
Strengthening Enterprise Performance with Competency and Collaboration Models

# Establishing Systems Competency in Enterprises: Recent Studies

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# Competency and Collaboration Models

Many organizations developing competency models to enable growth of systems workforce

- Models typically based on expert opinion of skills and abilities needed at engineering position levels
- Lack data on impact of competencies on programs

Systems competency also resides in teams who collaborate -- often across geographies, cultures, and time zones

- Models are needed for self-assessment of team collaboration readiness and effectiveness
- Includes both social and technical factors

**Competency Models are useful for recruitment, HR review, and training and development**

Brian Wells, Raytheon Chief Systems Engineering, 2008 IEEE Systems Conference

**EMPIRICAL RESEARCH NEEDED TO BETTER INFORM MODELS**

Factors underlying systems competency in workforce

Understanding of impact of knowledge, skills, abilities

Enablers and barriers to developing systems competency

Systems thinking at multiple levels – individual, team, enterprise

Socio-technical factors for collaborative distributed engineering

# Research Informing Competency Models

## Engineering Systems Thinking in Individuals

General systems thinking has been studied empirically, but engineering systems thinking largely unexplored

Frank (2000) characterized engineering systems thinking as unique

Davidz (2006) performed study of 200 engineers in aerospace industry to identify enablers, barriers, precursors

**Experiential Learning**

**Individual Characteristics**

**Supportive Environment**

Rhodes & Adams (2007) find similar indicators in government agency

Rhodes, D.H., Lamb, C.T. and Nightingale, D.J., "Empirical Research on Systems Thinking and Practice in the Engineering Enterprise," 2nd Annual IEEE Systems Conference, Montreal, Canada, April 2008

# Research Informing Collaboration Models

## Collaborative Distributed Systems Engineering

- Current environment increasingly requires collaboration of geographically distributed teams
- Utter (2007) performed empirical studies to identify successful practices/lessons learned
- Social and technical factors studied: collaboration scenarios, tools, knowledge and decision management, culture, motivations, others
- Preliminary set of success factors toward collaboration model

**<u>Success Factor</u>: Invest in Up-front Planning Activities**

*Spending more time on the front- end activities and gaining team consensus shortens the implementation cycle. It avoids pitfalls as related to team mistrust, conflict, and mistakes that surface during implementation.*

Utter, D.A., ***Collaborative Distributed Systems Engineering***, Master of Science Thesis, Engineering Systems Division, MIT, January 2007



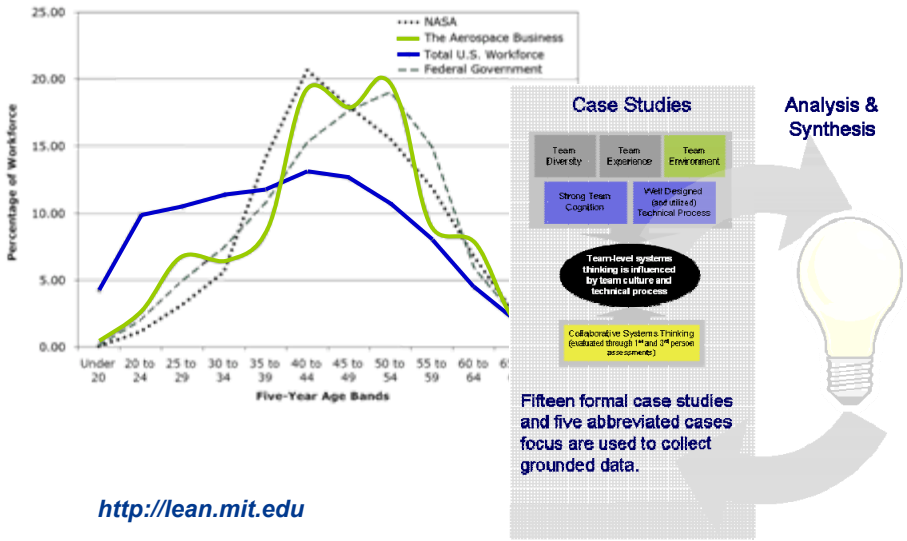
 

# Collaborative Systems Thinking: Promoting higher level systems thinking in aerospace teams

**Researcher:** Caroline Twomey Lamb **Advisor:** Dr. Donna Rhodes
**Committee:** Prof. Nightingale (Chair), Dr. Rhodes, Prof. Weigel
**Funding Source:** LAI **Completion:** Spring 2009

## Motivation

Industry demographics suggest upwards of 50% of the aerospace will be eligible for retirement within the next 5 years. This impending 'grey tsunami' places urgent emphasis on transferring systems-level skills to the next generation of leadership. However, systems skills such as systems thinking take years to develop. This research looks at teams as a unit to leverage collective experience towards team level, or collaborative, systems thinking.




## Synopsis:

Started in 2005, this research uses a series of interviews and case studies to first identify the greatest enablers and barriers to collaborative systems thinking and then validate these observations. By leveraging social science methods, a rich description of collaborative systems thinking is generated.

## Outcomes

1. Characterize collaborative systems thinking
2. Identify the major enablers and barriers to collaborative systems thinking development
3. Identify common team archetypes for systems thinking
4. Doctoral Thesis (May 2009)
5. Multiple conference papers and a journal paper

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# Future Research Directions

**2008 RESEARCH PUBLICATIONS**


Rhodes, D.H., Lamb, C.T. and Nightingale, D.J., "Empirical Research on Systems Thinking and Practice in the Engineering Enterprise," 2nd Annual IEEE Systems Conference, Montreal, April 2008

Lamb, C.T. and Rhodes, D.H., "Systems Thinking as an Emergent Team Property: Ongoing Research into the Enablers and Barriers to Team-level Systems Thinking," 2nd Annual IEEE Systems Conference, Montreal, Canada, April 2008.

Lamb, C.T., Nightingale, D.J., and Rhodes, D.H., "Collaborative Systems Thinking: Towards an Understanding of Team-level Systems Thinking," 6th Conference on Systems Engineering Research, Los Angeles, CA, April 2008.

Lamb, C.T. and Rhodes, D.H., "Collaborative Systems Thinking Research: Exploring Systems Thinking within Teams," INCOSE International Symposium 2008, Utrecht, Netherlands, June 2008.

Ogawa, A. and Rhodes, D.H., "How Do Cultural Differences Affect Utilization of the ICE Approach?", Proceedings of Asia-Pacific Conference on Systems Engineering, Keio, Japan, September 2008.


Additional research related to development of systems competencies in the workforce to inform competency models and frameworks for model integration

More extensive and rigorous studies to understand collaborative distributed systems engineering to inform collaboration models

Research to understand cultural differences impacting competencies and collaboration factors

Case studies of enterprises using competency and collaboration models to understand impacts and benefits