Development and Validation of a Systems Engineering Competency Model

Don Gelosh, Ph.D., CSEP-Acq

Senior Systems Engineer

Systems Engineering Support Office

Enterprise Development / Systems and Software Engineering

Office of the Deputy Under Secretary of Defense (A&T)

23 October 2008

Overview

- *Why Competency Management?*
- *Senior Leadership Support*
- *Competency Management Process*
- *Proposed Next Steps*
- *Summary*

Why Competency Management for AT&L and Systems Engineering?

Competencies are observable, measurable patterns of knowledge, skills, abilities, behaviors and other characteristics that an individual needs to perform work roles or occupational functions successfully.

Competency management helps:

- **Assess and refine the requisite competencies within the current workforce**
- **Develop appropriate strategies to shape the skill sets and capabilities needed by the future workforce**
- **Identify overall capabilities we need to execute the acquisition mission**
- **Evaluate which competencies are mission critical and highest priority**
- **Develop solutions that will help us mitigate risk and respond to the challenges**

Competency Model Applications

High(er)-Performing Workforce

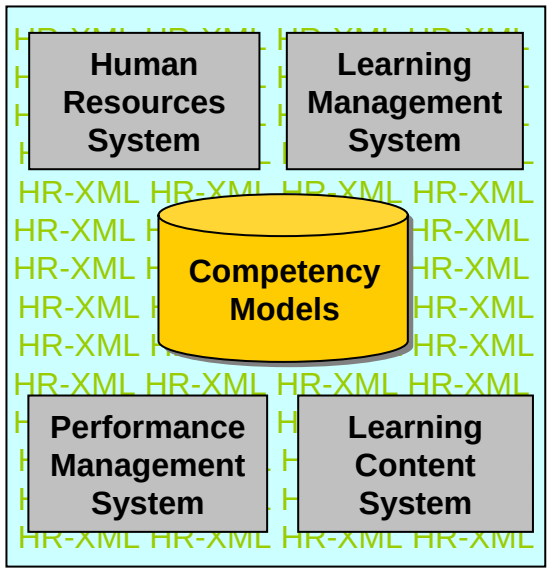
- Improved engagement of workforce to "successful performance" support resources (that make a difference)
- Better migration of Best Practices

Agile Mission Support

- Enables tactical, agile targeting of resources to achieve desired capability
- Enables improved organizational refinements to align the skills with mission needs

Improved Gap Assessment ROI

- Assess proficiency AND
- Assess Mission Criticality, Frequency, and Difficulty
- Migrate best practices & tools for successful performance



Improved Learning/Training

- Improved alignment of training to "successful performance" needs
- Improved training investment
- Enables 21st Century Training Framework (Core Plus)

Strategic Workforce Planning

- Strategic planning enabler for leaders
- Enhanced Management of Mission Critical Competencies
- Deliberate, earlier "change management"
- Information for tactical resource decisions

Succession Planning

- Identify expected critical vacancies
- Identify employees & candidate gaps

Recruiting & Selection

- Improve identification of key behaviors contributing to successful performance
- Improve the "Benefits Package" story – "World-class tools for your development and success"

Development & Career Planning

- Enhance Individual Development
- Enhance Organization Development

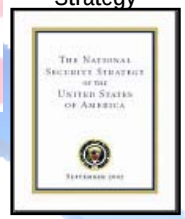
Senior Leadership Support is Critical!!!

Align with Senior Leadership

The President's Management Agenda

- Human Capital
- Competitive sourcing
- Financial management
- Expanded e-Government
- Budget & Performance Integration

National Security Strategy



- Transform our Military Forces
- Implement QDR

Robert Gates - SECDEF

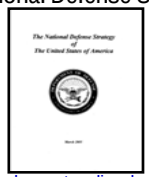
Gordon England – DEPSECDEF

DoD Alignment

"The department must have a vision that conveys to the public a commitment to attract & develop the best mix of people, both military & civilian. This vision must be supported by an effective human capital strategy that is actively measured against well defined goals."

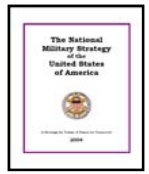
Top 25 DEPSECDEF Priorities

National Defense Strategy



- Changing long standing business processes within the Dept to take advantage of IT
- Foster a culture of innovation
- Divest & invest for the longer term

National Military Strategy



- Continuous Transformation
- Capabilities-based Approach
- Focused Logistics
- Joint Systems
- Network Centric Operations

Quadrennial Defense Review

DoD Civilian Human Capital Strategic Plan

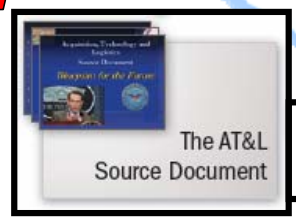
- "Big A" Acquisition
- Governance
- Risk-based Source Selection & Time Certain Acquisition Programs
- Defense Human Capital Strategy
  - Competencies & Performance Criteria

Hon. John J. Young, Jr. USD(AT&L))

AT&L Strategic Thrusts

Hon. James I. Finley DUSD (A&T)

Hon. Jack Bell DUSD (L&MR)



The AT&L Source Document

Strategic Thrust #3
Take Care of Our People

AT&L Workforce Programs & Initiatives

AT&L Competency Management Process

Collect Existing Competency Data

Framework Development

Phase I - Convene an expert panel (EP)

Actions:
- Develop a competency framework & input model
- EP identifies Subject Matter Experts (SMEs)
- EP communicates competency effort to the SMEs
- Develop communications package

Goal:
- Establish baseline of existing competency model.
- Communicate effort

Products:
- FA provides list of targeted high-performing SMEs
- Obtains expert panel concurrence on baseline competency framework
- Obtain approval from Dir, HCI and FA on competency model input

Approved Input Competency Model

Model Development

Phase II – Develop the model

Actions:
- SMEs review the competency framework and provide essential job data through structured interviews and online data collection tools.
- SMEs engaged to identify key "work" situations and competencies contributing to successful performance
- Analyze results and develop competency model content

Goal:
- Model development and identification of key behaviors

Products:
- Deliver Proposed Model Report to Dir, HCI and FA for review

Proposed Competency Model Report

Model Testing & Refinement

Phase III – Perform a beta test & refine model

Actions:
- Collect and synthesize feedback from proposed model report
- Pre-assessment communications to workforce
- Identify stratified workforce sample

Goal:
- Further refine model to include input from functional leads
- Obtain FA and Dir, HCI approval for validation assessment

Products:
- Obtain concurrence from FIPT on competency model
- Obtain approval from Dir, HCI and FA on competency model

Approved Initial Competency Model V 0.5

Competency Validation, Assessment, and Sustainment

Phase IV – Validate and Assess

Actions:
- Launch competency assessment tool
- Analyze results to evaluate model validity and generalizability to the workforce

Goal:
- Identify competencies required for superior performance
- Evaluate proficiency gaps for validated competencies
- Plan for continual updates and use of competency model

Products:
- Deliver proven (validated) competency model in HR XML format
- Provide competency validation and assessment and obtain Dir, HCI and FA approval

V 1.0 Competency Model

Competency Validation & Assessment Report

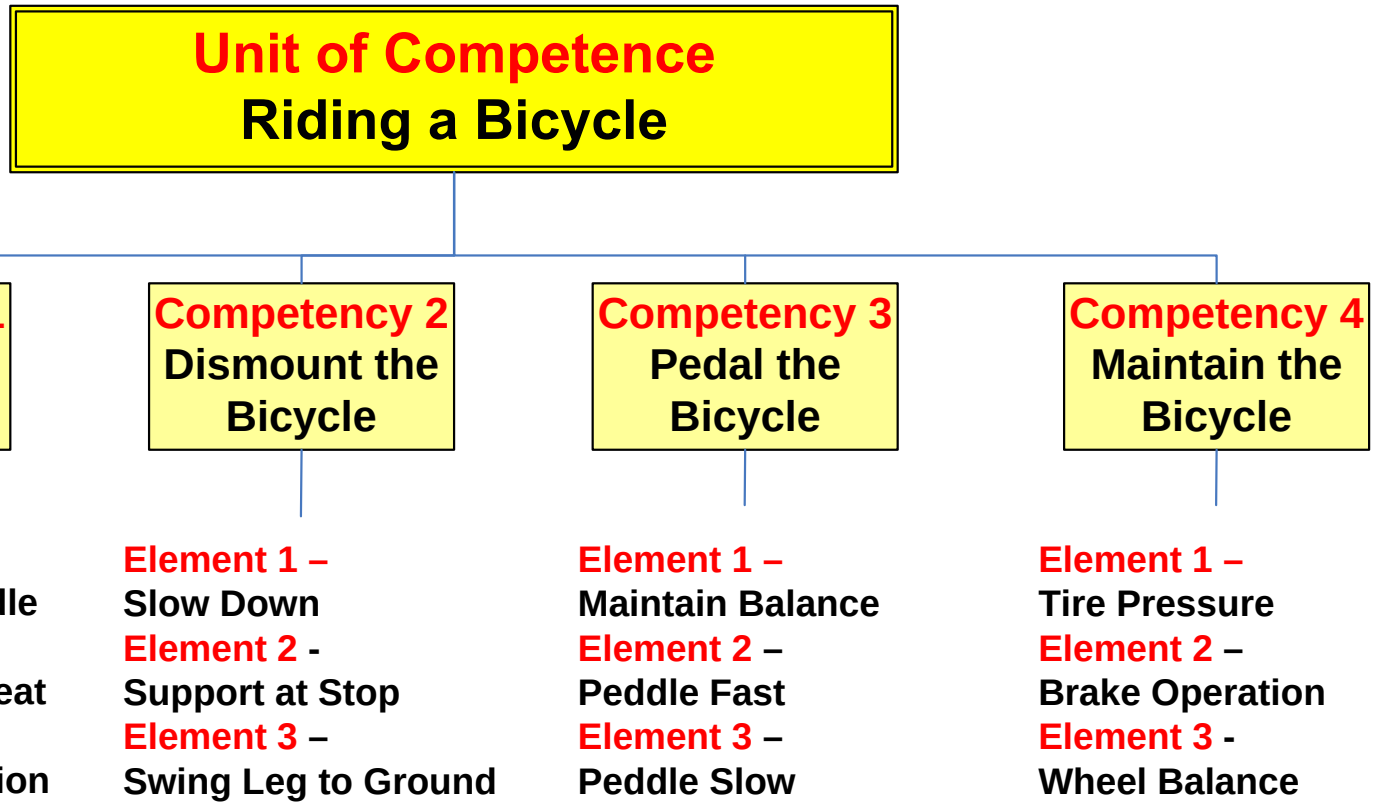
Phase I: Expert Panel and Competency Model Framework Development

AT&L Systems Engineering Learning Outcomes (199)

Professional Competencies

Competency Model Framework (40 Technical 10 Professional)

Competency Model Example



SE Competency Model Framework

Technical Competencies

Analytical
SE Tools & Techniques Design Considerations

1	Technical Basis for Cost
2	Systems Engineering Plans
3	Work Breakdown Structure
4	Value Engineering
5	Technical Performance Measurement
6	Trade Studies
7	Modeling and Simulation
8	Failure, Modes, Effects & Criticality Analysis
9	Requirements Traceability Matrix
10	Safety Analysis
11	SE Design Considerations
12	Requirements Development
13	Logical Analysis
14	Design Solution
15	Implementation
16	Integration
17	Verification
18	Validation
19	Transition
20	System Assurance

Technical Management
Technical Management Processes

21	Decision Analysis
22	Technical Planning
23	Technical Assessment
24	Requirements Management
25	Risk Management
26	Configuration Management
27	Technical Data Management
28	Interface Management
29	Technical Data Packages
30	Specifications
31	Earned Value Management
32	IMP/IMS
33	Technical Reviews
34	Software Engineering
35	Systems Engineering by Phases

General
Total Systems View

36	Acquisition
37	IPPD
38	Leadership
39	International Acquisition
40	Professional Ethics

Professional Competencies

41	Communication
42	Analytical Skills
43	Decision Making
44	Problem Solving
45	Technology Management
46	Team Building
47	Influencing and Negotiating
48	Interpersonal Skills
49	Strategic Thinking
50	Understanding Attributes of Evidence and Rational Decisions

SE Competency Model Examples

Unit of Competence	Competency	Elements	Knowledge Items
#1 Analytical	Technical Basis for Cost	Apply knowledge of cost drivers to develop cost estimates and program budgets that reflect program phase requirements and best practices.	Knowledge of cost drivers and cost estimating techniques and best practices
#1 Analytical	Systems Engineering Plans	Identify the proper points within a program's lifecycle to generate a Systems Engineering Plan (SEP) that describes the program's SE processes, resources, metrics, and technical review process.	Knowledge of SEP preparaton guidance
#1 Analytical	Requirements Development	Apply the Requirements Development process to translate inputs from relevant stakeholders into technical requirements.	Knowledge of requirements management tools
#1 Analytical	Verification	Apply the Verification process to confirm that the system element meets the design specifications as defined in the functional, allocated, and product baselines and to answer the question: 'Did you build it right?'	Knowledge of verification (test and evaluation) techniques
#1 Analytical	Validation	Apply the Validation process to test the performance of systems within their intended operational environment and to answer the question 'Did you build the right thing?'	Knowledge of validation (operational test and evaluation) techniques

Phase II: Subject Matter Expert (SME) Validation

- **SMEs review the competency model framework and provide essential job data through an online data collection tool.**
- **SMEs can add/delete competencies and associated elements and knowledge items.**
- **SMEs must identify at least two key "work" situations and associated competencies that contribute to successful performance.**
- **Results are analyzed and used to develop a complete competency model.**

SME Competency Review

SMEs review each competency element and provide information on:

- **Frequency**
- **Importance**
- **Level First Used**

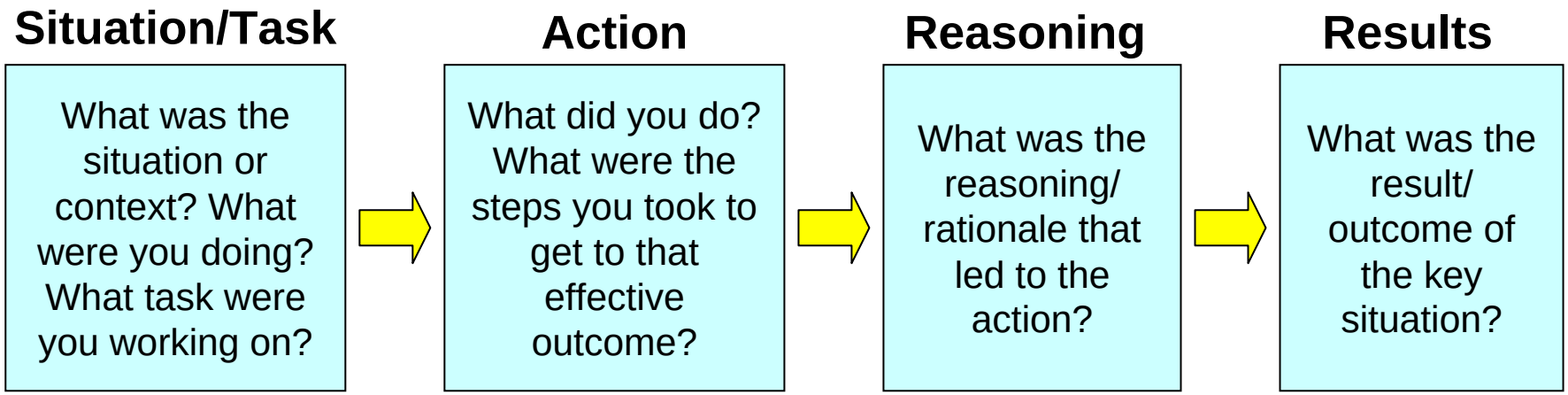
Unit of Competence #1 Analytical

Includes the analytical and technical processes of systems engineering with a full understanding of tools and techniques and all design considerations.

Competency Element	Frequency	Importance	Level First Used
Technical Basis for Cost - Element 1. Apply knowledge of cost drivers to develop cost estimates and program budgets that reflect program phase requirements and best practices.	○ 1 Never ○ 2 Sometimes ○ 3 Often ○ 4 Frequently ○ 5 Very Frequently ○ N/A	○ 1 Not Important ○ 2 Less Important ○ 3 Moderately Important ○ 4 Important ○ 5 Very Important ○ N/A	○ 1 Entry Level ○ 2 Mid-Level ○ 3 Expert/Senior Level ○ N/A
Systems Engineering Plans - Element 1 of 3 - Element 2. Identify the proper points within a program's lifecycle to generate a Systems Engineering Plan (SEP) that describes the program's SE processes, resources, metrics, and technical review process.	○ 1 Never ○ 2 Sometimes ○ 3 Often ○ 4 Frequently ○ 5 Very Frequently ○ N/A	○ 1 Not Important ○ 2 Less Important ○ 3 Moderately Important ○ 4 Important ○ 5 Very Important ○ N/A	○ 1 Entry Level ○ 2 Mid-Level ○ 3 Expert/Senior Level ○ N/A
Systems Engineering Plans - Element 2 of 3 - Element 3. Develop the critical contents of a SEP including government and contractor SE processes, the technical baseline approach, program control tools, and the role of SE to guide all technical aspects of an acquisition program.	○ 1 Never ○ 2 Sometimes ○ 3 Often ○ 4 Frequently ○ 5 Very Frequently ○ N/A	○ 1 Not Important ○ 2 Less Important ○ 3 Moderately Important ○ 4 Important ○ 5 Very Important ○ N/A	○ 1 Entry Level ○ 2 Mid-Level ○ 3 Expert/Senior Level ○ N/A
Systems Engineering Plans - Element 3 of 3 - Element 4. Determine what enterprise, system and software architectures are needed to reason about the system, to inform recommendations and decisions regarding software implementations in the context of the system being acquired and to allow effective communication across the stakeholders throughout the system life cycle.	○ 1 Never ○ 2 Sometimes ○ 3 Often ○ 4 Frequently ○ 5 Very Frequently ○ N/A	○ 1 Not Important ○ 2 Less Important ○ 3 Moderately Important ○ 4 Important ○ 5 Very Important ○ N/A	○ 1 Entry Level ○ 2 Mid-Level ○ 3 Expert/Senior Level ○ N/A
Work Breakdown Structure - Element 5. Translate the system design (including all products and services) into a Work Breakdown Structure (WBS) to ensure that all of the appropriate SE activities are implemented.	○ 1 Never ○ 2 Sometimes ○ 3 Often ○ 4 Frequently ○ 5 Very Frequently	○ 1 Not Important ○ 2 Less Important ○ 3 Moderately Important ○ 4 Important ○ 5 Very Important	○ 1 Entry Level ○ 2 Mid-Level ○ 3 Expert/Senior Level ○ N/A

Key Situation Interviews

- ***Key Situations:*** a method of data collection from subject matter experts regarding **"what it takes"** to perform effectively on your job.
  - Using the STARR Method of Description

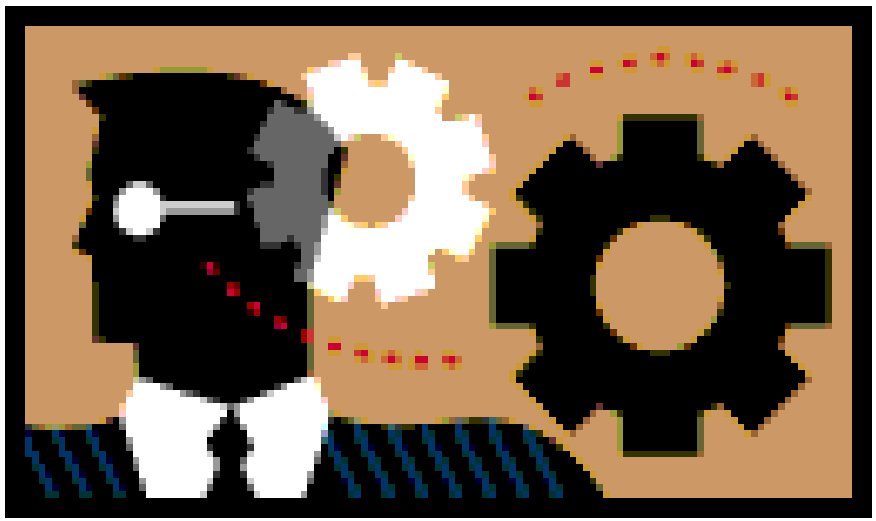


Additional SME Questions

1. Do you identify yourself to others as a systems engineer?
2. Do you have the appropriate resources to do your job?
3. Are you allowed to apply new skills acquired through recent education and training to perform your job?
4. Does your organizational culture encourage the application of new skills?
5. Do you believe additional advanced or senior level training in systems engineering is needed?
6. Have you received training associated with integrating software into warfare related systems?
7. If you answered yes to Question 6, has this training provided you with an adequate understanding of potential issues associated with integrating software into warfare related systems?
8. What do you see as the primary community wide SPRDE workforce capability challenge?

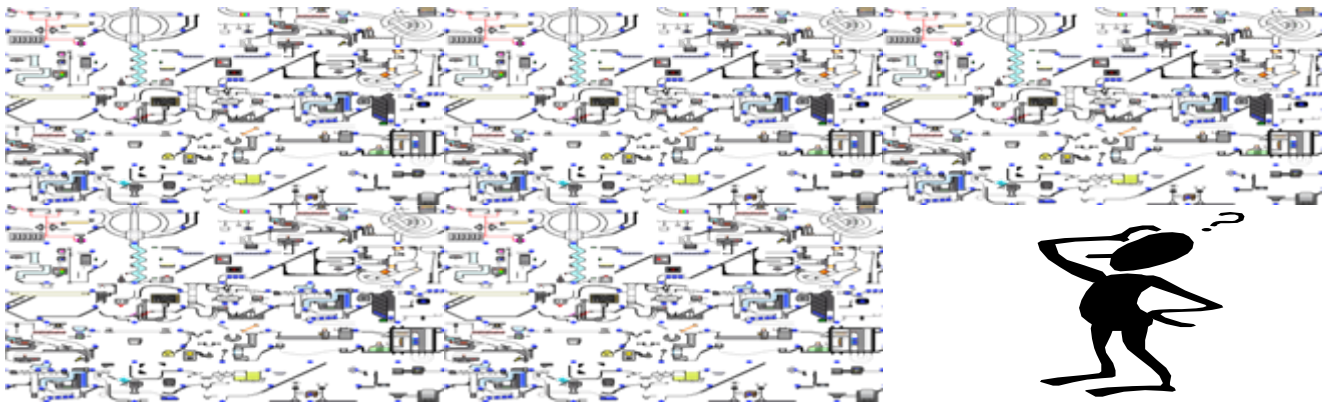
Phase III: Test and Refine the Model

- Collect and synthesize feedback, refine the model.
- Further refine model to include input from Expert Panel and functional leads.
- Send pre-assessment communications to workforce.
- Identify stratified workforce sample.



Phase IV: Workforce Assessment

- Launch competency assessment tool.
- Analyze results to evaluate model validity and general applicability to the workforce.
- Identify competencies required for superior performance.
- Evaluate proficiency gaps for validated competencies.
- Plan for continual updates and use of competency model.



Proposed Next Steps

Improve the Competency Model:

- Compare and contrast with other competency models – leverage best of the best
- Incorporate results from SE education and research efforts
- Develop a sub-set of "Core SE Competencies" that define the true Systems Engineers

Apply the Competency Model:

- Use the Core Competency sub-set to help identify the true SEs in the SPRDE career field
- Use the model to develop criteria for hiring Entry-level, Journeyman-level, and Highly Qualified Experts
- Use the model to drive SE education, training, and experience opportunities – a guide to where you should apply resources

Summary

To successfully develop and implement a competency management program, you should:

1. **Develop a competency management plan.**
2. **Solicit and obtain senior leadership support.**
3. **Develop a competency assessment model framework.**
4. **Validate the model with high-performing subject matter experts.**
5. **Test and refine the model with input from the functional leaders.**
6. **Assess the target workforce against the competency model to identify competencies required for superior performance and to evaluate proficiency gaps.**
7. **Update the plan and apply the competency model as needed.**
8. **Provide reports.**

Questions?

Don Gelosh, Ph.D., CSEP-Acq
Senior Systems Engineer
OSD (AT&L) SSE/ED

1851 SOUTH BELL STREET
CRYSTAL MALL 3 SUITE 102
ARLINGTON, VA 22202

OFFICE: 703-602-0851 EXT 194
FAX: 703-602-3560

Backup Slides

INCOSE UK Advisory Board
Systems Engineering Competencies Framework

Systems Thinking
- Systems concepts
- Super-system capability issues
- Enterprise and technology environment

Systems Engineering Management
- Concurrent engineering
- Enterprise Integration
- Integration of specialisms
- Lifecycle process definition
- Planning, monitoring and controlling

Holistic Lifecycle view
- Determine and manage stakeholder requirements
- *System Design:*
  - Architectural design
  - Concept generation
  - Design for …
  - Functional analysis
  - Interface Management
  - Maintaining Design Integrity
  - Modeling and Simulation
  - Select Preferred Solution
  - System Robustness
- Integration & Verification
- Validation
- Transition to Operation

INCOSE Systems Engineering Handbook v. 3.1, August 2007

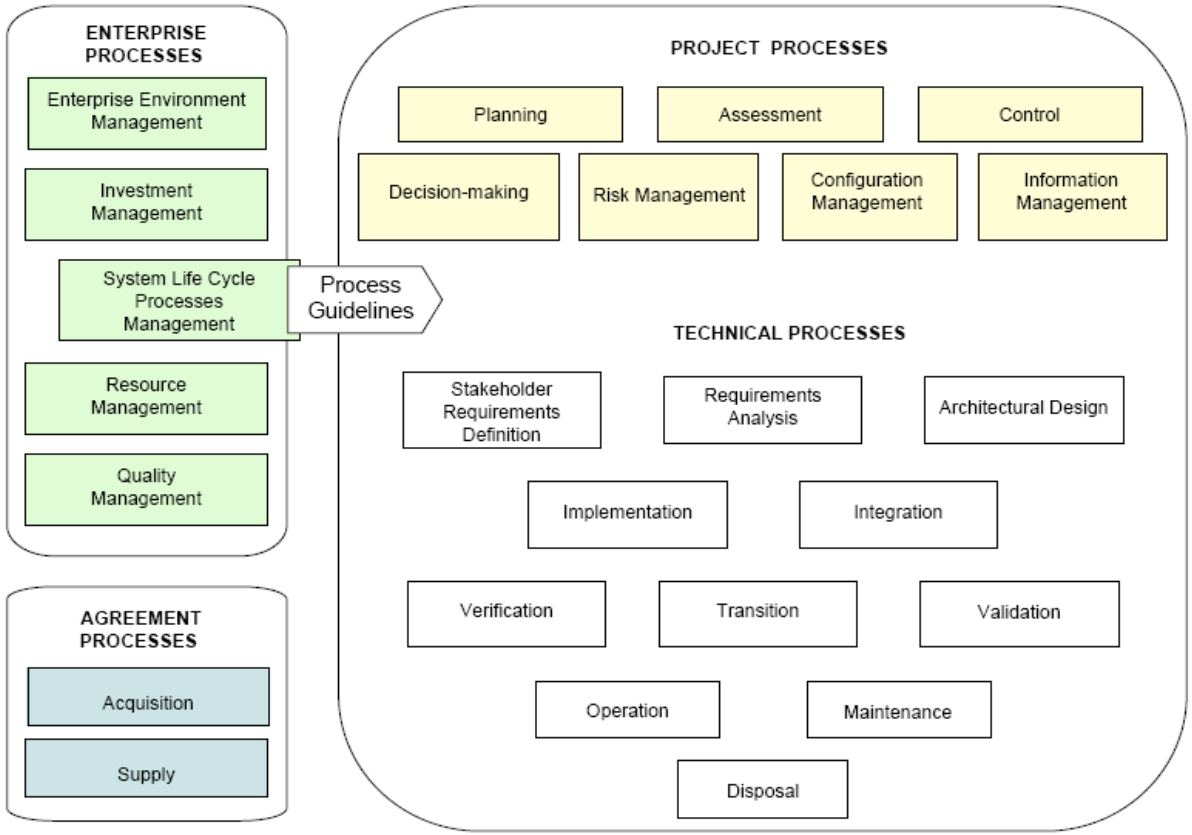


Figure 1-1 System Life Cycle Processes Overview per ISO/IEC 15288