2016 Conference on Systems Engineering Research

Enhancing systems engineering education through case study writing

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NASA/ Marshall Space Flight Center
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Agenda

• Case Study Writers Workshop
• SE educational need
• Improvement with Subject Area Knowledge
• Future Research
Why Case Study Writing?

- Wide variety of styles for a plethora of purposes
  - Advertising
  - Focus on teaching, instructional case studies, and decisional (~3-10 pages)
  - Academic Research

Learning from case studies “stretches your mind for 30 minutes. It won’t go back exactly to the shape it was before”

_Ed Rogers, GSFC Chief Knowledge Officer_
SE Educational Need

- Systems Engineering grand challenges and agendas for research
- The Silver Tsunami
- “Grow your own” systems engineers
  - Soft skills, picture skills, interviewing skills, teaming skills

Essential Elements of Systems Engineering Thinking

Case Study Writers Workshop (2-day) and Writer’s Experience (18 weeks)
SE skills

Case Study Writing
Case Study Writer’s Experience

• Interviews with people who know
• Finding the story in the quagmire of information
• Concept mapping to connect the story
• Balancing viewpoints
• Being comfortable with non-closure
• Structured process, on schedule
• Editing out nice but not necessary
• Opportunity to present at RWMMS*
• Interviewing/inquiry skills
• Appreciation emotional content of work environment
• Deep contextual knowledge about a real world event or situation

Behaviors of Good Engineers
(Gentry Lee, JPL)

• Intellectual curiosity
• Sees Big Picture view
• Sees connections
• Comfortable with change
• Comfortable with uncertainty
• Proper paranoia
• Tracks margins and resources
• Communication skills
• Self-confidence and energy
• Appreciation for process
• Personality
• Add to the knowledge of the world

*RWMMS= Real World Marshall Mission Success course
**Case Study Writers Workshop**

- **Impact of subject knowledge to success in producing quality case study**
  - Criteria for success: usable in the Real World Marshall Mission Success Course

<table>
<thead>
<tr>
<th>Subject Area</th>
<th>Mentor (if any)</th>
<th>Senior Partner Subject Knowledge (range)</th>
<th>Junior Partner Subject Knowledge (range)</th>
<th>Relative Success</th>
<th>No. Pages</th>
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<tbody>
<tr>
<td>Government-contractor relationships (PM)</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>Well polished final draft</td>
<td>7</td>
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<tr>
<td>Launch decision – technical issue (SE)</td>
<td>High</td>
<td>None</td>
<td>None</td>
<td>Excellent</td>
<td>4</td>
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<tr>
<td>SE implementation small project (SE)</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
<td>Well polished final draft</td>
<td>13</td>
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<tr>
<td>Small Project PI-led SE implementation</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Good preliminary draft</td>
<td>11</td>
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<tr>
<td>Launch Decision – technical issue</td>
<td>High (detailed out)</td>
<td>Medium</td>
<td>Low</td>
<td>Excellent</td>
<td>16</td>
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<tr>
<td>Launch Decision – technical issue (PM)</td>
<td>High (detailed out)</td>
<td>-</td>
<td>Medium</td>
<td>Excellent</td>
<td>6</td>
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<tr>
<td>- modified/shorter</td>
<td>Medium</td>
<td>Medium</td>
<td>Excellent</td>
<td>3</td>
<td></td>
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<tr>
<td>Center Operations large facility decision</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>Excellent</td>
<td>5</td>
</tr>
<tr>
<td>Small Project PM/PI conflict</td>
<td>High (detailed out)</td>
<td>High</td>
<td>Excellent</td>
<td>Did not complete; Time</td>
<td>-</td>
</tr>
<tr>
<td>Communication supports mission success</td>
<td>High (detailed out)</td>
<td>High</td>
<td>Outline; Not paired; Time</td>
<td>Did not start; Type of CS not desired by author</td>
<td>-</td>
</tr>
<tr>
<td>Center future challenges short cases</td>
<td>High</td>
<td>High</td>
<td>Did not start; Type of CS not desired by author</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

• Impact of subject knowledge to success in producing quality case study
• Criteria for success: usable in the Real World Marshall Mission Success Course
Case Study Writers Workshop

- Success and progression of knowledge and writing capability
Future Research

• Future research options
  • Exploring the pedagogical benefits of using case study-based learning in the engineering classroom
  • Studying the impact of systems engineering skills improvement with intentionally-taught case study writing skills included in the curriculum
  • Identifying systems engineering research enhancements through rigorous case study-based qualitative research applied to systems engineering practice
  • Examining impact of case study-based learning and writing skills on increased knowledge of systems approach in traditional engineering curriculum

• Working on
  • Civil servant students partner with industry and government systems engineers to capture real world situations