32nd Annual INCOSE international symposium

hybrid event

Detroit, MI, USA
June 25 - 30, 2022

Dr. Nicole Hutchison, Systems Engineering Research Center (SERC)

You're a Systems Engineer: Own It!

www.incose.org/symp2022

- Decade+ of SE Research for US DoD
- 5 years in US Defense Industry
- SE Training 5+ years
- PhD in SE

- US Army Spouse
- Mom of 4 (2 human, 2 canine)

Datasets

Participating Organizations	31	486	Participants Interviewed
Practicing Systems Engineers	75%	25%	Systems Engineers' Peers
Pages of Transcripts	6000+	200+	Survey Responses

3000+

SEP application forms received from May 2004 to May 2014

Applicants were given the option to opt out

Who are we?

"Put simply, systems engineers **analyze** organizational systems to find more **efficient** ways of doing things."

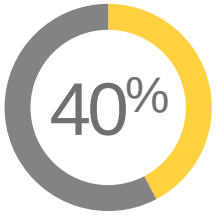
"A Systems Engineer's job is to **determine problems within specific systems**. They provide solutions for issues they find in the process, including designing new systems, upgrading hardware and maintaining an existing system."

"Systems engineers **develop and oversee all aspects of a complex system to solve a problem**, from the initial creation of the system to production and management through the end product or solution."

People who practice systems engineering: "a a **transdisciplinary and integrative approach** to enable the **successful realization, use, and retirement of engineered systems**, using **systems principles and concepts**, and scientific, technological, and management methods." (INCOSE)

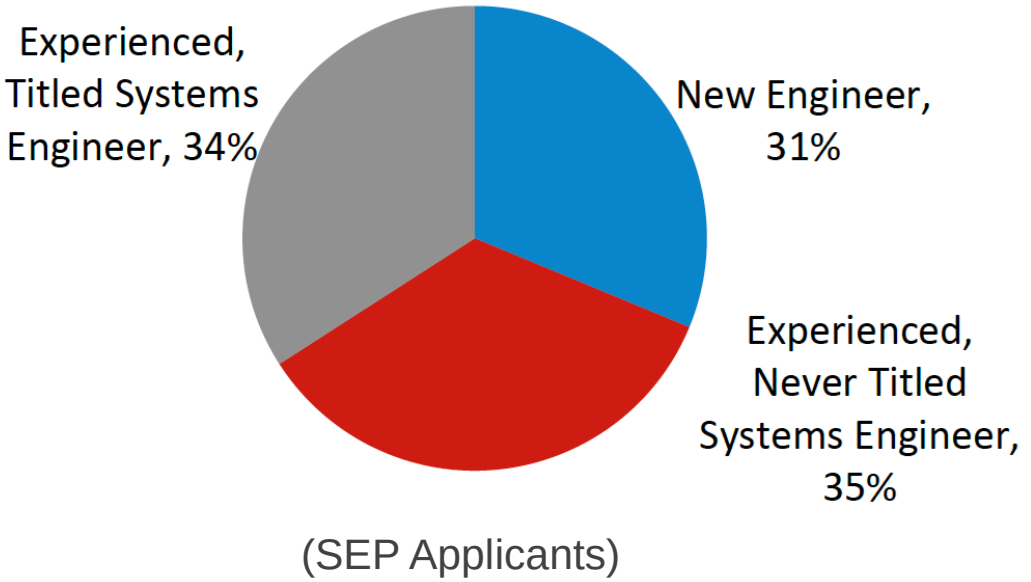
*"A systems engineer is 'a person who practices systems engineering' and whose systems engineering capabilities and experience include sustained **practice**, **specialization**, **leadership** or authority **over systems engineering activities**. Systems engineering activities may be conducted by any competent person regardless of job title or professional affiliation."* (SEBoK)

How about titles?



of systems engineers have never had that title (Helix)

Anyone who does systems engineering, regardless of title or formal role.



(SEP Applicants)

What my mom thinks I do

What society thinks I do

What I tell people I do

What my manager thinks I do

What I think I do

What I really do

What do we do? SE Roles

System Being Developed

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

SE Process and Organization

- Systems Engineering Champion
- Process Engineer

Teams That Build Systems

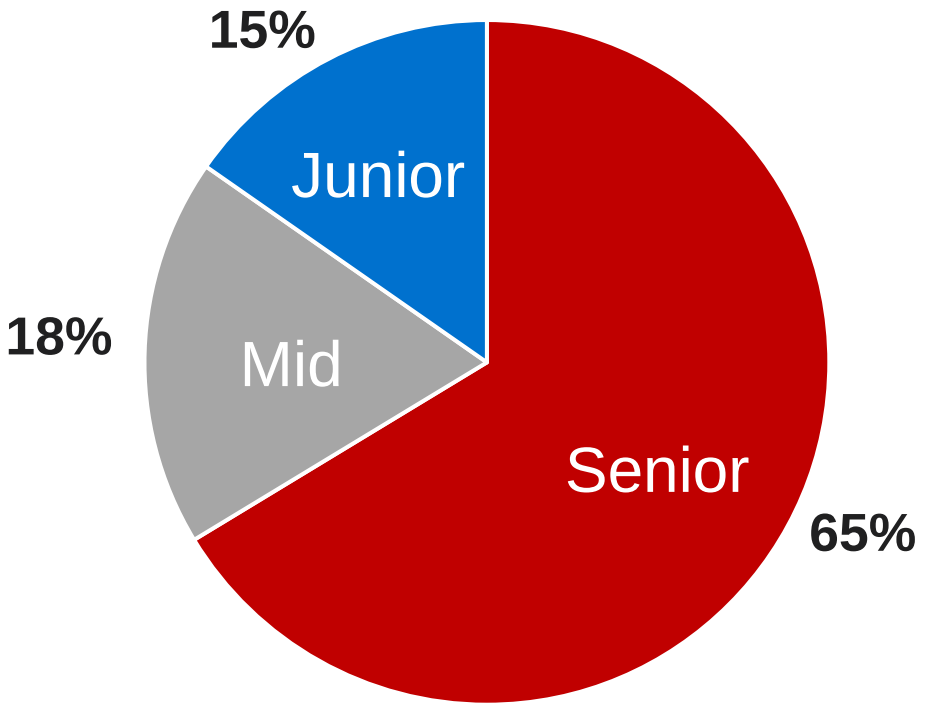
- Customer Interface
- Technical Manager
- Information Manager
- Coordinator
- Systems Instructor/Teacher

Ruth Crick – WILD Learning Framework

- **Develop a clear system vision** (and get a team to buy into it)
- **Enable successful communication** (between technical, business, and operational teams, corporate and national cultures, etc.)
- **Enable diverse teams to successfully develop systems**
- **Manage uncertainty and emergence** in the project and the system
- Make good **technical decisions** and **trades at the system level**
- Support the **business case** for the system

How did we get here?

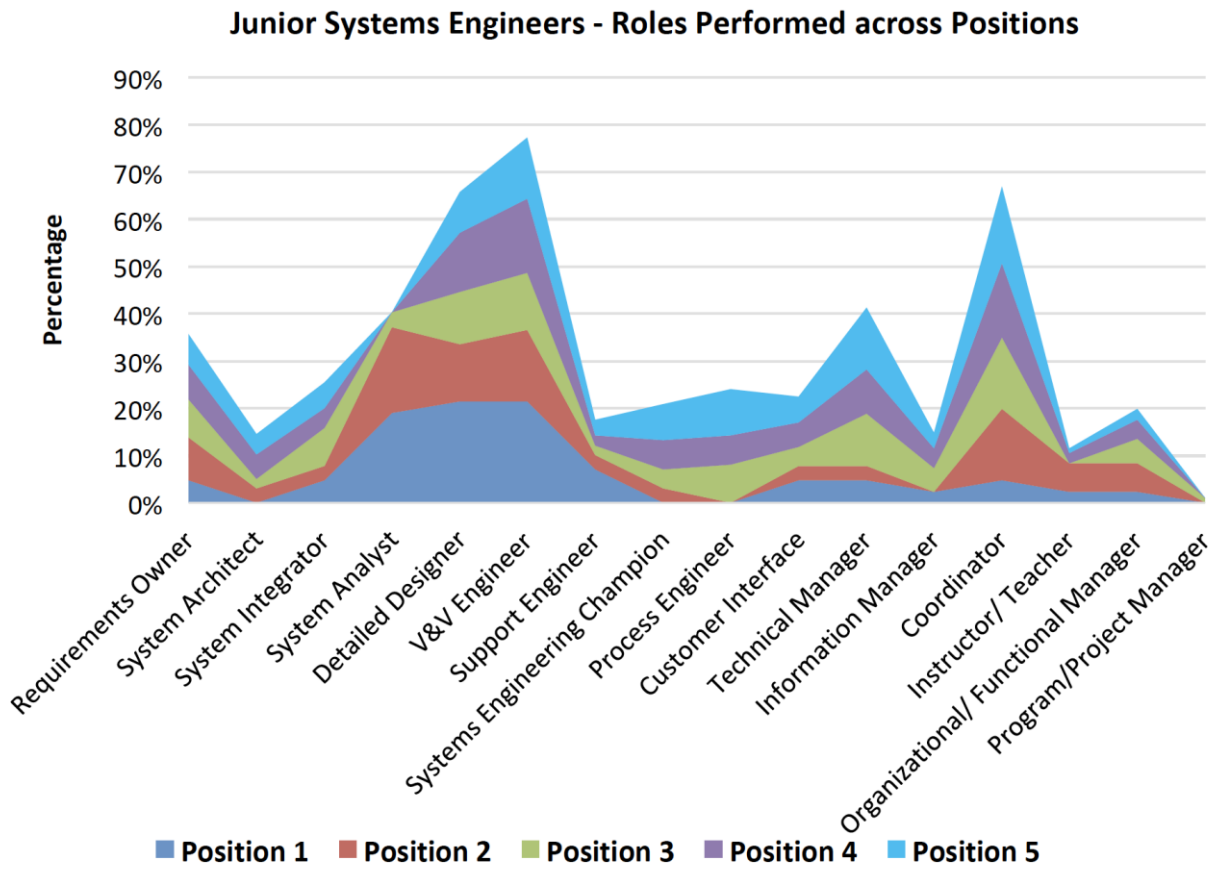
~~"You can't be a systems engineer unless you have at least 20 years of experience."~~

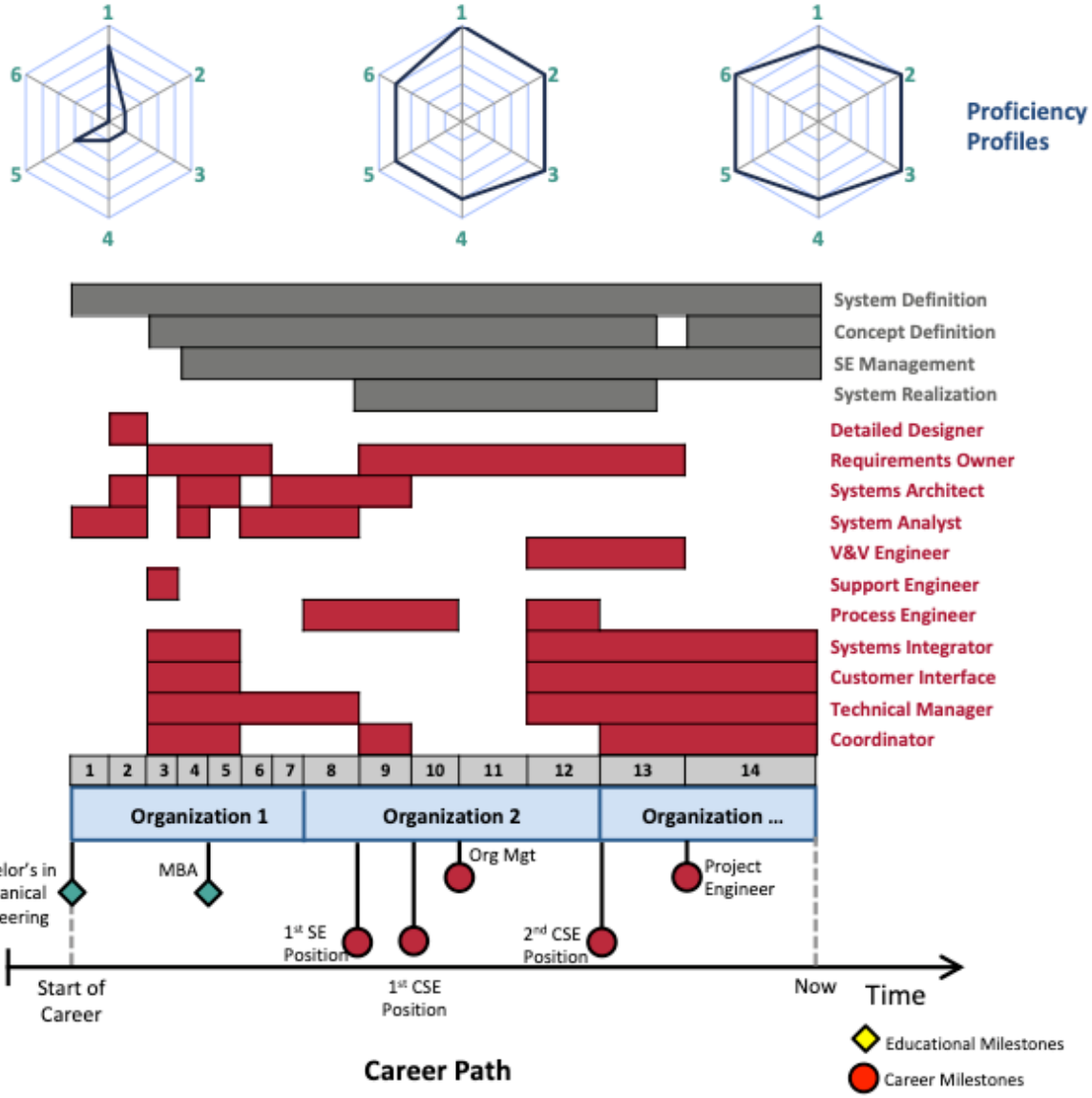


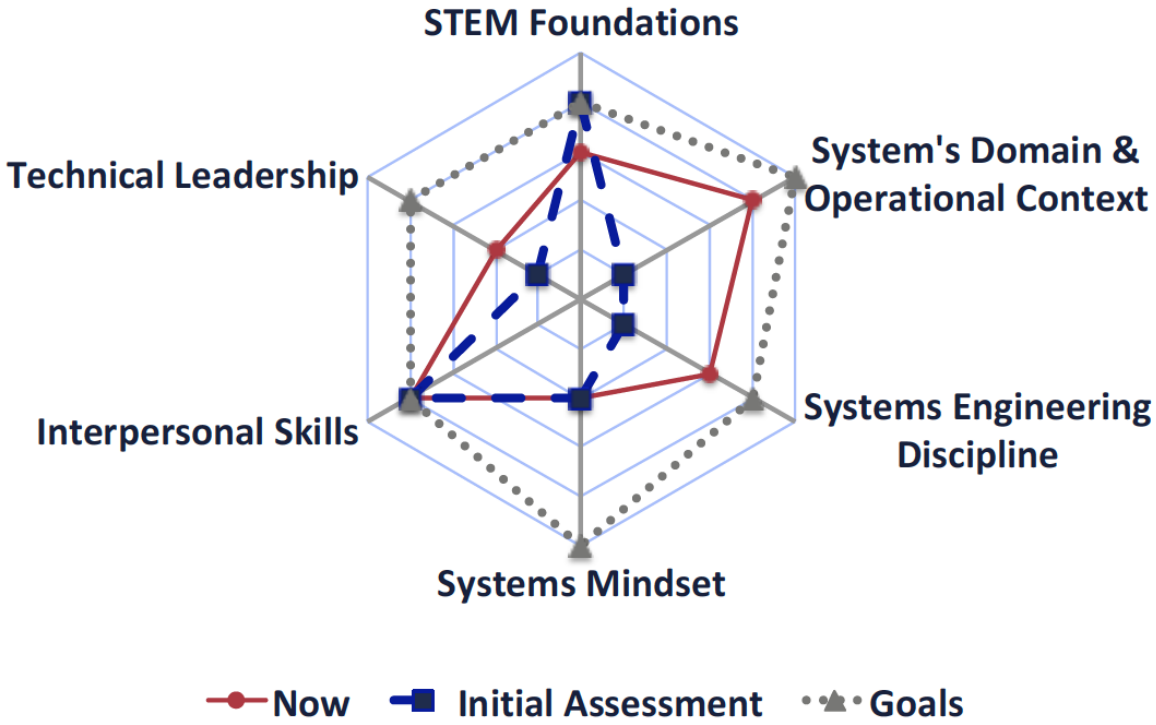
Criteria	Junior	Mid-level	Senior
Leadership	Primarily works as an individual contributor; has had zero or one formal leadership positions, which can be as an official supervisor or as a task leader	At least two formal leadership positions over teams or tasks of significant size and scope; viewed as a leader in a project, program, or business unit of the larger enterprise	Three or more formal leadership positions over teams or tasks of significant size and scope, including second-level management roles; viewed as a leader in the enterprise
Complexity	Relevant experiences on a simple project, system, or task, working primarily at the system components level or simple activities such as managing a requirements database	Relevant experiences on moderately complex projects or systems, working at the sub-system and system levels or on moderately complex activities such as managing the development and negotiation of requirements for a moderately complex system	Relevant experiences on complex projects or systems, working at the system and platforms/systems of systems levels or on quite complex activities such as managing the development and negotiation of requirements for a complex system of systems
Lifecycle	Relevant experiences in at least two phases of the systems lifecycle	Relevant experiences in at least three phases of the systems lifecycle	Relevant experiences in at least four phases of the systems lifecycle
Roles	Worked on up to 3 different roles, usually more detailed oriented	Worked on 4 to 6 different roles, with a mix of roles that are detail oriented and team and leadership oriented	Worked on 7 to 15 different roles with recent roles likely being more team and leadership focused rather than detail oriented

How did we get here?

~~"The right way to become a systems engineer is to work in a classic engineering discipline first."~~

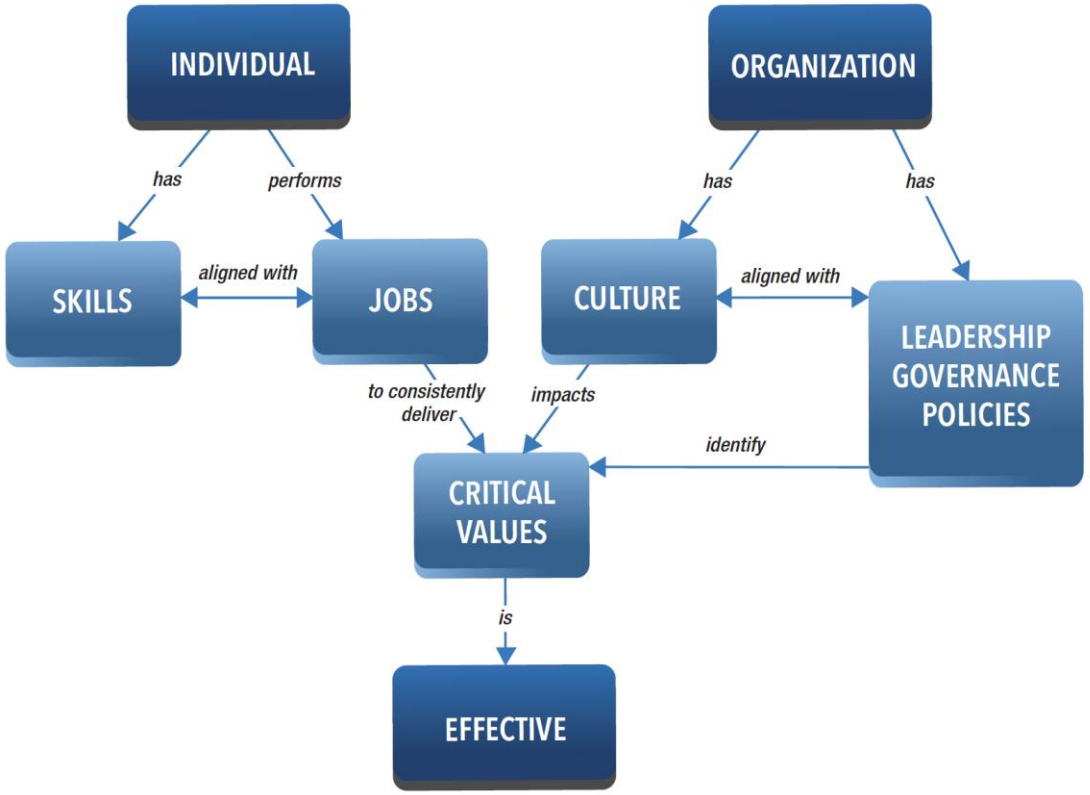


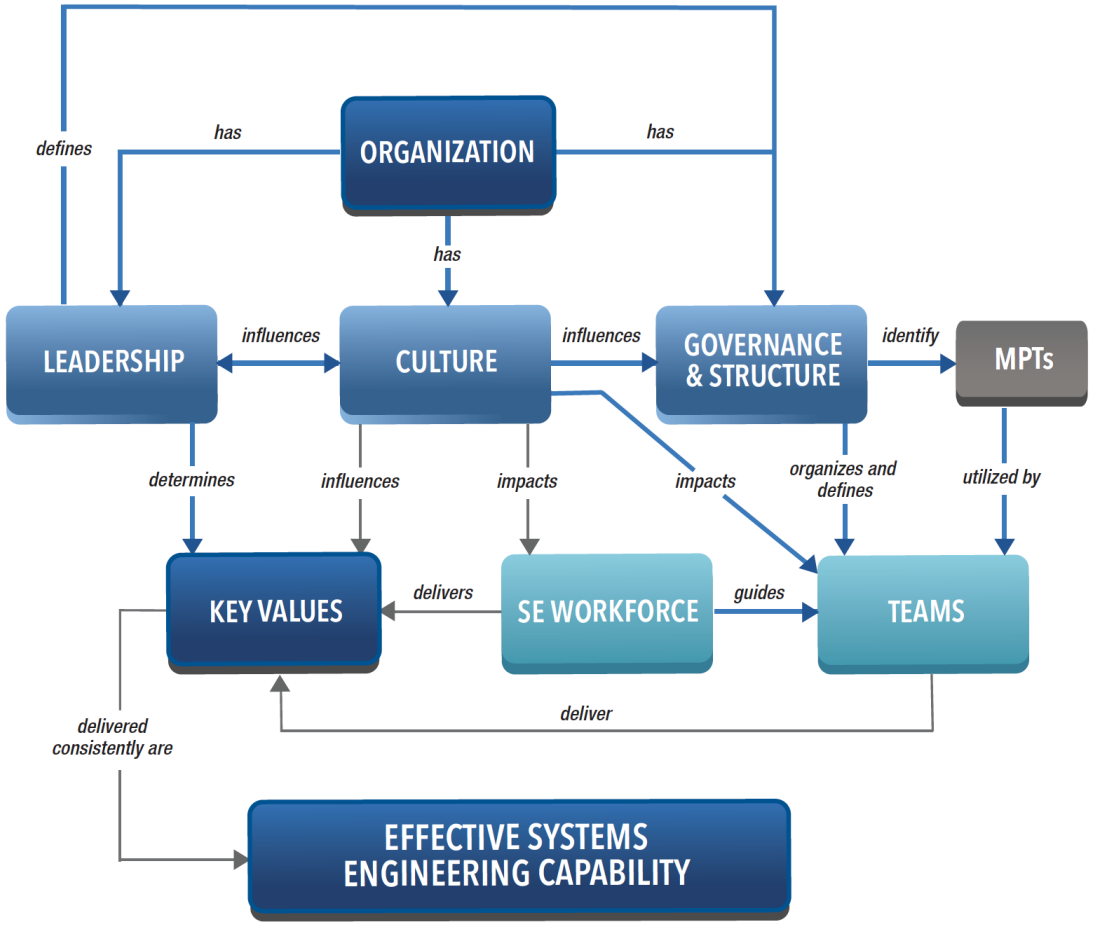

1
2
3
4
5
6
Proficiency Profiles
System Definition
Concept Definition
SE Management
System Realization
Detailed Designer
Requirements Owner
Systems Architect
System Analyst
V&V Engineer
Support Engineer
Process Engineer
Systems Integrator
Customer Interface
Technical Manager
Coordinator
1 2 3 4 5 6 7 8 9 10 11 12 13 14
Organization 1
Organization 2
Organization ...
Bachelor's in Mechanical Engineering
MBA
Org Mgt
Project Engineer
1st SE Position
2nd CSE Position
Start of Career
1st CSE Position
Now
Time
Educational Milestones
Career Milestones
Career Path


STEM Foundations
System's Domain & Operational Context
Systems Engineering Discipline
Systems Mindset
Interpersonal Skills
Technical Leadership
Now
Initial Assessment
Goals

helix-se.org

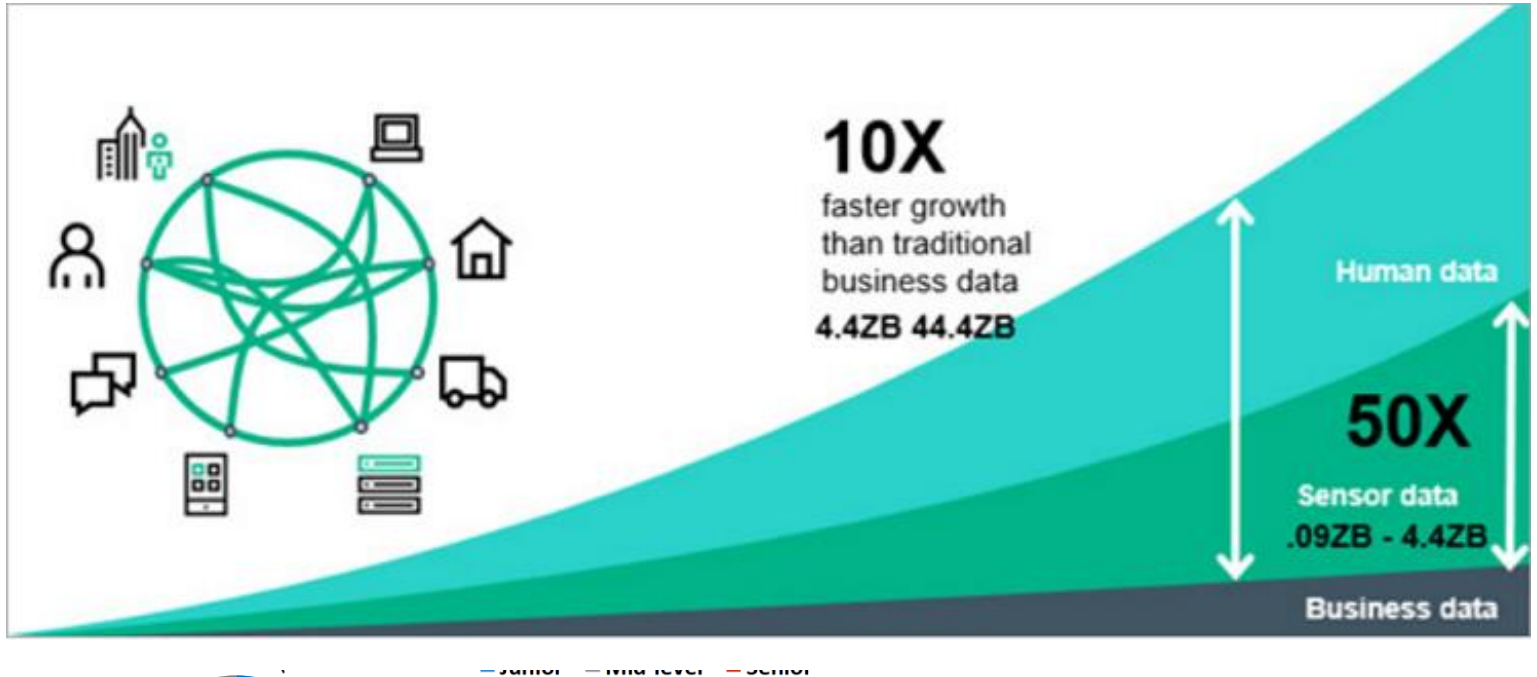
Where are we?

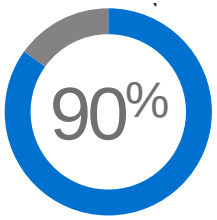

INDIVIDUAL
has
performs
SKILLS
aligned with
JOBS
to consistently deliver
ORGANIZATION
has
has
CULTURE
aligned with
LEADERSHIP GOVERNANCE POLICIES
impacts
identify
CRITICAL VALUES
is
EFFECTIVE


defines
has
ORGANIZATION
has
has
LEADERSHIP
influences
CULTURE
influences
GOVERNANCE & STRUCTURE
identify
MPTs
determines
influences
impacts
impacts
organizes and defines
utilized by
KEY VALUES
delivers
SE WORKFORCE
guides
TEAMS
deliver
delivered consistently are
EFFECTIVE SYSTEMS ENGINEERING CAPABILITY

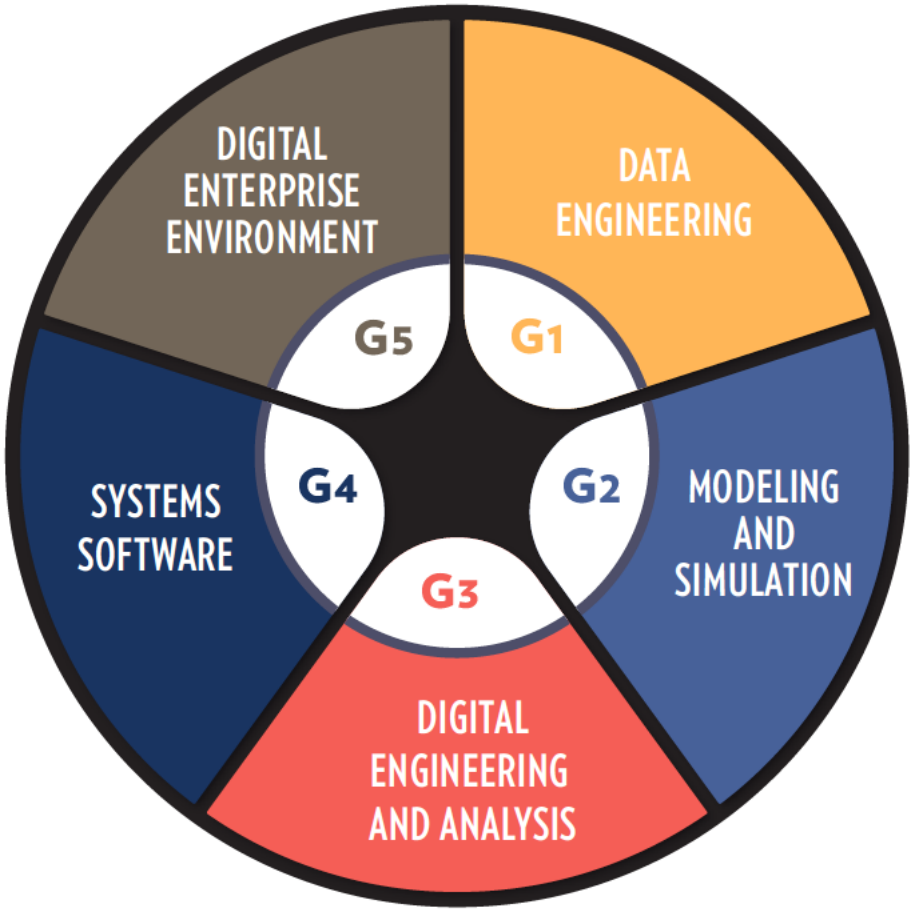
What's Changing?

https://insidebigdata.com/2017/02/16/the-exponential-growth-of-data/





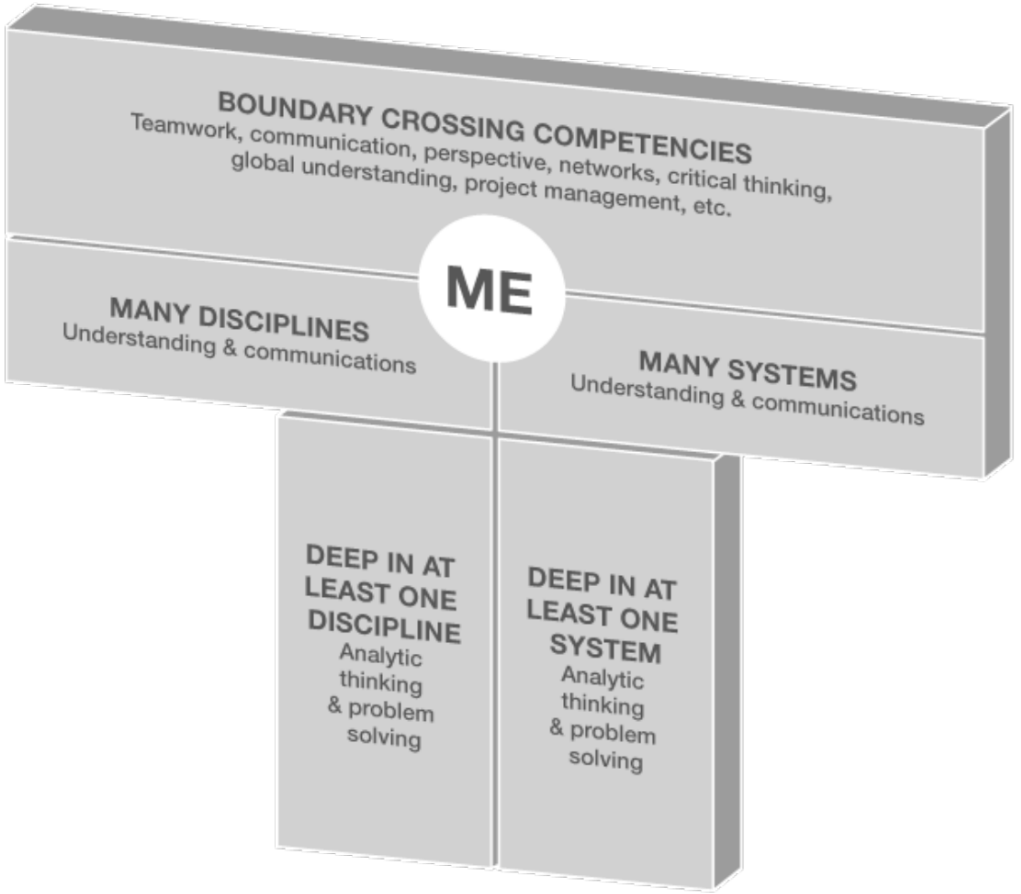
of the world's data generated in the last "2 years" (Forbes 2019)



Digital Engineering Competency Framework (DECF)

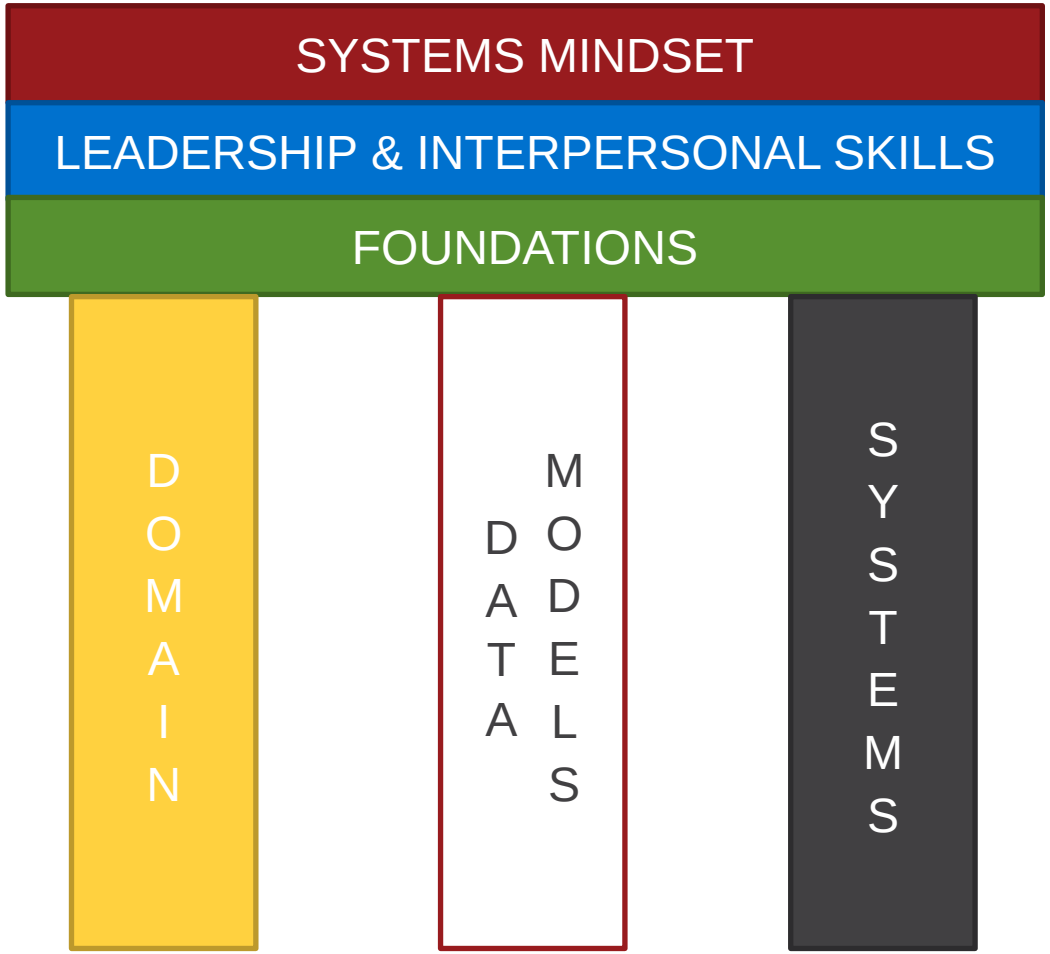
Changing Skills for a Changing World

T



Michigan State University (2015)

Π



Where do we go from here?

(Young) Professionals

- Aware
- Balanced
- Curious
- Data Conscious
- Explore

Images are property of Marvel®

Questions?

Thanks for attending

Continue the conversation on the IS2022 Platform and Social Cafes

emtnicole@gmail.com

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hybrid event

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Backups

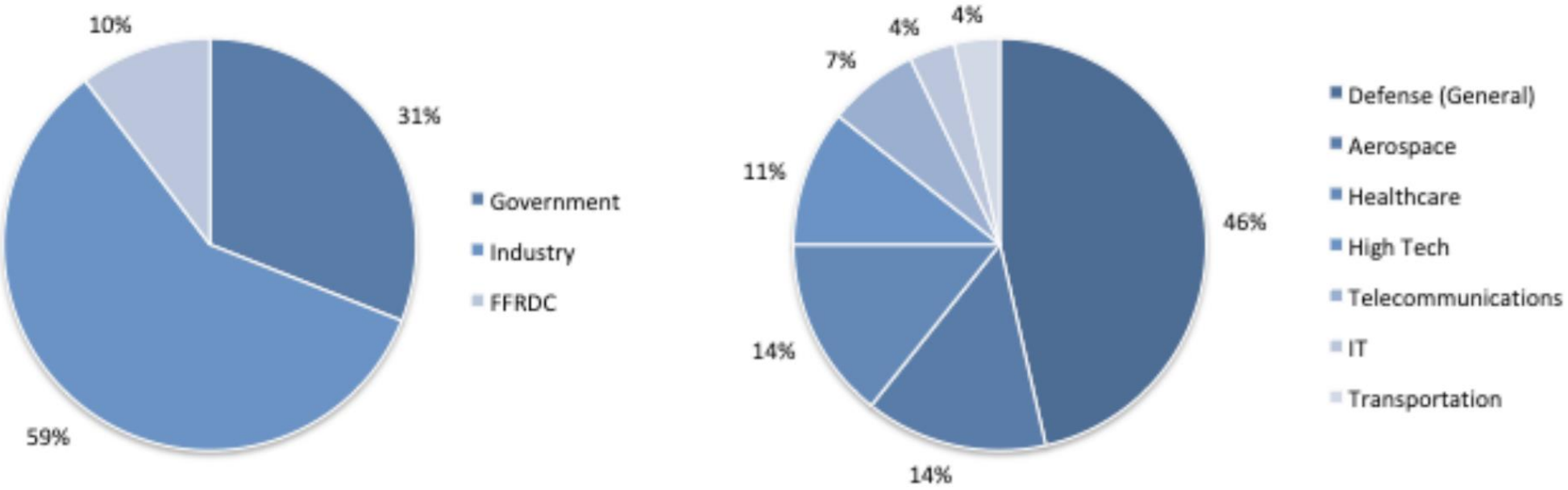

Figure 1. Demographics of Helix Interview Participants

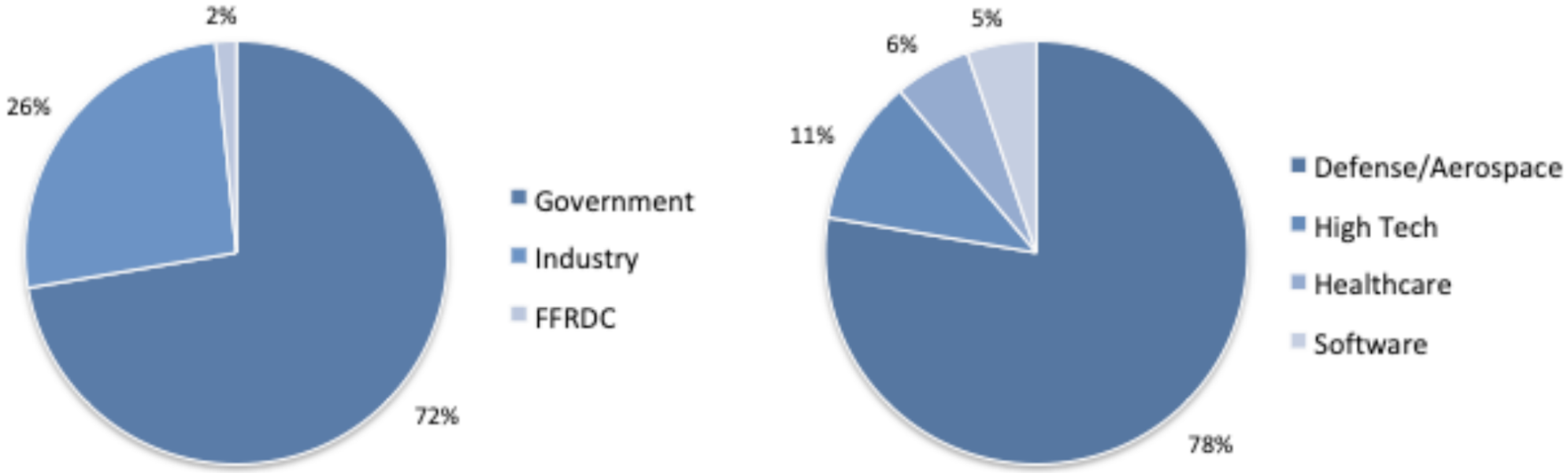

Figure 2. Demographics of Helix Survey Respondents