
Embedding Cognitive Systems into Systems Engineering Practice

INCOSE Intelligent Enterprises Working Group Workshop
January 29, 2006

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“Until we are able to shape corporate life around human values, the context for work won’t bring out the best in human behavior, nor will it produce the kind of creativity that corporations recognize they need in order to innovate and grow.”

Kathleen Gumbleton, Founder & CEO
E-Strategic Research, Inc.

Fast Company Magazine, September 2005

Needs

- Full Life Cycle Involvement
 - People Inside the Conceptual System Boundary
- Communication
 - What Can Be Done?
 - In 1997, Czaja wrote, “One problem faced by human factors engineers in system design is convincing project managers, engineers, and designers of the value of incorporating human factors knowledge and expertise into the system design process.”
 - What Has Worked?
 - Value
- Ability to “Answer the Mail”
 - Methods that don’t require three studies in order to deliver an answer
 - e.g., Wayne Zachary, CHI Systems – Work-Centered [Interface] Design Environment
 - Movement from Research Mentality to Project
 - What happens when you put 160 colonels in a one-acre AOC?

Initiatives

- DoD

- National Research Council
 - Army and Air Force
- Navy's Human Centered Design Environment (HCDE)
- Air Force Research Laboratory SBIRs
 - Sponsor of the work we're doing

- Commercial, too

- Microsoft, Lexis Nexis, National Cash Register, etc.
 - Microsoft hiring anthropologists
- Usability focus

NRC Committee Goals (Pew)

- Provide a comprehensive review of issues involved in design throughout the system life cycle that need to be addressed by a consideration of human cognitive and physical performance characteristics.
 - Evaluate the state of the art in Human-Systems Integration and product development processes, design methodologies, and design tools.
 - Develop a vision for an **integrated, interdisciplinary, and generalizable human-system design support methodology and tool set.**
 - Recommend a research plan on how to achieve this vision.
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NRC Committee Panel Members

- Dick Pew, BBN Technologies
- Frank Ritter, Penn State University
- Tom Sanquist, Battelle Northwest
- Michael Muller, IBM Research
- Emilie Roth, Roth
- Brian Kleiner, Virginia Polytechnical Inst. & State Univ.
- Nancy Cook, Arizona State University
- Barry Boehm, University of Southern California
- David Graeber, Boeing Phantom Works
- Ed Israelski, Abbott Laboratories
- Nigel Bevan, Serco Usability Services, UK
- Shelley Evenson, Carnegie Mellon University

NRC Committee Schedule

- **Meeting 1 June 13, 2005**
- **Meeting 2 September 7, 2005**
- **Meeting 3: December 7-9, 2005**
- Meeting 4: February 20-22, 2006
- Meeting 5: May 10-12, 2006
- Meeting 6: August 7-9, 2006
- Deliver Report March 2007

Cognitive Engineering in the Navy

- Capable Manpower Future Naval Warfighting Capability
 - Proposals due 03/2006. ATP Fall 2007
- Reduced Manning (DDX, circa 1998)
 - Human Centered Design Environment for Complex Systems
 - An **integrated engineering environment** wherein capabilities are provided for addressing the role of human operators and decision makers in complex systems.
 - Folded into Navy's Integrated Design Environment
 - People who worked to research and develop HCDE thought it had died.
 - Said to Have Been Used by One of the DDX Contractors.
 - Not the Winning Contractor
 - Anecdote: Was Shrink-Wrapped, Mailed Out. Not Used.
 - Hard to get a handle on what happened.

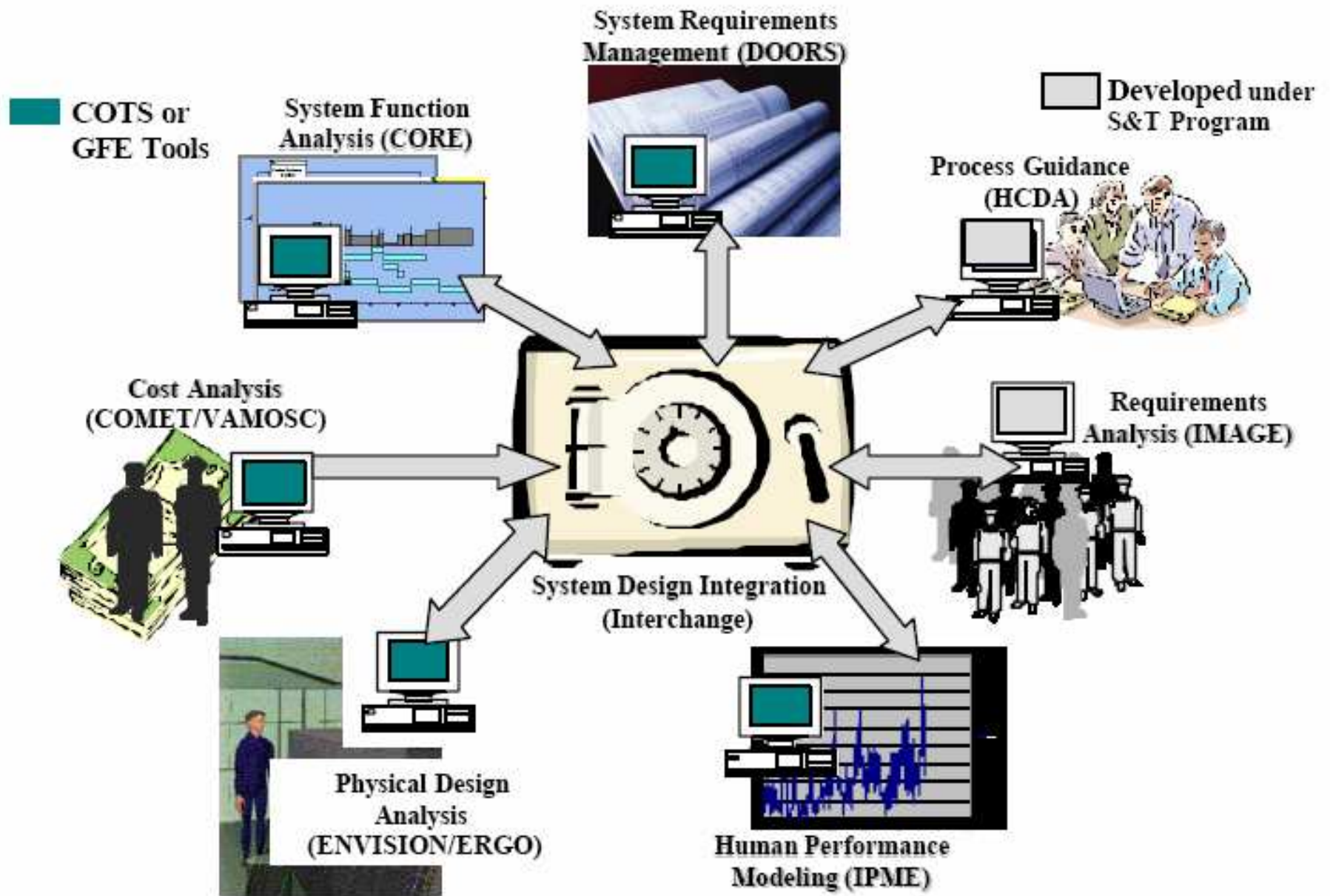


Figure 2. Prototype Human Centered Design Environment

AF SBIR 05-071

- Embedding Cognitive Systems into Systems Engineering Practice.

Develop a **process and toolset**

to embed the application of the emerging practices and technologies of cognitive systems into the traditional practice of systems engineering.

- Phase I Wrapped at End of January 2006
- Phase II Award Pending
 - May Be Multiple
 - On Hold for Congressional Budget Passage

SBIR AF 05-071 Participants – 5 Answers

■ Primes and Subs

1. Aptima
 - Roth Cognitive Engineering
2. Charles River Analytics
 - MIT
3. CHI Systems
 - Florida Institute for Human & Machine Cognition – Robert Hoffman
 - Ohio State University – David Woods
4. Deal Corp
 - University of Waterloo – Catherine Burns
5. Klein Associates Division of Applied Research
 - Northrop Grumman

Who's Answer is Right? Where Does it Go?

■ Three Services

- ❑ Navy: One integrated tool already exists
- ❑ Army: Four Staffers Overseeing HSI Implementation on Over 200 programs.
- ❑ Air Force: Five Answers from SBIR

■ What is Success?

Success Means Culture Change

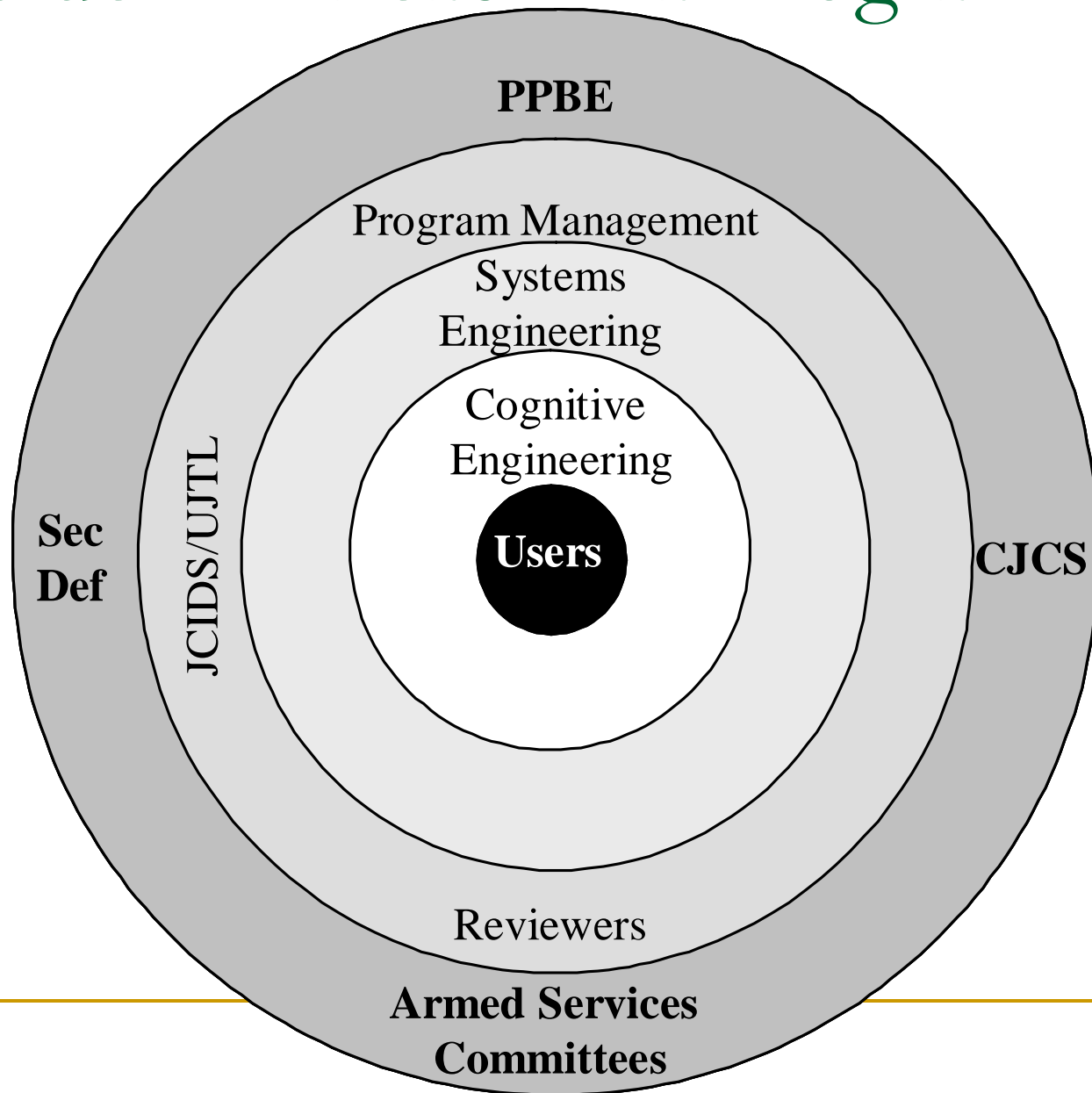
- Include ALL Stakeholders
 - But not necessarily all at once

- Make Change Mechanism Available, Attractive and Relevant
 - No Outsiders
 - Open Source Hook
 - Linux
 - AGI's Satellite Tool Kit (STK)
 - Community Ownership of "Solution"
 - Architecture Demonstrates Cognitive Systems Value
 - Provide Added Value When Budgets Are Tight

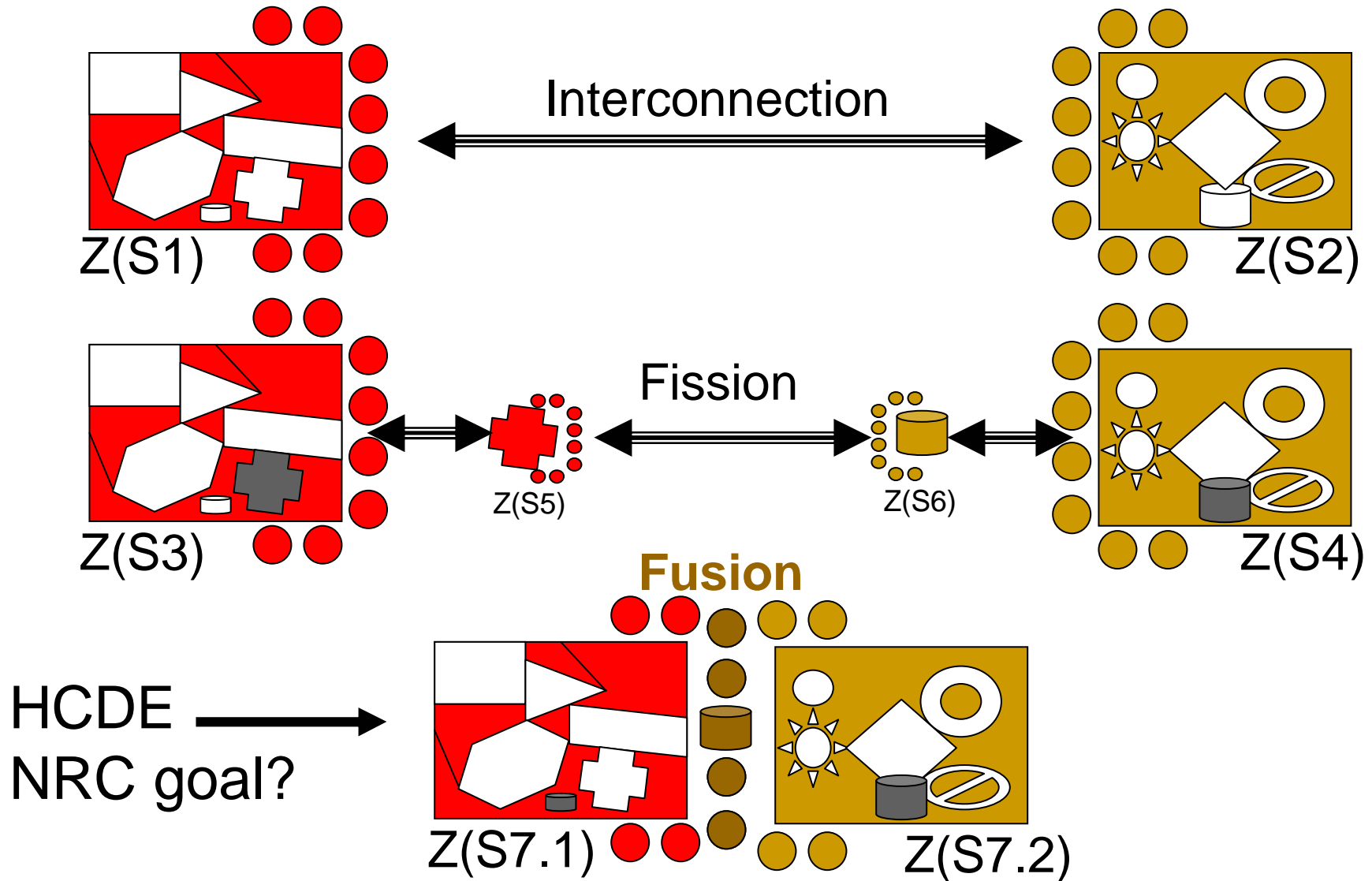
- Make Change Understandable to Stakeholders
 - Eliminate Frustrating Semantic Subtleties

Stakeholder Outreach – a Program

Each
Ring a
Separate
Project.



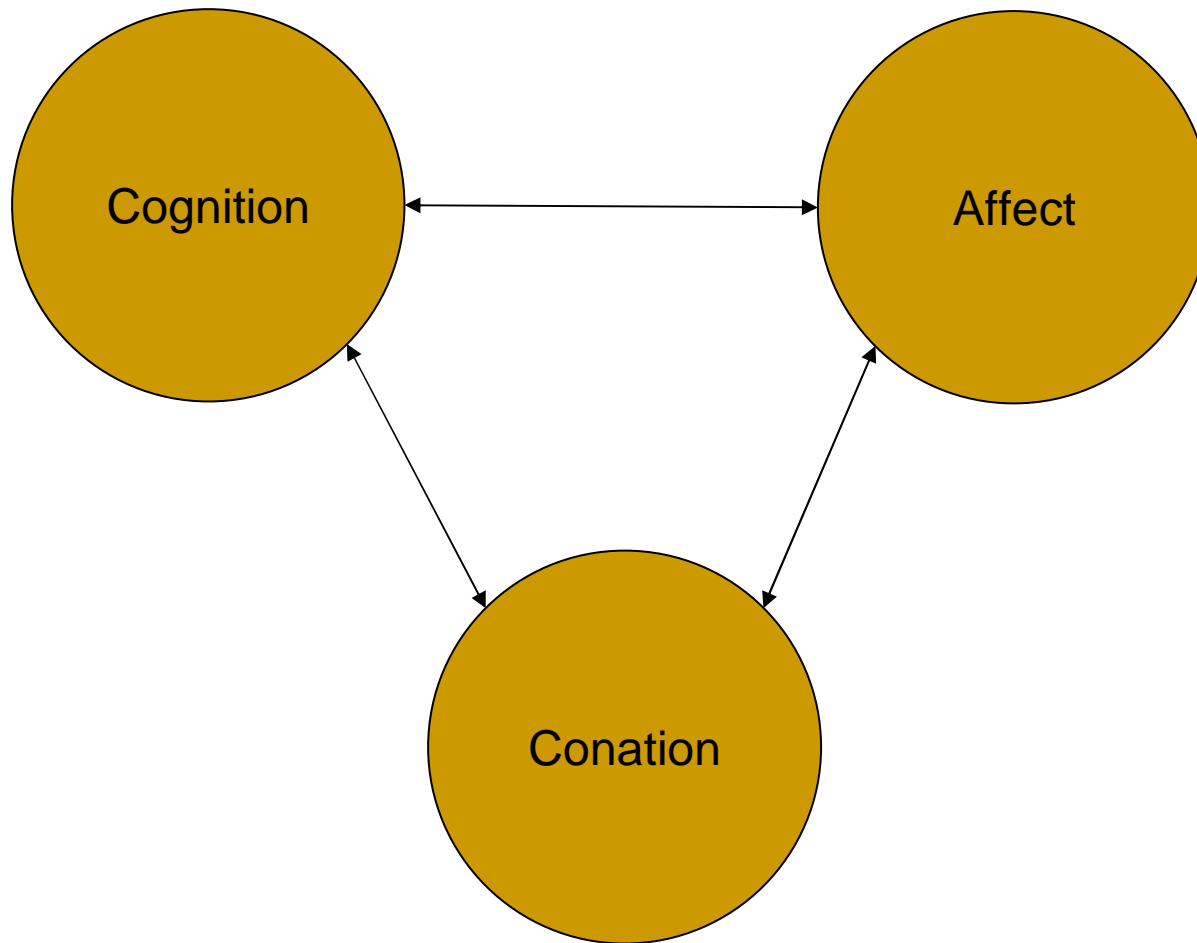
No Outsiders: Three Approaches to SoS – Jack Ring



Change Must Be Understandable

- Human Systems Need to be Addressed in An Integrated Fashion
 - PM: “How do you divide HSI boundaries?”
 - Manpower
 - Personnel
 - Training
 - Human Factors
 - Safety
 - Occupational Health
 - Habitability
 - Personnel Survivability
 - How do you communicate areas of responsibility to program planners?
 - “I don’t do safety or occupational health.”
 - PM: “Don’t give me that *?&%\$#* !”

Is The Whole Individual Being Addressed?

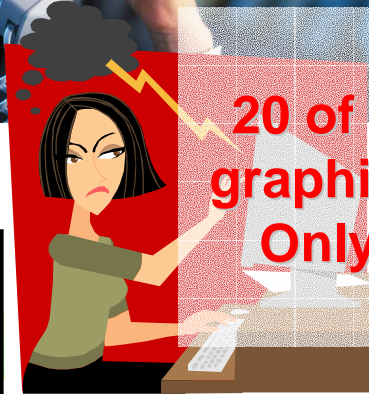


Ideas, Suggestions, Solutions, Updates

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Backups

Under-Utilized Capability



Type in "Frustration"
20 of the 56 MS Word standard clip art graphics depict people with electronics.
Only one of these appears when you type in "computer."

