

Update on the HELIX project: Understanding organizational attributes that make systems engineering organizations effective

Sponsor: OUSD(R&E) | CCDC

By

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11th Annual SERC Sponsor Research Review

November 19, 2019

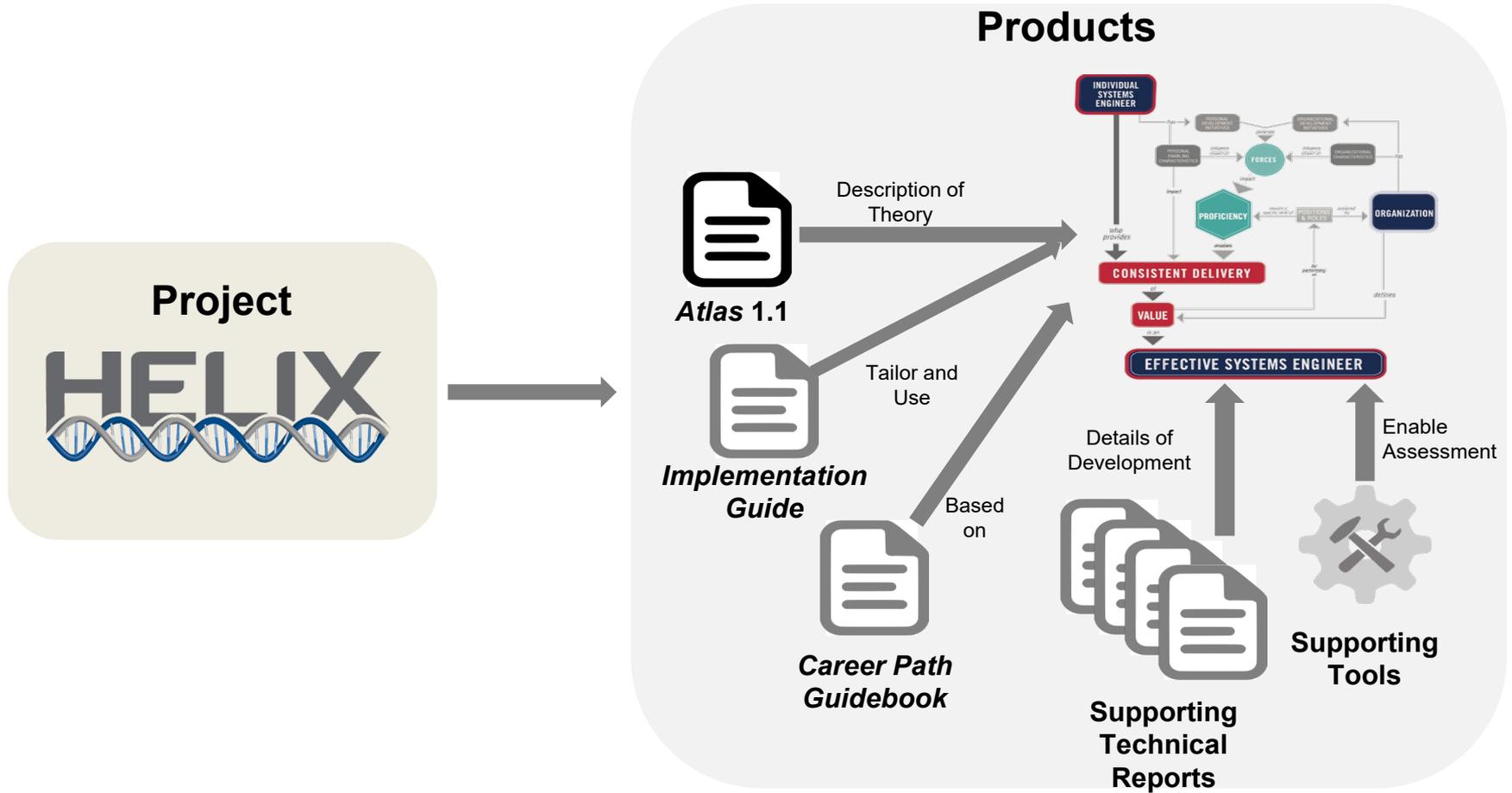
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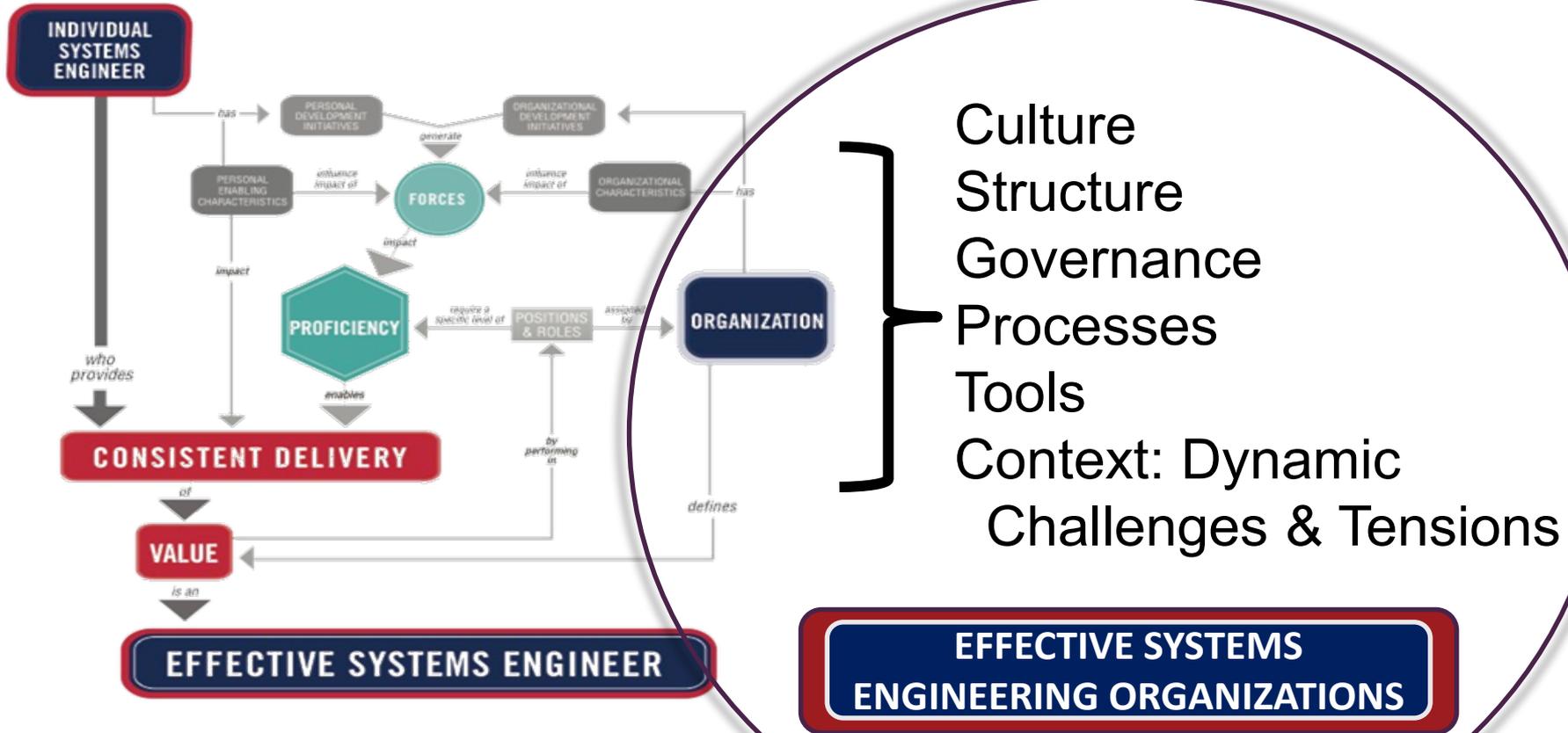
www.sercuarc.org

- Introduction to the Helix Project
- Research Questions
- Example Analyses
- Benefits of the Project
- Continuing Work

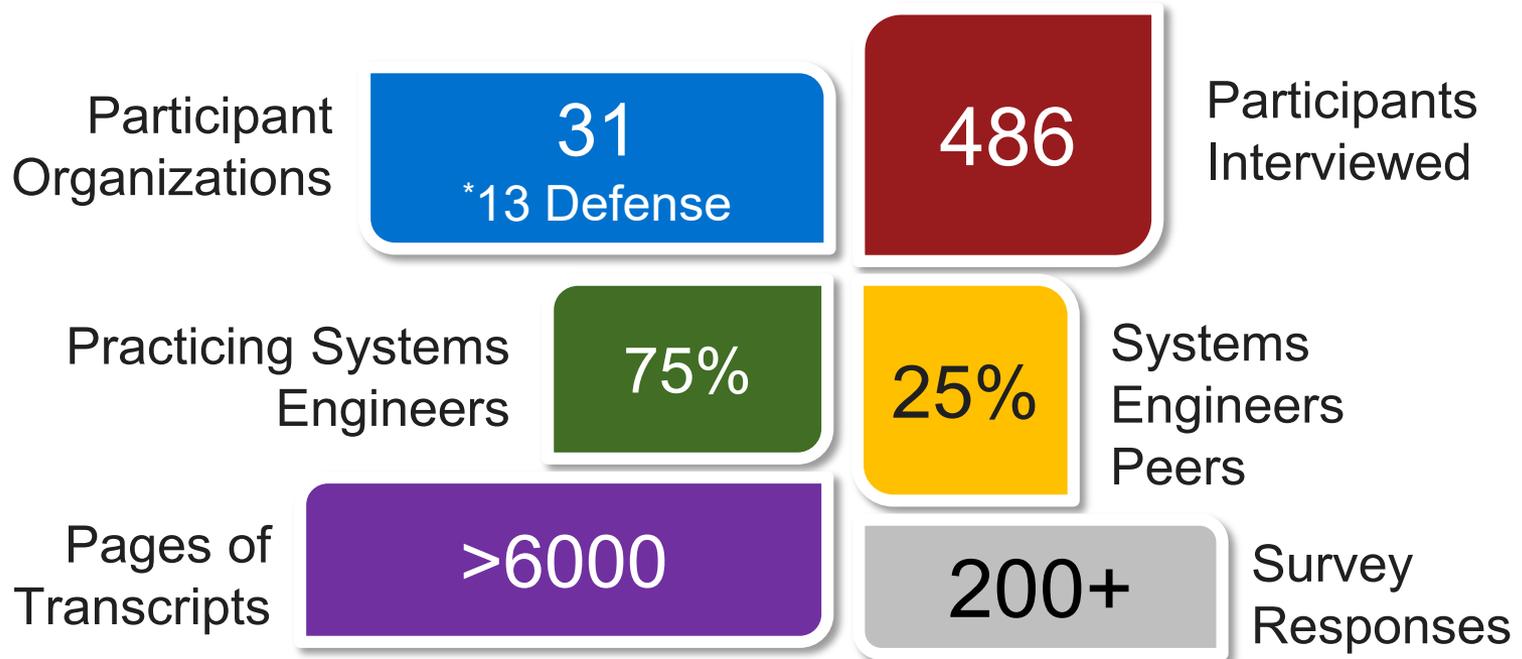


<https://helix-se.org/>

Now: Focus on Organizations



- How can organizations improve the effectiveness of their systems engineering workforce?
- What critical factors, in addition to workforce effectiveness, are required to enable systems engineering capability?
- What tools can we design, test and share to enable organizations to assess and improve their systems engineering capabilities?



On-line Survey Structure

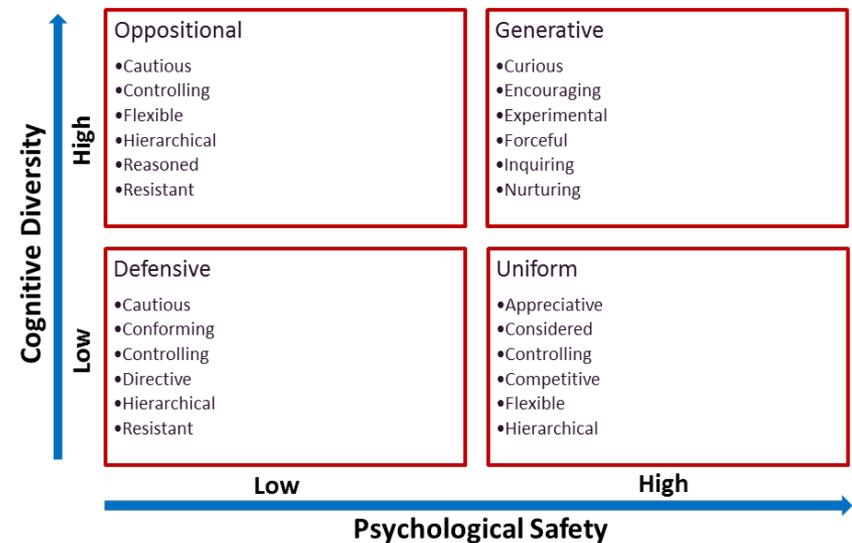
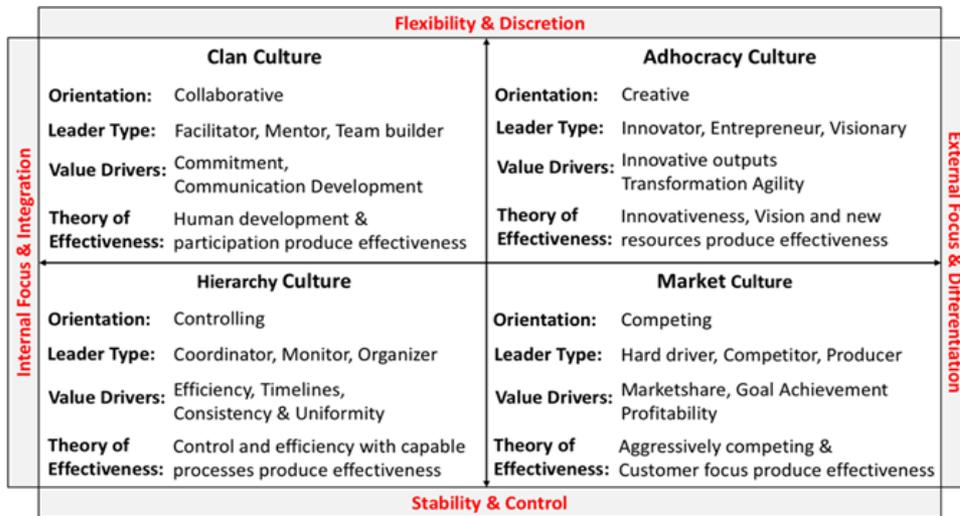
- Intro/Consent
- Competing Values Framework Culture Assessment (CVF)
- SE Specific Questions (culture, governance, structure, processes, tools, effectiveness)
- Qi Index Culture Assessment
- Demographics

Face-to-Face & Phone Interview Topics

- Intro/ Consent
- Defining Systems Engineering in the Organization
- Exploring Organizational Characteristics (culture, governance, structure, processes, tools, effectiveness)
- If you could do or change one thing in your organization to make systems engineering more effective, what would you do or change?

2 Methods for Exploring Organization Culture

- The Competing Values Framework highlights beliefs and assumptions about what drives value and effectiveness.
- The Qi Index reveals perceptions about how people work together and what it feels like to work there.



Competing Values Framework (CVF)

Cameron & Quinn

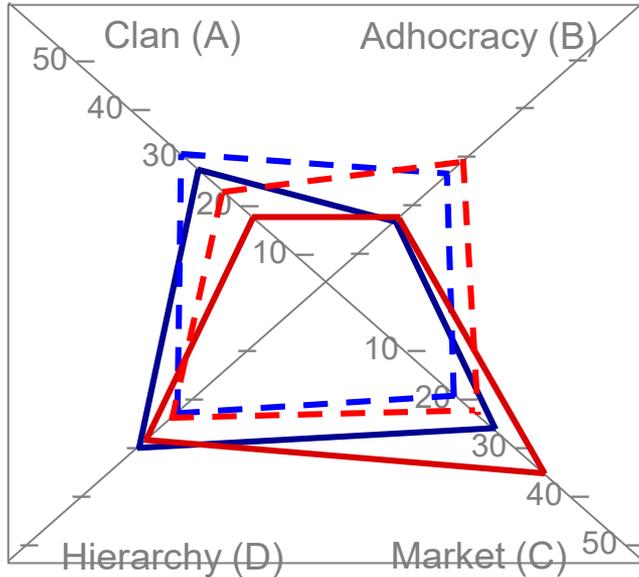
Quality of Interaction (Qi Index)

<https://www.human-insight.com/>

Reynolds & Lewis, Human Insight

Example Findings: Within Organizations

- Within an organization, the two culture assessments show agreement and disagreement on what it is like to work there and their desired future.



- SEs - Now
- - SEs - Future
- Peers - Now
- - Peers - Future

Flexibility & Discretion	
Clan Culture Orientation: Collaborative Leader Type: Facilitator, Mentor, Team builder Value Drivers: Commitment, Communication Development Theory of Effectiveness: Human development & participation produce effectiveness	Adhocracy Culture Orientation: Creative Leader Type: Innovator, Entrepreneur, Visionary Value Drivers: Innovative outputs, Transformation Agility Theory of Effectiveness: Innovativeness, Vision and new resources produce effectiveness
Hierarchy Culture Orientation: Controlling Leader Type: Coordinator, Monitor, Organizer Value Drivers: Efficiency, Timelines, Consistency & Uniformity Theory of Effectiveness: Control and efficiency with capable processes produce effectiveness	Market Culture Orientation: Competing Leader Type: Hard driver, Competitor, Producer Value Drivers: Marketshare, Goal Achievement, Profitability Theory of Effectiveness: Aggressively competing & Customer focus produce effectiveness
Stability & Control	

Competing Values Framework (CVF)

The Qi position you see below shows you where your team or organisation is situated based on all the data collected. From the Qi Spread you can see the distribution of the individual perspectives.

Legend

- System engineers
- Other peers
- Average

Quality of Interaction (Qi)

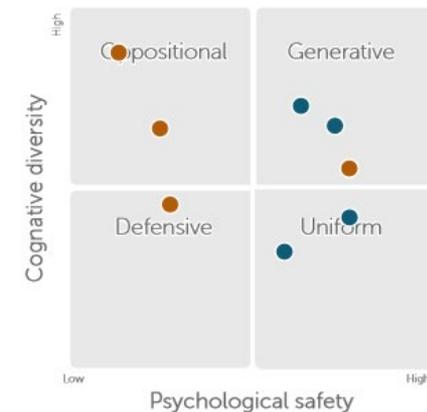
Qi: Average position

Generative factor: 5,34



Qi: Group spread

Generative factor: 5,34, standard deviation: 2,69





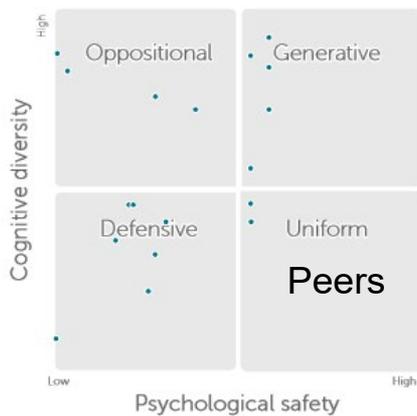
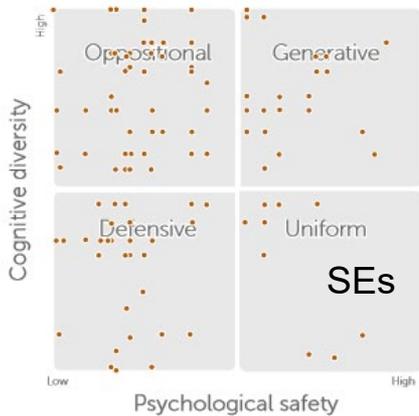
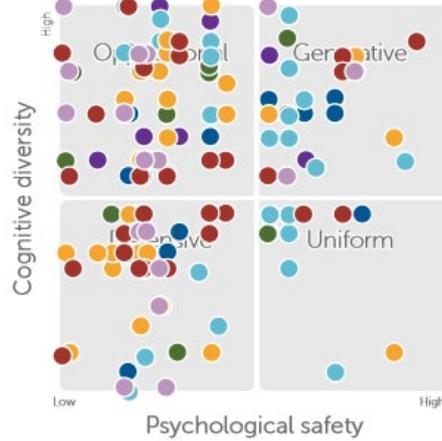
Example Within an Organization with Multiple SE Departments or Projects

- Group F
- Group A
- Group B
- Group C
- Group D
- Group E
- Other

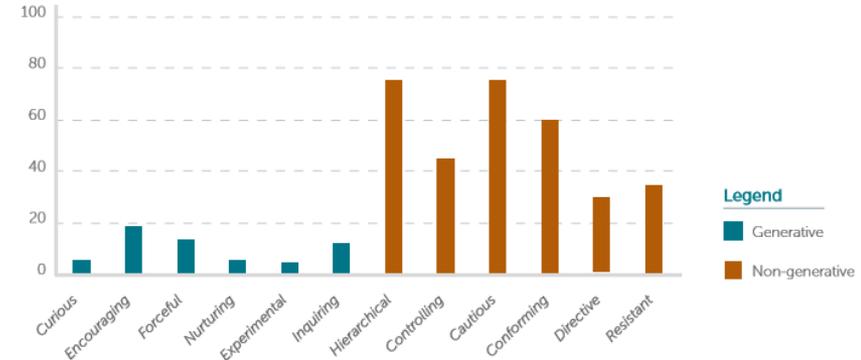
Qi: Team average positions



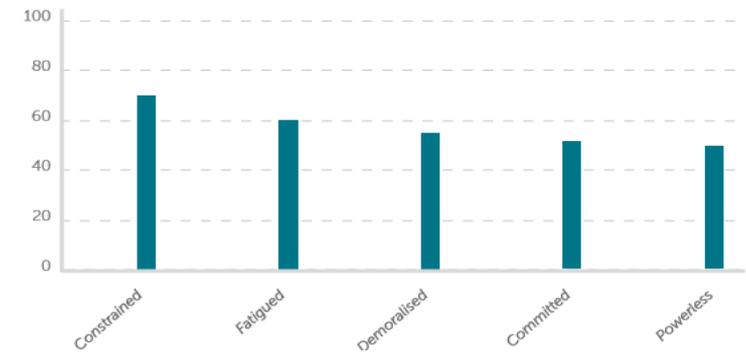
Qi: Team spread



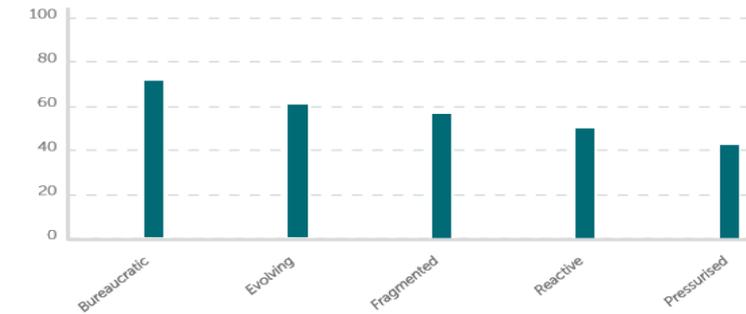
Generative and Non-Generative Behaviours: Bar chart



Top emotions: Bar chart

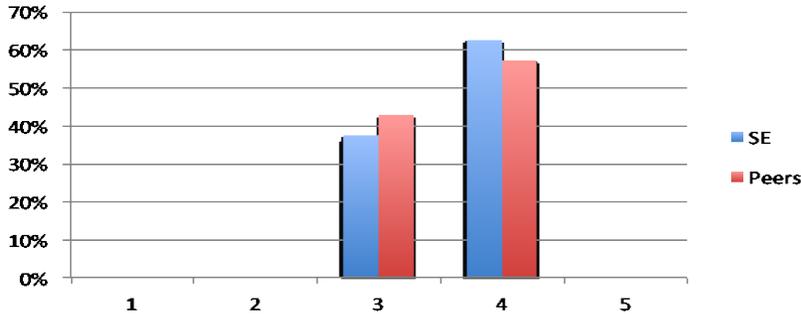


Top states: Bar chart

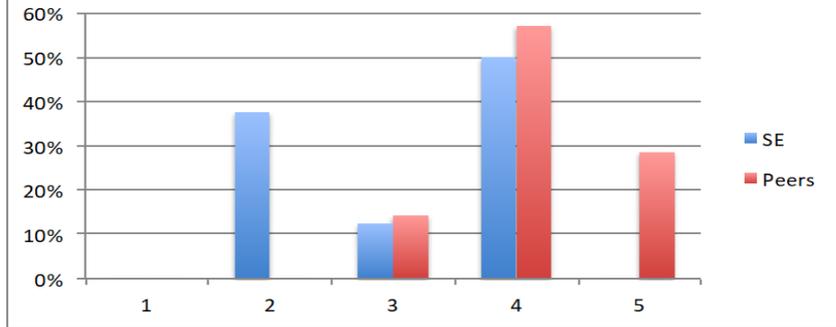


Example Within-Organization Data From Other Parts of the Survey

Overall, the Way Systems Engineering is Organized Here is Very Effective

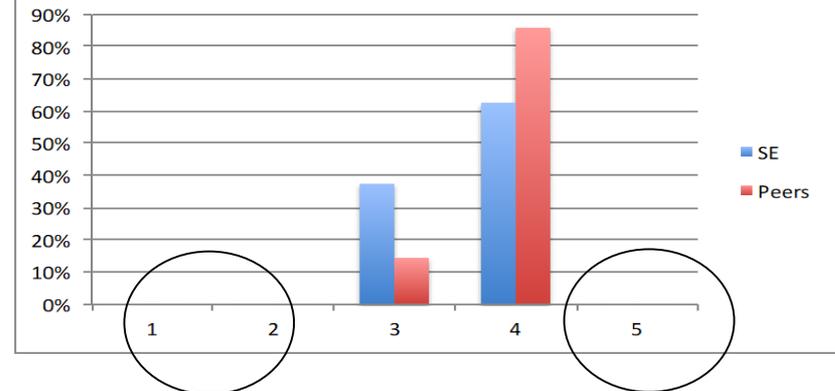


How clear is the role of the systems engineer by others?



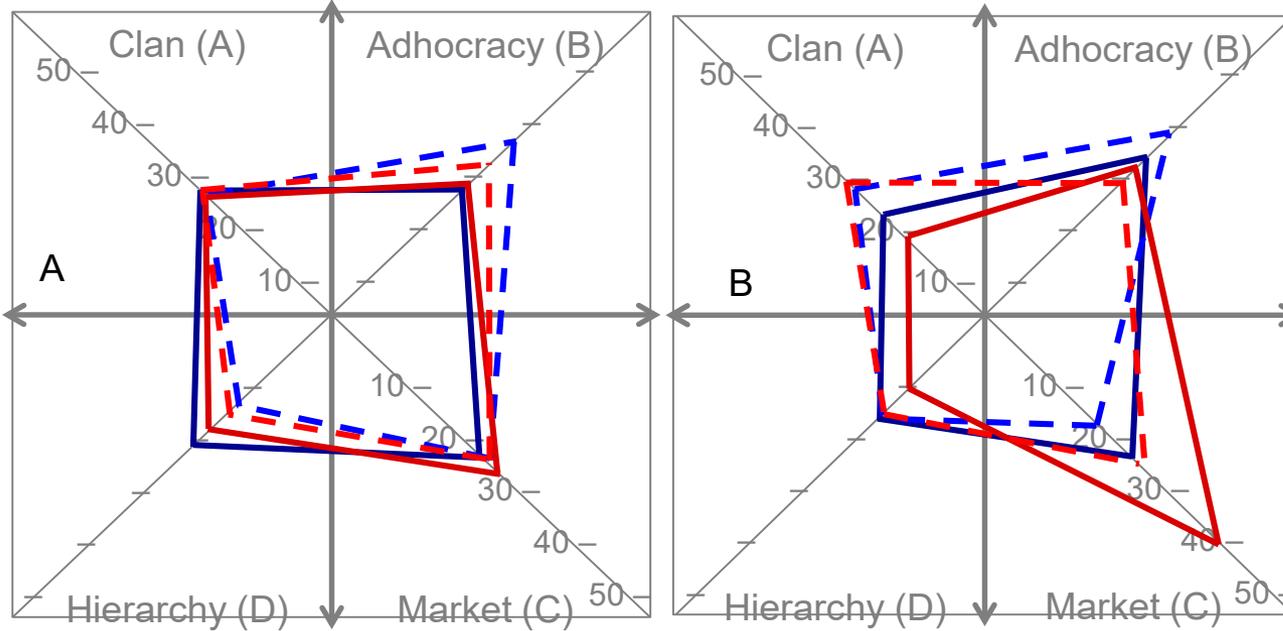
We are currently analyzing the free-text comments associated with each question and integrating those with the interview data.

Overall, How Effective is Systems Engineering?

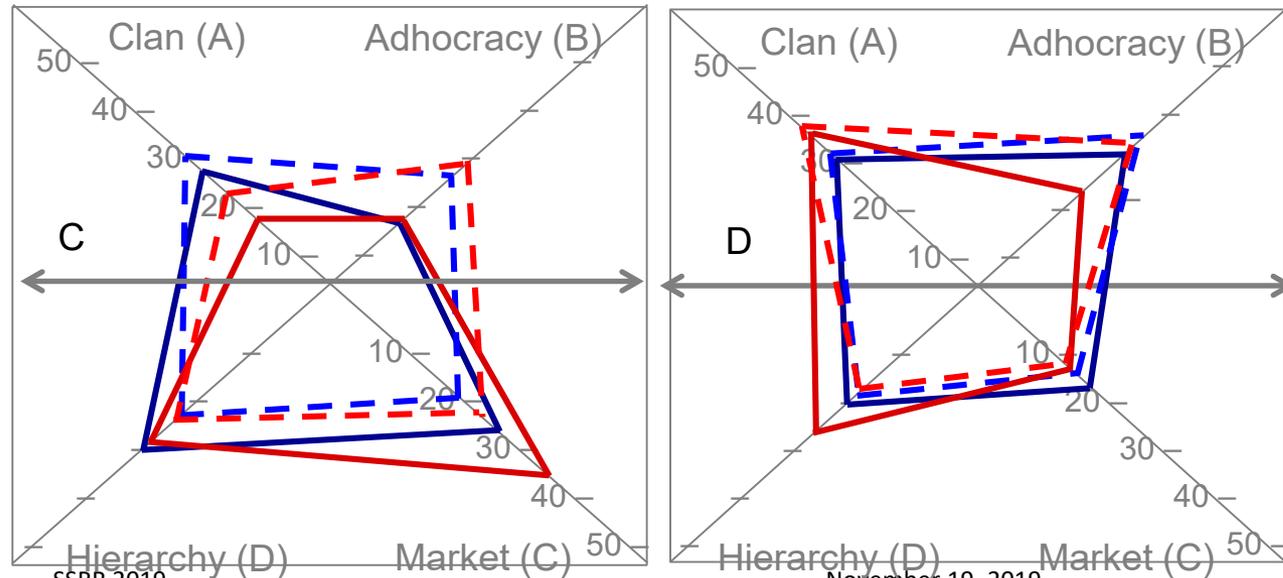


Example Across-Organization Analysis

4 Industry Organizations



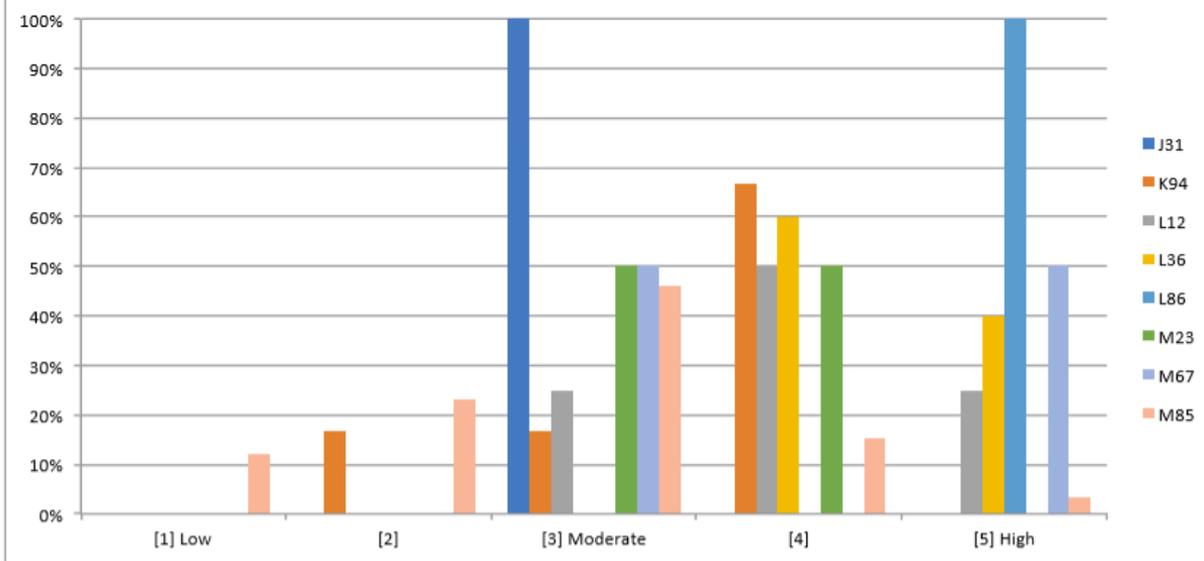
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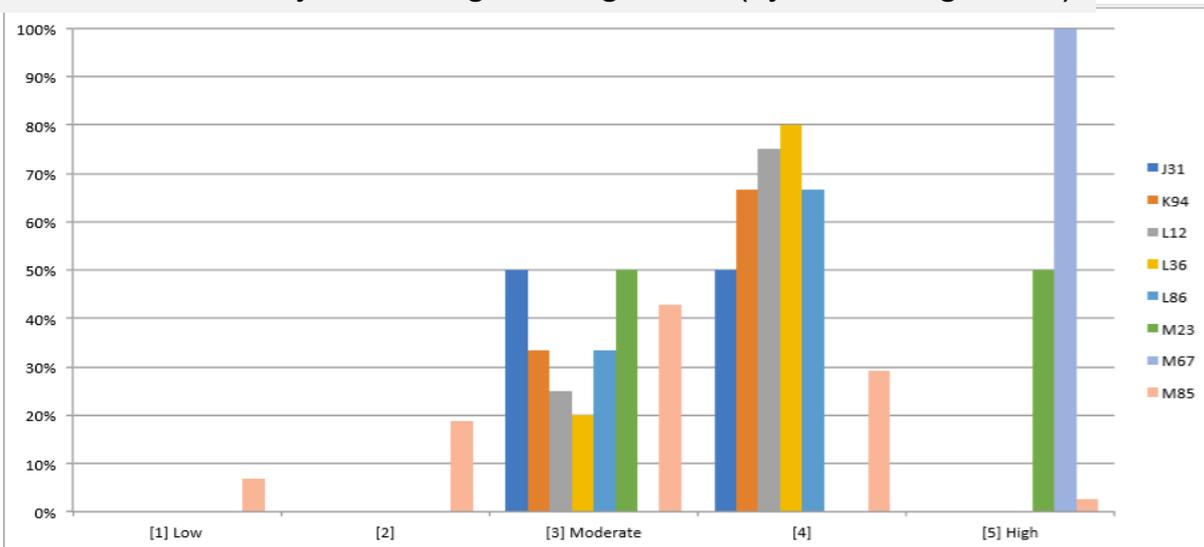
Data from 4 systems organizations in technologically sophisticated, complex product industries in the Netherlands December 2018

Example Across-Organization Analysis

The status of systems engineers in my organization is (systems engineers):



How effective is systems engineering here? (systems engineers)



Effectiveness:

Typical free-text responses for “Ineffective” or “Neutral”:

SE is misunderstood, underused, understaffed, undervalued, discounted because of schedule and cost, inexperienced staff, not organized, not mandated, no fit for purpose tools, policies, procedures & processes.

Typical free-text responses for “Effective”:

Repeatable processes, deliver high quality complex products on time in budget, flexible use of processes and tools, at the table to influence decisions, good practices and tools used throughout the life-cycle, customer & stakeholder access.

Industry and FFRDC

- System complexity requires different skills, tools, and strategic approaches to SE
- Maximizing benefits of Platform development AND Project focus
- Model-Based Systems Engineering (MBSE) not well understood within and across functions
- “Agilizing” Hardware
- Lack of SE depth in software

Government

- Constant changes of personnel and leadership undermine efficiency and clarity of mission
- Schedule overrides SE process and quality
- Military/ Operations mindset clashes with Engineering mindset and decision-making approaches
- SEs not respected, value not understood or championed
- Need to use contract organizations yet also maintain internal SE skills

Domain Specific Contexts: Example Perceived Needs for Change

Industry and FFRDC

- Invest in tools, training, rotations for SEs, especially on MBSE
- Do platform and cross-project road-mapping using SEs at the start of new projects
- Keep pushing down the hierarchy and increasing empowerment of SEs by educating managers and peers on SE expertise and value
- Learn from others who are a few steps ahead on new approaches.

Government

- Increase empowerment
- Keep key people in place and invest in knowledge transfer for people who rotate in and out of a project
- Make data-driven decisions on realistic schedules
- Redesign the SE processes to be faster, more customizable for different kinds of products, and of high value for other functions as well as for the customer
- Promote forward-thinking, openness to change, and systems-thinking mentality.

- **Benefits for participants in the research**
 - Current snapshot of cultural values and drivers of effectiveness
 - Indicators of congruence and disconnects among systems engineers and others
 - The research process sparks individual and group reflection and dialogue
 - Data to inform investments in capability

- **Benefits for the systems engineering community**
 - Explication of an easily replicable model and tools that can be used for reflection, dialogue, strategy development and change in any organization
 - Eventually, identifying systemic organization patterns and trends in technologically sophisticated, complex organizations that contribute to systems engineering innovation and effectiveness

- Integrating interview and survey data within and across organizations
- Developing an online dashboard to enable the Helix team (and possibly the community) to explore the data using data-mining tools
- Discussions with participants to expand understanding of patterns, trends, and uses of the data
- Summarizing all findings in a final Helix Report in May 2020
- For more information, please contact the Helix Project through our website: <https://helix-se.org/>

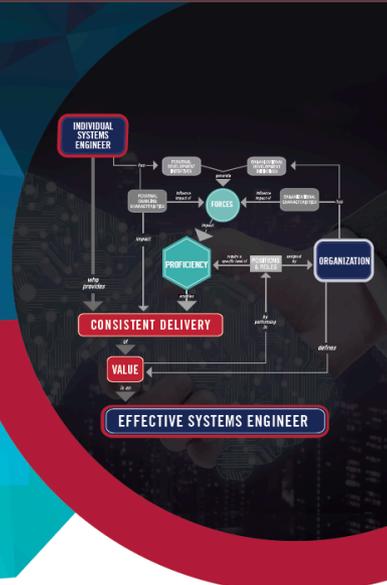
HELIX

CALL FOR PARTICIPATION

BENEFITS FROM PARTICIPATING IN HELIX

- What makes systems engineering **effective** where you work?
- How do your skills map to **career paths** in your industry?
- How does your **skillset** align with your **organization's view** of systems engineering?
- How does your organization foster **effective systems engineering** and **effective systems engineers**?

We need your insights to build experience-based models of effective systems engineering workplaces



Questions?

- helix@stevens.edu
- helix-se.org

HOW CAN I PARTICIPATE IN HELIX?

There are many ways to support Helix research:

For individuals:

- Online survey
- Proficiency and career path self assessments

For organizations:

- Organizational site visits - in-depth analysis and insights into your organization's approach to systems engineering

Scan the QR code below to participate



helix@stevens.edu
helixse.org

SINCE 2012, THE HELIX PROJECT HAS INVESTIGATED WHAT MAKES SYSTEMS ENGINEERS EFFECTIVE. THIS WORK CULMINATED IN ATLAS: THE THEORY OF EFFECTIVE SYSTEMS ENGINEERS. THE HELIX TEAM HAS EXPANDED THE RESEARCH TO LOOK MORE CLOSELY AT THE ORGANIZATIONAL FACTORS THAT INFLUENCE SYSTEMS ENGINEERING AS A DISCIPLINE AND THE DELIVERY OF EFFECTIVE SYSTEMS ENGINEERING CAPABILITY. 363 INDIVIDUALS FROM 23 ORGANIZATIONS HAVE PARTICIPATED TO DATE.

SE Specific Questions/Prompts

- What is the status of systems engineers in the organization?
- How valued is systems engineering?
- How connected do Systems Engineers feel with the broader SE community?
- How clear is the role of systems engineers to systems engineers?
- How clear is the role of systems engineers to others?
- Collaborating with others is:
- Diverse thinking is brought to bear on important decisions here.
- Systems engineering has an official role in making the most important technical decisions here.
- Systems engineers have a direct impact on the most important decisions here.
- Senior executives visibly champion systems engineering as a critical discipline here.
- I see direct connection between systems engineering activities and the mission of my organization.
- Overall, the way systems engineering is organized here is very effective.
- Overall, the systems engineering processes we use are very effective.
- We have the tools we need to do systems engineering effectively.
- We use leading-edge systems engineering processes and tools here.
- We have the right number of systems engineers on my project or program.
- Our systems engineers have the skills required to succeed.
- Overall, how effective is systems engineering here?