

Collaborative Systems Thinking:

The role of culture and process in promoting higher-level systems thinking within aerospace teams

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Research Contribution:

Strategies for improving engineering processes and efficiently leveraging social assets.

Publications:

C.T. Lamb and D.H. Rhodes (2007). "Promoting Systems Thinking Through Alignment of Culture and Process: Initial results." 5th Annual Conference on Systems Engineering Research (CSER), Hoboken, NJ.

C.T. Lamb and D.H. Rhodes (2007). "Promoting Systems Thinking Through Alignment of Culture and Process: The lean link." LAI Annual Conference, Cambridge, MD.

C.T. Lamb and D.H. Rhodes (2007). "Standardized Process as a Tool for Higher Level Systems Thinking." International Council on Systems Engineering (INCOSE) 2007 International Symposium, San Diego, CA.

C.T. Lamb and D.H. Rhodes (2008). "Collaborative Systems Thinking: Towards and understanding of team-level systems thinking", 6th Conference on Systems Engineering Research, Redondo Beach, CA.

D.H. Rhodes, C. T. Lamb and D.J. Nightingale (2008). "Empirical Research on System Thinking and Practice in the Engineering Enterprise", IEEE International Systems Conference, Montreal, Canada.

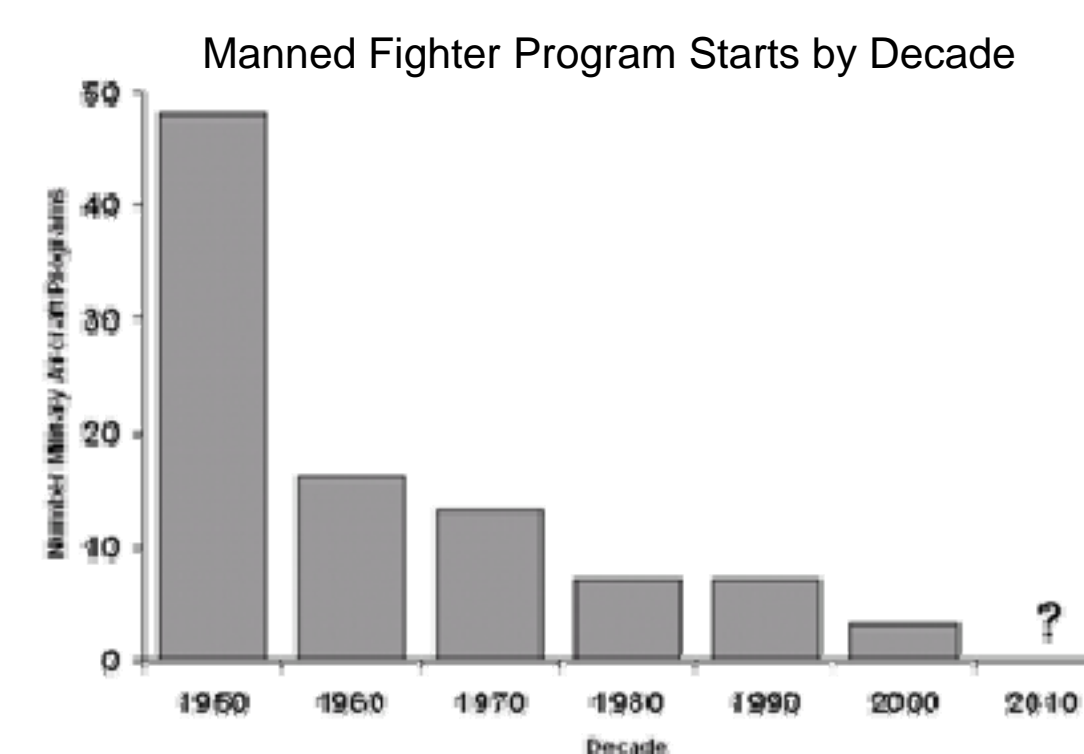
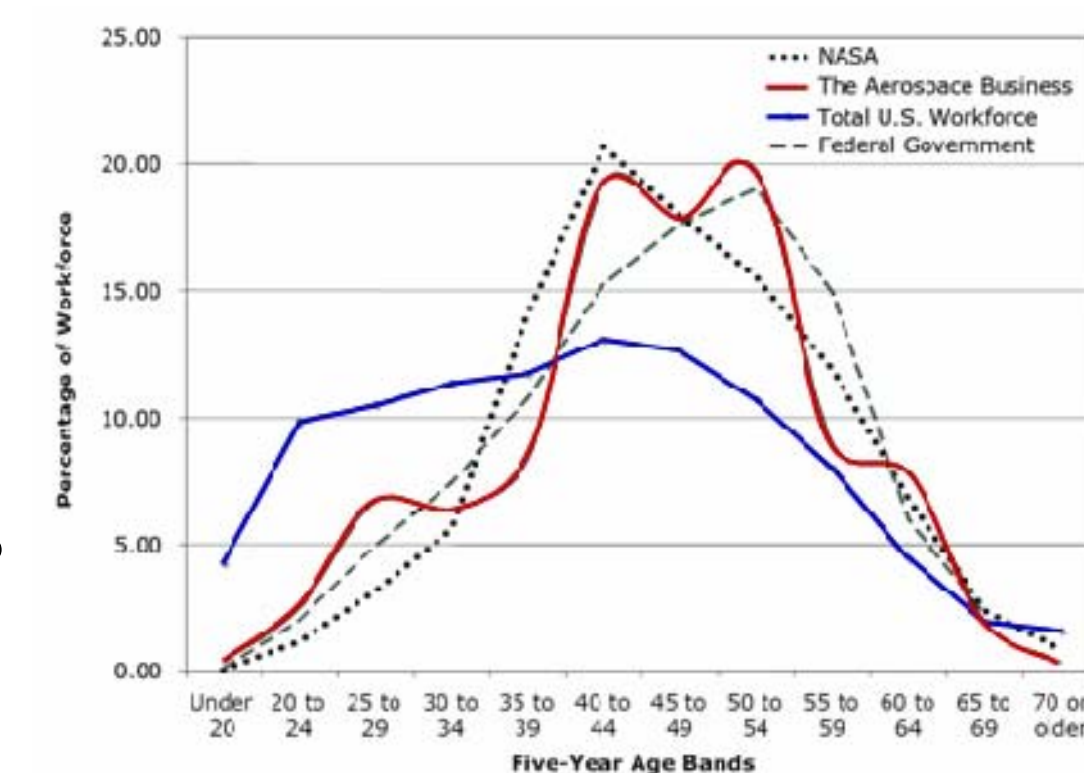


Motivation

Systems thinking skills are in short supply.

Experience is important in skill development. Experienced employees are retiring. Younger employees are finding fewer learning opportunities.

Concentrating on teams offers way to leverage aggregate experience and knowledge.



Existing Theory

Team Thinking (Salas and Fiore 2004)

1. Group processing of information through recall and interpretation
2. Dealing with collective knowledge as opposed to shared knowledge

Design Thinking (Dym et al 2005)

1. Design as a social process
2. Think and communicate using design languages
3. Utilize divergent and convergent thinking styles

Systems thinking is utilizing modal elements to consider the componential, relational, contextual, and dynamic elements of the system of interest. (Davidz 2006)

Collaborative Systems Thinking

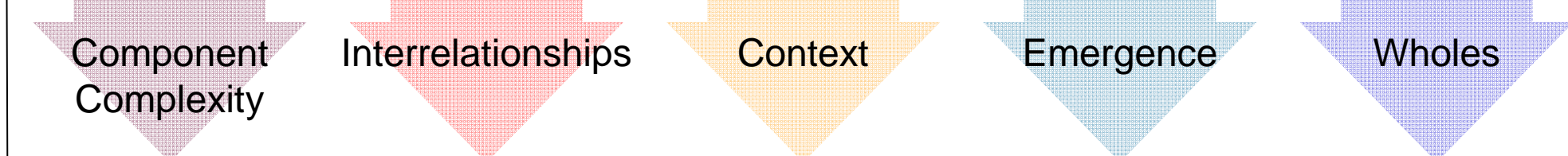
A framework for systems with four basic ideas: emergence, hierarchy, communication and control. Human activity concerns all four elements. Natural and designed systems are dominated by emergence. (Checkland 1999)

A method of placing the systems in its context and observing its role within the whole. (Gharajedaghi 1999)

A skill to see the world as a complex system and understanding its interconnectedness. (Sterman 2000)

A skill of thinking in terms of holism rather than reductionism. (Ackoff 2004)

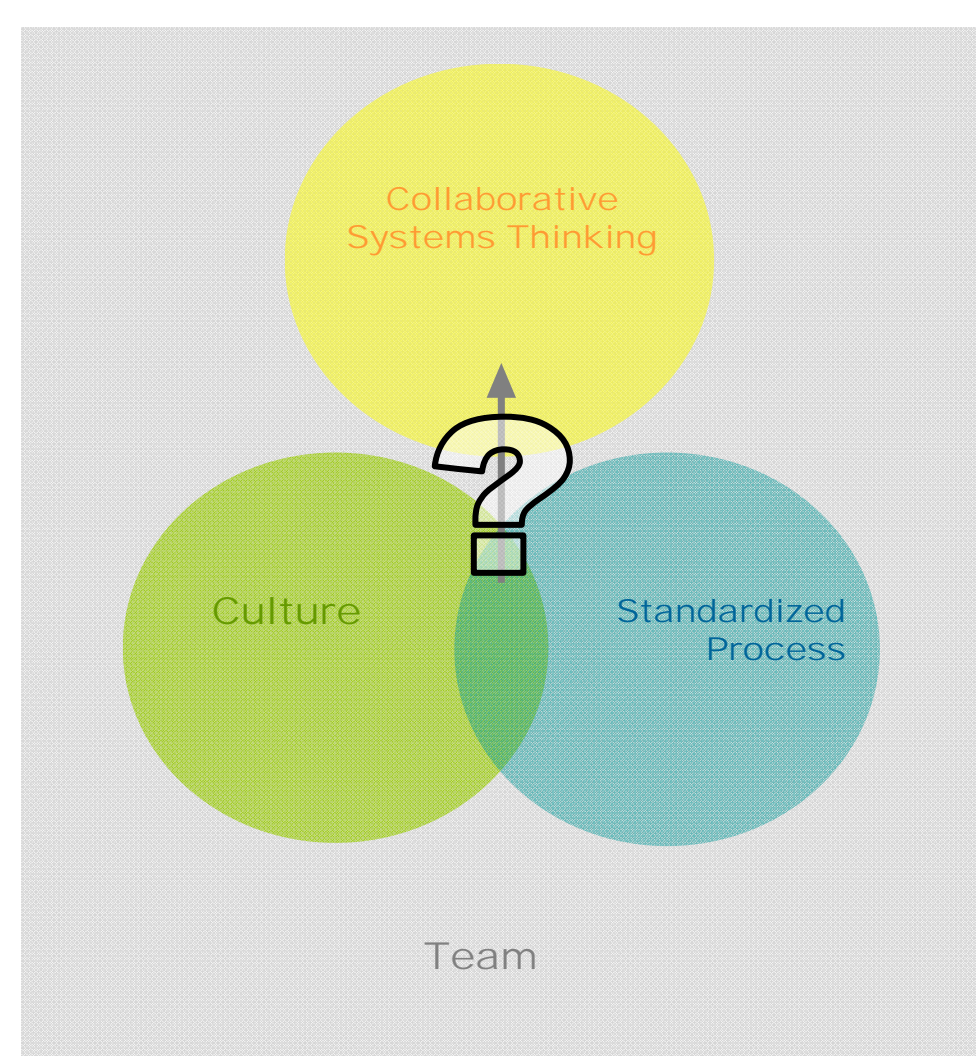
A method and framework for describing and understanding the interrelationships and forces that shape system behavior. (Senge 2006)



Collaborative systems thinking is an emergent behavior of teams results from the interactions of team members and utilizing a variety of thinking styles, design processes, tools and communication media to consider the **system**, its **components**, **interrelationships**, **context**, and **dynamics** toward executing systems design. (Lamb 2008)

What aspects of an organization's culture and standard technical process enable team-level, or collaborative, systems thinking?

Research Framework



Organizational culture and technical process are recurring themes in the literature. Both impact team interactions and group information processing.

Organizational Culture **Standardized Technical Process**

Team norms **Documented tasks and methods**

Espoused beliefs **Vision statements**

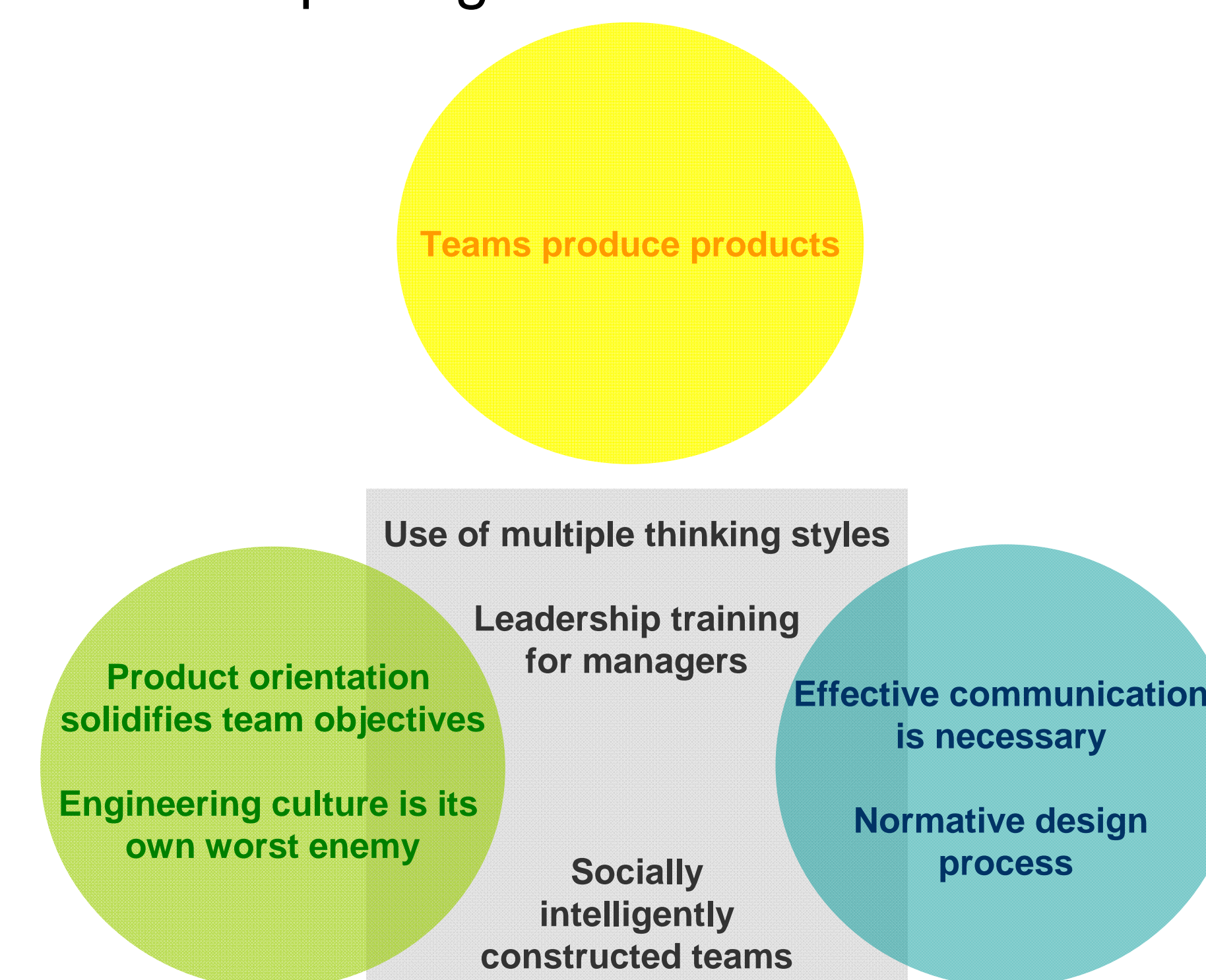
Underlying assumptions **Strategy for standardization**

Social networks **Process flow maps, org -charts**

A framework for comparing cultural and process alignment was developed. This framework aided in structuring case study interview and survey questions.

Pilot Interview Results

Pilot interview validated the key research themes and added more detailed direction towards exploring each construct.



Ongoing Case Studies

Independent Variables					Dependent Variable
Customer	Industry Sector	Program Lifecycle	Process Maturity	Team Size	Collaborative Systems Thinking
US Gov.	Aircraft (Hardware)	Conceptual Design	High	<10	Strong
Commercial	Spacecraft (Hardware)	Detail Design	Low	>10	Weak
Private					

Expected Outcomes

1. An operation definition of collaborative systems thinking
2. Heuristics for enabling collaborative systems thinking
3. Descriptive theory of collaborative systems thinking
4. Knowledge to improve workforce development initiatives, process tailoring and team composition

Research Timeline

In-Depth Literature Review	Pilot Interviews	Generals and Thesis Proposal	Case Study Field Research	Publish Results	Finish Thesis, Publish Results
12-2006	6-2007	12-2007	6-2008	12-2008	1-2009