

Emerging Topics

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The Emerging Topics section is intended to introduce and inform the reader on significant and rapidly emerging needs and trends in practicing systems engineering within the community. It is not intended to be all-inclusive. Instead, those topics that have a high probability of significantly impacting the practice of systems engineering, as determined by the SEBoK editorial board, are covered. If the reader has recommendations of emerging topics that should be covered, please send an email to SEBoK@incose.org, or leave a comment in the comment feature at the bottom of this page.



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Introduction to Systems Engineering Transformation

The knowledge covered in this KA reflects the transformation and continued evolution of SE, which are formed by the current and future challenges (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.

The INCOSE Systems Engineering Vision 2035 (INCOSE 2021) 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 largely based on heuristics, with efforts 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**. Such complexity arises from human and societal needs, global megatrends, grand engineering challenges, and then are shaped by stakeholders expectations, and the enterprise environment. System solutions require both depth and breadth, and the design of those solutions must consider both technical and social aspects (see Socio-technical Systems).

Many systems engineering practices have become standard (e.g. studies, risk analysis) while some other are in transitioning phase (e.g. Model-Based Systems Engineering, agile, systems-of-systems). More recently, the rise of Artificial Intelligence (AI) introduces unprecedented challenges in verification and validation of AI-infused systems, but also opens up new opportunities to implement AI methodologies in the design of systems.

Systems engineering has gained 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 2035 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 2035 and define the attributes of a transformed SE discipline in the future:

- The future of systems engineering is model-based, enabled by enterprise digital transformation.
- Systems engineering practices will make significant advancements to deal with systems complexity and enable enterprise agility.
- Systems engineering will leverage practices from other disciplines such as data science to help manage the growth in data.
- Formal systems engineering theoretical foundations will be codified leading to new research and development in the next generation of systems engineering methods and tools.
- AI will both impact the systems engineering practice and the types of systems designed by the systems engineering community.
- There will be a step change in systems engineering education starting with early education with a heavy focus on lifelong learning.

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.

Topics in Part 8

- Transitioning Systems Engineering to a Model-based Discipline
- Model-Based Systems Engineering Adoption Trends 2009-2018
- Digital Engineering
- Set-Based Design
- Socio-technical Systems
- Systems Engineering and Artificial Intelligence

References

Works Cited

None.

Primary References

None.

Additional References

None.

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