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DEFINING THE FUTURE

Strategies for Systems Engineering Training

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Rick Hefner, Ph.D.
Director, Process Management
Northrop Grumman Corporation

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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**

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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?**

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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**

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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**

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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?

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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**

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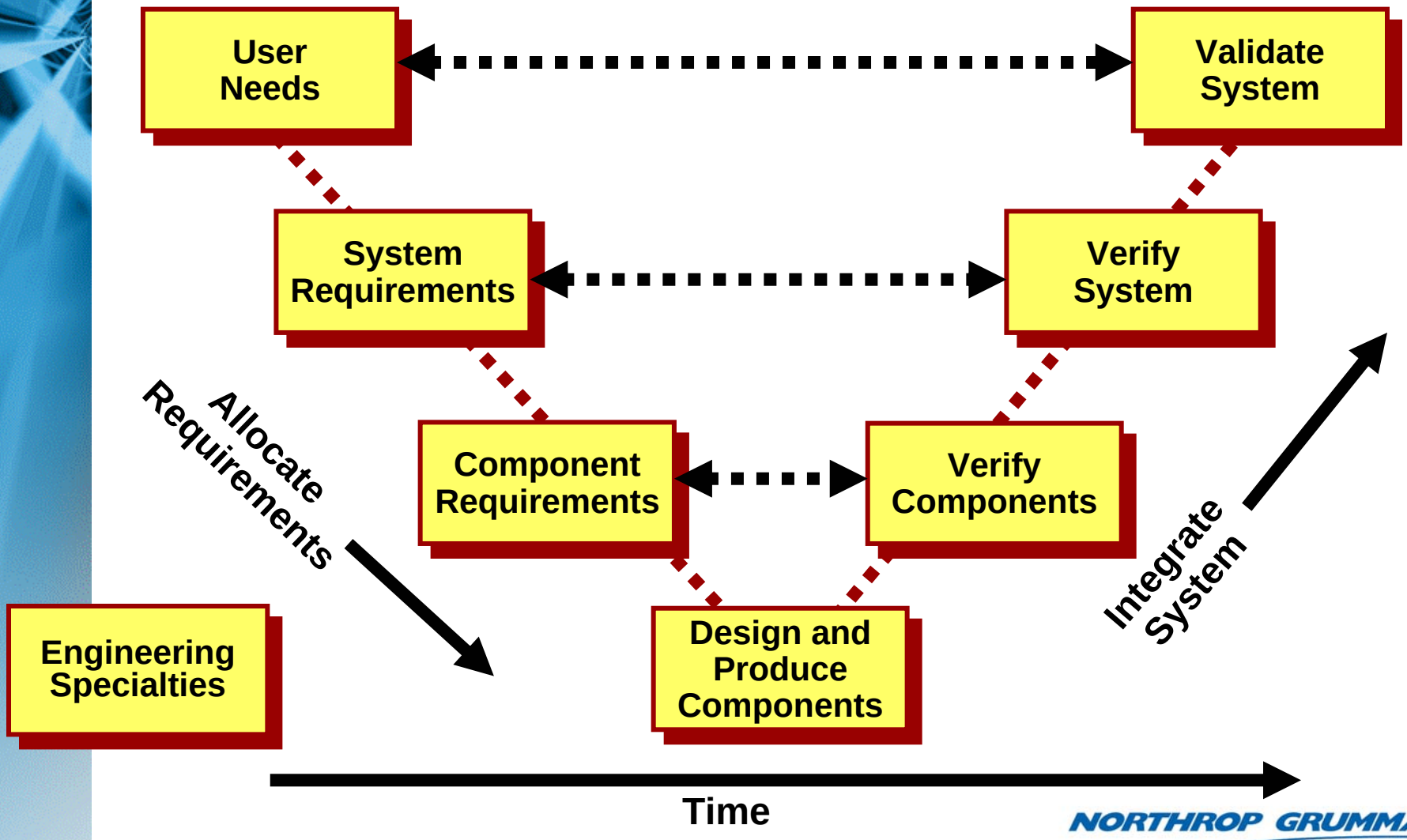
Systems Engineering Discipline



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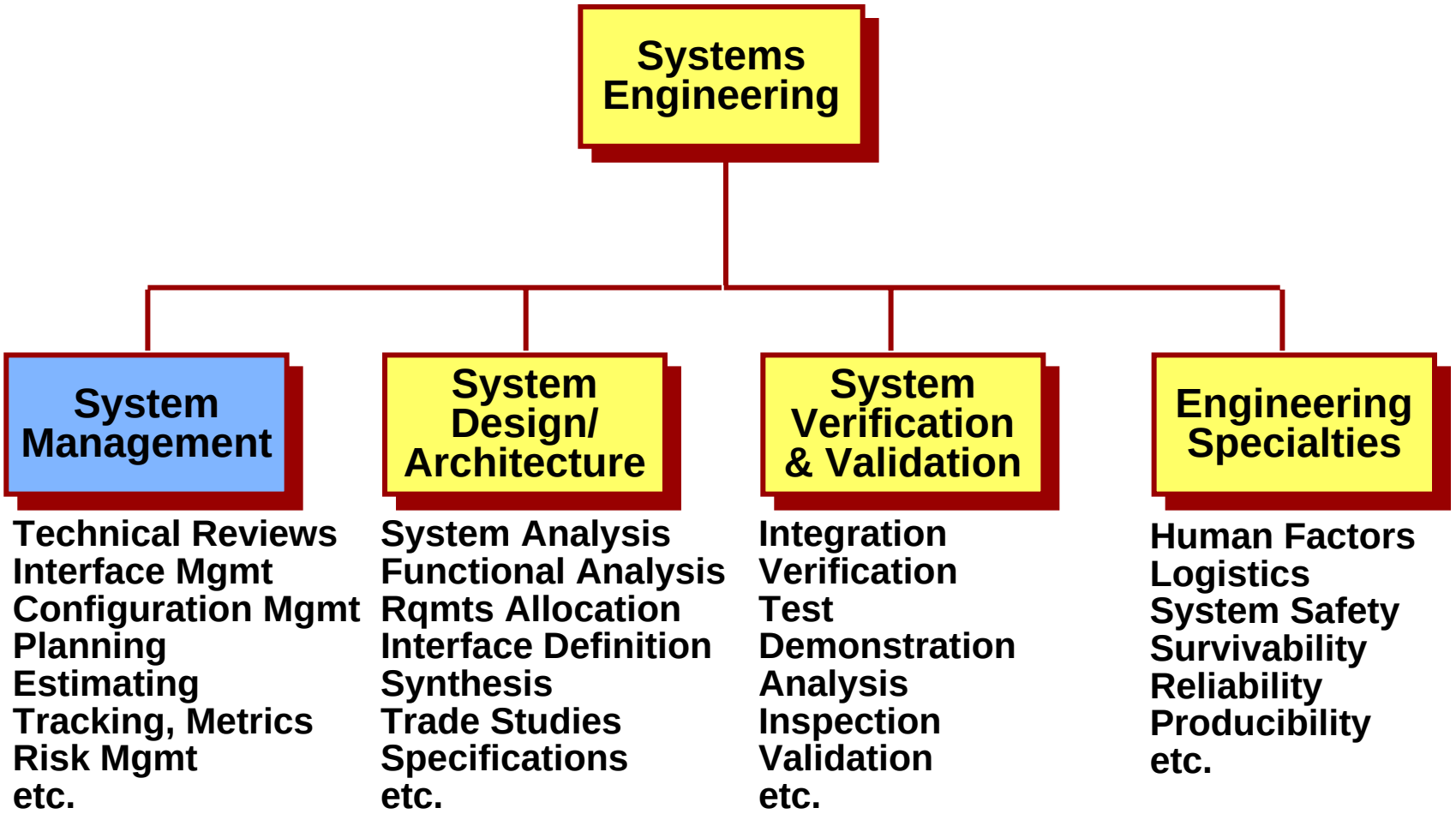
Engineering a System



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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
✓	
✓	
✓	✓

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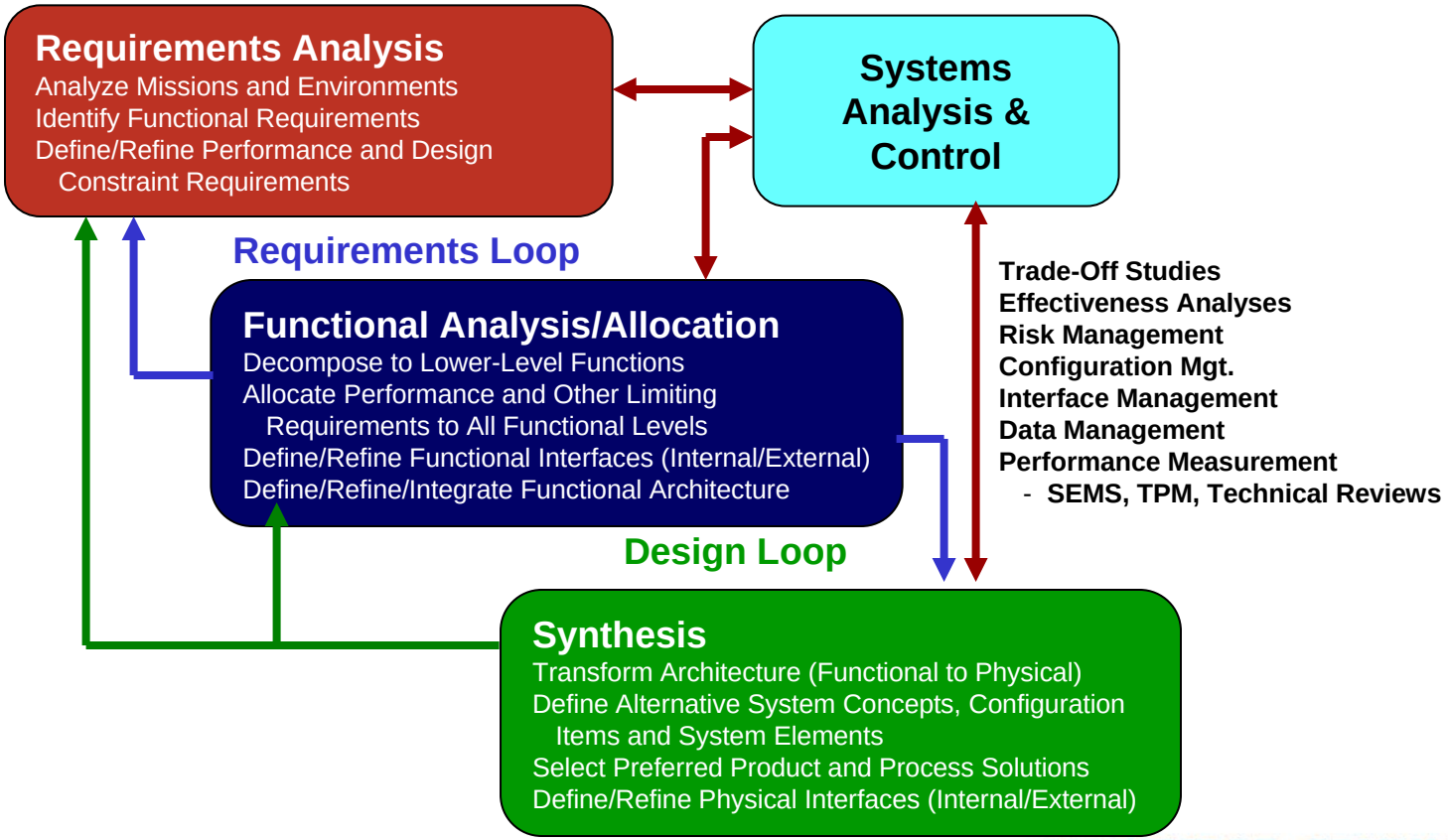
Body of Knowledge - MIL-STD-499C (draft)

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



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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

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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

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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

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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

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