Challenges in the Development of Systems Engineering as a Profession

Indrajeet Dixit, USC
Ricardo Valerdi, MIT

June 25th, 2007
Agenda

• Professions

• Systems Engineering

• Central Questions

• Challenges

• Conclusions

• Q & A
Definition

From the Merriam-Webster Online Dictionary,

Main Entry: profession

4 a : a calling requiring specialized knowledge and often long and intensive academic preparation
b : a principal calling, vocation, or employment
c : the whole body of persons engaged in a calling

Common Professions: Medicine, Law, Engineering(?)
Initial Ideas

• History of “Firsts”
  – First journal, conference, society etc…

• Different folks, different strokes
  – Power, social legitimacy etc…

• Adler and Kwon (2006): “engineering is a “semi-profession””
“System of Professions”

• Professionalization
  – Nature of the problem
  – Competition between professions
  – Body of knowledge
  – Abstraction in practice

• History of IEEE
  – Radio vs. Power engineers

Abstraction in Practice

The Diagnosis-Inference-Treatment Mechanism

Presented to the INCOSE 2007 Symposium
Systems Engineering
Initial Ideas

“What we’ve got here is failure to communicate.”

*Cool Hand Luke* (1967)

- **Post-Second World War**
  - Bigger, larger, more complex systems
  - Management of technical effort
  - Response of engineers
  - Several definitions/views
Current Ideas

• Post-INCOSE
  – Customer requirement
  – More university programs
  – Greater industry involvement
  – Annual conference and journal
  – Several definitions/views?

• More communication failures?
The Organization

• The hierarchy of Systems Engineering
  – Micro
    • Specialty/Discipline Engineer
  – Meso
    • Senior Systems Engineer
  – Macro
    • Program Manager

• Every engineer does Systems Engineering
  – Caveat: There is something unique in what every engineer does!
Central Questions
Central Questions

• What is a Systems Engineering problem?

• What are the characteristics of this Systems Engineering problem?

• How does a System Engineer know what the characteristics are?
# State of the Art?

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
</tr>
<tr>
<td>Classification</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
</tr>
<tr>
<td>Abstraction</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
</tr>
<tr>
<td>Quantification &amp; Measurement</td>
<td></td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
</tr>
<tr>
<td>Symbolic Representation</td>
<td></td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
</tr>
<tr>
<td>Symbolic Manipulation</td>
<td></td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
</tr>
<tr>
<td>Prediction</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
</tr>
</tbody>
</table>
Challenges
Challenges

1. The problem space in systems engineering remains undefined

2. Lack of a coherent body of knowledge of Systems Engineering

3. The compounding effect of the lifecycle perspective
More Challenges

4. Inability to falsify (overarching) theories of Systems Engineering

5. Lack of standard of proof in Systems Engineering
Conclusions
Final Thoughts

• Engineering as a Profession
  – History of pragmatic problem-solving
  – Problem solving preceding theoretical development
  – Pragmatic usefulness, must not be lost in the quest for theorizing.
Q & A