Helix Goes International: Observations on Systems Engineering in the Netherlands

Dr. Nicole Hutchison, Dr. Pamela Burke

ESI Symposium

9 April 2019
• Systems Engineering Research Center – the University Affiliated Research Center (UARC) for Systems Engineering Research

• Collaborative network of universities

• The national resource for systems engineering research
What is Helix?

- 2012 Kickoff
- Initiated due to US Department of Defense concerns about systems engineering workforce
- 2012-2018 – Systems engineers’ effectiveness
- 2018 – present – Systems engineering effectiveness

<table>
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<tr>
<th>Participant Organizations</th>
<th>Participants Interviewed</th>
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<td>29* (12 DoD/DIB)</td>
<td>464</td>
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<tr>
<th>Practicing Systems Engineers</th>
<th>Systems Engineers’ Peers</th>
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<td>91%</td>
<td>9%</td>
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<tr>
<th>Pages of Transcripts</th>
<th>Hours of Audio</th>
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<td>&gt;6000</td>
<td>270</td>
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What makes individual systems engineers effective?
What makes individual systems engineers effective?

- Math/Science/General Engineering
- Technical Leadership
- Interpersonal Skills
- System's Domain & Operational Context
- Systems Engineering Discipline
- Systems Engineering Mindset

An Example Systems Engineer's Proficiency
What makes individual systems engineers effective?

- Detailed Designer
- Requirements Owner
- Systems Architect
- System Analyst
- V&V Engineer
- Support Engineer
- Process Engineer
- Systems Integrator
- Customer Interface
- Technical Manager
- Coordinator

Educational Milestones
Bachelor’s in Mechanical Engineering
MBA

Career Milestones
1st SE Position
1st CSE Position
2nd CSE Position
Org Mgt
Project Engineer

Career Path

Time
Now
Start of Career
• Keep and maintain the system vision.

• Translate technical jargon into business or operational terms and vice versa.

• Enable diverse teams to successfully develop systems.

• Manage emergence in both the project and the system.

• Enable good technical decisions at the system level.

• Support the business case for the system.

• Guide long-term vision/roadmap for systems
What makes individual systems engineers effective?

Systems Engineering Effectiveness
High Level Observations: Governance

• Decisions taken at low levels – “power to the edges”

• Hierarchy exists on paper though SA/SD expected to challenge anyone

• Strong consensus decision "processes" - high participation, high social influence geared toward allowing decisions to emerge from the collective experience of the group rather than be done in a closet and handed down to the team
  — Advantages - high cognitive and experiential diversity brought to bear on decisions because of inclusion, decisions are understood because all participated
  — Challenges - speed, decisions don't always stay "final" as conversations continue, works well in teams where people know each other well and respect the expertise in the group but hard to scale with many new people who have not yet earned social influence credibility, as an informal process it is more subject to cognitive decision bias

• In the US
  — Varies a lot, though tend to have more hierarchical and defined decision practices
  — SE make recommendations, higher levels make the major decisions (sometimes a SE, sometimes PM or other role)
High Level Observations: MPTs

- No common standard for tools in the Netherlands (or even within companies)
  - "Fit for purpose" lot of flexibility in which SA/SD tools are implemented on a project

- V model most common (waterfall also cited)
  - Conflict in approaches HD SW

- Interest and skepticism MBSE

- Little interaction with other SA/SDs in professional organizations to share and learn new tools and practices

- In the US
  - V model is most common approach (may be called DoD 5000.2, V model, etc.)
  - Incremental/Spiral development or agile approaches desired but not common
  - MBSE/MBE/MOSE/DE gaining popularity – but only a few organizations seem to really know how to utilize
  - No standardization of tools (though Doors is most common requirements tool in Helix sample)
Comparing Profiles of 5 Organizations (CVF)

Data from 5 systems organizations in technologically sophisticated, complex product industries in the Netherlands December 2018

- SEs - Future
- Peers - Now
- Peers - Future
5 Company Combined Qi Results

Legend

A  B  C  D  E

Qi: Team average positions

Qi: Team spread

Oppositional  Generative
Defensive  Uniform

Psychological safety

High  Low
Cognitive diversity
Much of what we saw indicates you are already working to manage tensions that when managed well support stellar innovation as described by Gary Pisano in “The hard truth about innovative cultures”

1. Tolerance for failure but no tolerance for incompetence

2. Willingness to experiment but highly disciplined

3. Psychologically safe but brutally honest

4. Collaboration but with individual accountability

5. Flat but strong leadership

Where can Helix go?

- What do SE need to look like in the future?
- What critical new skills can be developed?
- What can we learn from each other?
Questions?

Nicole Hutchison & Pam Burke: helix@stevens.edu
Helix-se.org