

# Collaborative Systems Thinking:

## Identifying the enablers and barriers of higher-level systems thinking in aerospace engineering teams

Caroline Twomey Lamb, PhD in Aero/Astro (expected in 2009)

Committee: Prof. Deborah Nightingale, chair; Prof. Annalisa Weigel; Dr. Donna Rhodes

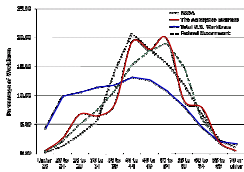
**Biography**  
Caroline Twomey Lamb is pursuing her doctorate through the MIT Department of Aeronautics and Astronautics. Caroline received her S.B and S.M from MIT in 2003 and 2005 respectively. Her educational philosophy has been to construct a broad tool box of skills and experiences. Upon graduation, Caroline plan to work in the industry as either a design or test engineer.

**Related Publications**  
D.H. Rhodes, C.T. Lamb and D.J. Nightingale (2008). "Empirical Research on Systems Thinking and Practice in the Engineering Enterprise", IEEE International Systems Conference, Montreal, Canada  
C.T. Lamb and D.H. Rhodes (2008). "Collaborative Systems Thinking Research: Exploring systems thinking within teams", INCOSE International Symposium, Utrecht, Netherlands  
C.T. Lamb and D.H. Rhodes (2009). "Collaborative Systems Thinking: Case study research investigating enablers of team-level systems thinking" AIAA Aerospace Sciences Meeting, Orlando, Florida

### Motivation

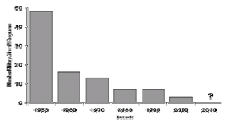
Systems thinking development takes time and experience.

*Why then, study team-level systems thinking?*

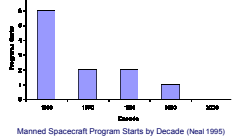


**Demographics:** 50% of the aerospace workforce, those with the greatest levels of experience, are eligible to retire by 2013.

**Program Trends:** The aerospace industry has fewer (larger and longer) programs than 50 years ago. This results in fewer opportunities to gain systems experience.



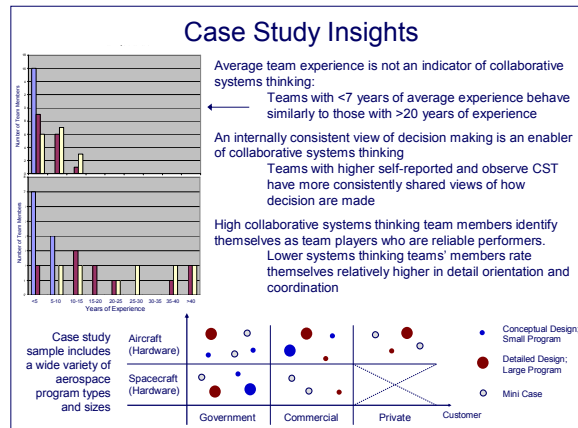
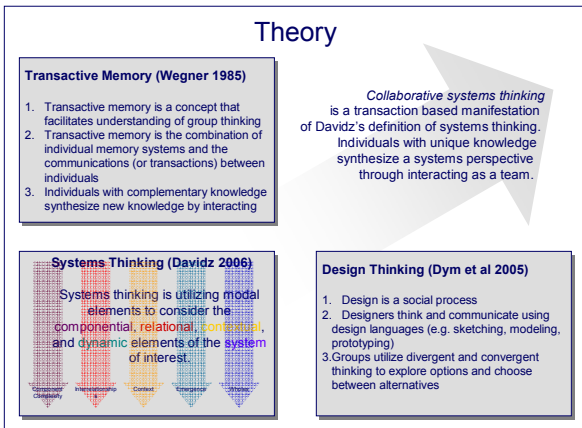
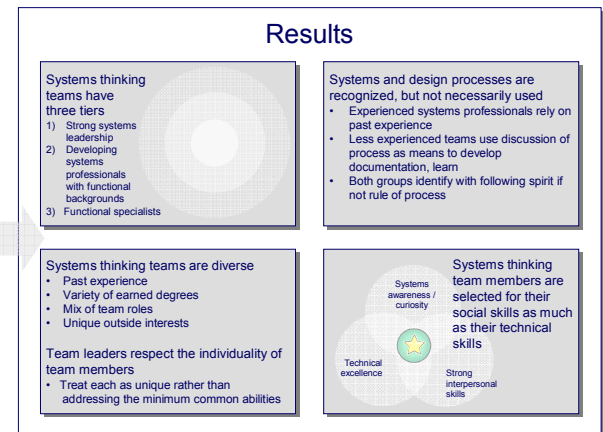
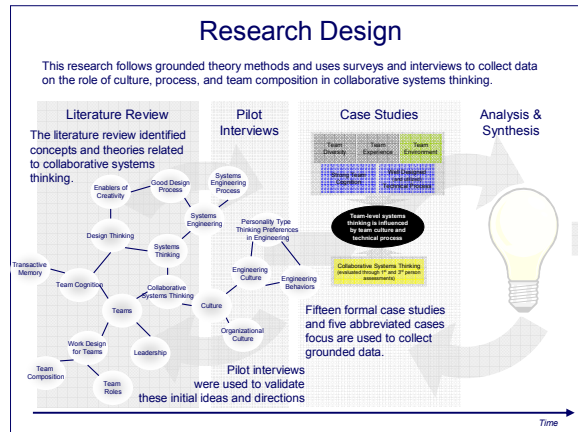
Manned Fighter Program Starts by Decade (Murnan et al 2002)



Manned Spacecraft Program Starts by Decade (Neal 1995)

**Integrated Design Practices:** Integrated Product Development (IPD) improves design through early integration of multiple disciplines. IPD is predicated on teams of engineers working closely together on systems-level issues.

**Workforce Development:** It is hoped that team-level systems thinking will provide the supportive environment and career guidance required to develop good systems thinking engineers.



### Expected Outcomes and Future Work

Understanding team-level systems thinking.

*A possible tool for workforce development.*

#### Expected Outcomes

- An operational definition of collaborative systems thinking
- Heuristics for enabling collaborative systems thinking
- Descriptive theory of collaborative systems thinking
- Data for improving workforce development initiatives

#### Future Work

- Tracking members of 'middle tier' to measure effectiveness of participation for systems skill development
- Longitudinal study to explore relationships between final system performance and collaborative system thinking in systems architecture teams

For more information, please visit:  
<http://seari.mit.edu>