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The Roles of Systems Engineers Revisited

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Outline

- Motivation
- Overview of Helix Project
- Methodology
- Examination of Roles
- Dataset Analysis
- The Revised Roles of Systems Engineers
- SE Roles vs Roles SE Play
- Roles of SE in the Helix Sample
- Future Directions

Motivation for Helix

- Systems Engineering is a critical factor in the successful development of increasingly complex and interconnected systems.

- U.S. Department of Defense is eager to understand:
  - The capabilities of its existing SE workforce.
  - The capabilities of the existing defense industry workforce.
  - Any capability gaps that will impact the development of future systems.
  - How retirement of senior systems engineers will impact overall workforce capabilities.

Overview of Helix Project

- Helix is a multi-year longitudinal study designed to build an understanding of the systems engineering workforce in the DoD and the Defense Industrial Base (DIB). *(that scope is expanding)*

- Data collection has primarily been through semi-structured interviews with systems engineers.

- Reporting is done in an aggregated anonymous manner that does not reveal the identities of participating individuals or organizations.

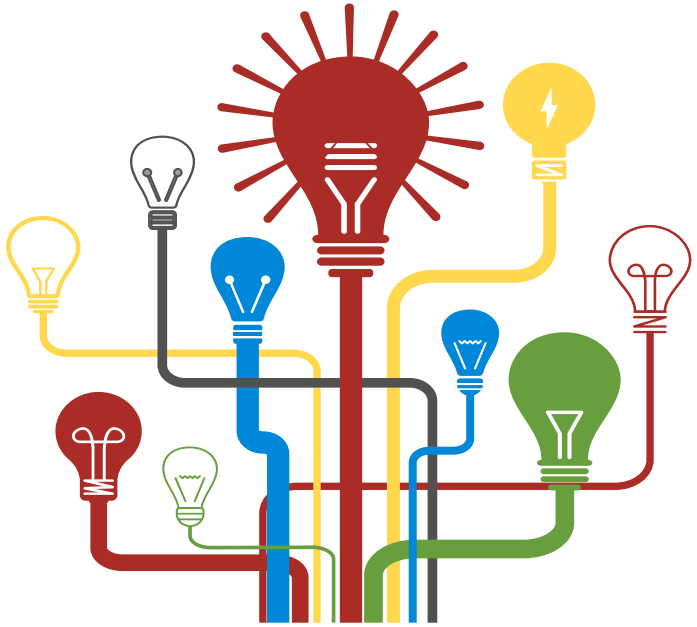
Helix Research Questions

Through 2016, Helix focused on three main research questions:

Research Question 1:
What are the characteristics of systems engineers?

Research Question 2:
How effective are systems engineers and why?

Research Question 3:
What are employers doing to improve the effectiveness of their systems engineers?



Methodology

Overall implemented Mixed-Method – 2 main methodologies

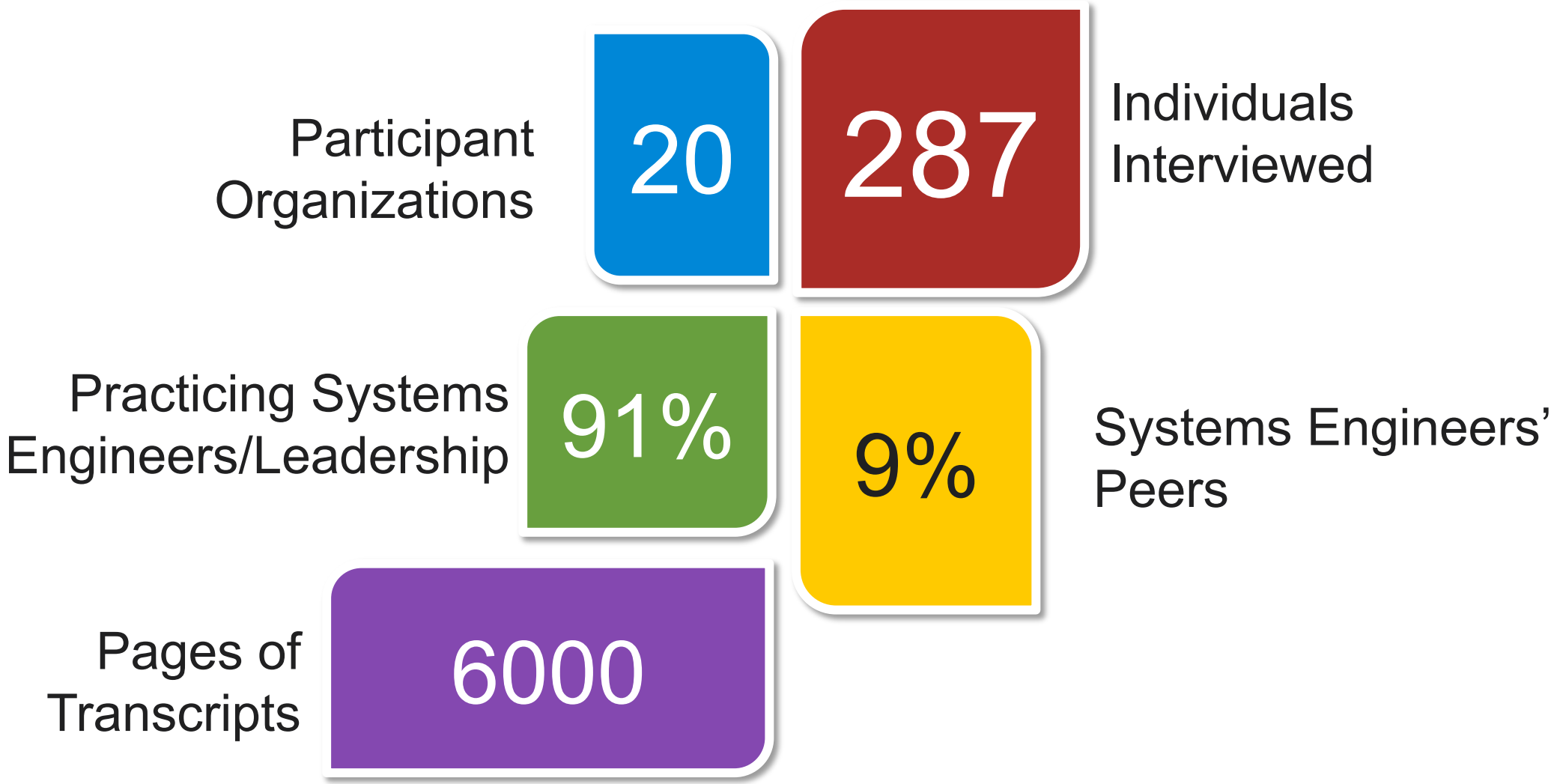
Early Stage: Qualitative Study

Grounded Theory	Data collection of semi-structure interviews with systems engineers.

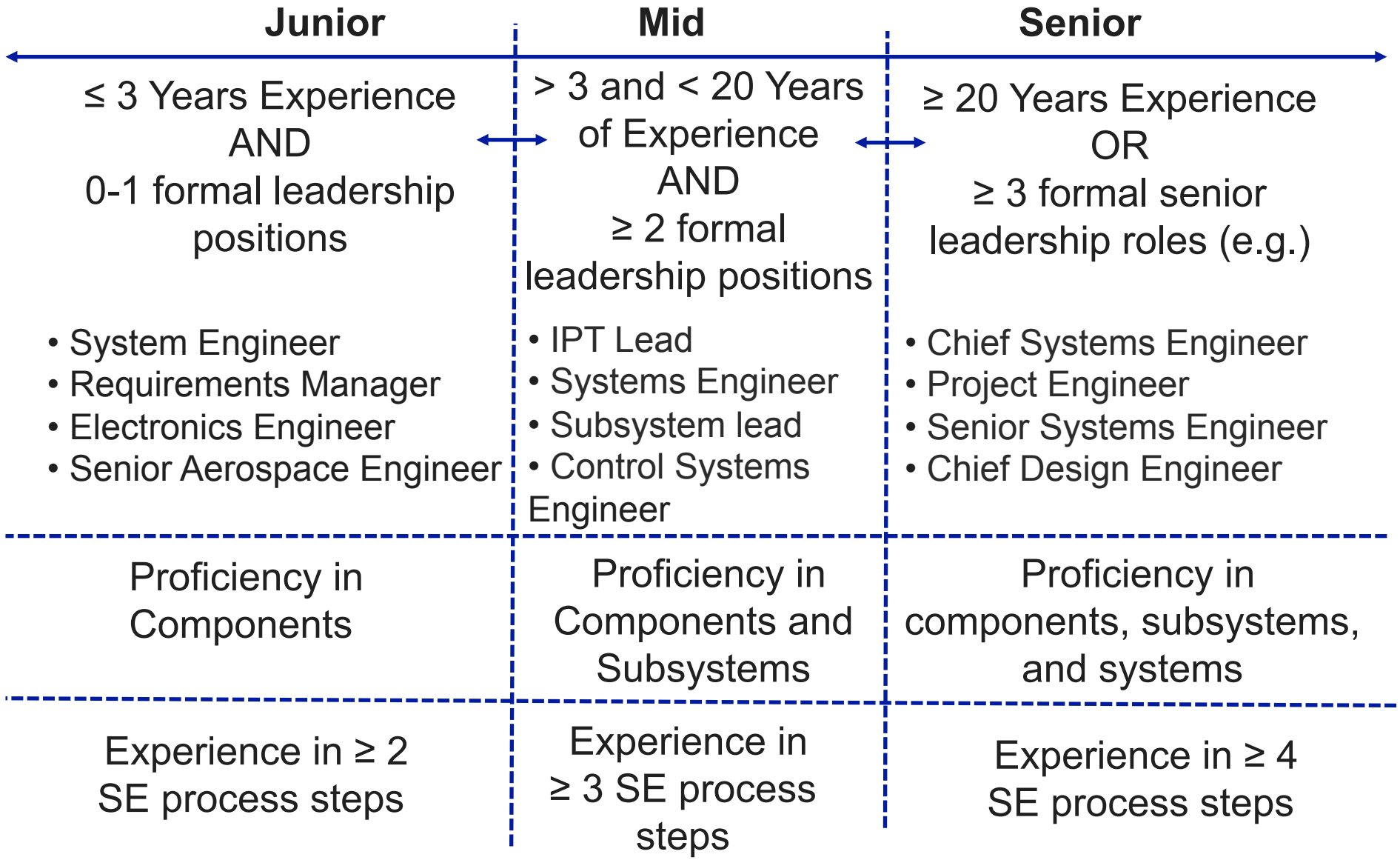
Current Stage: Qualitative Study

Pattern Identification	Analysis of aggregated data. Patterns emerge, guiding further data collection.

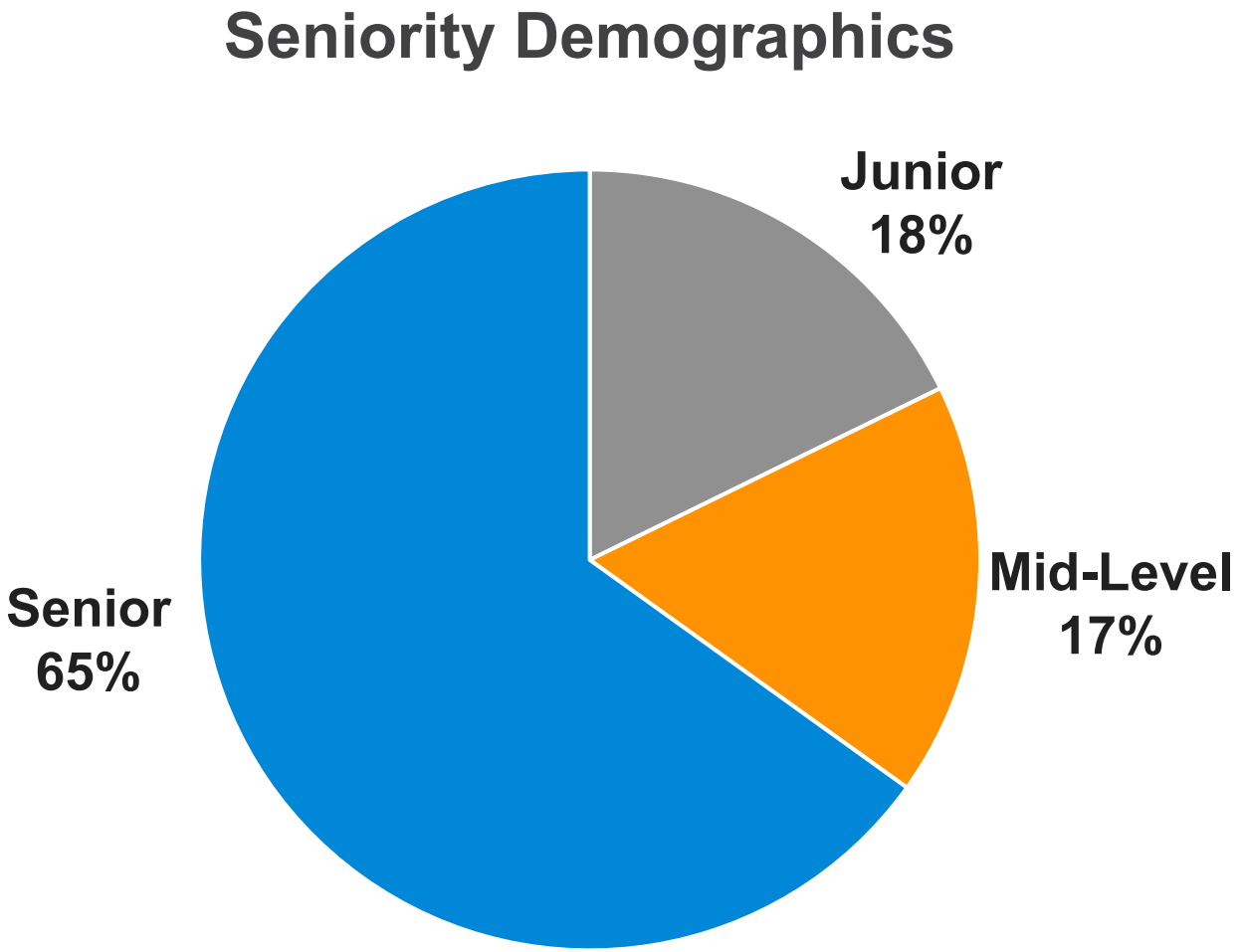
Helix Dataset



Seniority Criteria



Seniority of Systems Engineers: Helix data

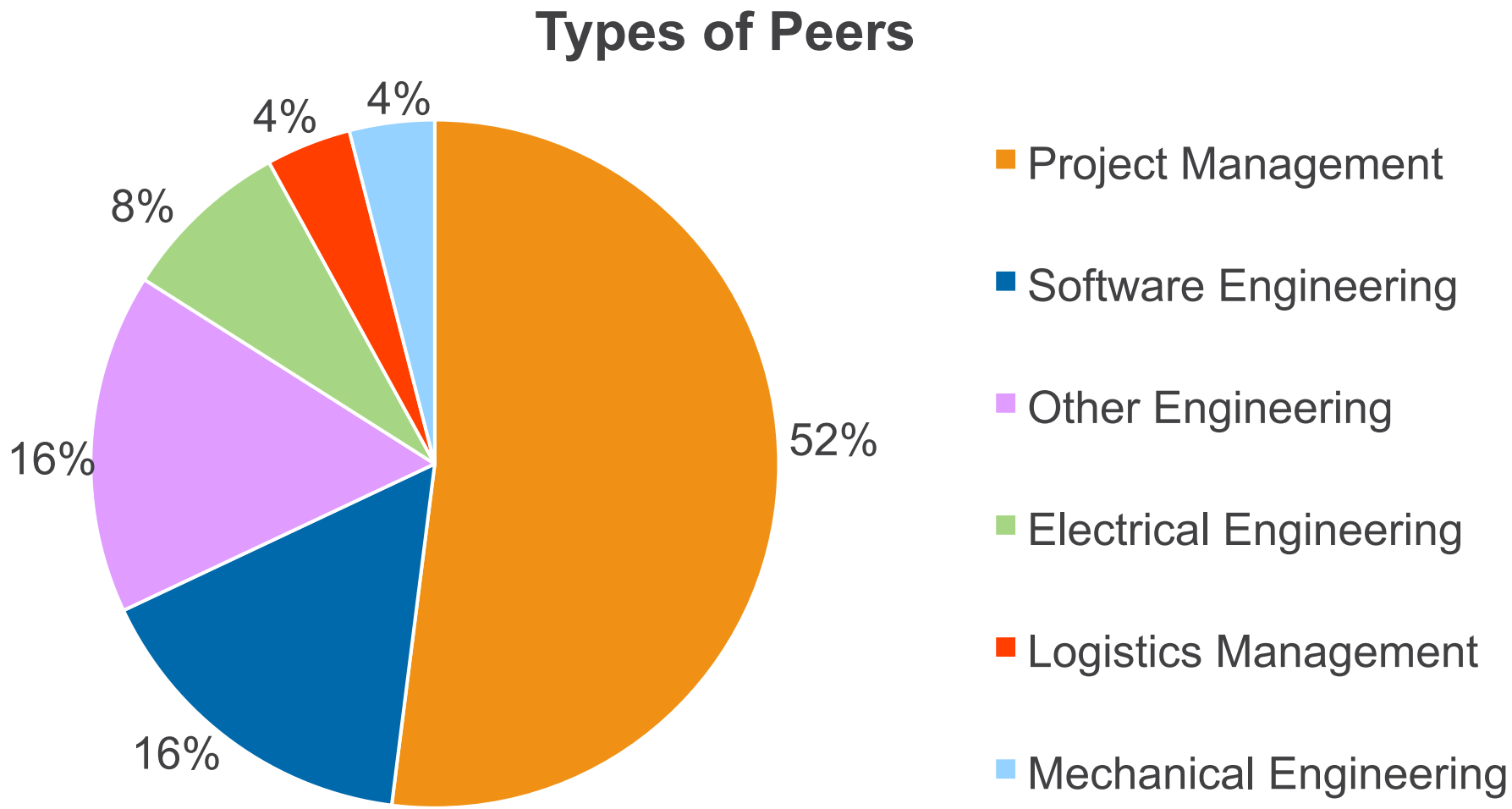


Why do we care about seniority?

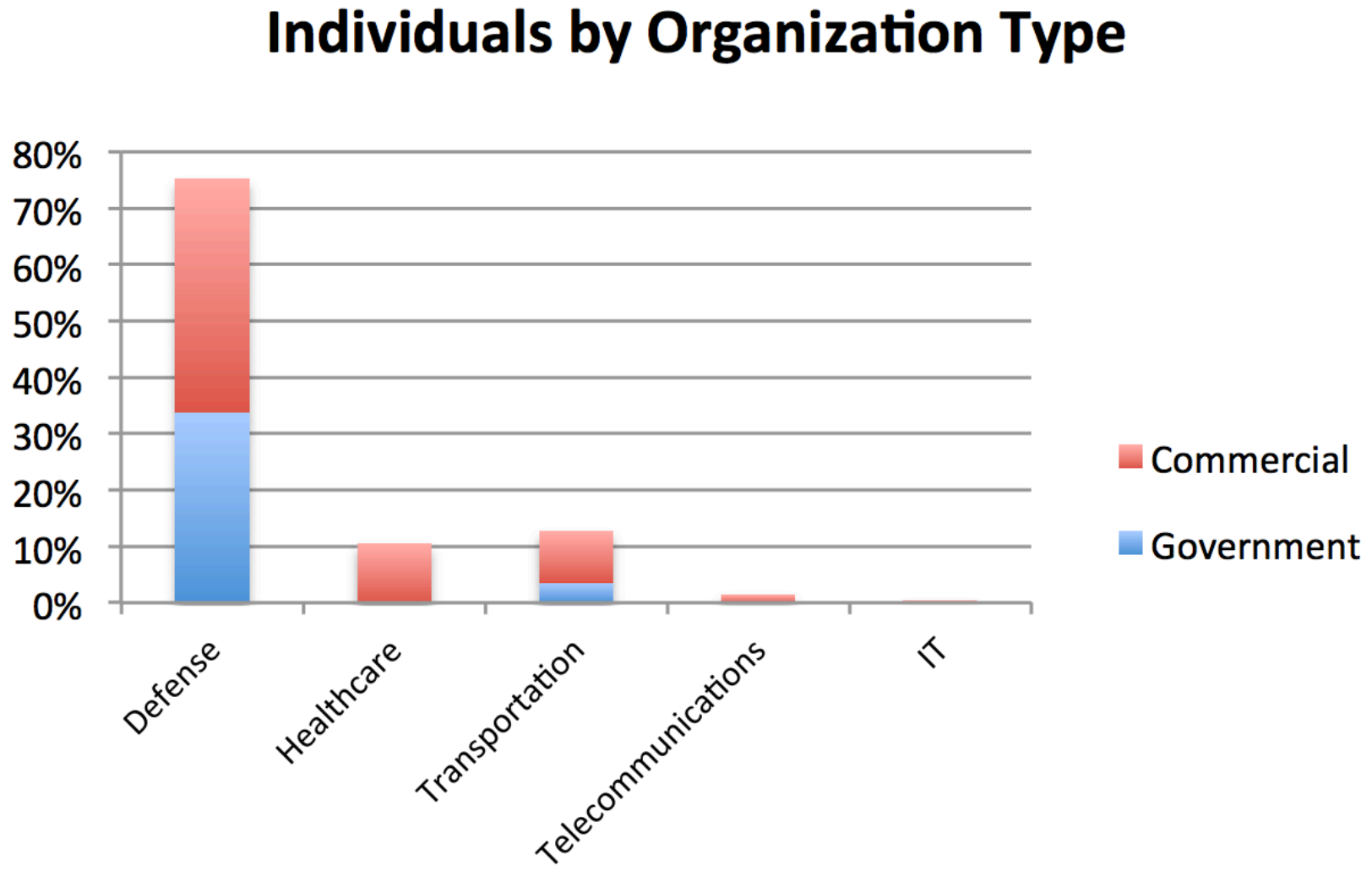
It allows us to:

- Compare across individuals and groups at different parts of their careers
- Highlight differences in the way that senior systems engineers have developed and how junior and mid-level systems engineers are developing

Systems Engineers Peers



Systems Engineers Organizations: Helix data



Why do we care about SE roles?

- Roles are used to define what systems engineers actually do
  - To ourselves
  - To our managers/leaders
  - To our peers

Examination of Roles

A systems engineering role is a specific set of related systems engineering activities.

Helix roles data = Participants interviews + resume/CV

- Each position was compared to previously published roles by (Sheard, 1996 and 2000).
- Activities not included in (Sheard, 1996 and 2000) were documented.
- Validations of patterns presented to the systems engineering community
- Validation with peers

Approach

- Collected raw data on activities systems engineers perform
  - Interviews
  - Resumes/CVs
- Analyzed activities compared to Sheard's roles
- Captured activities that did not fit within Sheard's roles → new roles
- Collected community feedback on roles
  - Validation
  - Reactions to titling
  - Desire for structure
- Created a structure for roles

The Revised Roles of Systems Engineers

Roles Focused on the System Being Developed:

- Concept Creator
- Requirements Owner
- Systems Architect
- System Integrator
- System Analyst
- Detailed Designer
- V&V Engineer
- Support engineer

The Revised Roles of Systems Engineers

Roles Focused on SE Process and Organization:

- Systems Engineering Champion
- Process Engineer

Roles Focused on Teams That Build Systems:

- Customer Interface
- Technical Manager
- Information Manager
- Coordinator
- Instructor/Teacher

The Revised Roles of Systems Engineers: Helix

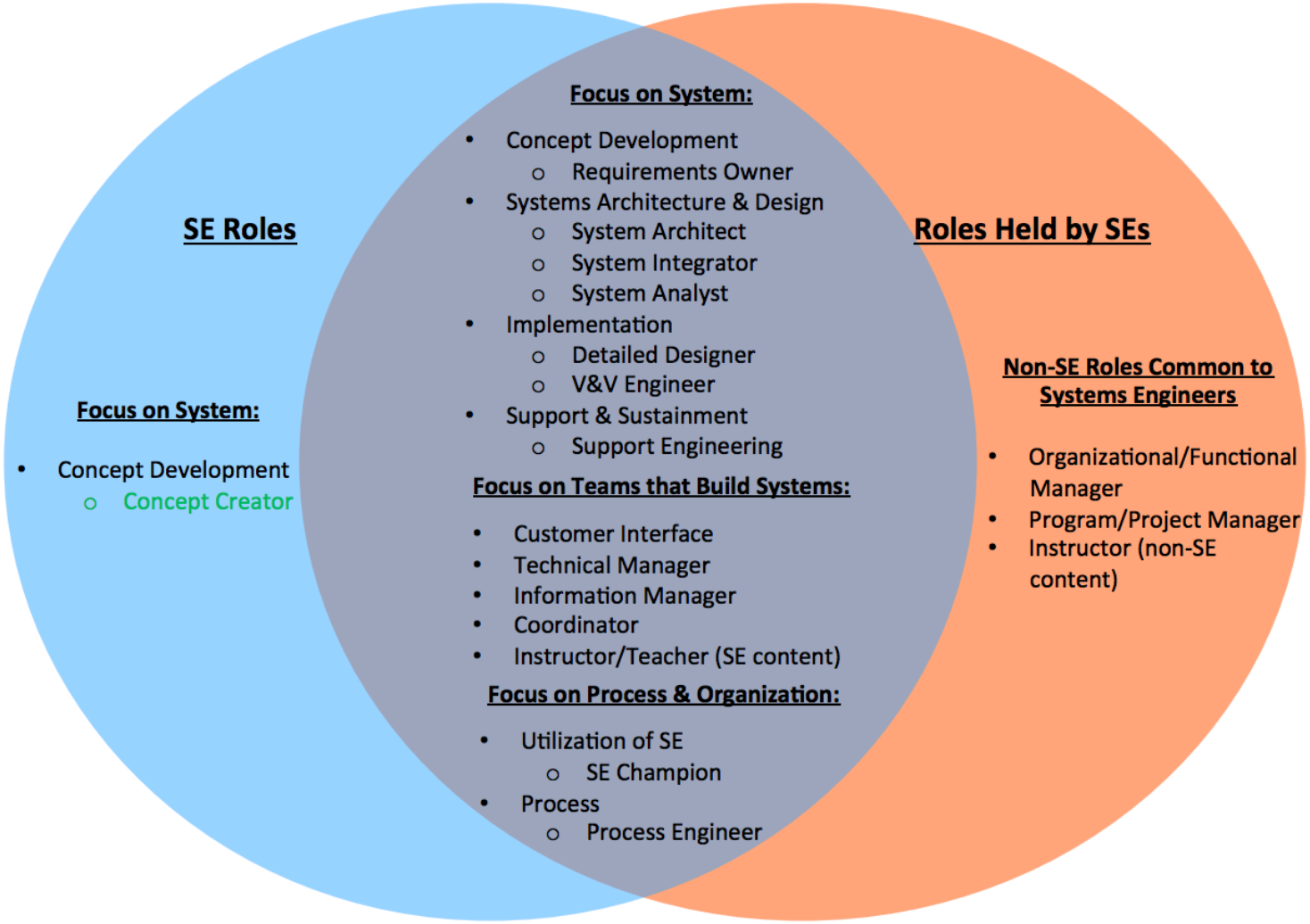
Roles Focused on the System Being Developed

Roles Focused on the SE Process and Organization

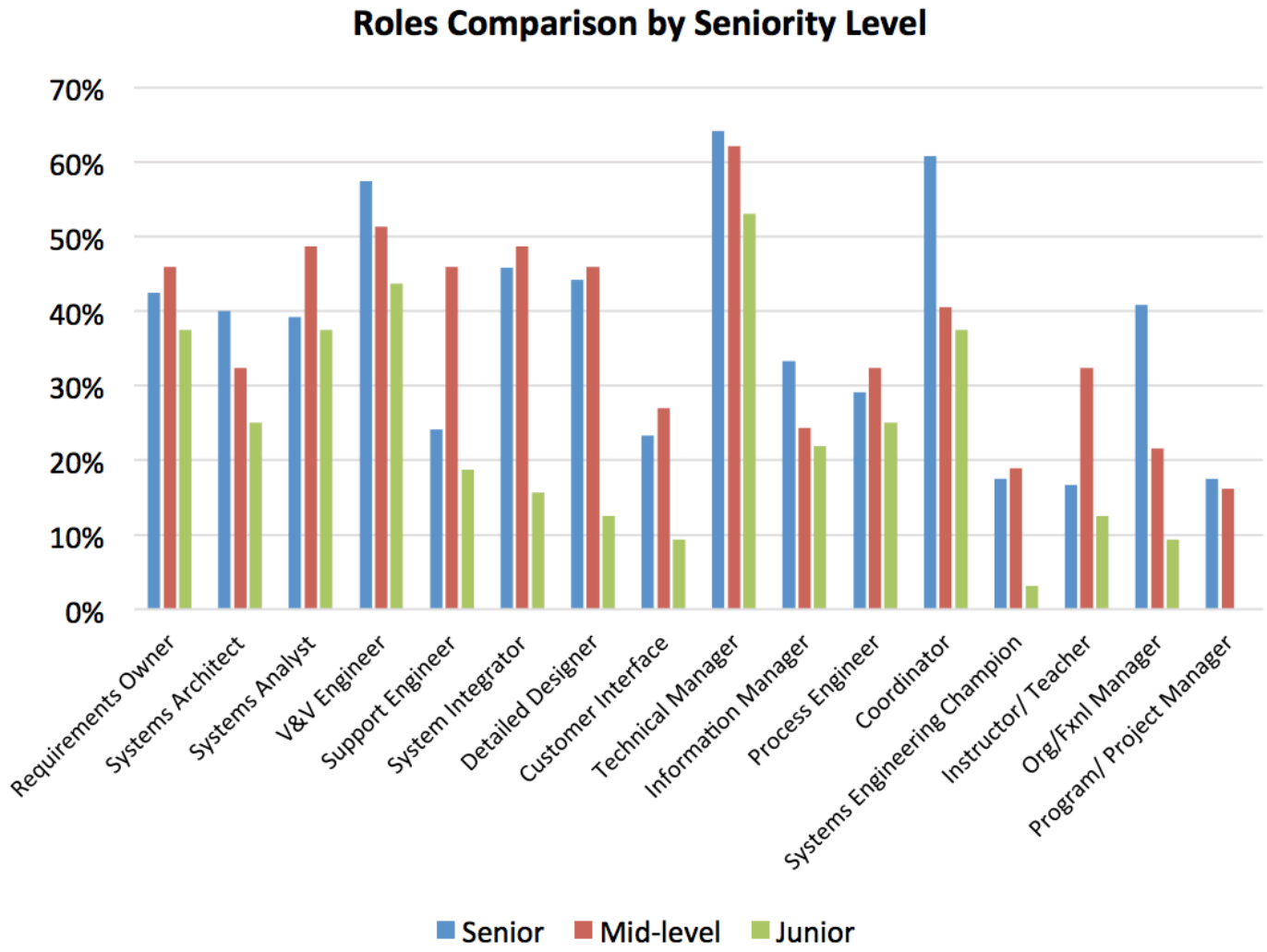
Roles Focused on the SE Process and Organization

Sheard	Helix
	Concept Creator
Requirements Owner	Requirements Owner
System Designer	Systems Architect
System Analyst	System Analyst
V&V Engr.	V&V Engr.
Logistics/Operations Engr.	Support Engineer
Glue	System Integrator
Customer Interface	Customer Interface
Technical Manager	Technical Manager
Information Manager	Information Manager
Process Engineer	Process Engineer
Coordinator	Coordinator
Classified Ad	
	Detailed Designer
	Systems Engineering Champion
	Instructor/Teacher

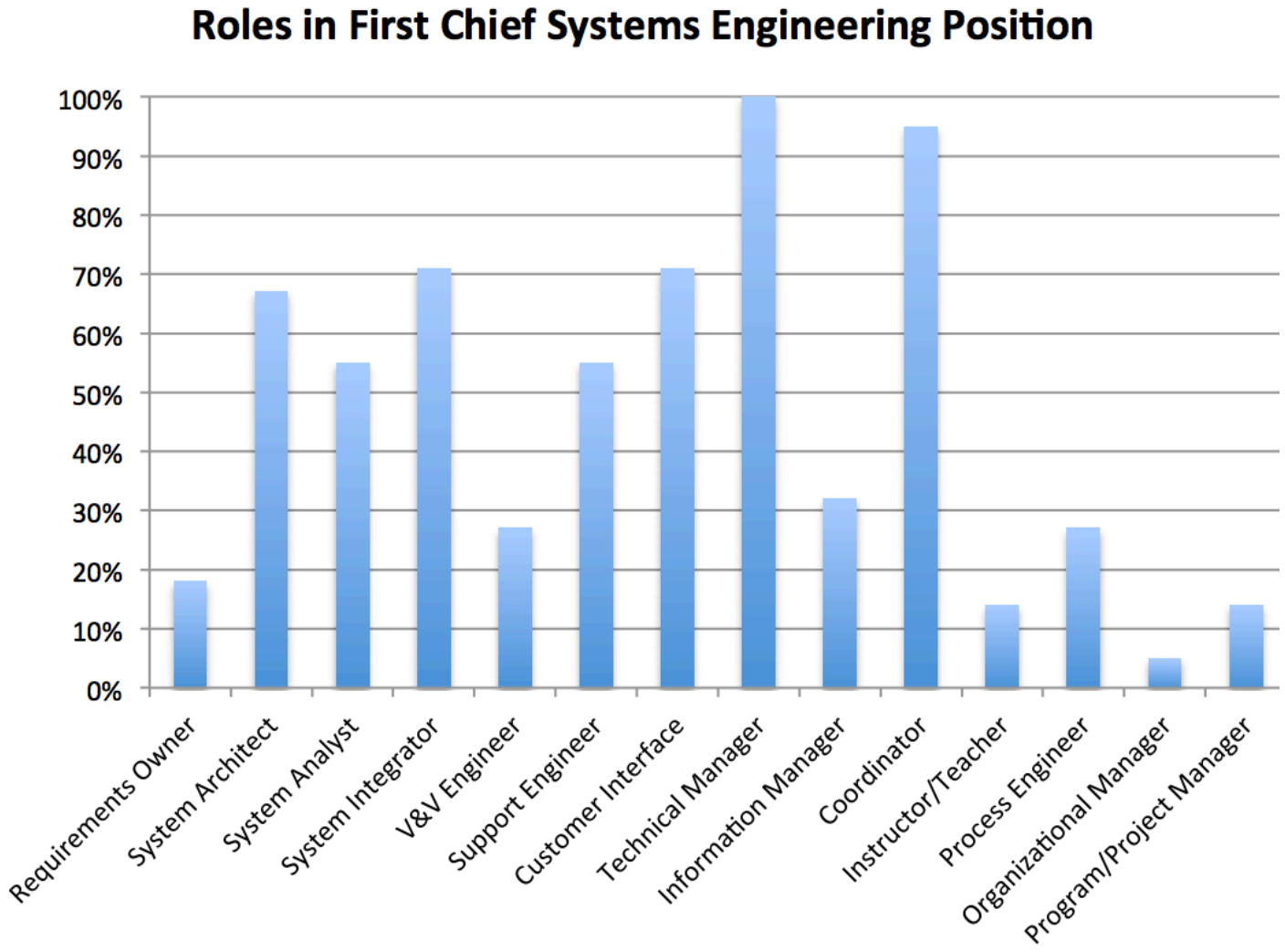
Systems Engineering Roles vs Roles Systems Engineers Play



Roles by Seniority



Roles in First Chief Systems Engineering Position

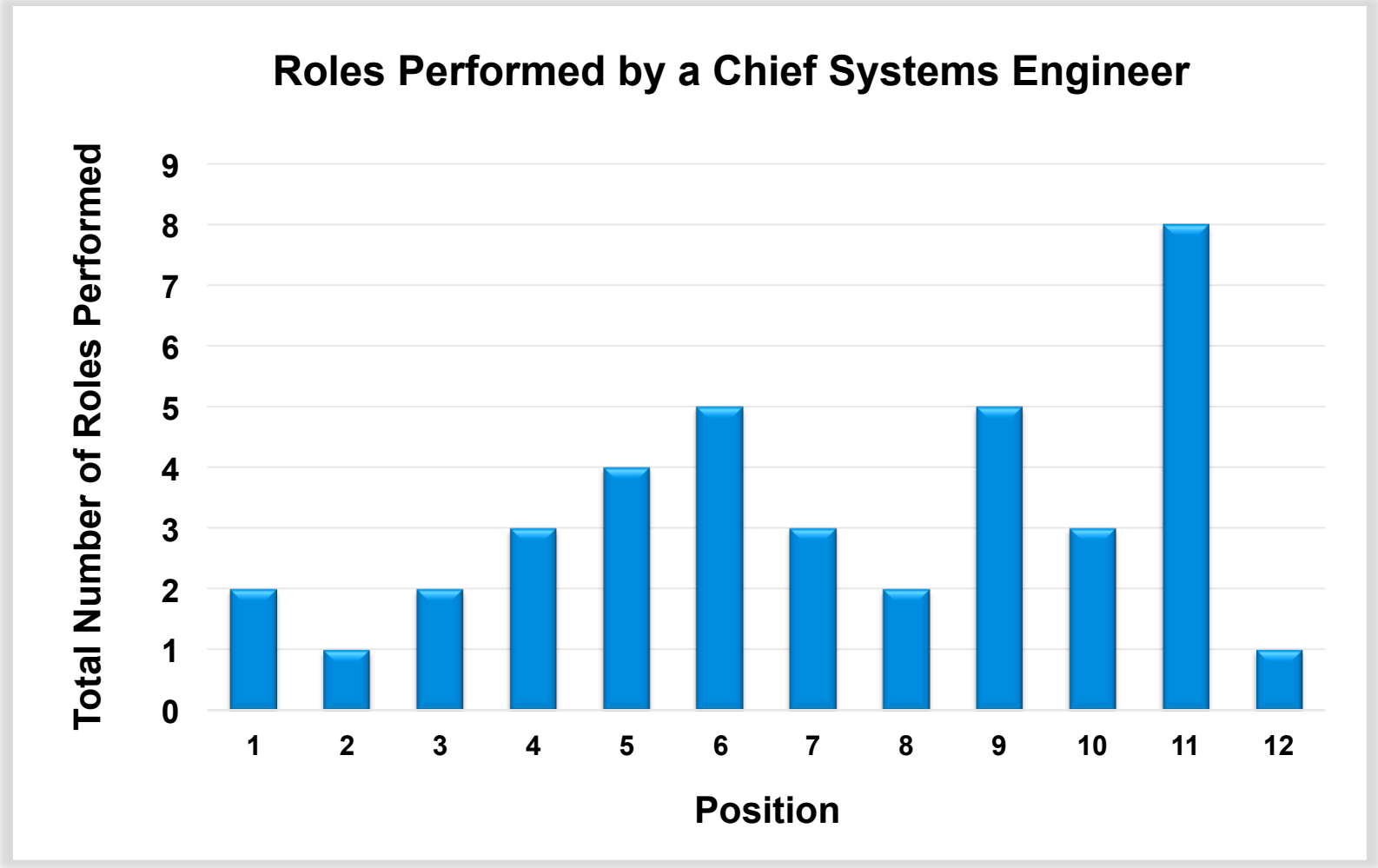


Roles Performed by a Chief Systems Engineer

Sample: 1 Chief Systems Engineer

30+ years of experience

Career: 12 Positions



Position 1

System Analyst
Detailed Designer

Position 2

System Analyst

Position 3

Requirements Owner
System Architect

Position 4

System Architect
Detailed Designer
Support Engineer

Position 5

Requirements Owner
System Architect
Detailed Designer
V&V Engineer

Position 6

Requirements Owner
Detailed Designer
Technical Manager
Information Manager
Program/Project Manager

Position 7

Detailed Designer
Systems Engineering Champion
Process Engineer

Position 8

Information Manager
Org/Functional Manager

Position 9

Requirements Owner
Detailed Designer
Customer Interface
Coordinator
Org/Functional Manager

Position 10

System Architect
System Integrator
Coordinator

Position 11

System Architect
V&V Engineer
Systems Engineering Champion
Process Engineer
Customer Interface
Technical Manager
Information Manager
Coordinator

Position 12

Instructor/Teacher

Career Paths

- Roles analysis (by individual) for 187 participants
- Starting to unravel the patterns in roles over time
- Follow up, additional data collection to further support

HELIX

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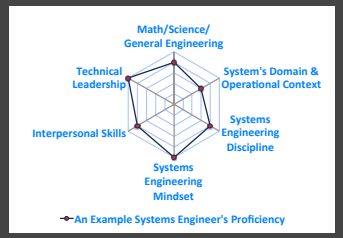
Helix – Developing Effective Systems Engineers

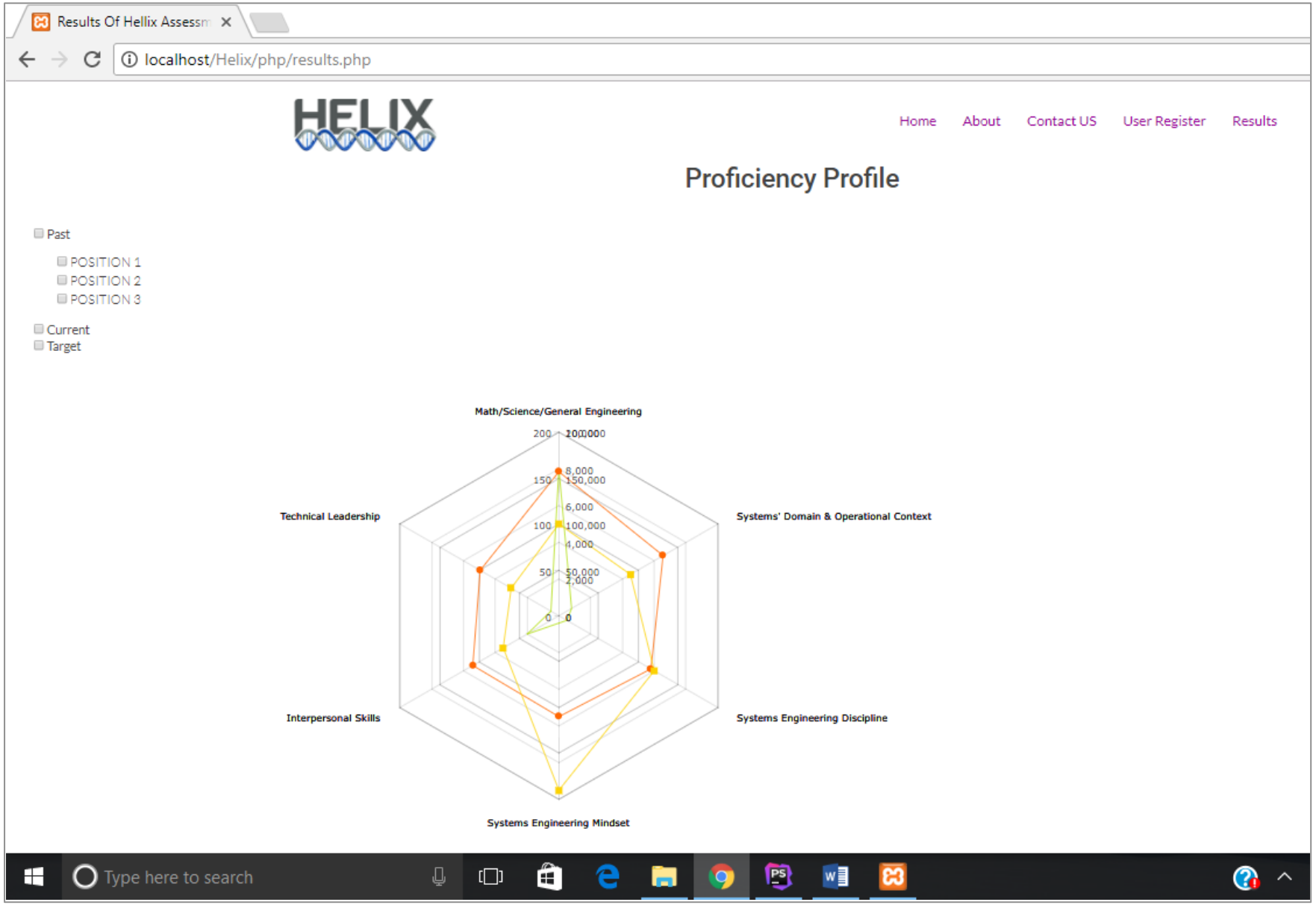
User Profile
Last Updated 7/11/17



Proficiency
Click to get started

Career Path
Last Updated 7/11/17

View Results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POSITION 2
POSITION 3
Current
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Systems' Domain & Operational Context
Systems Engineering Discipline
Systems Engineering Mindset
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Conclusion

- Continue pattern analysis around roles
- Complete career paths for other aspects of SE (lifecycle phases, domains, system types, etc.)
- Looking for beta testers for our tool – email helix@stevens.edu

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