## ModuleSEFS Cross Cutting Topics

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#### Abstract

Various topics, such as Trends and Future and Value of Systems Engineering, and Human Factors.

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## SEFS Future and Trends

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### Abstract

In the previous century, the military and aerospace domain developed systems engineering to support the development of complicated systems. The functionality and services that we are using depend on the interaction of many systems and organizations. We call this complex rather than complicated. When developing complex systems, the developers cope with more uncertainties, and unknowns, and the inherent complexity of the dynamics between many systems and humans. Digitalization facilitates the development of interconnected systems. We view models as a means to help us coping with the complexity

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# SE in Cynefin; Moving into Complex



after: Dave Snowden, a.o. https://en.wikipedia.org/wiki/Cynefin\_framework







# **Digitalization Cloud**

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	augmented reality virtual reality	miniaturization	5G	technologies	block chair	1	



# **Digital Twins**





## Systems of Sytems





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## SEFS Value of Systems Engineering

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### Abstract

How can we explain to managers, customers, or colleagues what the value is of applying systems engineering? This nugget uses Eric Honour's work to explain the value of systems engineering.

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# Problem Statement

Why is it so difficult to convince people (managers, customers, colleagues) to use systems engineering?

- Many of them see only a part of problem and solution space
- and are **unaware** of the **relations** between the parts
- Consequences of lacking a systems view become visible at the end of development or in the field
- when repairing them is **costly** and **time consuming**
- Introducing systems engineering is a change, requiring change management



# **Operational Scope**





# Lacking Systems Engineering Results in Late Failures

failures found late in development

can be traced back to *unknowns*, *unforeseens*, and *wrong assumptions* 





# Eric Honour's Research



Equivalent SE Effort as % Program Cost



## **SEFS Human Factors**

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#### Abstract

Humans interact with systems. Humans have behavior and properties that we do not control, nor can we predict them. The emotional and physical state of humans impacts their behavior and capabilities. Humans show group behavior, emerging from the interaction of the individuals in the group. Organizations show more complex behavior resulting from individuals, groups, and organizational processes. Legislation and standards are means to cope with human aspects when developing systems.

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# For and By Humans



A wide variety of humans are developing the systems for a wide variety of human users





# Humans: Ratio + Emotion





# **Risk of Engineer-Only Design**

unexpected behavior causing safety and usability problems





# Many Human Factors Experts



