

Professor Derek Hitchens,
CEng, PhD, MSc, FIET, FCMI, Wg.Cdr.,
RAF, Retired.,

INCOSE Fellow, INCOSE Pioneer

Systems Scientist & Systems Anthropologist

February 2024



sit vis vobiscum

So, Just What Is... ***Systems Engineering***

*Why does INCOSE substitute **Engineering of Systems** for it?*



he following LinkedIn articles have been previously addressed SE, in preparation for the above Title & Strapline Questions facing INCOSE:

- A. *So, What is a System? October 2023*
- B. *Hazardous Mission? Viable Solution System! Nov. 2023*
- C. *Systems Methodology Feb 2024*
- D. *If—No Systems Approach? Then—No Systems Design & No Systems Engineering! Feb 2024*
- E. *Could INCOSE be held liable for fraudulently certifying:*
 - *Associate Systems Engineering Professional (ASEP);*
 - *Expert Systems Engineering Professional (ESEP);*
 - *Certified SE Professional (CSEP); Feb 2024*

And, *if words are to mean anything*, systems engineering means, and has always meant: “systems creation...” i.e. *the synthesis of complex, organized wholes of material, or immaterial things... (Article A.)*

Perhaps the best way to start “So, just what is Systems Engineering” is, first, to eliminate the contenders— “what is NOT Systems Engineering.”

F*irst and foremost, it is NOT Engineering!* As in NOT “applied physical science.” Official INCOSE documents typically show multiple divisions of engineering—mechanical engineering, electrical engineering, electronic engineering, civil engineering, software engineering, etc.—feeding into a central oval entitled “Systems Engineering.”

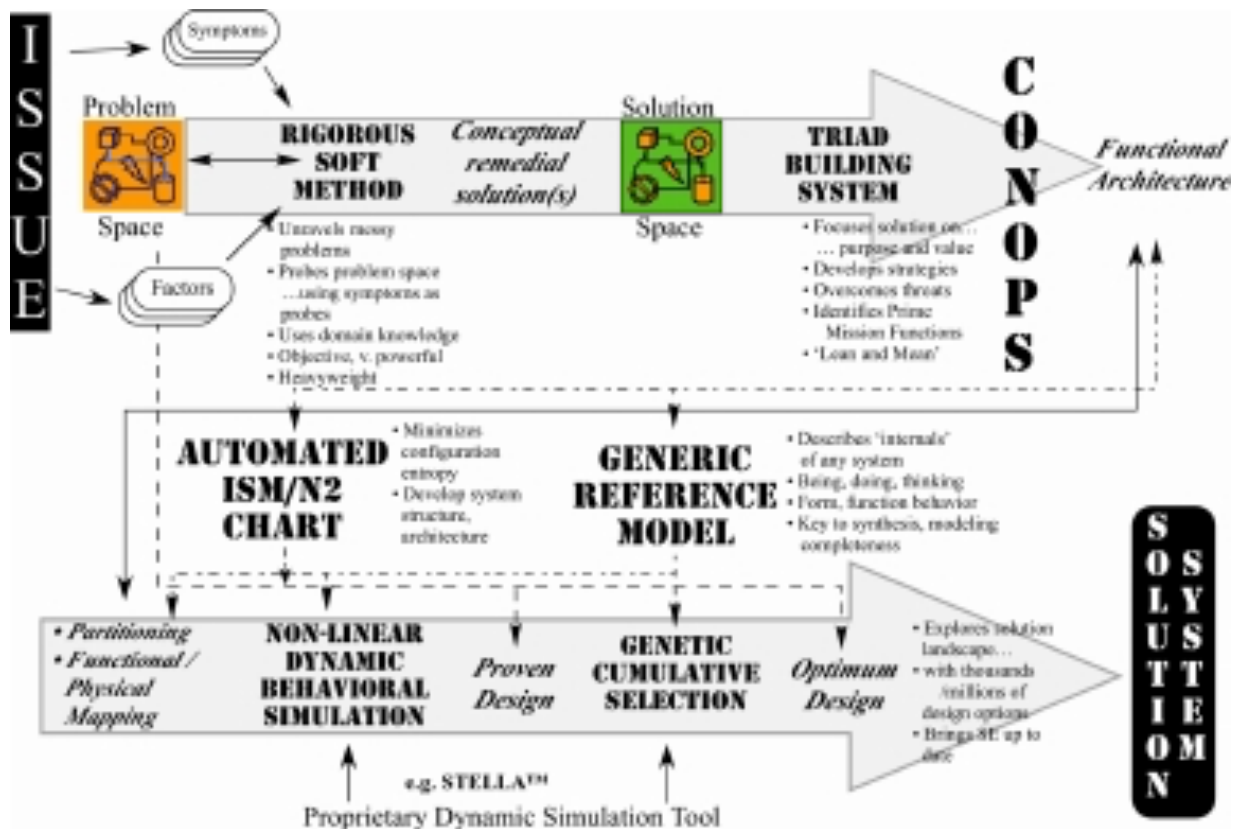
Really? Reassemble the *segments of an orange*, and you get—an **Orange!** Conjoin *segmented engineering disciplines*, and you get—**Engineering!**

Hang on! I hear you cry...what about electrical systems engineering, electronic systems engineering, etc. Surely, they are systems engineering? No, but Yes...but, of a different sort. These are worthy disciplines, concerned with the installation, operation and maintenance of equipments, networks, power

supplies, communications, etc. And by “system” they appear to mean “the whole, extensive arrangement/organization.” So, for instance, national power supplies. The National Grid. Worthy.

But not Systems Engineering, i.e. not Applied Systems Science.

Methods, Tools and their Points of Action within the progress of the Systems Methodology.



Follow the arrows: top, left to right, then bottom left to right. At each stage, the output from one tool or method provides the input to the next tool, or method.

Note: the Systems Methodology is *holistic synthesis: functional before physical*. (c.f. “Form follows Function:” Louis Sullivan. (1856-1924)

S *econd, it's NOT Engineering Management.* INCOSE Certified Systems Engineers do NOT, as their title might suggest, practice systems engineering, i.e. “systems creation.” Instead, their rôle is to assist project, program and engineering managers to sort out problems during the process of creating engineered *products (artifacts)*, typically comprising hardware and software.

So, these CSEPs give engineering management support in the creation of artifacts. Which is an important and creditable skill set. But, artifacts are NOT systems. Article A.

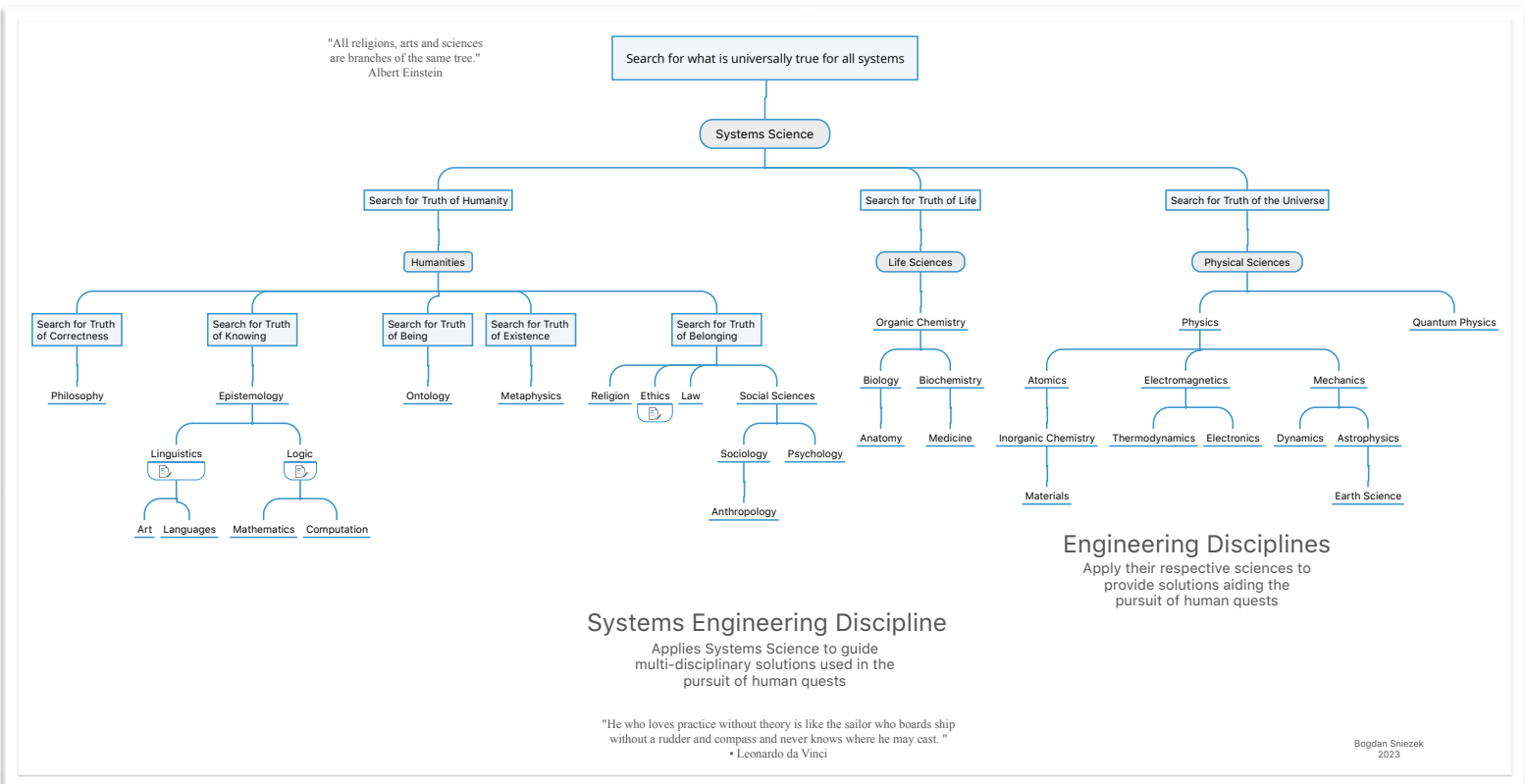
I have some sympathy with this viewpoint, though—as a one-time professor of Systems Engineering—and, independently, of Engineering Management. Which is not dissimilar to Systems Engineering Management. See graphic above, from Article C.

The resemblance is superficial, however, as the Systems Methodology is one of *holistic synthesis*, with “*functional before physical*,” as the graphic caption shows. So, quite unlike that of engineers, with their ‘Cartesian reduction/physical decomposition’ engineering methods.¹ And Systems Engineers would be expected to have a working knowledge of Systems Science, of the Systems Approach (Article B), of Systems Design (Article D), and of the Systems Methodology in general. OK, so, that’s what its NOT. But, what *is* systems engineering...?

¹**Which, it has to be said, have worked very well for centuries, but which are inappropriate for addressing more complex, large scale, social, existential & environmental problems and issues.**

S ystems Engineering is:—

- **Applied Systems Science**, incorporating, not only the Physical Sciences, but also the Life Sciences and the Humanities. (*Exemplary figure by Bogdan Sniezek below...*)
- **Systems Engineering, the Discipline**, with its own science, theory (GST), principles, tenets, practices, etc.
- **Systems Methodology (SM)**. SM is, by definition, domain independent, scale independent, type independent, and *synonymous with Systems Engineering...*
- **Holistic Synthesis, viz...**
- *..’A creative, problem-solving process...seeking value truths by matching the properties of wanted systems, and their parts, to perform harmoniously with their full environments over their entire life cycles.’ (Hall, 1989)*



All of which differs markedly from INCOSE's Engineering of Products/Artifacts. And the repeated assertion that "it's just engineering done properly." Which is —Engineering.

So, now we come to the crunch question. *Why* does INCOSE disavow real Systems Engineering? After all, it is the International Council on Systems Engineering. In short, an unfortunate combination of *ignorance, envy and fear*:—

- Ignorance, in that the "hard" engineers who founded NCOSE, did not understand, how Systems Engineering 'worked.' SE was, certainly, viewed by physical engineers as a 'Black Art,' 'arcane knowledge,' in the past. Their attitude is alive and kicking today. An INCOSE member, nameless, recently declared his distaste for my "airy-fairy" nonsense. Jovial, but indicative nonetheless...
- Envy. During the Cold War, Systems Engineering was King. Why? Because SE was innovative, managed complexity, and was thus *preeminent* in conceiving new counters to evolving Soviet Existential Threats. So, SE created the designs, the requirement specifications. *Not* the traditional engineers, who had their noses put firmly out of joint.
- Fear. That true Systems Engineering was *very big!* That, after the Cold War, Systems Engineering and Systems Engineers would continue to transcend traditional engineering, and jobs—and reputations—would be at stake.

So, with this background, the engineers who founded NCOSE, the purpose of which was to certify Systems Engineers, to fill the gap, for post-cold War US industry, evidently seized their golden opportunity, and certified engineers, but NOT systems engineers, except by title.

And that is where we are today. INCOSE membership undoubtedly includes experienced, capable, *real* systems engineers. But INCOSE corporate is not representing Systems Engineering as Applied Systems Science, nor is it representing Systems Engineering, the Discipline. Indeed, it seems that INCOSE corporate would prefer to dispense with the “incomprehensible *systems*²” connotation altogether...killing off any perceived Systems Engineering ‘threat’ in the process.

Which seems grossly inappropriate for an International Council on Systems Engineering. So, after some 30 futile years of head-butting the INCOSE “engineers’ bastion,” this old billy goat is finally...

² See Article A: INCOSE is still unable to define the paradigm “system” without constraining it to be ‘engineer friendly...’

..Signing off...

Don Del

March 2024

References: —

- A. Hall III, Arthur D., 1989, *MetaSystems Methodology*, Pergamon Press, IFSR International Series on Systems Science and Engineering, ISBN 0-08036956-1
- B. Hitchins, D.K., 2003, *Advanced Systems: Thinking, Engineering and Management*, Artech House, Norwood, MA02062, ISBN 1-58053-619-0
- C. Hitchins, D. K., 2007, *Systems Engineering: A 21st Century Systems Methodology*, Wiley Series in Systems Engineering and Management, ISBN 978-0470-05856-5