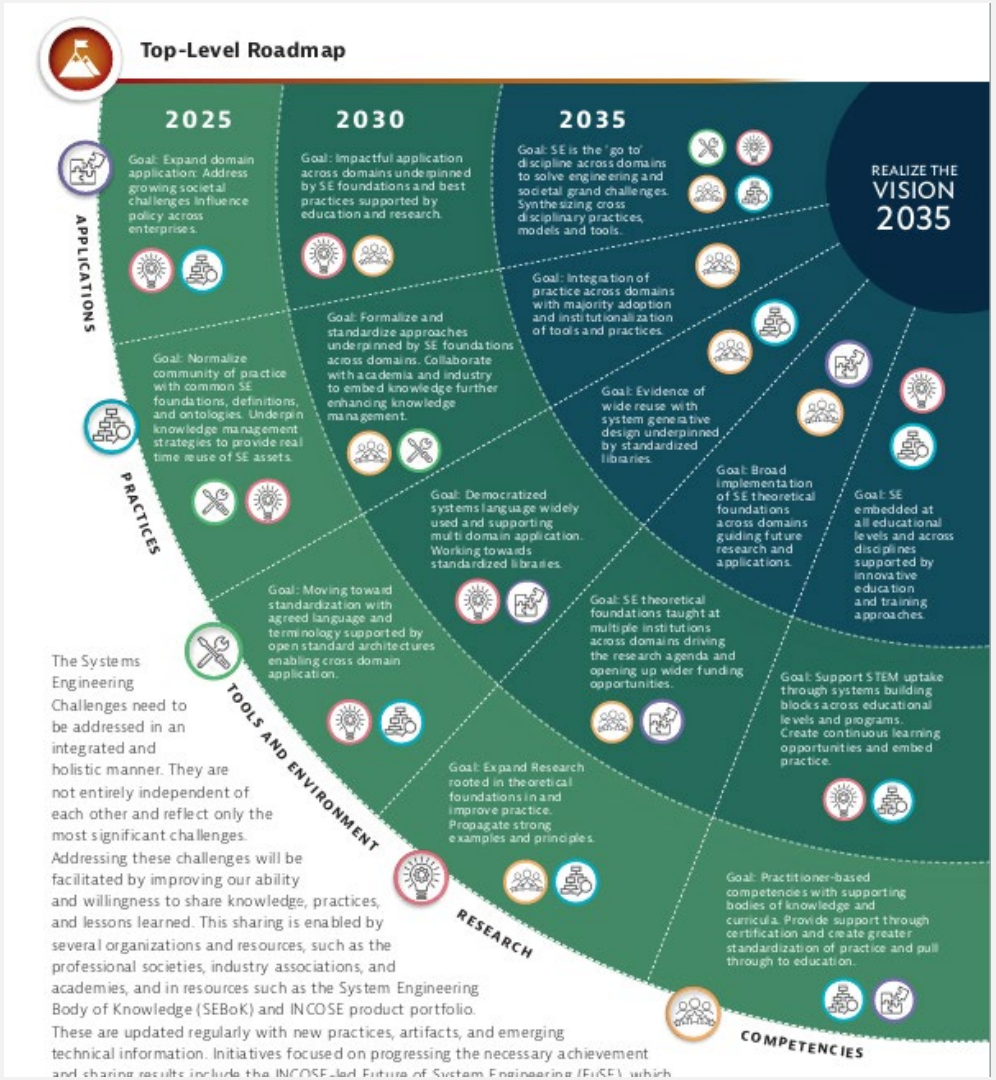
Competencies

9. Systems engineering education is part of the standard engineering curriculum, and is supported by a continuous learning environment.

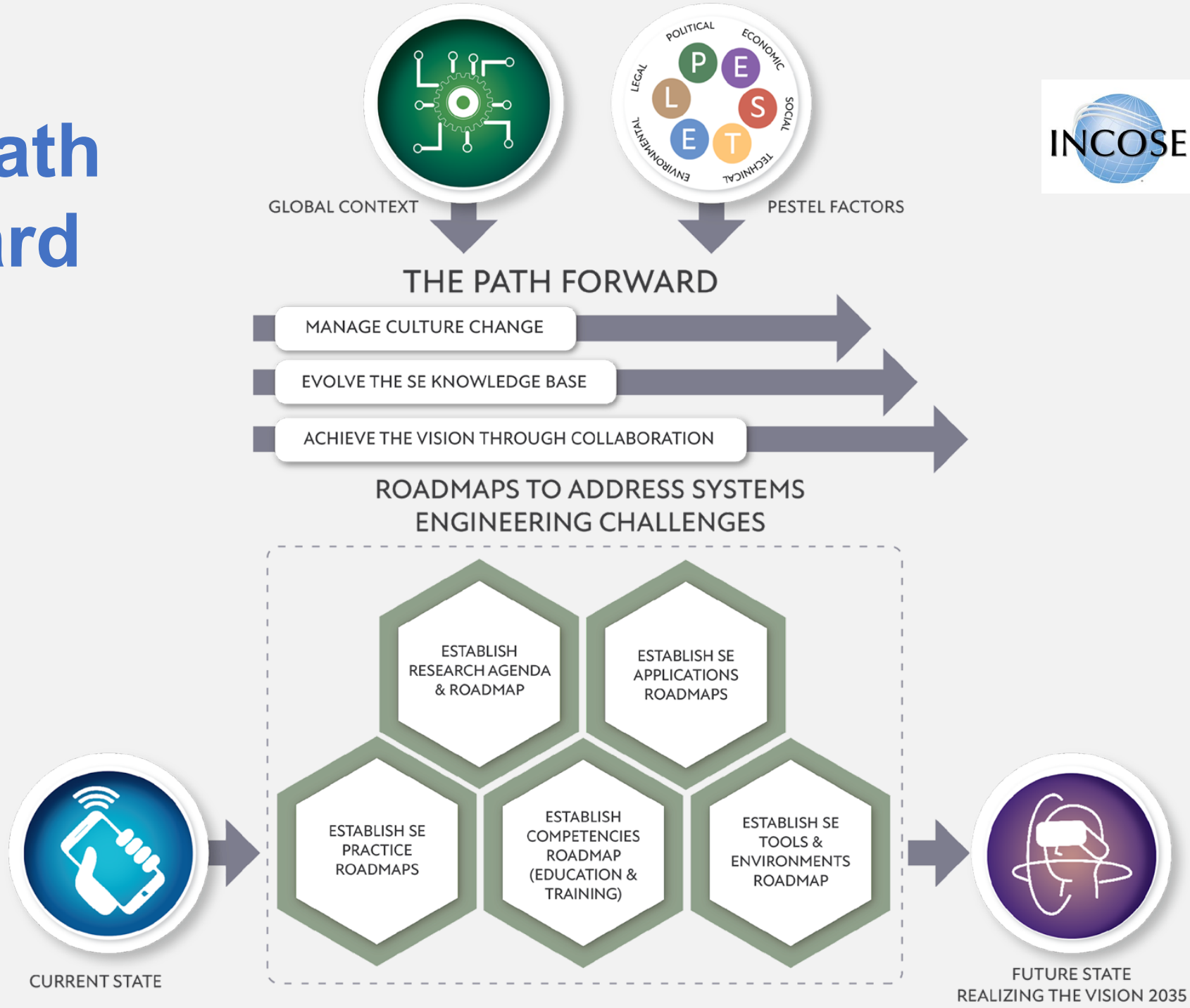
Realizing The Vision

Specific Recommendations

- Systems Engineering Contributions to Solving Societal Challenges
- Demonstrate the Value of Systems Engineering
- Addressing Dynamic Change and Uncertainty
- **MBSE– Digital Transformation**
- Analytic Framework for Enhanced System Understanding
- Systems Engineering Adoption of Reuse Practices
- **Systems Engineering Tools for Digital Environment**
- Foundations and Research
- Advancement of Education



The Path Forward



INCOSE FuSE

Future of Systems Engineering

Future of Systems Engineering Initiative

FuSE Program Mission Statement

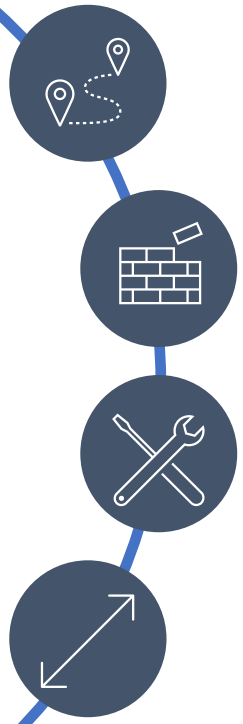
FuSE refines and evolves the SE Vision 2035 across competencies, research, tools & environment, practices, and applications.

FuSE identifies critical gaps towards the vision realization and initiates & supports relevant actions

FuSE fosters involvement and collaboration within and outside of INCOSE.

FuSE educates, shares success, and expands.

FuSE Program Mission Statement



Vision & Roadmaps

The Systems Engineering Vision and Roadmaps stream continuously refines, evolves, and complements the SE Vision 2035. Furthermore, we create an integrated set of roadmaps.

Foundations

The SE Foundations stream has its basis in both theory and industrial practice. First goal is to assess the adequacy of the foundations and identify gaps to determine future directions

Methodology

The SE Methodology stream guides the advancement of practices, methods, and tools for engineering systems to be fit for purpose.

Application Extensions

The SE Application Extensions stream integrates social sciences and soft systems into systems engineering practice to address grand challenges.

MBSE within FuSE Methodology Stream

INCOSE FuSE
Future of Systems Engineering

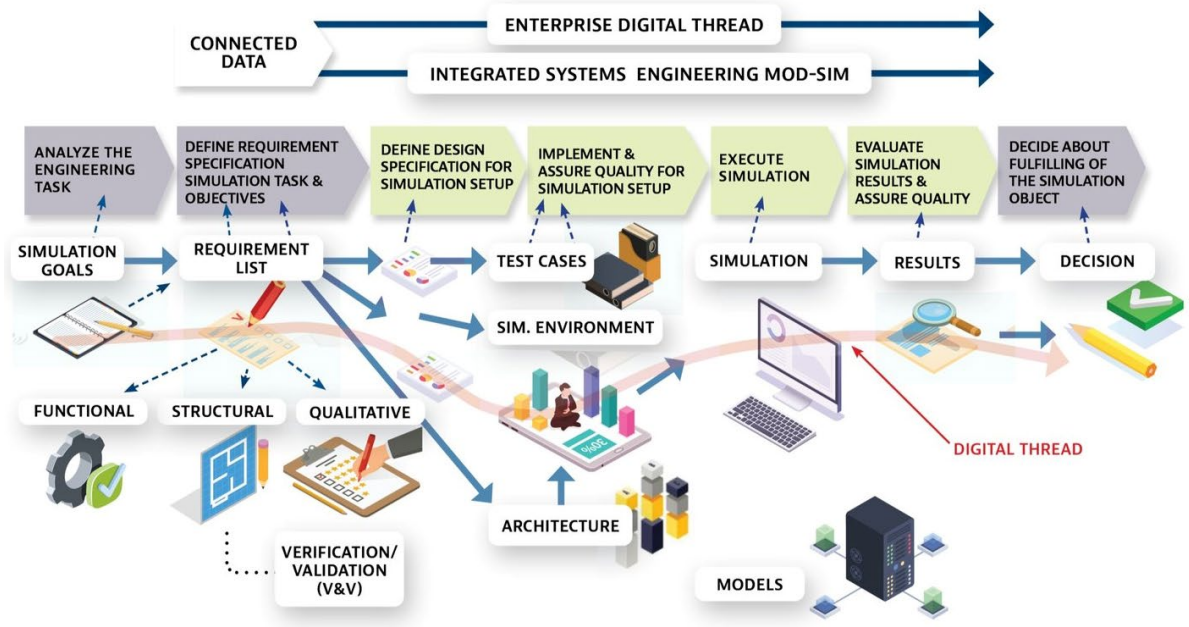
The future of systems engineering is predominantly Model-Based (MBSE)

FROM:

- The adoption of MBSE is uneven across industry sectors and within organizations.
- Custom, one-off simulations are used for each project, and there is still limited reuse of models especially during critical early phases of systems architecting and design validation.

TO:

- Systems engineers routinely compose task-specific virtual models using ontologically linked, digital twin-based model-assets.
- These connected models are updated in real-time providing a virtual reality-based, immersive design and exploration space. This virtual global collaboration space is cloud- based, enabled by modelling as a service and supports massive simulation leveraging cloud-based high-capacity compute infrastructure.
- Families of unified ModSim frameworks exist enabling small and medium businesses along with Government agencies to collaborate.



INCOSE

Contact Us

International Council on Systems Engineering

A better world through a systems approach

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