

Market Place

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William Miller wdmiller220@gmail.com

A Systems Community Initiative



Emerging Challenges and Technologies

Future of Systems Engineering

- The future environment is becoming:
 - More dynamic and nondeterministic
 - Increasingly evolutionary, with an accelerating rate of change
 - Resource constrained driving a need for sustainability
 - Highly interactive among individuals, communities, organizations, and systems
- There are growing expectations for systems engineering solutions:
 - Increased level of functionality providing more comprehensive solutions
 - Higher order of intelligence and adaptability augmenting human performance
 - Greater level of connectivity and interoperability across and between systems
 - Trust, safety, and cybersecurity of digital representations
 - Increased inclusivity, growing the scale and scope of solutions
- Emerging technologies provide opportunities to enhance the practice of systems engineering:
 - Machine Learning
 - Autonomous Physical Systems
 - 3D Printing, Genomics
 - Quantum and Nano Technology •
- Biomimicry
- Complexity Science
- Systems Sciences
 - Data Science (Big Data)

- Smart Everything
- Connected Everything (IoT)
- Artificial Intelligence
- Cybersecurity



Charter



Purpose: Evolve the practice, instruction and perception of systems engineering to:

- 1) Position systems engineering to leverage new technologies in collaboration with allied fields
- 2) Enhance the systems engineer's ability to solve the emerging challenges
- 3) Promote systems engineering as essential for achieving success and delivering value

Goal: Create a road map that drives the evolution of systems engineering to:

- 1) be increasingly *adaptable, evolvable and fit for purpose*
- 2) account for human abilities, needs as an integral system element and their interactions with a system
- 3) be more responsive in resolving increasingly challenging societal needs
- 4) realize and enhance Systems Engineering Vision 2025 and other visionary inputs

Scope: Identify the needs, priorities and means for transforming systems engineering including:

- 1) underlying foundations, systems theory and principles
- 2) people, methods, tools, processes, education and training
- 3) the future social and ethical duties, contributions, and responsibilities of future systems engineers

Imperative



Future of Systems Engineering

"If the rate of change on the outside exceeds the rate of change on the inside, the end is near." - Jack Welch

Why: Our customer's pace of change is exceeding our ability to respond to their needs on their timelines.

The mission of Systems Engineering is to ensure that we are able to accommodate the customer's needs.

We realize that traditional systems engineering practices are limited with respect to their speed and ability to accommodate increasing complexity, and that there is dramatic growth in systems in which these practices are inadequate.

We are looking to work with a diverse range of communities to address the challenges to ensure that SE can evolve to meet these challenges.



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From idea picking to action plans



- Credibility & Value
- AI Systems (Machine Learning, Deep Learning, Autonomy)
- Theoretical Foundations
- Complex Systems
- Agile Methods (in Development, in Operation, Continuous Evolution)
- Digital Engineering
- Systems engineering as an expanding field to include new frontiers of knowledge than what we conceive of today
- Lifecycles
- Security



Future of Systems Engineering



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Next Steps



- 1. Collaborate with groups inside and outside the system community to develop:
 - a. Theoretical Foundations including Ontology, Principles, and General Theory (David Rousseau)
 - b. Methods, Processes, Tools for AI including Autonomous Systems and ML (Tom Shortell)
 - c. Methods, Processes, Tools for the acquisition, support and use of data
 - d. Methods, Processes, Tools for Complexity
 - e. Methods, Processes, Tools for Agility
- 2. Evolving Systems Expertise
 - a. Create roadmap of emerging systems engineering Methods, Processes, Tools (Duncan Kemp)
 - b. Create a body of knowledge for evolving, adaptive systems
 - c. Develop a set of heuristics and guidelines relevant to these evolving systems and variable environments
- 3. Workforce
 - a. Create an Education/Training capability to educate the evolving system workforce
- 4. Broadly apply
 - a. Evangelize the credibility & value of systems engineering and a systems approach (Mike or Juan?)
 - b. Develop in our community the understanding that complicated/deterministic systems are a special case and that different MPTs are required for complex/non-deterministic systems.
 - c. Build community and expansion of boundaries of systems engineering use (John Artus)