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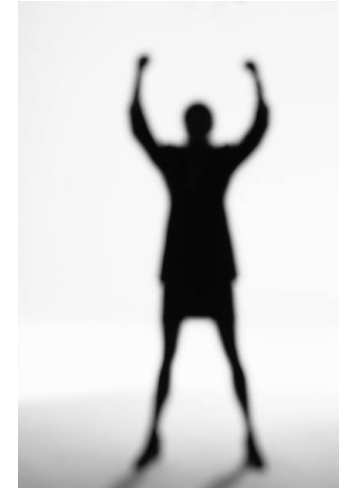
Davidz (2006) performed study of 200 engineers in aerospace industry to identify enablers, barriers, precursors

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

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

<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.

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

Fifteen formal case studies and five abbreviated cases focus are used to collect grounded data.
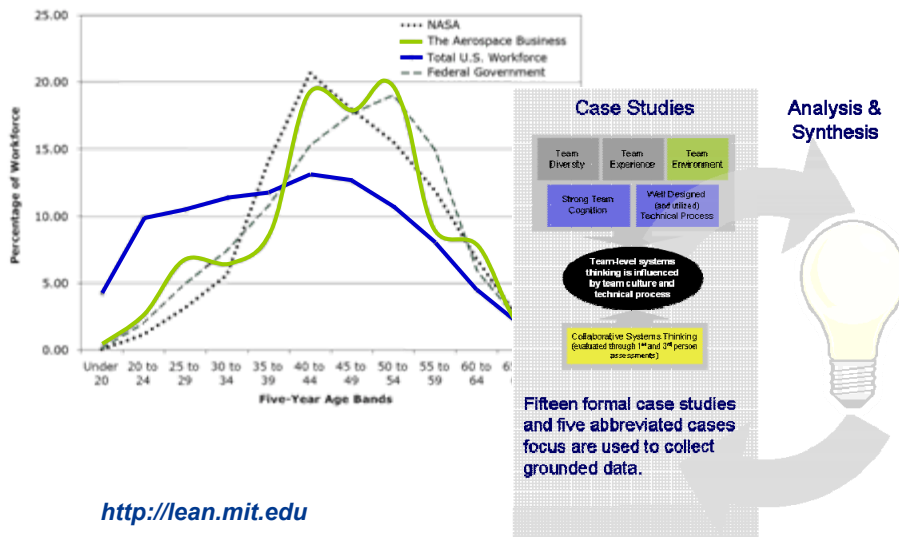
2008 RESEARCH PUBLICATIONS

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