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DEFINING THE FUTURE

Strategies for Systems Engineering Training

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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**

Competency Model

- 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?



An organizational responsibility!

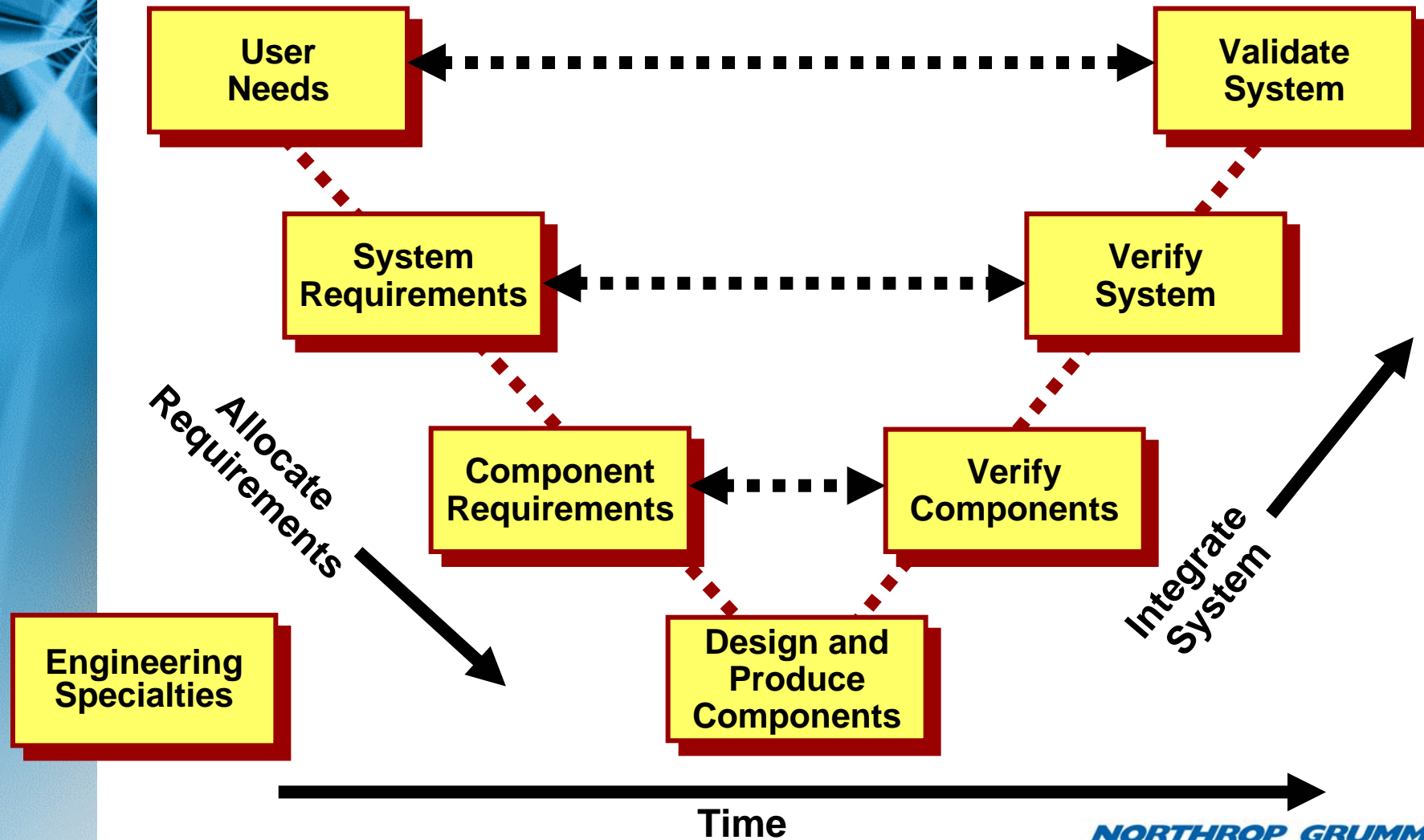
- What are the minimum skills and knowledge needed to perform their job function?
- Does each individual possess these skills?
 - If not, training should address the gaps

How does the organization maintain a skilled and knowledgeable workforce?

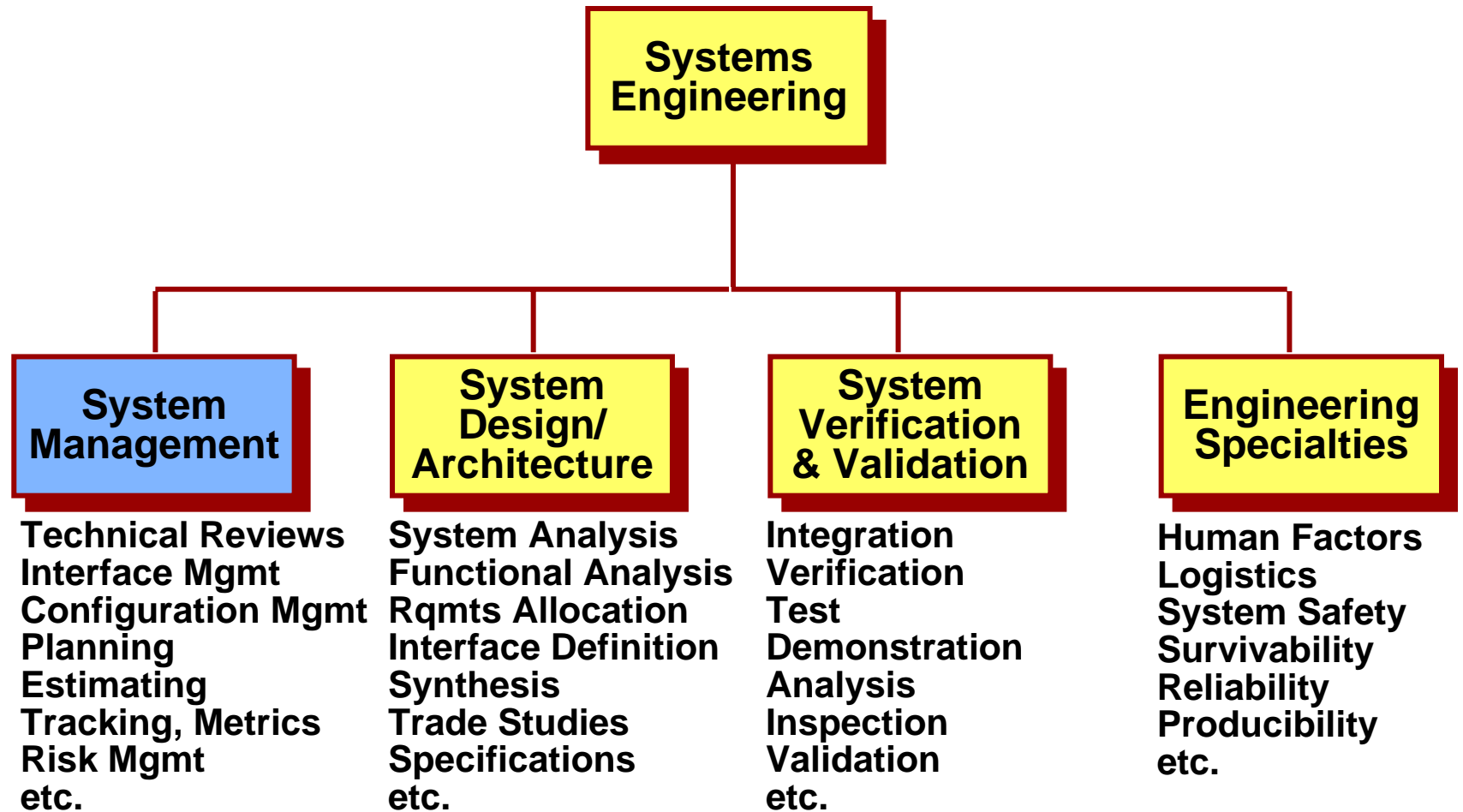
SE Competency Issues

- **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



Engineering a System



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

System Engr	Engr a System
✓	
✓	
✓	✓

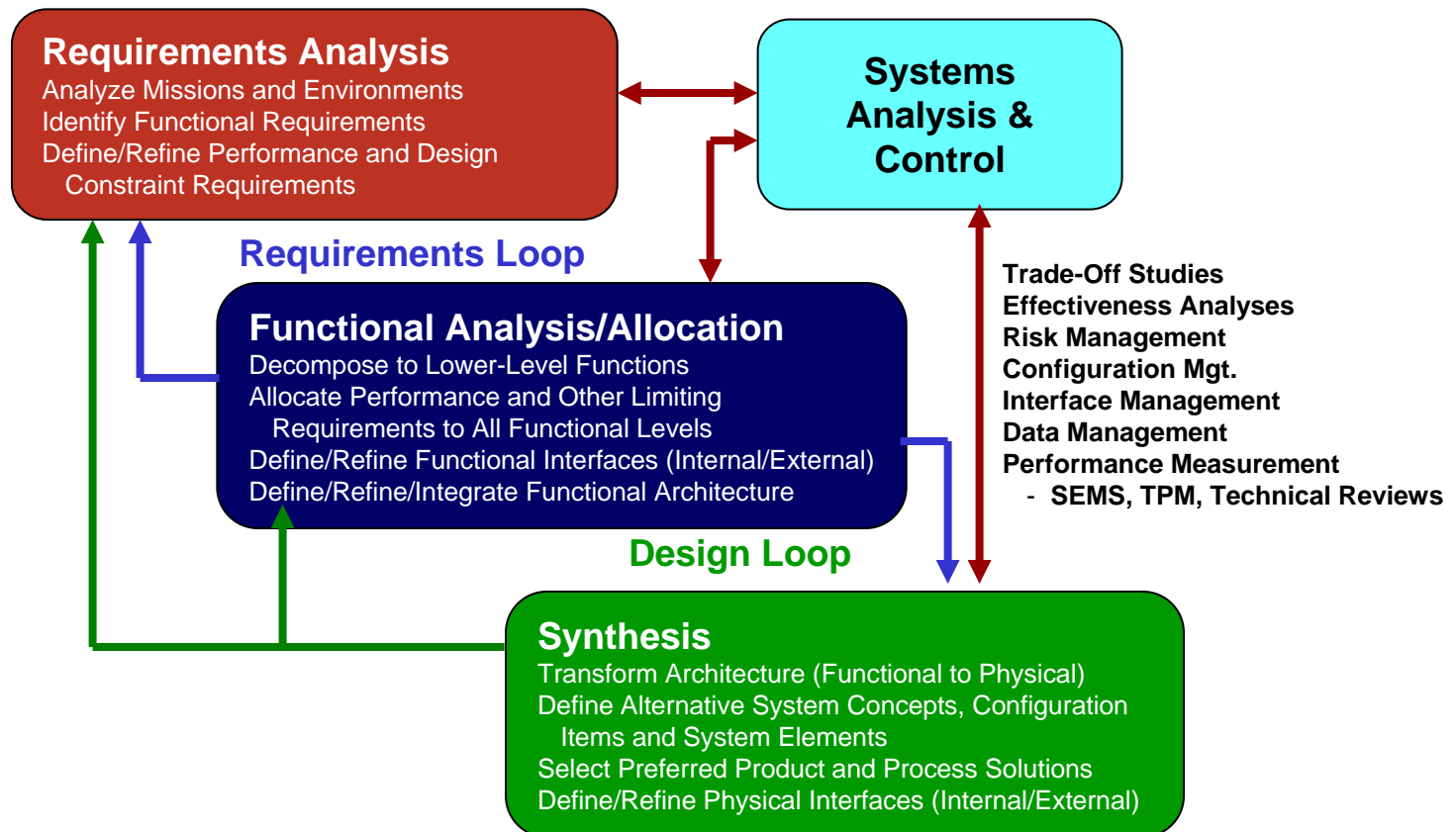
Body of Knowledge - MIL-STD-499C (draft)

Process Input

Customer Needs/Objectives/Requirements
 - Missions, Measures of Effectiveness, Environments, Constraints
 Technology Base
 Output Requirements from Prior Development Effort
 Program Decision Requirements
 Requirements from Specs and Stds

Organizational-specific topics

- Processes and procedures
- Tools and methods
- Customer acquisition practices
- Domain-specific technologies



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**



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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**