

# Systems Engineering Implementation Examples

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## Systems Engineering Implementation Examples

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Part 7 is a collection of systems engineering (SE) implementation examples to illustrate the principles described in the Systems Engineering Body of Knowledge (SEBoK) Parts 1-6. These examples describe the application of SE practices, principles, and concepts in real settings.



**Figure 1 SEBoK Part 7 in context (Modified from Adcock et al. 2016).** For more detail see Structure of the SEBoK

The intent is to provide typical instances of the application of systems engineering (SE) and relate these to key SE principles and concepts from the rest of the SEBoK. This can improve the practice of SE by illustrating to students, educators, and practitioners the benefits of effective practice, as well as the risks and liabilities of poor practice.

A published case study will typically describe aspects of the practice of SE in a particular situation and then provide comments and critique of that practice. Where possible, examples in the SEBoK refer to published case studies and relate the discussions in them to appropriate areas of the SEBoK. In some case, good or bad examples of SE practice are available but have not been documented in a case study. In these cases the SEBoK authors have described and commented on these examples directly.

A matrix of implementation examples is used to map these examples to main topics in the SEBoK which they cover.

More examples will be added over time to highlight the different aspects and applications of SE. In addition, new examples can be added to demonstrate the evolving state of practice, such as the application of model-based SE and the engineering of complex, adaptive systems.



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## **Knowledge Areas in Part 7**

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Part 7 is organized in the following way:

- Matrix of Implementation Examples
- Implementation Examples

# Value of Implementation Examples

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Learning from critical examples has been used for decades in medicine, law, and business to help students learn fundamentals and to help practitioners improve their practice. A Matrix of Implementation Examples is used to show the alignment of systems engineering case studies to specific areas of the SEBoK. This matrix is intended to provide linkages between each implementation example to the discussion of the systems engineering principles illustrated. The selection of examples covers a variety of sources, domains, and geographic locations. Both effective and ineffective use of systems engineering principles are illustrated.

The United States Air Force Center for Systems Engineering (AF CSE) has developed a set of case studies "to facilitate learning by emphasizing the long-term consequences of the systems engineering/programmatic decisions on cost, schedule, and operational effectiveness." (USAF Center for Systems Engineering 2011) The AF CSE is using these cases to enhance SE curriculum. The cases are structured using the Friedman-Sage framework (Friedman and Sage 2003; Friedman and Sage 2004, 84-96), which decomposes a case into contractor, government, and shared responsibilities in the following nine concept areas:

1. Requirements Definition and Management
2. Systems Architecture Development
3. System/Subsystem Design
4. Verification/Validation
5. Risk Management
6. Systems Integration and Interfaces
7. Life Cycle Support
8. Deployment and Post Deployment
9. System and Program Management

This framework forms the basis of the case study analysis carried out by the AF CSE. Two of these case studies are highlighted in this SEBoK section, the Hubble Space Telescope Case Study and the Global Positioning System Case Study.

The United States National Aeronautics and Space Administration (NASA) has a catalog of more than fifty

NASA-related case studies (NASA 2011). These case studies include insights about both program management and systems engineering. Varying in the level of detail, topics addressed, and source organization, these case studies are used to enhance learning at workshops, training, retreats, and conferences. The use of case studies is viewed as important by NASA since "organizational learning takes place when knowledge is shared in usable ways among organizational members. Knowledge is most usable when it is contextual" (NASA 2011). Case study teaching is a method for sharing contextual knowledge to enable reapplication of lessons learned. The MSTI Case Study is from this catalog.

## References

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## Additional References

None.

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