

# Introduction to SE Transformation

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While the primary focus of the SEBoK is on the current practice of domain independent systems engineering, it is also concerned with the future evolution of the discipline.

The topics in this Knowledge Area (KA) summarize SE knowledge which is emerging and transitioning to become part of the practice of systems engineering, such as Model-Based Systems Engineering (MBSE). In general, topics will be introduced here and then expanded into other SEBoK KA's over time.

The knowledge covered in this KA reflects the transformation and continued evolution of SE. For a summary of the current and future challenges that contribute to this evolution, see Systems Engineering: Historic and Future Challenges. This notion of SE transformation and the other areas of knowledge which it includes are discussed briefly below.



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## Topics

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Each part of the SEBoK is divided into Knowledge Areas

(KAs), which are groupings of information with a related theme. The KAs, in turn, are divided into topics. This KA contains the following topics:

- Transitioning Systems Engineering to a Model-based Discipline
- Digital Engineering
- Set-Based Design
- Model-Based Systems Engineering Adoption Trends 2009-2018
- Systems Engineering Core Concepts

## **Systems Engineering Transformation**

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The INCOSE Systems Engineering Vision 2025 (INCOSE 2014) describes the global context for SE, the current state of SE practice and the possible future state of SE. It describes a number of ways in which SE continues to evolve to meet modern system challenges. These are summarized briefly below.

Systems engineering has evolved from a combination of practices used in a number of related industries (particularly aerospace and defense). These have been used as the basis for a standardized approach to the life cycle of any complex system (see Systems Engineering and Management). Hence, SE practices are still largely based on heuristics. Efforts are under-way to evolve a theoretical foundation for systems engineering (see Foundations of Systems Engineering) considering foundational knowledge from a variety of sources.

Systems engineering continues to evolve in response to a long history of increasing system complexity. Much of this evolution is in the models and tools focused on specific aspects of SE, such as understanding stakeholder needs, representing system architectures or modeling specific system properties. The integration across disciplines, phases of development, and projects continues to represent a key systems engineering challenge.

Systems engineering is gaining recognition across industries, academia and governments. However, SE practice varies across industries, organizations, and system types. Cross fertilization of systems engineering practices across industries has begun slowly but surely; however, the global need for systems capabilities has

outpaced the progress in systems engineering.

INCOSE Vision 2025 concludes that SE is poised to play a major role in some of the global challenges of the 21st century, that it has already begun to change to meet these challenges and that it needs to undergo a more significant **transformation** to fully meet these challenges. The following bullet points are taken from the summary section of Vision 2025 and define the attributes of a transformed SE discipline in the future:

- Relevant to a broad range of application domains, well beyond its traditional roots in aerospace and defense, to meeting society's growing quest for sustainable system solutions to providing fundamental needs, in the globally competitive environment.
- Applied more widely to assessments of socio-physical systems in support of policy decisions and other forms of remediation.
- Comprehensively integrating multiple market, social and environmental stakeholder demands against "end-to-end" life-cycle considerations and long-term risks.
- A key integrating role to support collaboration that spans diverse organizational and regional boundaries, and a broad range of disciplines.
- Supported by a more encompassing foundation of theory and sophisticated model-based methods and tools allowing a better understanding of increasingly complex systems and decisions in the face of uncertainty.
- Enhanced by an educational infrastructure that stresses systems thinking and systems analysis at all learning phases.
- Practiced by a growing cadre of professionals who possess not only technical acumen in their domain of application, but who also have mastery of the next generation of tools and methods necessary for the systems and integration challenges of the times.

Some of these future directions of SE are covered in the SEBoK. Others need to be introduced and fully integrated into the SE knowledge areas as they evolve. This KA will be used to provide an overview of these transforming aspects of SE as they emerge. This transformational knowledge will be integrated into all aspects of the SEBoK as it matures.

# References

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## Works Cited

International Council on Systems Engineering (INCOSE). 2014. *Systems Engineering Vision 2025*, July, 2014; Available at <http://www.incose.org/docs/default-source/aboutse/se-vision-2025.pdf?sfvrsn=4>. Accessed February 16.

## Primary References

None.

## Additional References

None.

## Relevant Videos

- Leading the Transformation of Model-Based Engineering

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