Analysis of Results for the SE Worldviews Survey (July 2017)

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28th Annual INCOSE international symposium
Washington, DC, USA
July 7 - 12, 2018

PURPOSE / PROBLEM

In 2016 INCOSE leadership asked the INCOSE Fellows to initiate a study to compare the current INCOSE definition of Systems Engineering (SE) with the aspirations set out in the SE Vision 2025. The Fellows SE Definition Committee sought answers to two fundamental questions in two separate surveys:

1. What is a system?
2. What is Systems Engineering?

In 2017, a survey was created by the INCOSE Fellows Definition Committee to address the second item; Systems Engineering perceptions. The analysis of SE Worldviews Survey results culminated in 5 aggregated questions:

1. What is Systems Engineering (SE)?
2. What are the defining characteristics of SE?
3. What is the scope of SE?
4. Who should have knowledge of SE? and
5. What does the future of SE look like?

OBJECTIVES / GOALS

The Analysis of Results for the SE Worldviews Survey (July 2017) (Arnold et al 2018) objectives are to:

- Uncover what Systems Engineering is perceived to be by the INCOSE membership with the most SE knowledge
- Understand what INCOSE membership agrees with as basic concepts and capture any disparity of agreement for further study and reflection of future SE definitions
- Understand where SE may be headed in the future
- Uncover demographic differences in perspectives if they exist

METHODS / DESCRIPTION

- Assumed: The Systems Engineers with the most INCOSE knowledge are those that attend the INCOSE International Symposium and International Workshop – around 1000 participants
- 200 SE World Views Survey respondents (20% of INCOSE-targeted population). Accurate and statistically significant at a confidence level of 95%.
- SE perspectives questions were analyzed for differences by region, age or other demographic interest.
- SE perspectives questions were analyzed for differences among other survey perspectives questions of interest.
- Basic statistics contained in the survey results (Sillitto et al 2018) include standard deviation (the amount of variation of a set of data values), minimum value, maximum value, mean and median, where applicable for each question. A weighted average is provided for Likert Scale questions.

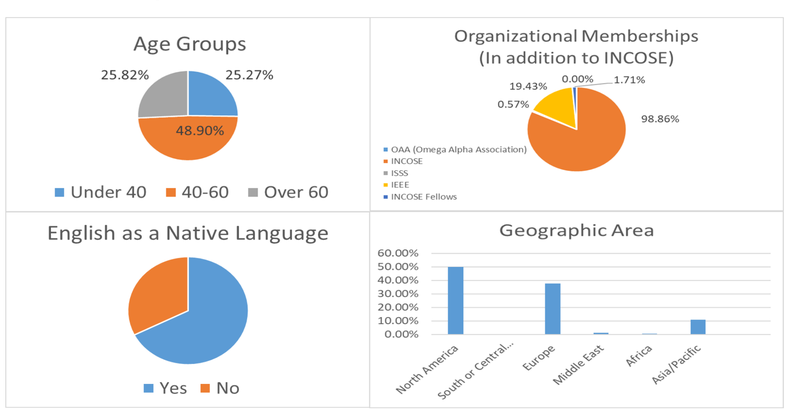

Figure 1. Demographics of the Sample Population

DATA / RESULTS

Agreement Perspectives at 80% and above:

- **What is SE?**
- The primary mission of SE is to enable the realization of successful systems

- **Aggregated Question 2. What are the defining characteristics of SE?**
- SE is an inter- or multi- or trans-disciplinary form of engineering looking at the problem in its entirety.
- The systems engineering process is adapted depending on whether the situation is green-field, brown-field or reverse engineering.
- The critical skills desirable for an SE team include Systems Thinking and Systems Analysis.

- **Aggregated Question 3. What is the scope of SE?**
- SE starts when the problem is formally recognized by stakeholders and when the scope and purpose of the system of interest are defined
- Scope includes: "technologically enabled services", "service systems“, complex systems within the scope of a single engineering discipline, creation of new systems in a "brown-field" environment / new systems in a "green-field" environment, problem of reverse engineering existing systems to recover or improve performance or create a derivative system
- ***SE is applicable to:***
- a form of Engineering with aspects that are engineering and aspects that are not and is relevant to systems that do and do not involve engineering
- engineered "products”
- ***Part of the SE task (in complex and ambiguous situations) is to:***
- architect the solution and lifecycle so that the flexibility of the solution and of the plan match the uncertainty and rate of change in the problem
- understand which aspects of problem are unknowable at start of the job, to define the "learning journey" required to discover them, and a process able to tolerate the continuing uncertainty until the "unknowable" becomes knowable and then known
- understand which aspects of the problem are fixed and which will remain dynamic through the life of the project

- **Aggregated Question 4. Who should have knowledge of SE?**
- The Systems Engineer should have immense knowledge of SE.

- **Aggregated Question 5. What does the future of SE look like?**
- A desirable and credible aim for the future development of SE beyond 2025 is that SE will be relevant to a broad range of application domains, well beyond its traditional roots in aerospace and defense, to meet society’s growing quest for sustainable system solutions to providing fundamental needs.

CONCLUSIONS

- Agreement was strong (greater than 80%) for most questions
- There were no statistically significant indications of regional differences
- INCOSE should consider hiring a skilled survey development resource for a follow-on survey to improve upon and extend the line of questioning and broader reach of participants
- Interfaces and interactions were not perceived to be strong cornerstones of SE as it evolves
- SE will grow and diversify as it moves forward, into new domains picking up more specialties (e.g. cyber, digital twins)
- SE includes engineering and aspects beyond engineering
- SE includes both technical and managerial aspects
- SE applies to domains beyond product systems
- SE is evolving into a more collaborative space due to the multi-disciplinary and wholeness effects of the SE concept
- Persons in roles beyond engineering should have adequate knowledge of SE
- SE consists of more than a process, it requires cognitive skills and cross-discipline collaborative skills in addition to those previously mentioned

CONTACTS / REFERENCES

Arnold et al, 2018, “Analysis of Results for the SE Worldviews Survey (July 2017)”, INCOSE Proceedings of the 28th International Symposium, Washington, DC, 7-1 July

Sillitto et al, 2018, “SE Worldviews Survey - July 2017” Results, SurveyMonkey: https://www.surveymonkey.com/results/SM-FNS3SND6/

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