Background

- There are wide variations in the style and content of systems engineering training throughout industry and universities
  - Content
  - Duration
  - Style

- This presentation will highlight these differences, and offer strategies for selecting the proper type of systems engineering training for a given audience and purpose
Key Questions in Establishing SE Training

- What topics should be addressed?
  - Technical, process, organizational, contextual?

- Should training be developed in-house or bought from a vendor or university?

- Are alternatives to classroom training effective? Under what conditions?
  - Mentoring, on-line, guided self-study, on-the-job?

- How should training be paid for?

- How do you determine whether training is effective?

- How much SE training is enough?
Background

- The purpose of organizational training is to develop the skills and knowledge of people so they can perform their roles effectively and efficiently.

- An organizational training program involves:
  - Identifying the training needed by the organization
  - Obtaining and providing training to address those needs
  - Establishing and maintaining training materials
  - Establishing and maintaining training records
  - Assessing training effectiveness

- The training strategy and tactics employed will greatly influence cost, quality, retention of knowledge, and student satisfaction.
A competency is a set of behaviors that encompasses skills, knowledge, abilities, and personal attributes that are critical to successful performance at a particular job.

- Should be observable and measurable through behaviors
- These behaviors provide a model for superior job performance

- Can provide a powerful mechanism for identifying gaps in individual and workforce-wide skills sets, to identify appropriate training

- Must be integrated with an organization’s strategic goals and individual performance plans
Is the Staff Qualified to Do Their Work?

- What are the minimum skills and knowledge needed to perform their job function?
- Does each individual possess these skills?
  - If not, training should address the gaps

An organizational responsibility!

How does the organization maintain a skilled and knowledgeable workforce?
SE Competency Issues

- Systems engineering as a discipline versus the process of engineering a system
- SE body of knowledge
- Organizational-specific topics
  - Processes and procedures
  - Use of specific tools and methods
  - Customer acquisition practices
  - Domain-specific technologies
- Student background and experience
- Student expectations
Systems Engineering Discipline

- User Needs
- System Requirements
- Component Requirements
- Design and Produce Components
- Verify Components
- Verify System
- Validate System
- Engineering Specialties
- Allocate Requirements
- Integrate System

Time
Engineering a System

Systems Engineering

System Management
- Technical Reviews
- Interface Mgmt
- Configuration Mgmt
- Planning
- Estimating
- Tracking, Metrics
- Risk Mgmt
- etc.

System Design/Architecture
- System Analysis
- Functional Analysis
- Rqmts Allocation
- Interface Definition
- Synthesis
- Trade Studies
- Specifications
- etc.

System Verification & Validation
- Integration
- Verification
- Test
- Demonstration
- Analysis
- Inspection
- Validation
- etc.

Engineering Specialties
- Human Factors
- Logistics
- System Safety
- Survivability
- Reliability
- Producibility
- etc.
Who is the Audience?

Junior SEs and component engineers
- Seeking to broaden their understanding of SE, as it applies to their engineering tasks

Support personnel
- Seeking to understand SE, to more effectively support it

Senior SEs
- Seeking to effectively manage the SE process
Evaluating Effectiveness – The Kirkpatrick Model

Level 1 – Collect student and instructor reaction to the training

Level 2 – Measure student learning through testing

Level 3 – Measure transference of learning to the job

Level 4 – Measure impact on job performance
Strategies for Organizational Training - 1

- Start by defining the key job functions in the organization
  - E.g., project manager, software engineer, quality assurance specialist

- Identify the requisite knowledge associated with each function

- Define a set of course modules that impart this knowledge
  - Map modules to job functions
  - Some modules will be common to multiple job functions

- Acquire training materials and trainers
  - Should reflect the organization’s policies and processes
  - Unlikely that standard vendor/university courses will fit
Strategies for Organizational Training - 2

- Identify each employee by their job function(s), map to required courses
  - If the employee already has the identified minimum knowledge, they do not need to take the course
- Establish student records
  - Who has completed what course, waivers
- Review required training with employees
  - Career-planning, promotions, new hires
- Add project-specific training (e.g., tools, methods), where needed
Example: University SE Extension Course

- 56 hours; 7 full-day classes, held once a month
- Addresses all MIL-STD-499C topics
  - Balance between SE and Engineering a System
  - Includes “soft skills” - team development, conflict management
  - Includes customer and industry specific standards (e.g., DoD acquisition process, CMMI, Six Sigma)
- Taught by a experienced team of systems engineers
- Students form teams to apply the lecture material to a threaded class project
  - Present results in class and obtain feedback
Lessons Learned

- Students’ individual motivations greatly effect the degree of learning
- Classroom setting provides low risk environment
- Students value and understanding of the overall SE process and SE perspective
- Class project provides practical feedback on implementation details, team dynamics
- Course encourages further study and connections with other functional areas on the students’ current project