

Atul Patel
Director, Systems Engineering
Lockheed Martin Simulation, Training and Support
International Council on Systems Engineering
Orlando Chapter
January 21, 2010

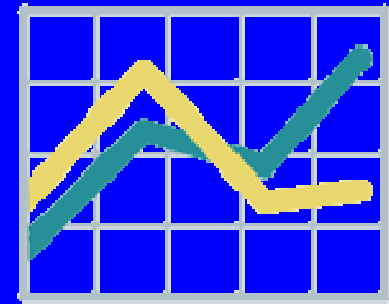
APPLICABILITY OF KNOWLEDGE MANAGEMENT TO SYSTEMS ENGINEERING

Agenda

- ◆ Program Environment
- ◆ Systems Engineering – The Basics
- ◆ Knowledge Management – The Basics
- ◆ Success Factors
- ◆ Knowledge Management Execution
- ◆ Summary

The Changing Environment

- ◆ Competition
- ◆ Innovation
- ◆ Changing Workforce
- ◆ Decentralized Execution
- ◆ Shortened Product Life-Cycles
- ◆ Rate of Change of Technology



Systems Engineering – The Basics

Systems Engineering is an interdisciplinary approach and means to enable the realization of successful systems. It focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, then proceeding with design synthesis and system validation while considering the complete problem: Operations, Cost & Schedule, Performance, Training & Support, Manufacturing, Test and Disposal.

Systems Engineering integrates all the disciplines and specialty groups into a team effort forming a structured development process that proceeds from concept to production to operation. Systems Engineering considers both the business and the technical needs of all customers with the goal of providing a quality product that meets the user needs.

INCOSE

Continuously Successful Execution of Systems Engineering of Complex Programs Requires Proactive Knowledge Management

Knowledge Management

- Right Information to the Right People at the Right Time



- Identifying and mapping intellectual assets
- Exploiting past experience – Sharing of best practices, lessons learned, etc.
- Making information and context available to transform data into knowledge

Of central importance is the changing nature of competitive advantage - not based on market position, size and power as in times past, but on the incorporation of knowledge into all of an organization's activities

Leif Edvinsson, Swedish Intellectual Capital guru in Corporate Longitude (2002)

Opportunities for Knowledge Dissemination

- Knowledge Repositories

- **Documents (Explicit)**

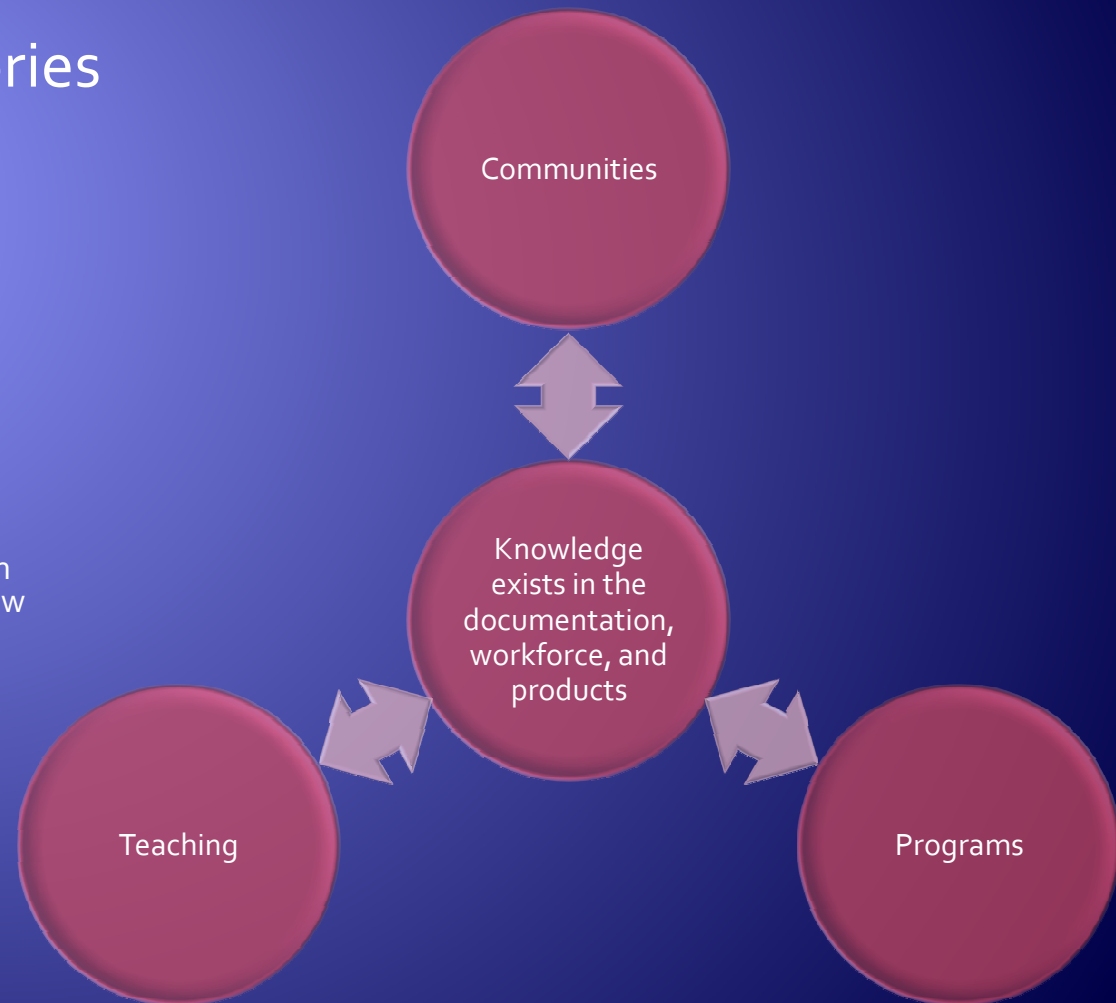
- Design Documentation
- Reviews
- Interim Status

- **Workforce (Tacit)**

- SME
 - "An expert is a man who has made all the mistakes, which can be made, in a very narrow field."- *Niels Bohr*
- Lessons Learned
- Journey

- **Products (Implicit)**

- Capabilities
- Performance
- Cost



Success Factors for Knowledge Management

People, Process and Tools

There is less to fear from outside competition than from inside inefficiency, miscalculation, lack of knowledge. Beat your competitors with the knowledge edge!
Anonymous

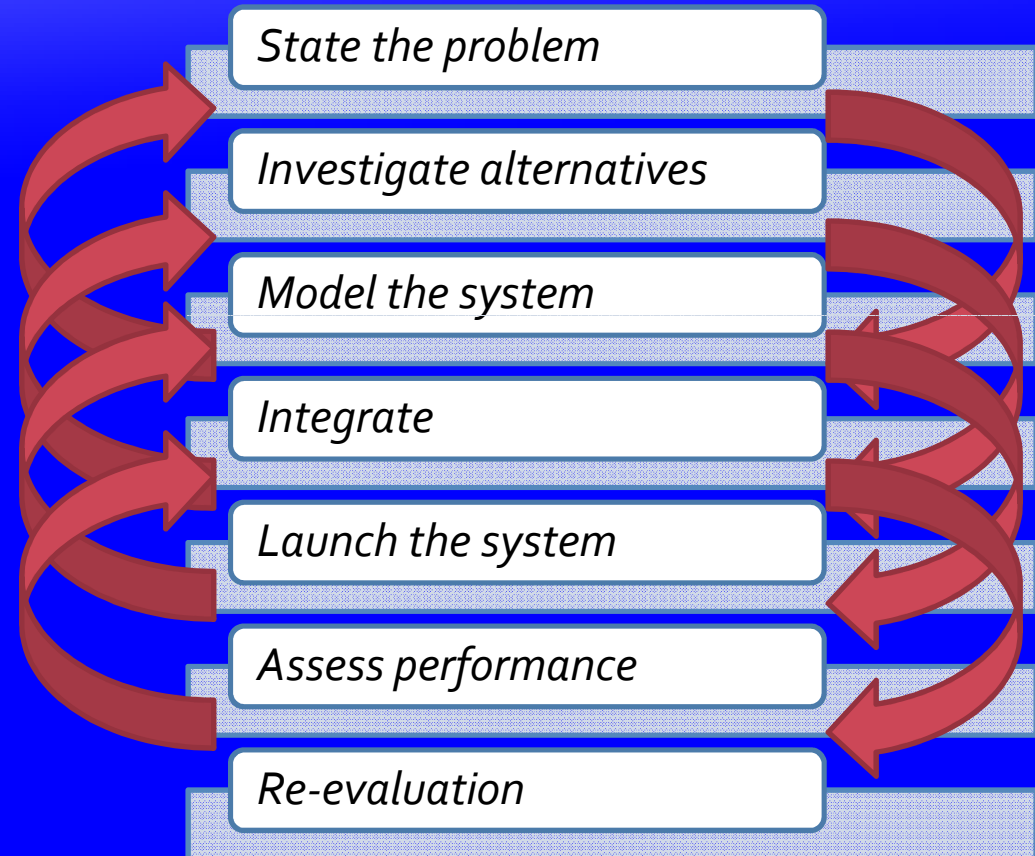
- Encourage sharing
- Promote Communities of Practice
- Institutionalize reuse – technology, process, products
- Protect the team's IP



Knowledge Management Execution

Correlation with Systems Engineering

- ◆ *Elements of SE require knowledge management for repetitive, successful execution*
 - ◆ *Program Status – performance, schedule, cost, quality*
 - ◆ *Risk Management*
 - ◆ *Requirement modulation, trade space definition and assessment*
 - ◆ *Spiral / Agile development progress*
 - ◆ *Peer reviews, Communities of Practice – best practices*



Tools and Technologies and Process Capture, Communicate and Preserve

- ◆ Technology alone is not the answer – technology without appropriate processes introduces risk and may regress an organizations knowledge base
- ◆ Selective and strategic implementation of tools tied to processes help address organizational stagnation
 - ◆ Web based applications – portals, e-learning, collaboration sites, etc. with Push/Pull Processes
 - ◆ Data capture and mining
 - ◆ Expert system development and validation tools
 - ◆ Repositories - Journey sharing, lessons learned, communities of practice, etc. tied to a trained, empowered workforce
- ◆ Timely knowledge communication – push and pull – can successfully steer systems engineering programs to success

Knowledge Management: An Essential Component of CMMI

... the quality of a product is a direct function of the process capability, the technology capability, and the people capability used to develop the product ...

Systems Engineering Capability Maturity Model
SEI, Carnegie Mellon

- Knowledge management is required to address controlled / continuously improving performance with a dynamic workforce
 - Institutionalizing knowledge management allows for continuous improvement by leveraging best practices
-
- Performed Informally**
- Basic practices performed
- Planned and Tracked**
- Planning Performance
 - Disciplined performance
 - Verifying performance
 - Tracking performance
- Well Defined**
- Define the standard process
 - Perform the standard process
- Quantitatively Controlled**
- Establishing measurable quality goals
 - Objectively managing performance
- Continuously Improving**
- Improving organizational capability
 - Improving process effectiveness

Summary

- ◆ Environmental dynamics require the need for knowledge management for System Engineering in a competitive landscape
 - ◆ Leveraging the experience of the past - Sharing of knowledge and best practices
 - ◆ Accelerating innovation
 - ◆ Reducing time-to-market and cost
 - ◆ Exploiting decentralized execution
 - ◆ Addressing staffing dynamics
- ◆ The required *trifecta* for success - People, Process and Tools
 - ◆ Incentivized people working in a collaborative environment
 - ◆ Manageable process to capture, communicate and preserve knowledge
 - ◆ Appropriate tools and training to successfully execute in a push-pull tool configuration
- ◆ Knowledge Management reinforces predictability, control and effectiveness

Is Systems Engineering possible without knowledge management?

YES

Is continuously successful Systems Engineering possible in a competitive environment without knowledge management?

NO