Welcome

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A101
Introduction to Acquiring Standards-based ITS Systems

Target Audience

- Procurement managers
- Procurement decision makers
- Project managers

Instructor

Ken Vaughn, P.E.

President

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Herndon, VA, USA

Recommended Prerequisites

- I101: Using ITS Standards: An Overview
- Helpful to have knowledge of
    - Intelligent Transportation Systems (ITS)
    - Managing ITS deployment projects
    - Government procurement processes
    - Benefits of standards
    - Systems engineering process (SEP)

Curriculum Path (SEP)

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┌─────────────────┐      ┌─────────────────┐      ┌─────────────────┐
│      I101       │      │      A101       │      │      A102        │
│   Using ITS     │ ───▶ │ Introduction to │ ───▶ │ Introduction to  │
│  Standards: An  │      │    Acquiring    │      │ User Needs       │
│    Overview     │      │ Standards-based │      │ Identification   │
│                 │      │   ITS Systems   │      │                  │
└─────────────────┘      └─────────────────┘      └─────────────────┘

┌─────────────────┐      ┌─────────────────┐      ┌─────────────────┐
│      A201       │      │  Understanding  │      │   Specifying     │
│ Details on      │ ───▶ │   User Needs    │ ───▶ │  Requirements    │
│ Acquiring       │      │ A311a NTCIP 1203│      │ A311b NTCIP 1203 │
│ Standards-based │      │ A313a NTCIP     │      │ A313b NTCIP      │
│ ITS Systems     │      │ 1204 v03        │      │ 1204 v03         │
│                 │      │ A321a TMDD v3.0 │      │ A321b TMDD v3.0  │
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Curriculum Path (Non-SEP)

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┌─────────────────┐     ┌─────────────────┐     ┌─────────────────┐
│ I101            │     │ A101            │     │ A102            │
│ Using ITS       │ ──→ │ Introduction to │ ──→ │ Introduction to │
│ Standards: An   │     │ Acquiring       │     │ User Needs      │
│ Overview        │     │ Standards       │     │ Identification  │
│                 │     │ -based ITS      │     │                 │
│                 │     │ Systems         │     │                 │
└─────────────────┘     └─────────────────┘     └─────────────────┘
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┌─────────────────┐     ┌─────────────────┐     ┌─────────────────┐
│ A201            │     │ A202            │     │ A103            │
│ Details on      │     │ Identifying and │     │ Introduction to │
│ Acquiring       │ ──→ │ Writing User    │ ──→ │ ITS Standards   │
│ Standards-based │     │ Needs When ITS  │     │ Requirements    │
│ ITS Systems     │     │ Standards Do    │     │ Development     │
│                 │     │ Not Have SEP    │     │                 │
│                 │     │ Content         │     │                 │
└─────────────────┘     └─────────────────┘     └─────────────────┘
                                                          │
┌─────────────────┐     ┌─────────────────┐     ┌─────────────────┐
│ A203            │     │ *A3xxa          │     │ *A3xxb          │
│ Writing         │     │ Identifying and │     │ Developing and  │
│ Requirements    │ ──→ │ Writing         │ ──→ │ Writing         │
│ When ITS        │     │ Specific User   │     │ Specific        │
│ Standards Do    │     │ Needs for NTCIP │     │ Requirements    │
│ Not Have SEP    │     │ 12xx vxx        │     │ for NTCIP       │
│ Content         │     │                 │     │ 12xx vxx        │
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RITA U.S. Department of Transportation
Research and Innovative Technology Administration
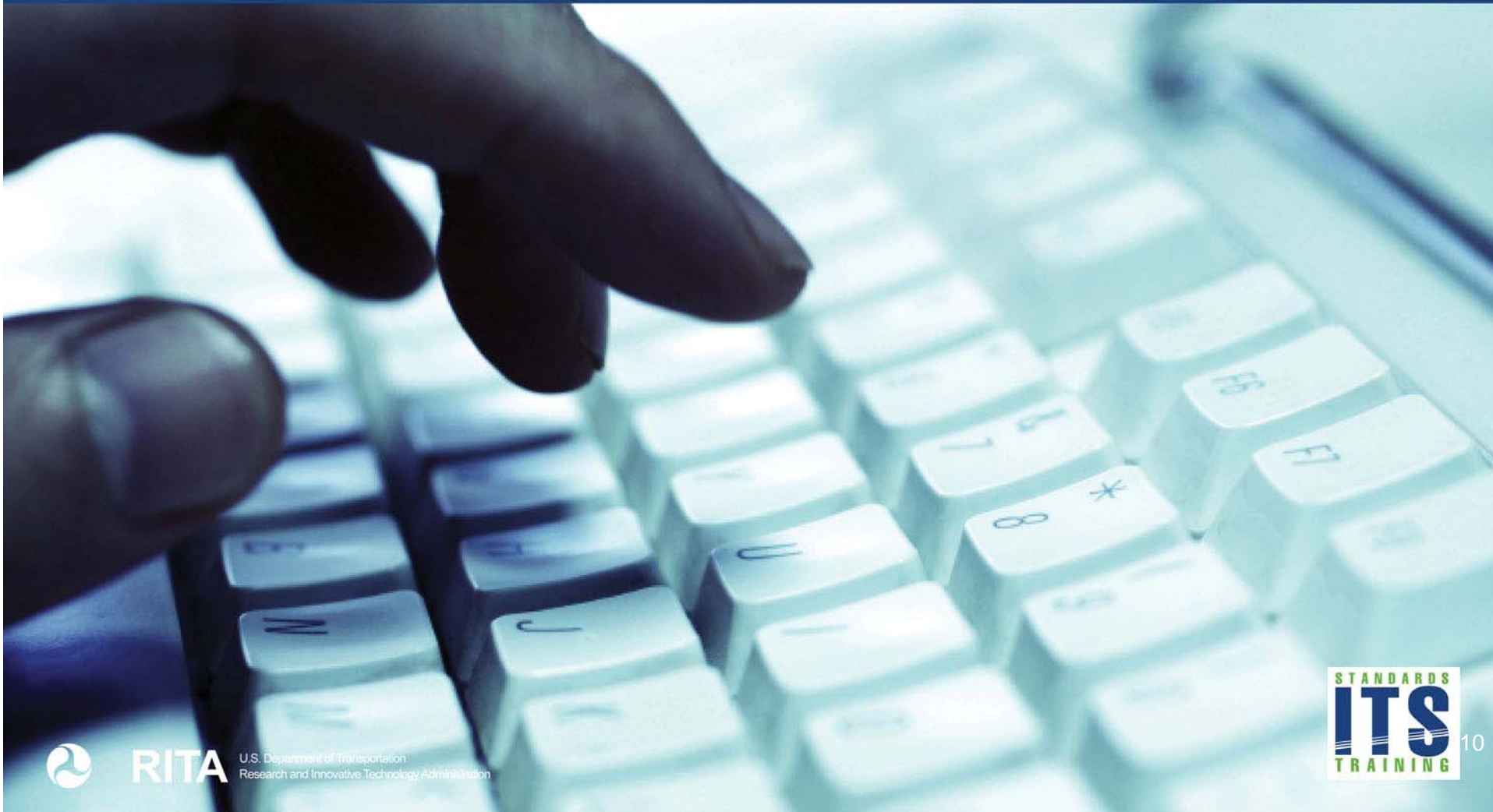*expected in Year 2 training modules

STANDARDS ITS TRAINING

8

Learning Objectives

1. Identify what managers should know

2. Articulate process for acquiring standards-compliant ITS systems

3. Differentiate between standards with and without SEP

ACTIVITY

Discuss

- What do you think of when someone mentions "ITS Standards"?

- Use the chat pod to answer

Types of ITS Standards

- Data Standards
  - Define domain-specific information
  - DMS, ESS, TMDD, etc.
- Communication Standards
  - Define low-level communications
  - TCP/IP, Ethernet, serial, etc. in ITS environment
- Both must be defined for a system interface

Additional Key Terms

- Management system
- Device

POLLING

Multiple Choice Poll

- How do ITS standards assist in procurements?
  - They define all requirements
  - They define details, but need tailoring
  - Communication standards are precise, but data standards need to be tailored
  - Data standards define precise requirements, but communication standards need to be tailored

Benefits of ITS Standards

- Standards define technical details, but need tailoring
  - Standard provides a checklist of features to consider
    - Optional features (e.g., display of graphics)
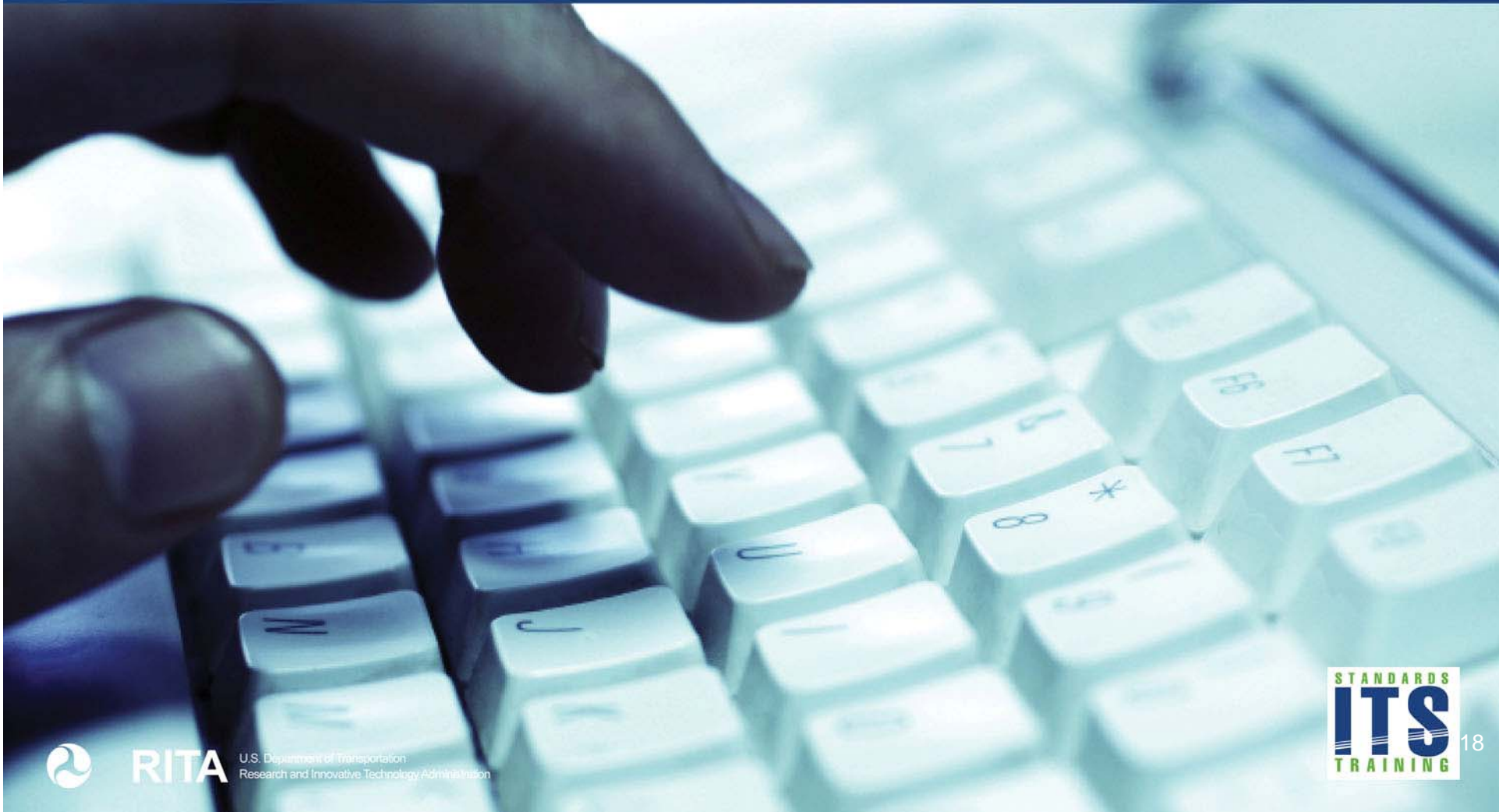   - Desired ranges (e.g., number of messages)

Other Benefits of ITS Standards

- Management Benefits
  - Addressed in Module I101
- Acquisition Benefits
  - Price competition among product vendors
  - Easier to switch from one vendor to another
  - Reduced integration costs for central system
  - Market synergies
    - Off-the-shelf testing tools
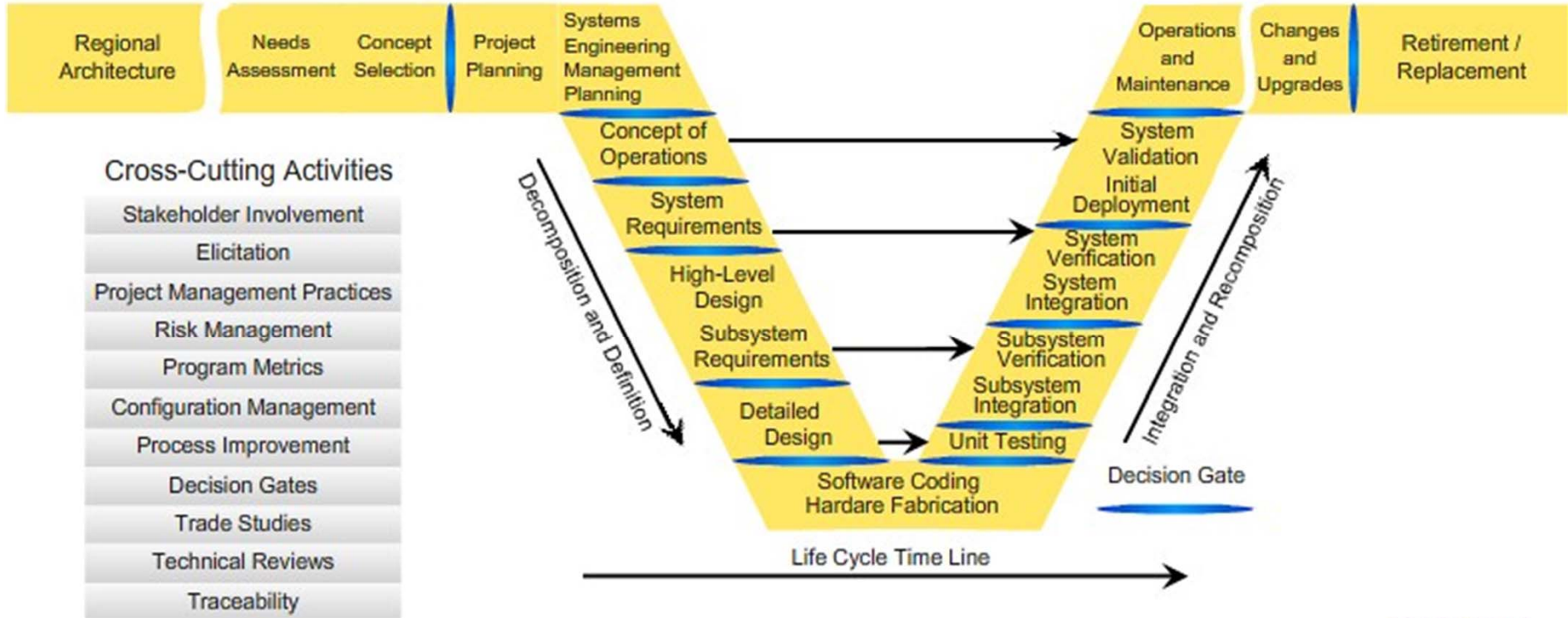
ACTIVITY

Discussion

- How do we determine the appropriate tailoring?

- Use the chat pod to answer

Systems Engineering Process (SEP)

Phase -1	Phase 0	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Interfacing with Planning and the Regional Architecture	Concept Exploration and Benefits Analysis	Project Planning and Concept of Operations Development	System Definition and Design	System Development and Implementation	Validation, Operations and Maintenance, Changes & Upgrades	System Retirement / Replacement

Regional Architecture | Needs Assessment · Concept Selection | Project Planning | Systems Engineering Management Planning | Operations and Maintenance | Changes and Upgrades | Retirement / Replacement

Cross-Cutting Activities
- Stakeholder Involvement
- Elicitation
- Project Management Practices
- Risk Management
- Program Metrics
- Configuration Management
- Process Improvement
- Decision Gates
- Trade Studies
- Technical Reviews
- Traceability

Decomposition and Definition

Concept of Operations

System Requirements

High-Level Design

Subsystem Requirements

Detailed Design

Software Coding Hardare Fabrication

System Validation

Initial Deployment

System Verification

System Integration

Subsystem Verification

Subsystem Integration

Unit Testing

Integration and Recomposition

Decision Gate
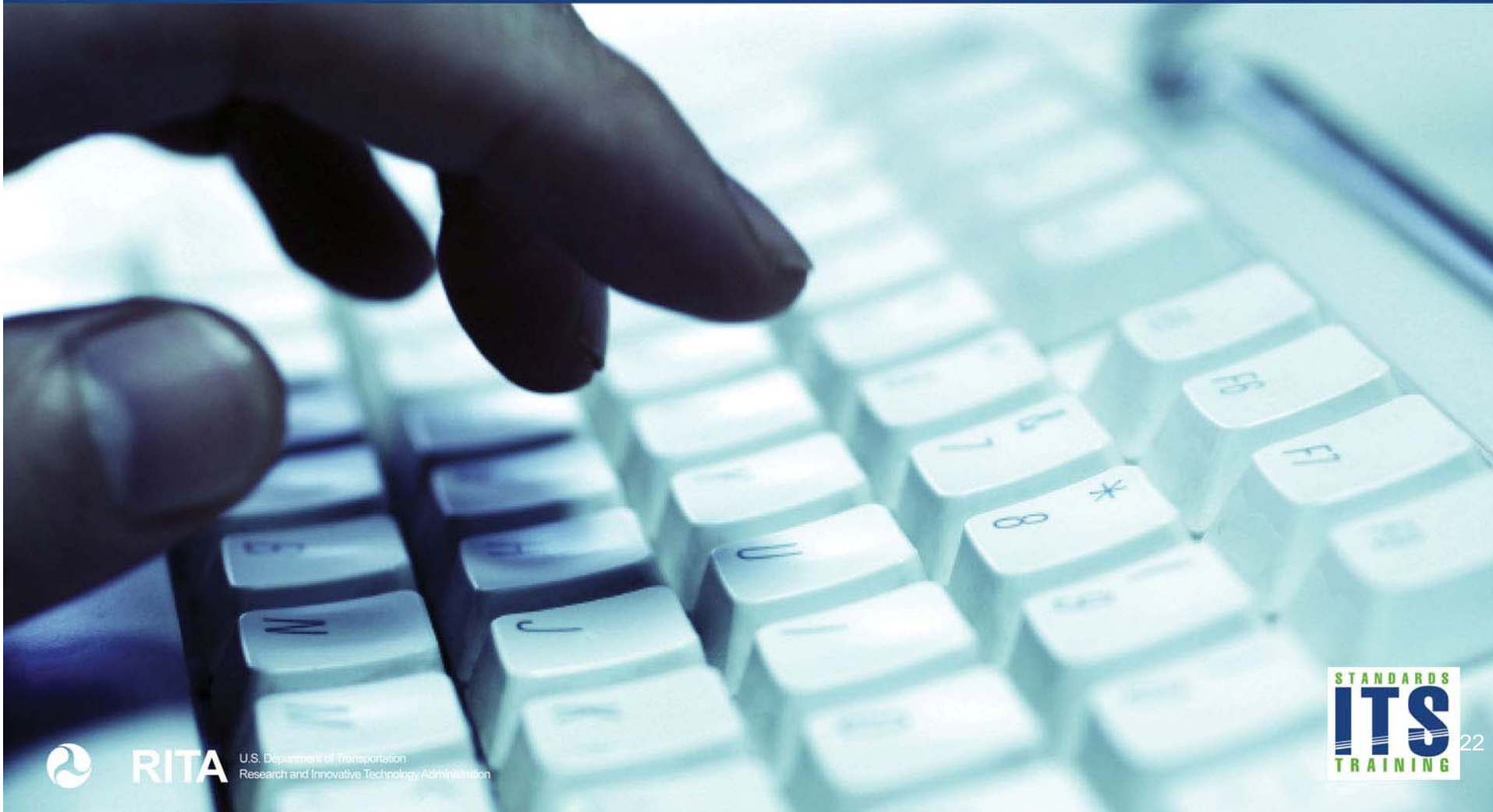
Life Cycle Time Line

Benefits of SEP

- Helps define scope
  - Higher level of stakeholder participation
  - More likely that system meets user expectations
  - Better system documentation
- Reduced risk of cost and schedule overruns
  - Fewer defects in accepted product
  - More predictable outcomes

ACTIVITY

Discuss Roles

- Who are the key players that are involved in a typical systems procurement?

- Use the chat pod to answer

Roles

- Identify key players of the systems engineering process
  - System owner
  - Systems engineering assistant
  - Development team

Interaction Among Team

- Communication is critical
  - All three roles have distinct perspectives and skills
  - Each role provides value to the project
  - Issues should be identified and discussed early

POLLING

Multiple Choice

- Where do the standards fit into the SEP "V" diagram?

  – At the top of the "V"

  – Concept of Operations, System Requirements, and High-Level Design

  – High-Level Design and Detailed Design

  – ITS standards address issues outside of the "V" diagram

ITS Standards and the SEP
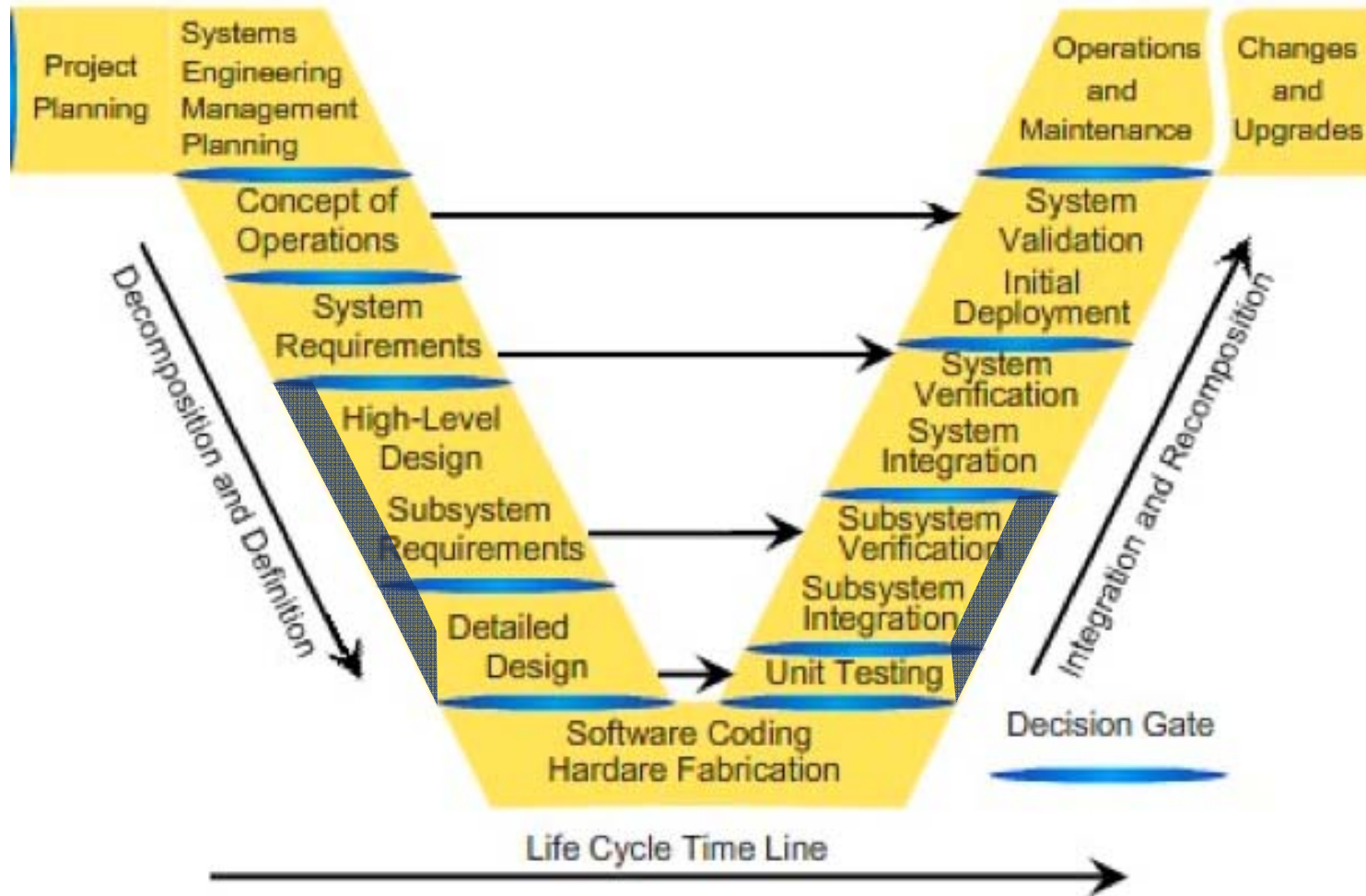
Standards With SEP Content

- Define subsystem user needs
    - E.g., manage fonts for a message sign
- Define subsystem requirements
    - E.g., determine number of fonts
    - Traced to user needs
- Trace each requirement to a single design

Standards Without SEP Content

- Earlier ITS standards only document design
  - Content was derived by perceived needs
  - Context has to be inferred by user
  - Missing components need to be defined by user
    - User needs
    - Requirements
    - Some design details
  - Must map user requirements to remaining details

POLLING

STANDARDS ITS TRAINING

Multiple Choice

- How rigid are subsystem requirements?

- What type of contract do you use to acquire this subsystem?
  - Requirements are known, use fixed price
  - Requirements will be revised, use cost-plus
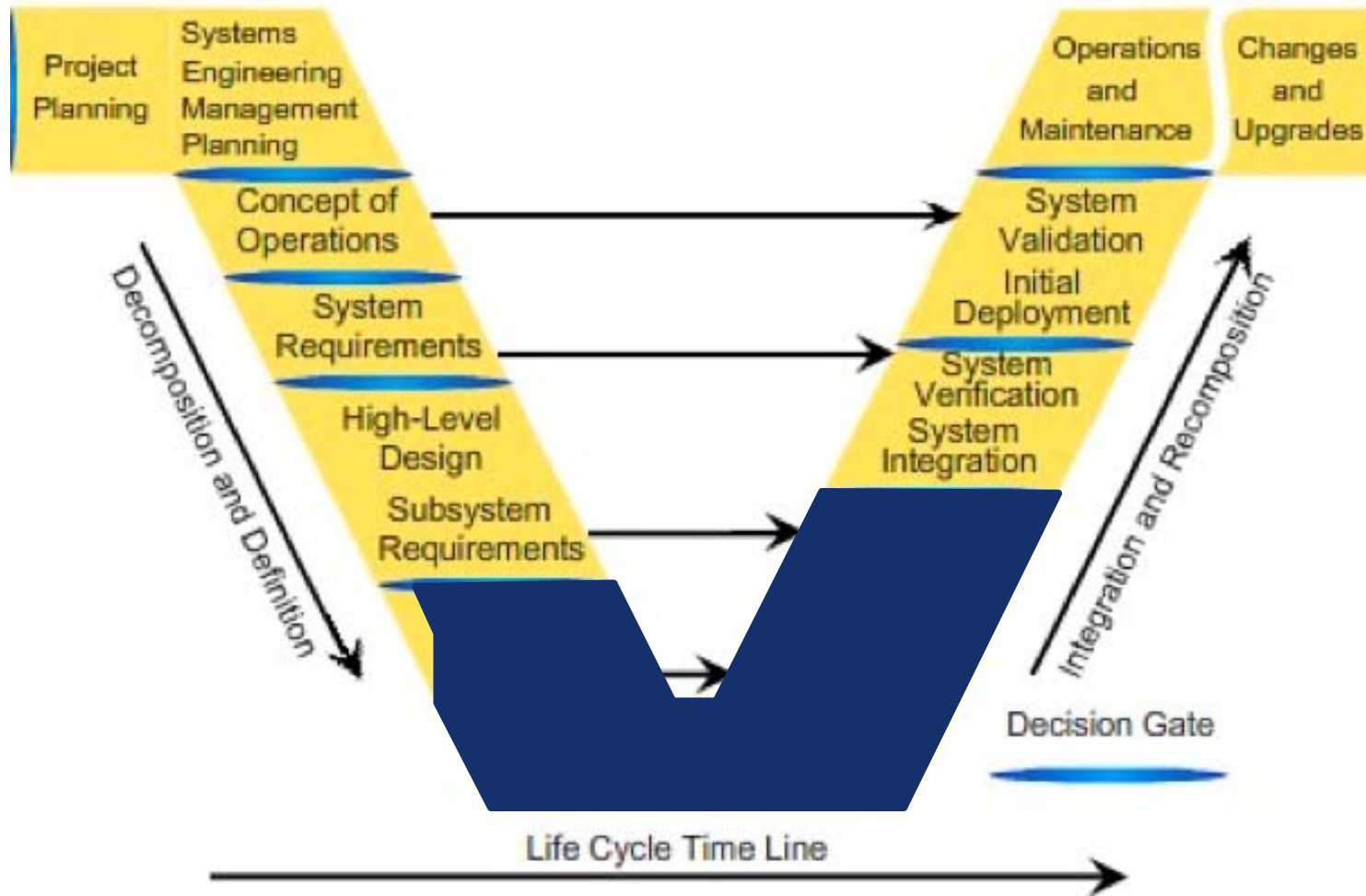 - It depends
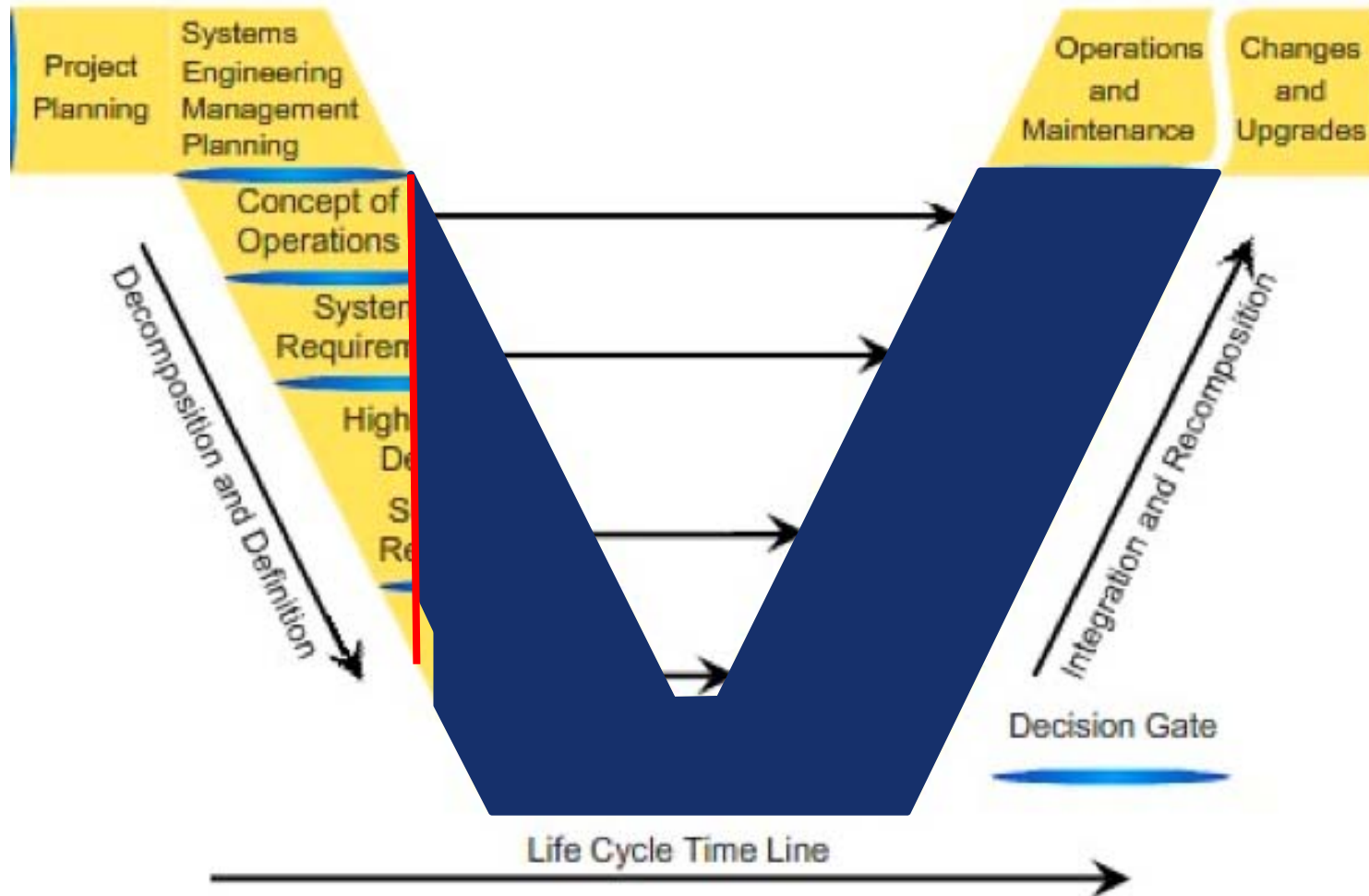
Combining SEP and Procurement

- Devices are largely off-the-shelf
  - Requirements are well-known
- Management systems often require software development
  - Requirements are refined during project life
- Different scope requires
  - different procurement vehicle
  - different interface within the SEP

Typical Scope of Device Vendor

Typical Scope of System Integrator

ITS Standards

- Reduce work
  - Simplifies project specification
  - Allows reuse of design and implementation
  - Facilitates testing
- Reduce risk
- Reduce schedule

Four Procurement Scenarios

- Device procurement
  - Standard with SEP content
  - Standard without SEP content
- Management system procurement
  - Standard with SEP content
  - Standard without SEP content

Preparatory Steps

- Define system concept of operations
  - Inform public about current traffic-related events
- Define system requirements
  - System shall allow the user to define the message to convey to the public, which will automatically expire when the event ends

Preparatory Steps

- Define major subsystems

  – Management system

  – Message signs

- Define communications environment

- Identify services needed from external subsystems

Device: Standard With SEP Content

- Select services from defined user needs
  - Define a message
  - Activate and display a message
- Select subsystem requirements from standard
  - Support multi-page messages
- Mapping to design elements is standardized

Device: Standard Without SEP Content

- Define needed services
- Define subsystem requirements
- Map to standardized design elements
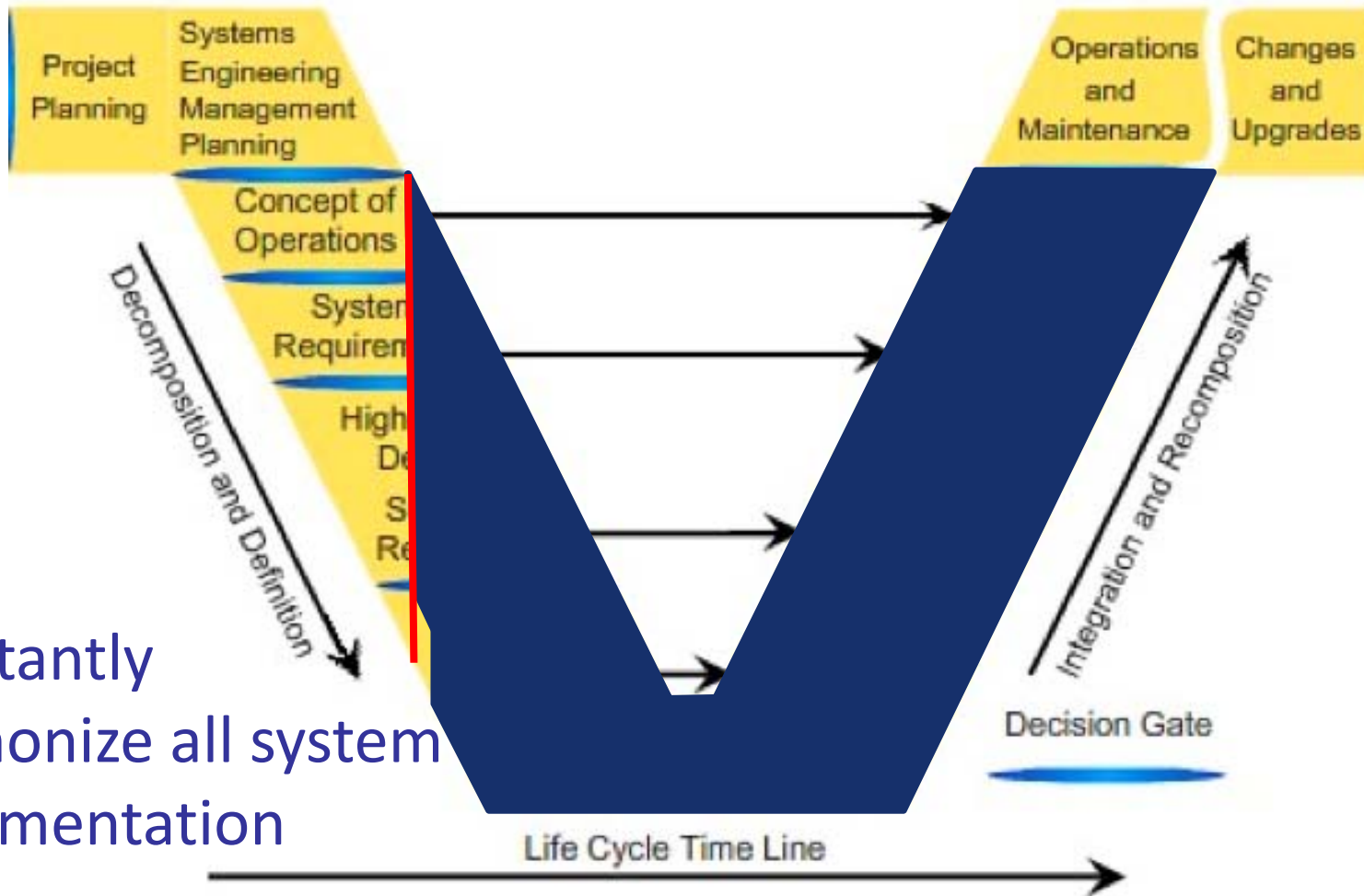 - Define missing design elements (e.g., dialogs)

Management System:
Standard With SEP Content

- Standard with SEP Content
  - Select user needs from standard
  - Select requirements from standard
  - Define scenarios when data exchange is required

When Do We Document Need for Standardized Features?

Constantly harmonize all system documentation

Management System:
Standard Without SEP Content

- Standard Without SEP Content
  - Define detailed requirements for each exchange
  - Map exchanges to design details and enhance
    - Dialog
    - Messages
    - Data Elements
  - Define scenarios when data exchange is required

Management System: Real-World

- Most management systems will control multiple types of devices
  - Some based on standards with SEP content
  - Some based on standards without SEP content
  - Some not based on standards
- All projects should follow SEP
  - The SEP content within standards merely simplify this work

Follow-on Steps

- Select communication stacks and standards
- Define other requirements (e.g., hardware)
- Procure
- Implement
- Test

Testing with SEP

- Standards with SEP Content
  - Standardized test procedures (ESS and soon for DMS)
    - Facilitates testing and testing market
  - Others have reusable test procedures in industry
    - Requirements are standardized and stable
    - Once a test procedure is written for one deployment, it can be reused repeatedly
- Standards without SEP Content
  - Test development effort is more involved since tests must be based on system requirements

Testing the Final Product

- Testing is critical step
  - Verify subsystems meet standardized interface
  - Verify system integrates all components together
  - Validate system meets user needs
- Document all testing
  - Allows reproducible results
  - Documents what was done
- Budget and schedule for multiple rounds
  - Allows for problems identified during initial tests

ACTIVITY
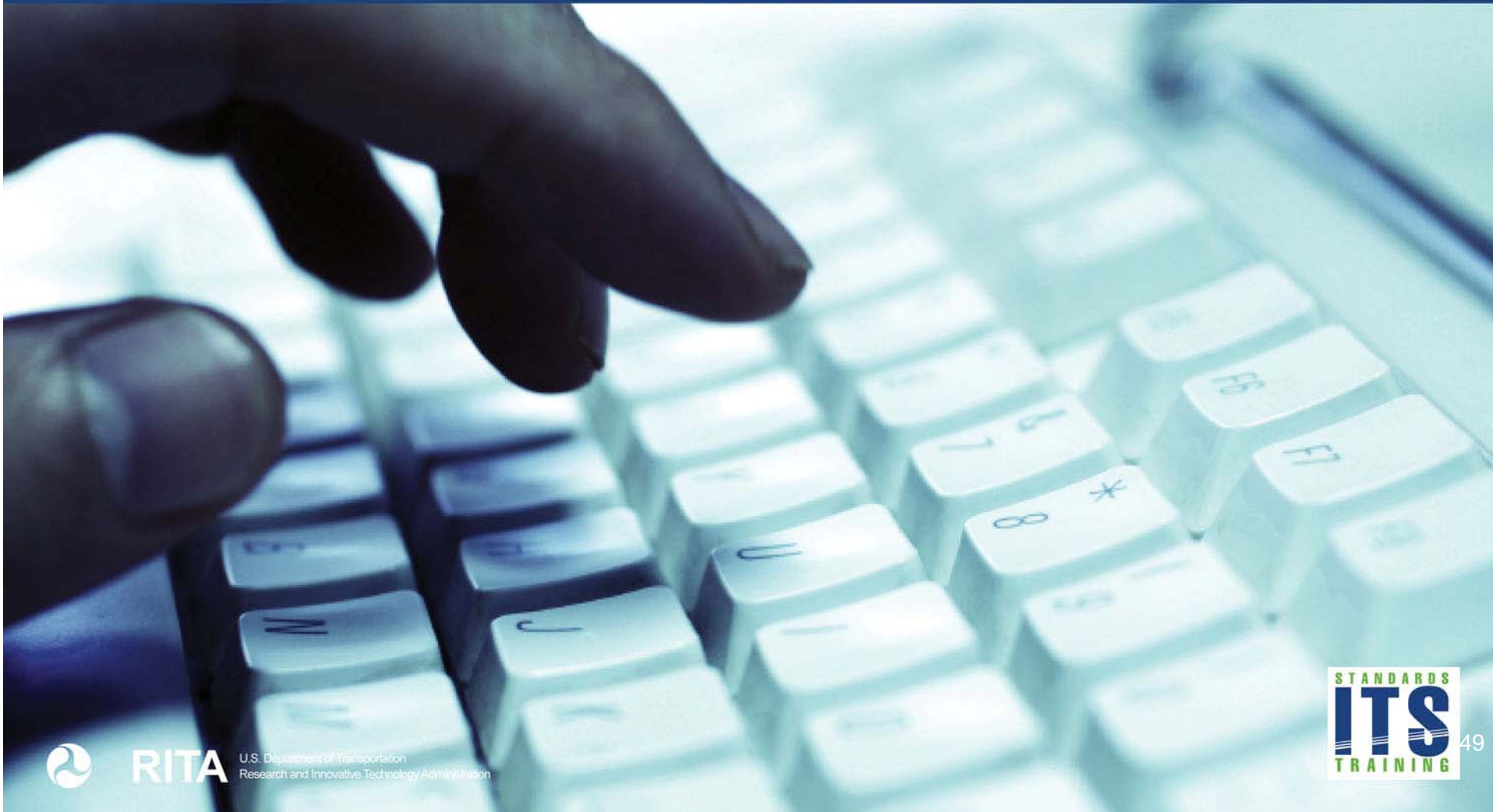
Practical Impacts

- What are your concerns about applying the Systems Engineering Process, as we have described, to acquire standards-based ITS systems?

- Use the chat pod to answer

Practical Impacts

- How large is the resulting specification?
  - Specifications should be as detailed as necessary
- Is a feature important? If yes,
  - Identify in concept of operations
  - Define in requirements
  - Verify in a test procedure
  - Validate that it meets user needs
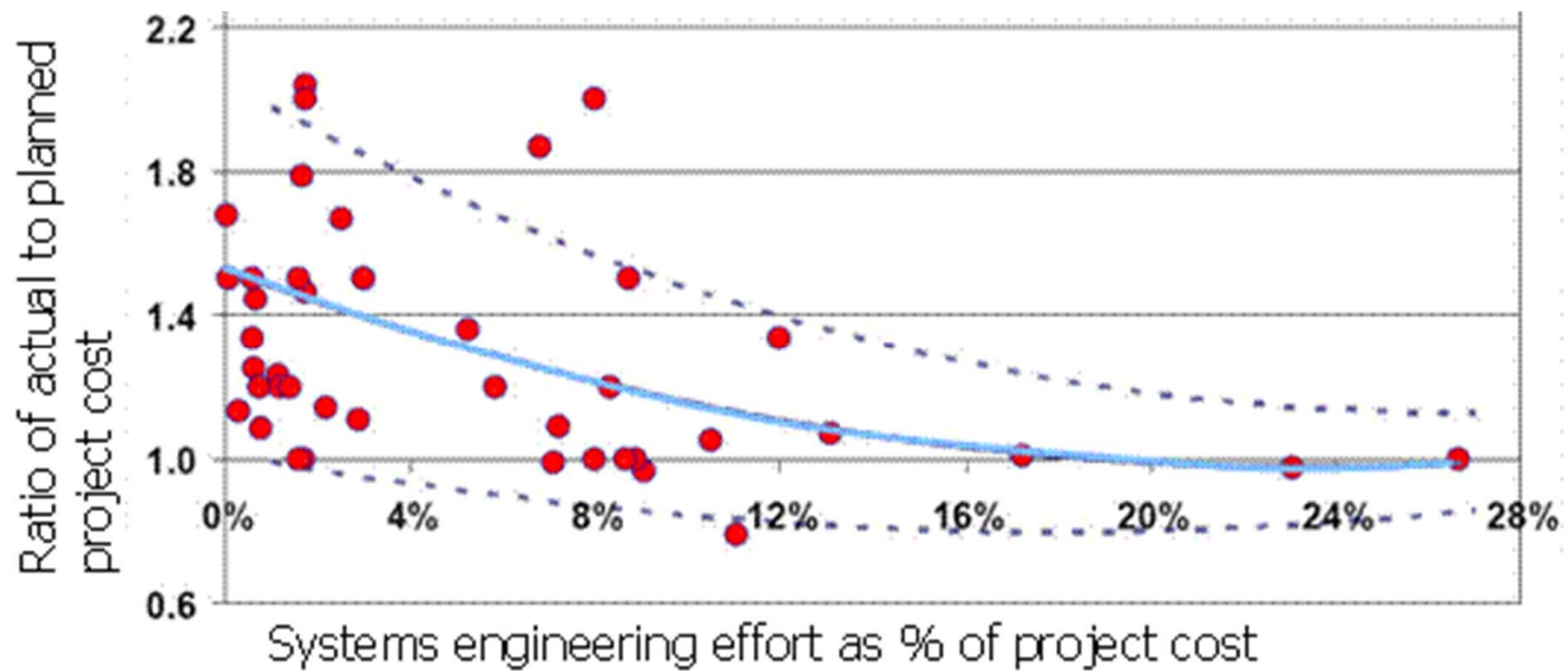 - Budget for the effort

Understanding Cost Implications

- SEP requires
  - Time
  - Experienced personnel
  - Commitment
- Proven to lower risks and increase quality
- Requires investment

Benefits of SEP

Eric Honour, "Understanding the Value of Systems Engineering," 2004.

SEP Benefits vs. Type of Acquisition

- SEP reduces risks
- Even acquiring a DMS entails risks
- Risks are higher for standards without SEP content
- Risks are higher for custom development (e.g., central systems)
- Risks are higher when dealing with multiple standards (e.g., central systems)

Today's Objectives

- Identified key concepts that managers should know
- Described process for acquiring standards compliant ITS systems
- Differentiated between standards with and without SEP

What Did We Learn Today?

1) All projects should follow the __Systems__ __Engineering__ Process.

2) The SEP assists in defining the __Scope__ for a project and in meeting the project __Budget__ and __Schedule__.

3) ITS Standards with SEP content reduce __Systems Engineering__ effort on a project.

4) ITS Standards without SEP content still __Assist__ in projects using the SEP.

5) All requirements should be fully __Tested__ prior to acceptance.

Where to Learn More

- Module supplement
  - NTCIP Guide
  - TMDD Guide
  - IEEE 1512 Guide
  - Systems Engineering Guidebook for ITS
- Other ITS courses
  - A102: Next module for all standard curriculum paths
  - A201: Follows A102 for all paths
  - T101: For more information on testing

QUESTIONS?