

Back to Basics –

Up, Out, and Down: Three Critical Perspectives for the Systems Engineer

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Abstract

This paper introduces three key perspectives critical for success as a Systems Engineer. First, one must **look up** to fully understand the higher-levels you are a part of. Second, one must **look out** to understand the critical peer-level interfaces and relationships. And finally, one must **look down** to understand the lower levels that are part of your responsibility. To illustrate these perspectives, examples will be provided for three viewpoints: systems, requirements, and projects/teams.

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Topics

- **Introduction/Background**
- Up, Out, and Down for Systems
- Up, Out, and Down for Requirements
- Up, Out, and Down for Projects/Teams
- Wrap-up and Conclusions

Systems Engineering Builds Upon Systems Science and Systems Thinking

- Fundamental concepts leveraged include:
 - **Holistic view**
 - **Understanding relationships**
 - Emergent properties
 - Patterns
 - Soft systems



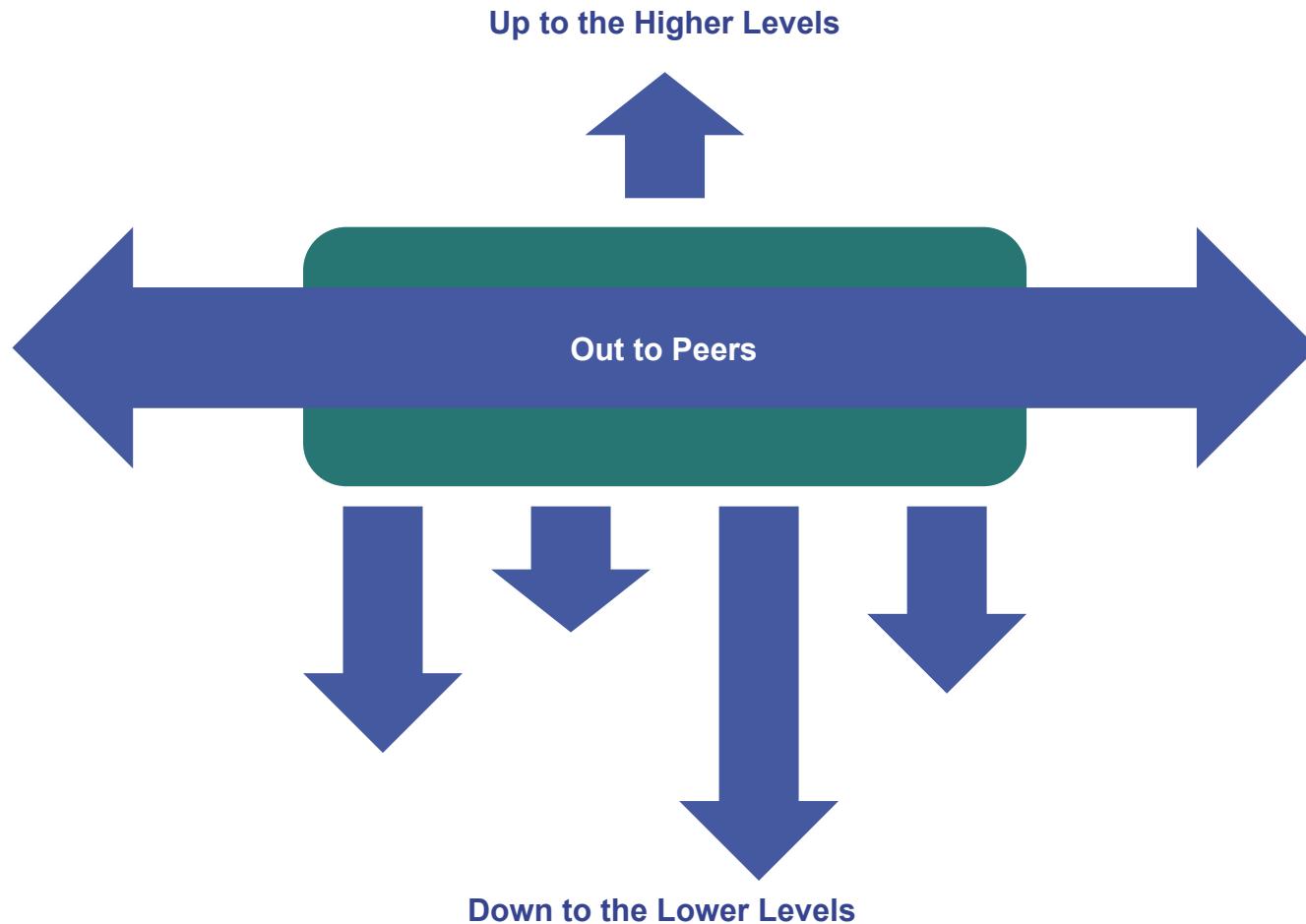
For both the system being developed (i.e., the System of Interest or SOI) and the effort being used to develop that system (i.e., the project).

Key System Architecture Concepts

- Structure
- **Views**
- **Viewpoints**
- Frameworks
- Emergent Properties
- Product Lines
- **Interfaces**
- Allocation and Partitioning
- Multiple Candidate Architectures
- Iteration and Recursion



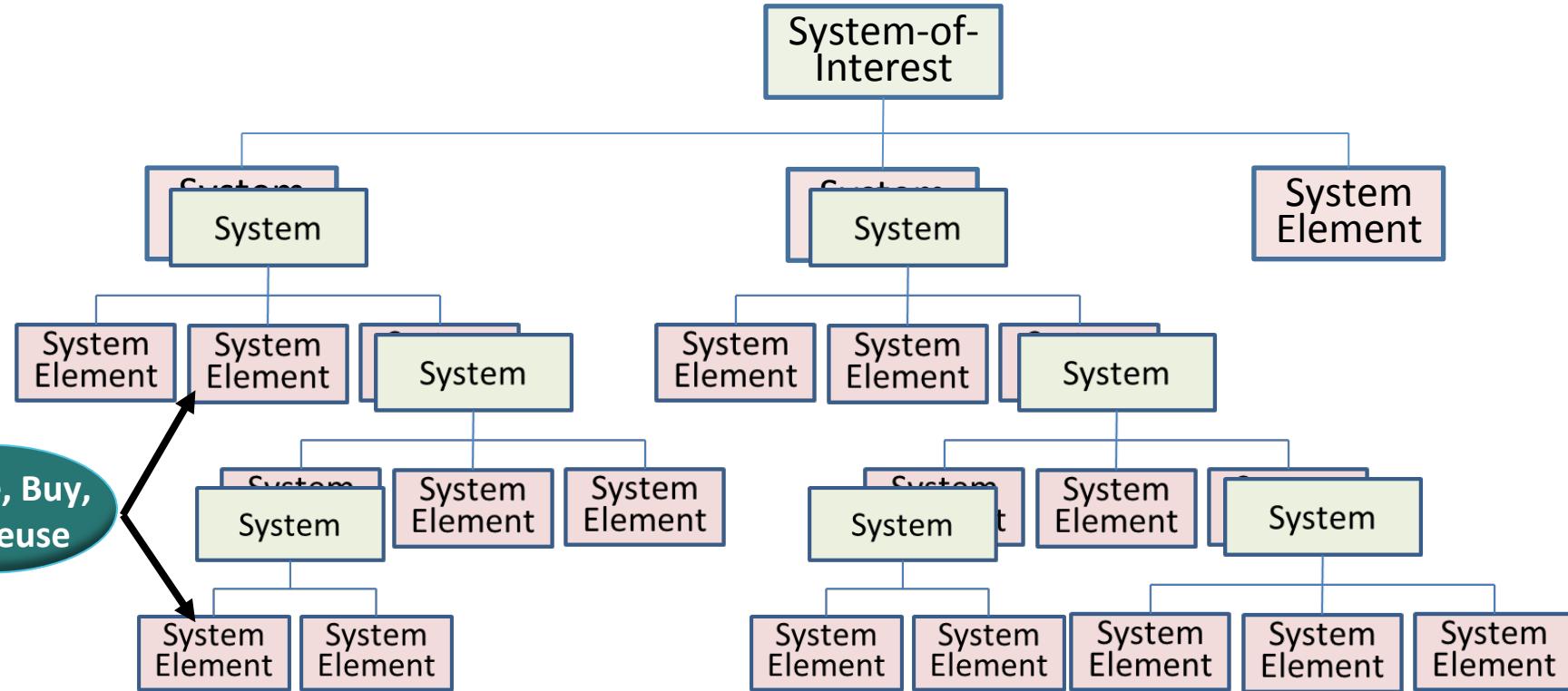
Systems Engineers Look Up, Out, and Down



Topics

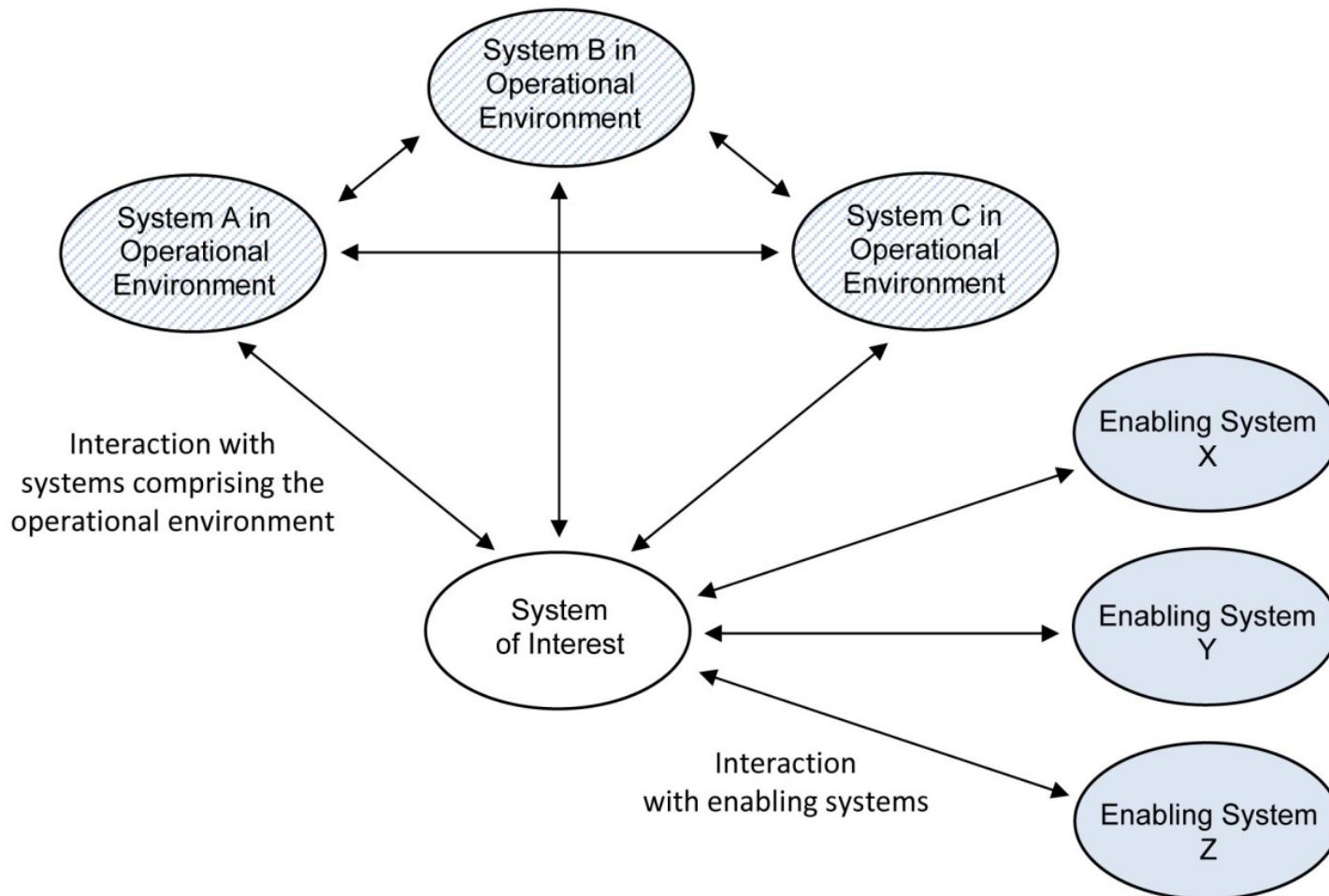
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Systems Have Hierarchies



A System is composed of Interacting System Elements, some of which are Systems that need to be decomposed

Enabling Systems

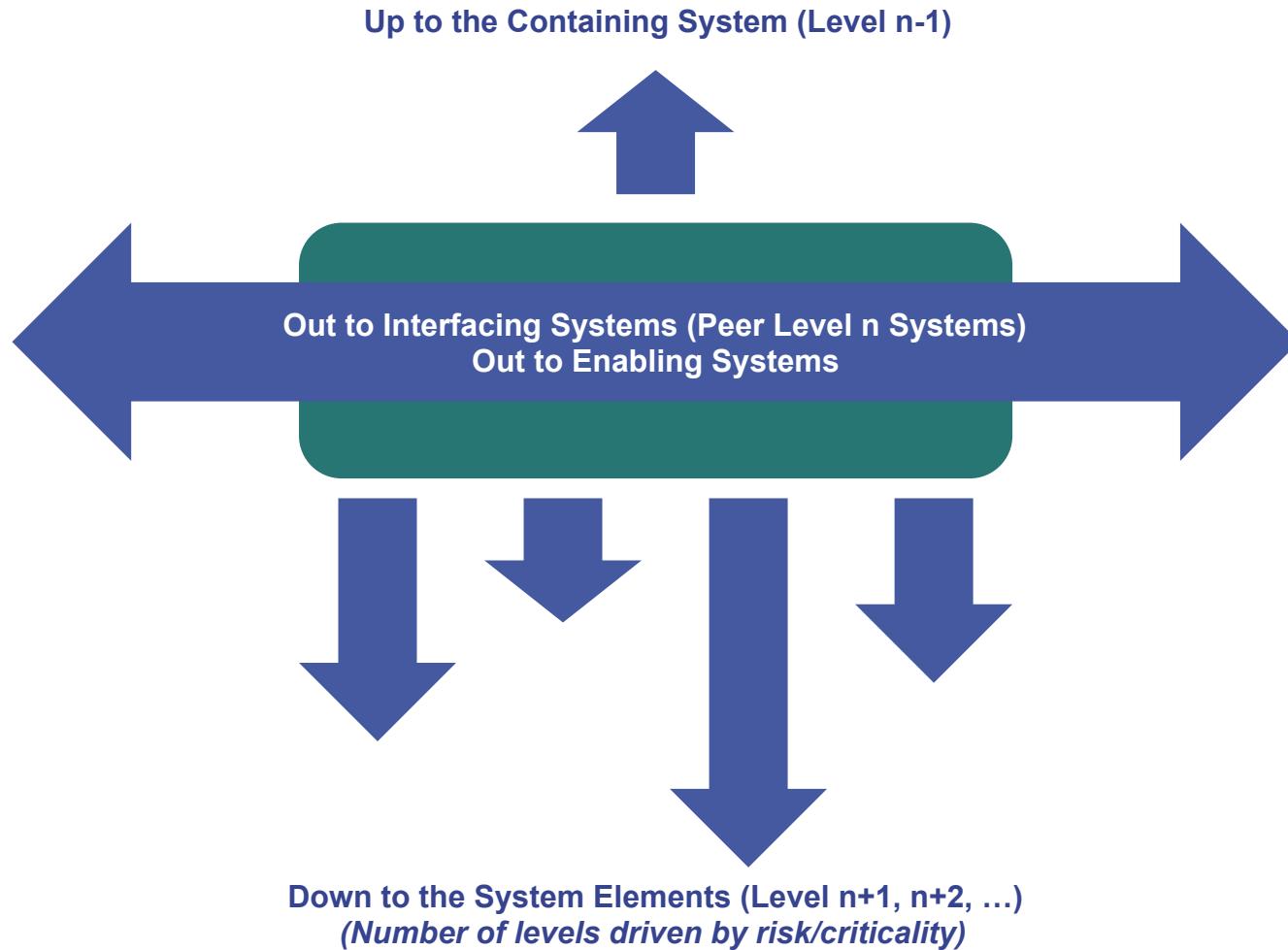


Enabling systems facilitate the life cycle activities of the SOI.

Source: (ISO/IEC/IEEE 15288, 2015 – Fig 3) (INCOSE SEH, 2015 – Fig 2.3)

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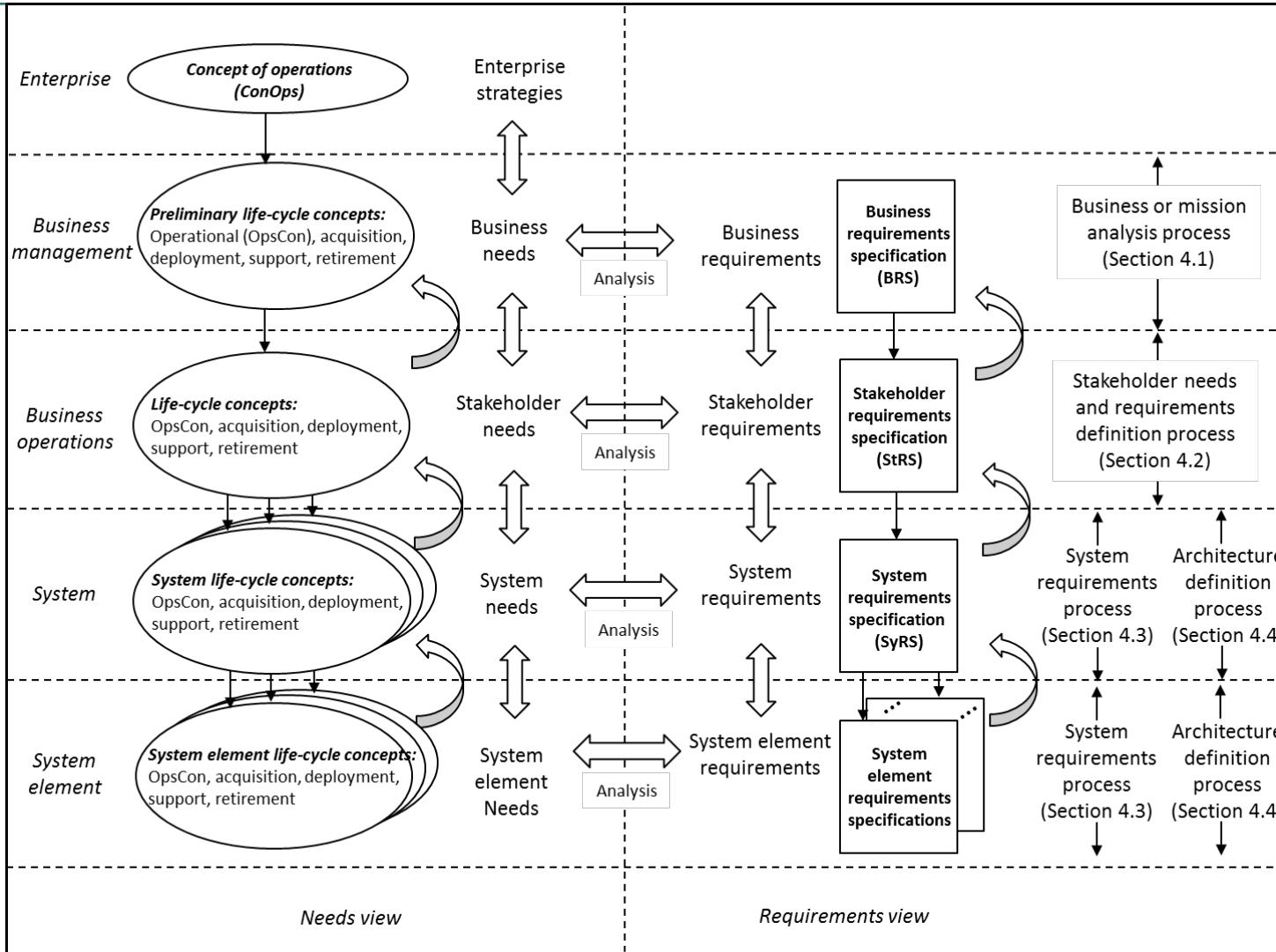
Up, Out, and Down for Systems



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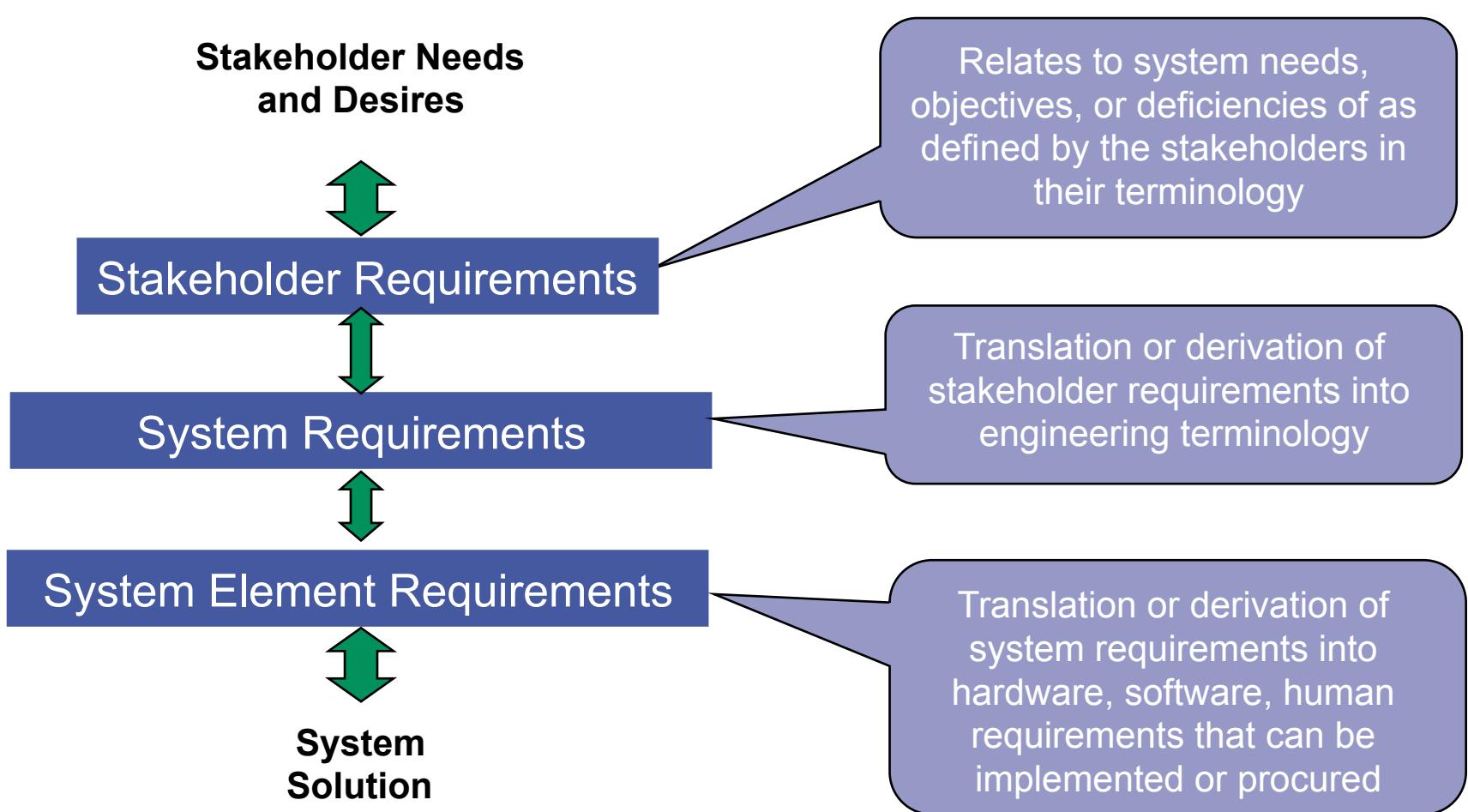
Transformation of Needs Into Requirements



Source: (INCOSE SEH, 2015 – Fig 4.1)

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Requirements Hierarchies

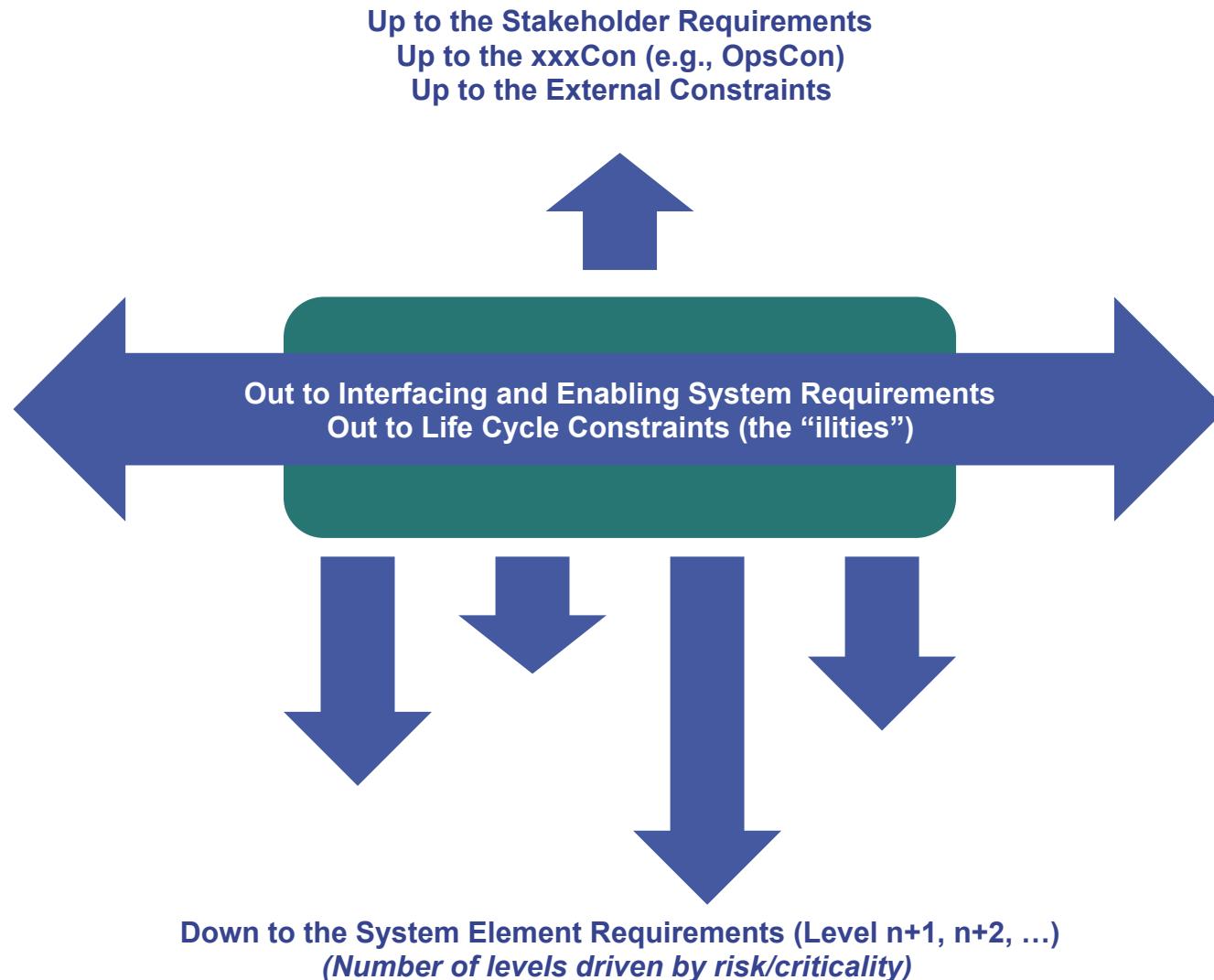


Specialty Engineering (“ilities”) (Chapter 10)

1. Affordability/Cost Effectiveness/Life Cycle Cost Analysis
2. Electromagnetic Compatibility
3. Environmental Engineering/Impact Analysis
4. Interoperability Analysis
5. Logistics Engineering
6. Manufacturing and Producibility Analysis
7. Mass Properties Engineering
8. Reliability, Availability, and Maintainability
9. Resilience Engineering
10. System Safety Engineering
11. System Security Engineering
12. Training Needs Analysis
13. Usability Analysis/Human Systems Integration
14. Value Engineering



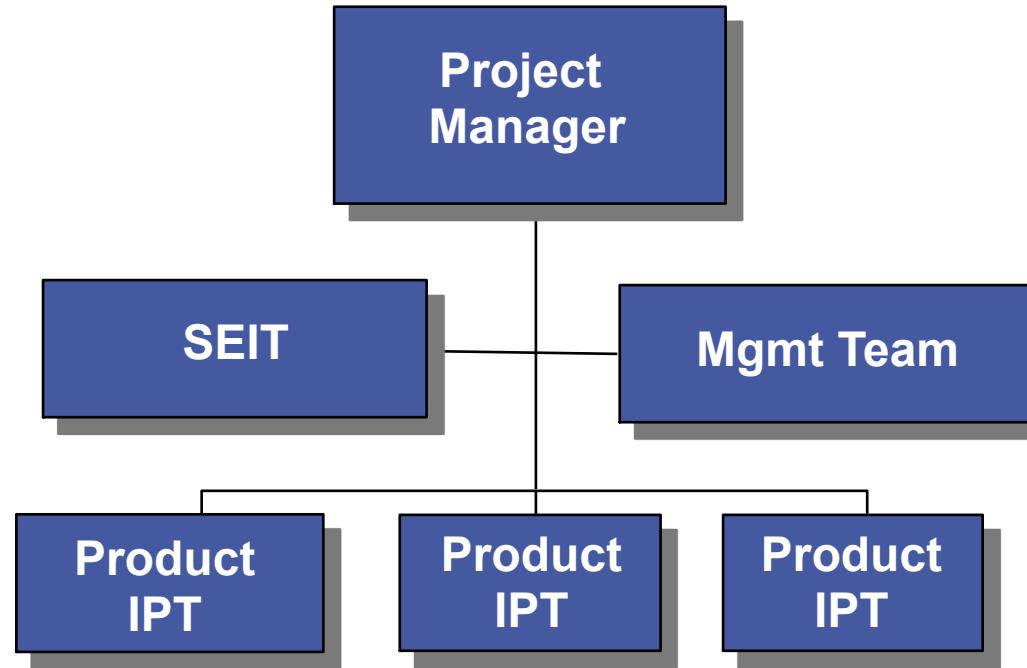
Up, Out, and Down for Requirements



Topics

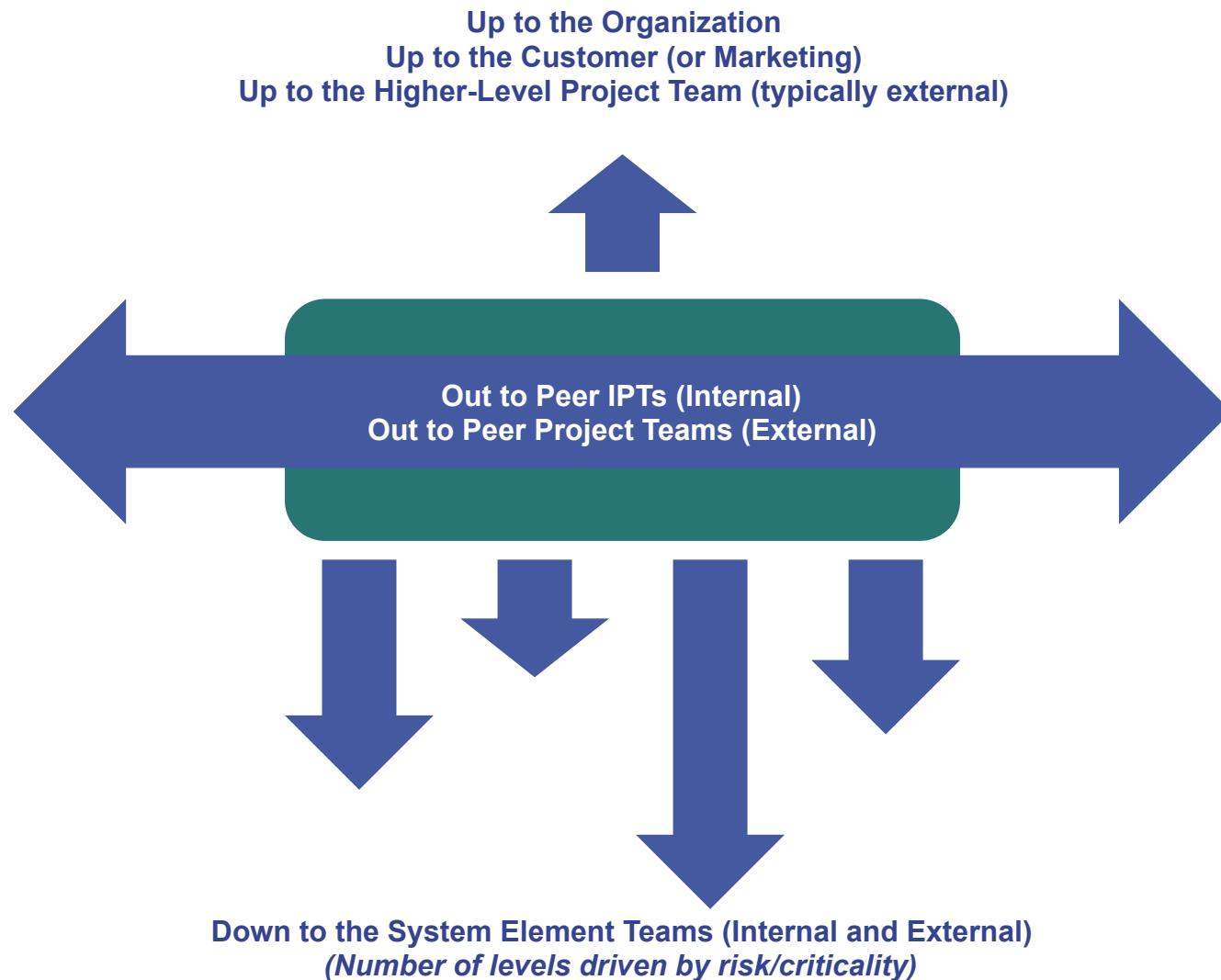
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Integrated Product Teams (IPTs)



SEIT - Systems Engineering & Integration Team
IPT – Integrated Product Team

Up, Out, and Down for Projects/Teams



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Wrap-up/Summary

- This paper introduced three key perspectives critical for success as a Systems Engineer:
 - First, **look up** to fully understand the higher levels you are a part of.
 - Second, **look out** to understand the critical peer-level interfaces and relationships.
 - Third, **look down** to understand the lower levels that are part of your responsibility.
- To illustrate these perspectives, examples were provided for systems, requirements, and projects/teams viewpoints.
- By embracing these three perspectives, Systems Engineers will be better able to take a holistic approach and understand the key relationships that exist.
- By understanding these multiple perspectives, they will be in a position to better understand how to make their systems and their teams more effective.