RT-154: Helix

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Research Task / Overview

Helix is a multi-year longitudinal research project that is developing ***Atlas***, a theory of what makes systems engineers ***effective***. *Atlas* is based primarily on in-depth interviews with well over 200 systems engineers and those who work with them. The sample population comes largely from the DoD and its industrial support base, but also includes professionals from other industry sectors such as healthcare and information technology. ***Atlas 0.6*****,** the current release, has been implemented in an number of organizations. Atlas ***1.0*** will be released in December 2016 and is expected to be mature enough for independent deployment and assessment by individuals and organizations.

Goals & Objectives

Helix is a multi-year longitudinal study building an understanding of the systems engineering workforce in the DoD, the Defense Industrial Base (DIB), and other sectors that perform systems engineering.

Helix is focused on three main research questions:

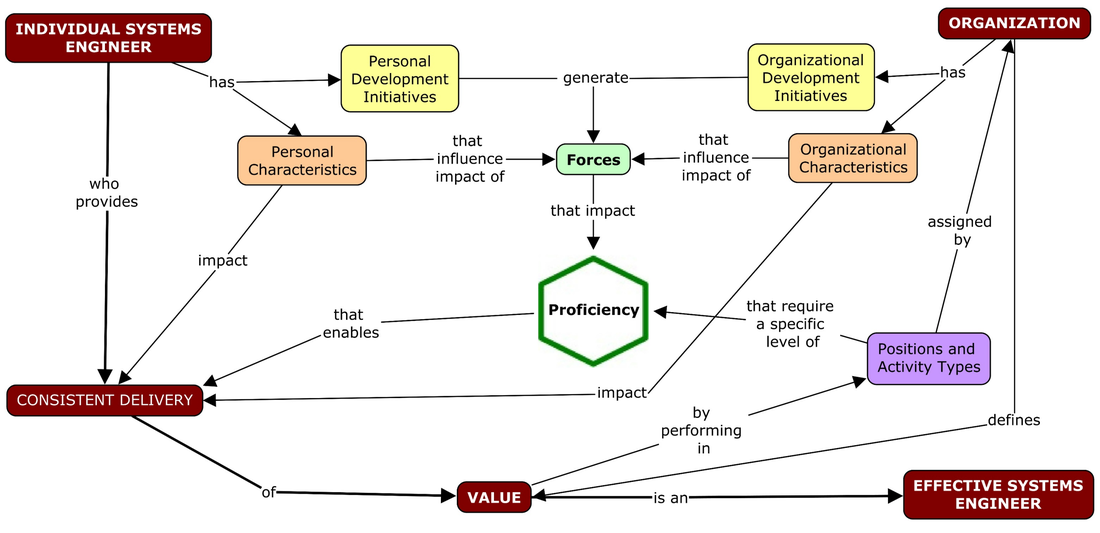
1. What are the characteristics of systems engineers?
2. How effective are those who perform SE activities and why?
3. What are employers doing to improve the effectiveness of systems engineers?

Most data collection has been through face-to-face, semi-structured interviews with systems engineers

287 participants from 20 organizations

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

Data & Analysis



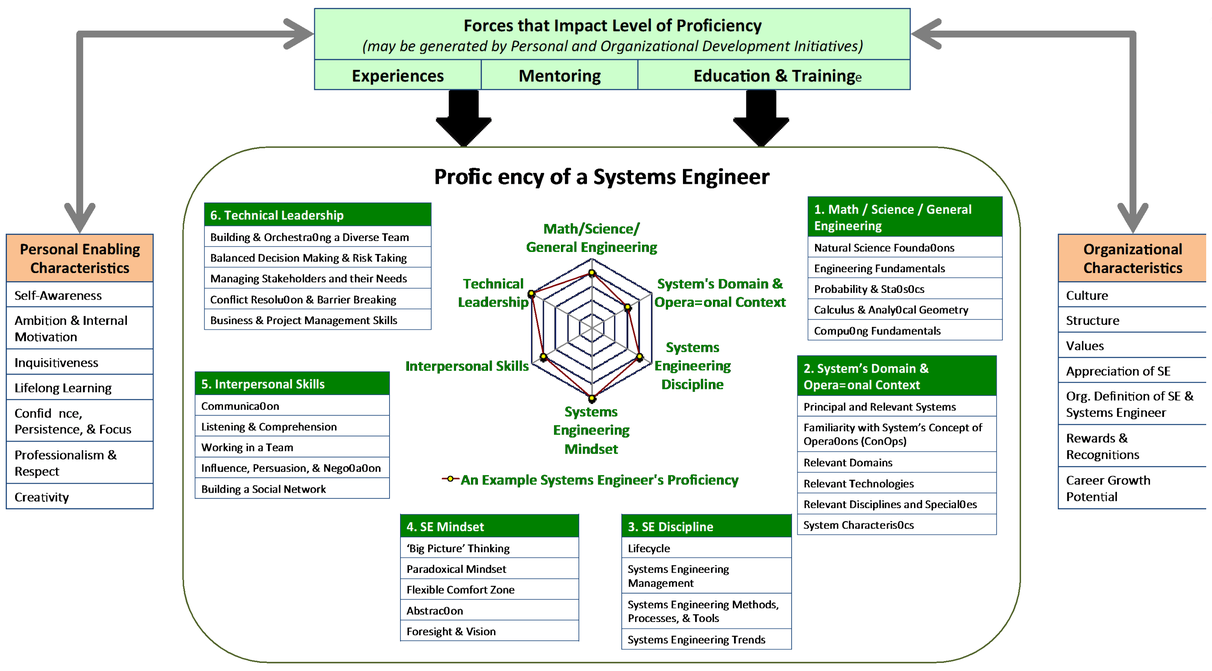
Atlas 1.0 – The Theory of Effective Systems Engineers

Atlas defines systems engineer as ***effective*** when she consistently delivers value as defined by the organization. Value delivery occurs over time when the individual performs specific ***roles*** (such as ***customer interface***) in a series of ***positions*** (such as ***chief systems engineer***).

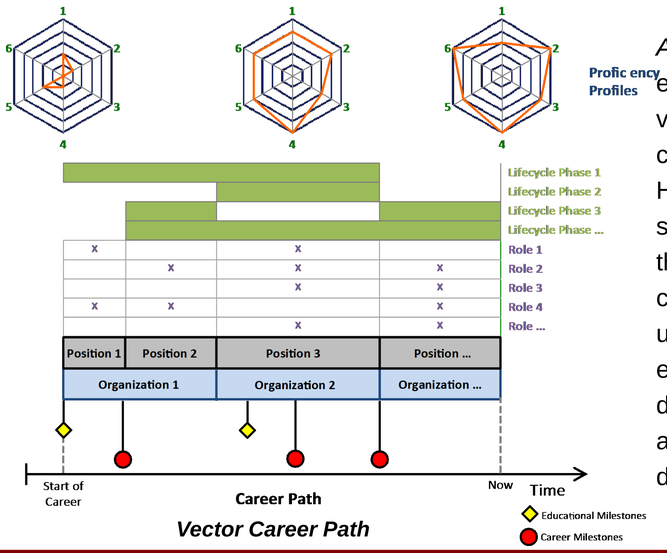
Enabling value delivery are ***proficiencies*** the systems engineer possesses. Over time, ***forces*** impact the level of those proficiencies, influenced by her ***personal characteristics*** and ***personal development initiatives***, and by ***organizational characteristics*** and ***organizational development initiatives.***

Primary Values Systems Engineers Provide

- Keeping and maintaining the system vision.
- Enabling diverse teams to successfully develop systems.
- Managing emergence in both the project and the system.
- Enabling good technical decisions at the system level.
- Supporting the business cases for systems.
- Translation of technical jargon into business or operational terms and vice versa.



The Proficiencies of Systems Engineers and the Forces and Characteristics that Impact Them

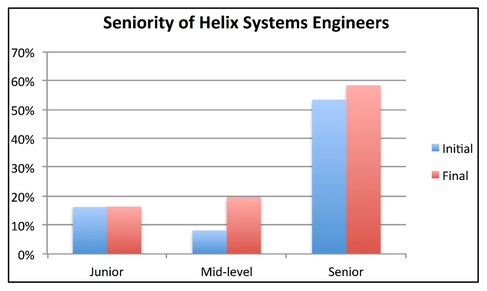


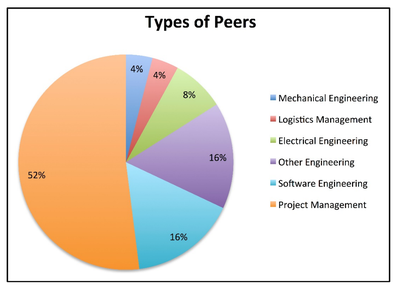
Vector Career Path

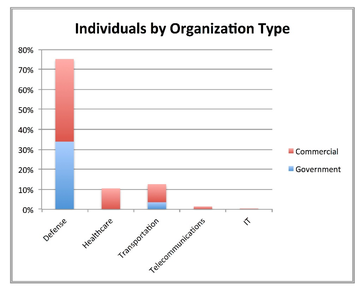
Atlas provides a snapshot of a systems engineer's effectiveness – their abilities, values provided, and influencing characteristics at a given point in time. However, systems engineers are not static and therefore a dynamic view of the characteristics in *Atlas* and how they change over time is critical to fully understand current and potential future effectiveness. The Helix team developed *Vector*, a career path analysis methodology to capture the dynamic aspects of effectiveness.

Methodology

- Initially, the Helix team focused on a mixed-methods approach (Creswell and Plano 2011), combining the development of basic research questions with grounded theory.
- Helix is primarily a qualitative study, with the primary means of data collection being interviews with systems engineers and their peers.
  - Interviews were semi-structured, meaning that there were basic questions to frame discussion, but interviewees were free to focus on areas important to them.
  - Later interviews were structured more around responding to drafts of Atlas or implementation of Atlas tools.
- The Helix team has interviewed 287 individuals from 20 organizations
  - 91% of these individuals were practicing systems engineers
  - 9% were their peers: a mix of program managers; classic engineers such as electrical, mechanical, or software engineers; or individuals in related disciplines

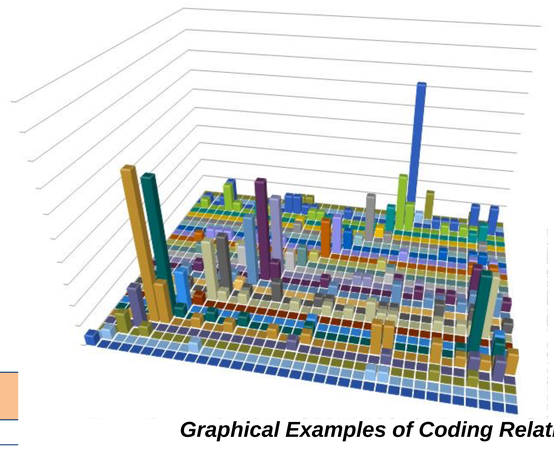


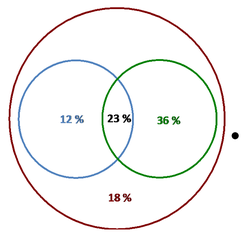




Demographics from and Composition of the Helix Dataset

- Dataset comprises nearly 6,000 pages of transcripts and summaries.
- The Helix team used qualitative data analysis, primarily through data coding with NVIVO.





- Comparing coding for multiple characteristics helped to identify relationships that participants believed were important across organizations.
- Validation was done through a series of follow-up interviews, examining research findings with current participants, community presentations, and public workshops.

Graphical Examples of Coding Relationships

Future Research

- Additional data must be collected to better understand how to characterize the effectiveness of a systems engineering team or workforce.
- To enable an increased understanding of organizational effectiveness, the Helix team needs to create a robust model(s) that can aid understanding of not only the effectiveness of individual systems engineers but systems engineers as a group.
- The Helix team will examine the potential for collaboration with additional SERC research tasks as well as community based activities, particularly existing research on systems engineering capabilities at the organizational level.
- Additional infrastructure must be put in place to enable widespread use by individuals or organizations, including publicly-available tooling to support analysis and data collection.

Contacts/References

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***Atlas* 0.5**: http://www.sercuarc.org/wp-content/uploads/2014/05/Helix-Report-Atlas-0.5-December-2015.pdf
***Atlas* 0.6**: http://www.sercuarc.org/wp-content/uploads/2014/05/Helix_Atlas_0-6_final.pdf