



26th annual **INCOSE**
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The U.S. Department of the Navy's Systems Engineering Career Competency Model: Identification of Proficiency Levels and Career Path Modeling

Presented by Dr. Cliff Whitcomb
Naval Postgraduate School, Monterey, California
USA

Research and Working Group Team Members: Rabia Khan, Corina White (Naval Postgraduate School); Dr. Dana Grambow (U.S. Office of Personnel Management); Jessica Delgado (Deputy Assistant Secretary of the US Navy)

Overview

- Brief introduction to the Systems Engineering Career Competency Model (SECCM)
 - Project Scope, methodology and approach
- Competency Model Verification process
- SECCM Development Methodology and Structure
- Occupational Analysis Methodology
- Proficiency Level Development
- Career Development
- Summary of Results and Implications of Research



Problem Statement

- Recent studies into career development models have led to the general finding that contemporary firms are searching for well-rounded individuals, who possess both technical and non-technical skills (Joshi et al. 2010).
- Scholarly studies examining hiring practice trends through content analysis of job advertisements and job types, have observed that stakeholders prefer to employ well-rounded employees with business knowledge, interpersonal skills and technical skills (Joshi et al. 2010).
- Research also cites the notion that while skills can be taught and learned, skilled workers continue to be in short supply (Moore and Rudd 2005)



Introduction - Gap Analysis

- The Naval Postgraduate School (NPS) has identified systems engineering as an area requiring a career development model, to ensure employees performing systems engineering tasks, particularly within the US Department of the Navy (DON), are proficient in the competencies required for success.
- NPS', the US Office of Personnel Management's and the US Navy's research highlights the application of competency modeling for ***establishing career paths*** and for ***determining appropriate proficiency levels required to complete job related SE tasks.***



What is a Competency?

An observable, measurable pattern of knowledge, skills and abilities (KSAs), and other characteristics, that an individual needs to perform work roles or occupational functions successfully (OPM).

Individuals



What is Competency Modeling?

The activity of determining the specific competencies that are characteristic of high performance and success in a given job (LaRocca) - a key tool for ensuring a capable staff.



Project Scope

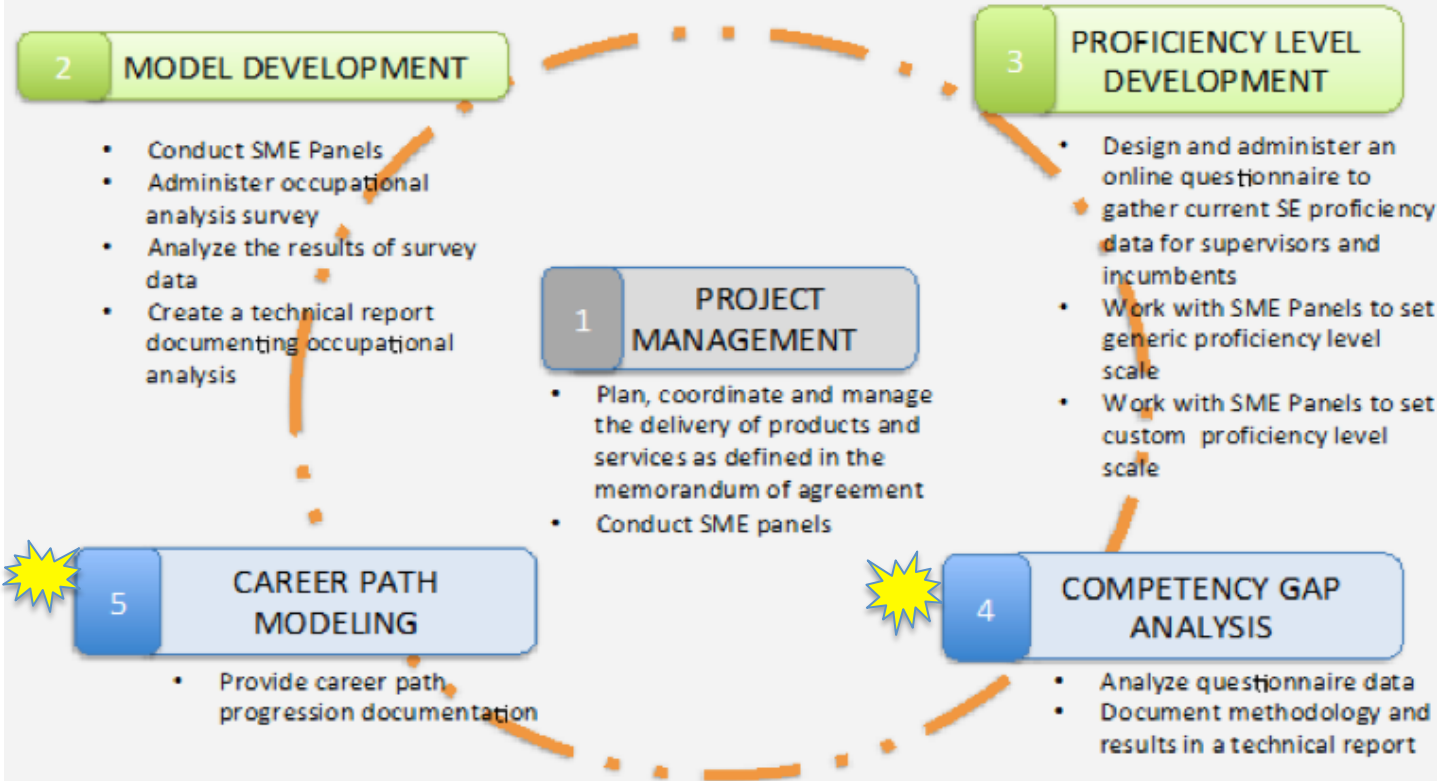
- In an effort to cover the scope of the overall SECCM project, it was broken down into 3 phases:

1. Development of the competency model

2. Competency assessment via an occupational analysis (reference White et al., 2016)

3. Competency Gap Analysis and Career Path Modeling

SECCM Project Scope



Focus:
**Competency
Gap Analysis
and Career
Path Modeling
(Steps 4 and 5)**

Competency Model Verification – Why?

There is no systems engineering competency model verified IAW
Uniform Guidelines on Employee Selection Procedures.

Only a **model** that is verified with the Uniform Guidelines can be
used with confidence **for human resource functions**.

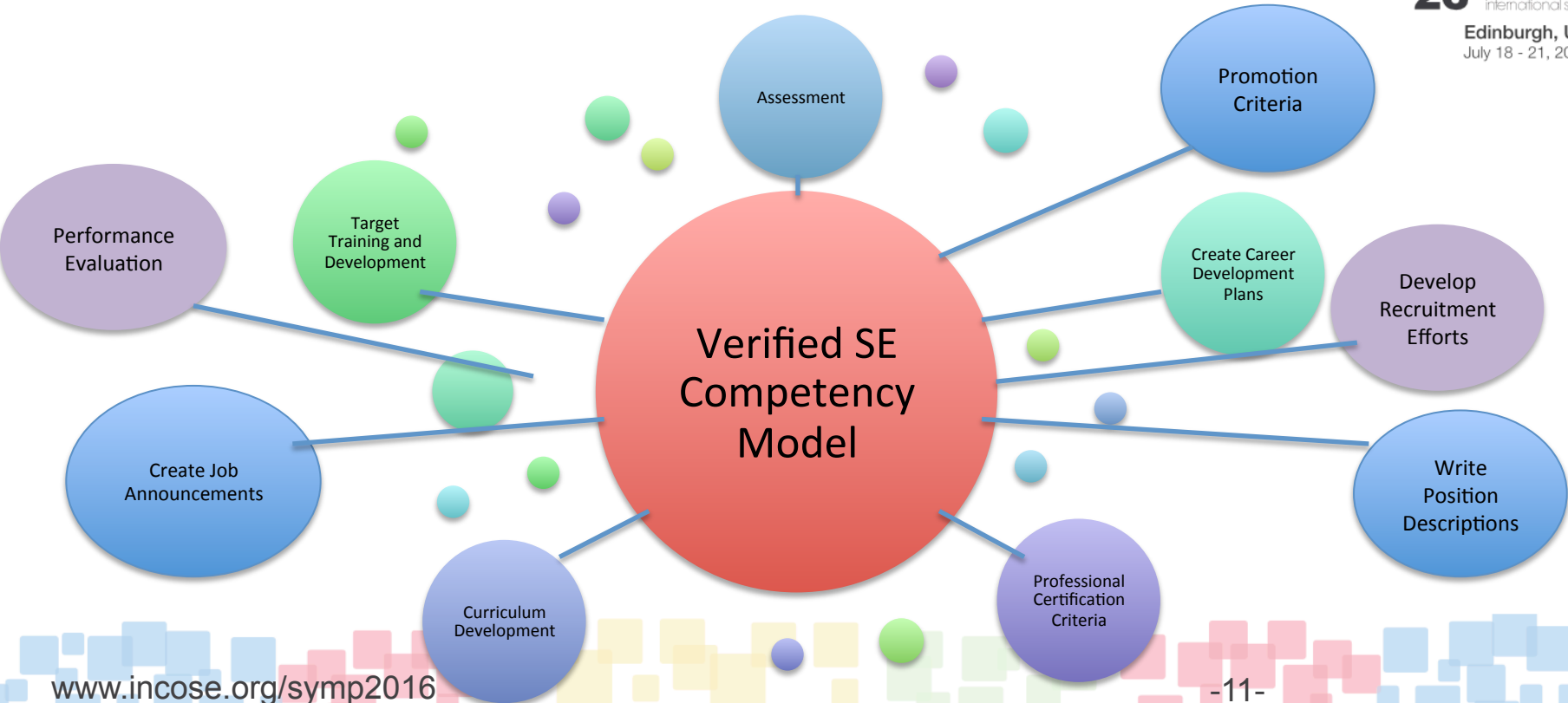


Competency Model Verification

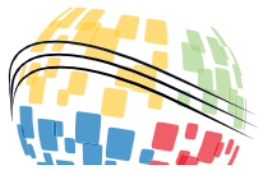


- The ***Uniform Guidelines*** are federal regulations designed to assist employers, labor organizations, employment agencies and licensing/certification boards in complying with requirements that prohibit discriminatory employment practices.
 - Designed to provide a framework for determining the proper use of tests and other selection procedures in employment practices
- Due to the importance of having a model verified for HR functions, NPS engaged in a model verification process with the U.S. Office of Personnel Management (OPM) in an effort to make a model that is useful for all of the US Department of Defense and related defense organizations.

Applications of a Verified Competency Model (Following Uniform Guideline Procedures)

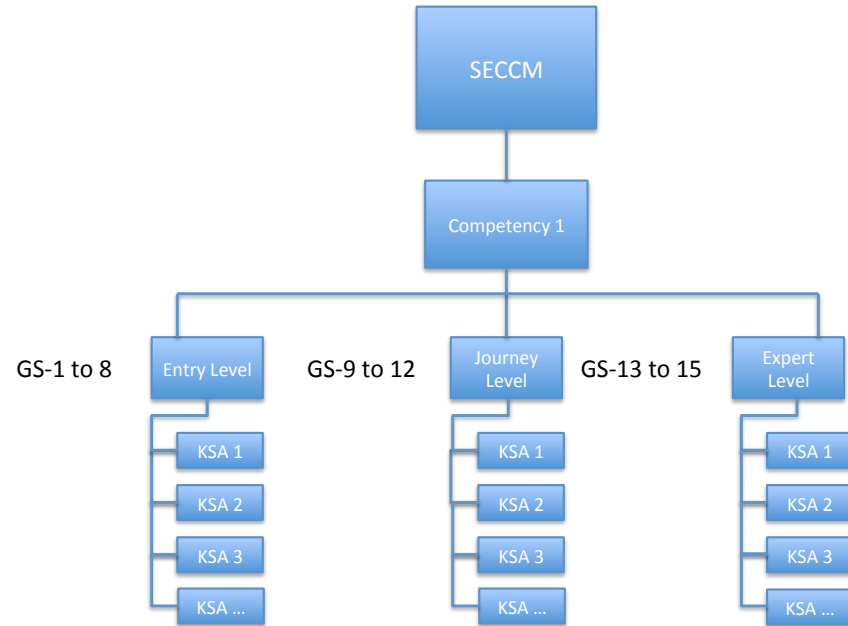


SECCM - Structure



- The SECCM competencies are categorized across 41 technical, technical management and professional competencies.
- The KSAs in each competency are divided into one of three notional career levels, designated as *Entry Level*, *Journey Level* or *Expert Level*

SECCM Structure



SECCM Proficiency Level Structure for Career Development

SECCM – Bloom's Taxonomic Approach

The SECCM categorizes KSAs using Bloom's taxonomic classification schema: Cognitive and Affective learning processes



Cognitive and affective processes within Bloom's taxonomy refer to levels of observable actions that indicate learning is occurring



If a KSA and its cognitive/affective level can be identified, it can be reasonably assumed that learning is occurring and as such, the amount and depth of learning can be assessed and measured

(Khan 2014)

SECCM – Using Bloom's Taxonomy



- Categorizing the KSAs using Bloom's taxonomic classification schema allowed the NPS research team to highlight the cognitive and affective learning levels needed for achievement of the competencies requisite of proficient systems engineers.
- A benefit in using Bloom's taxonomic classification schema was that the KSAs would be stated such that their achievement by systems engineers could be assessed using typical methods, already widely employed by educational organizations.
- Bloom's taxonomy also allowed the NPS team to map the competencies into proficiency levels, in an effort to create a foundation for a SE career development path within the Department of the Navy.

Verification of SECCM (Following OPM Guidelines)

Verification of SE Competency Model with OPM

Step 1:
Conduct SME Panels

- Use existing information to develop competency descriptions and list of tasks
- Conduct SME panels to refine the task and competency lists

Step 2:
Administer Occupational
Analysis Survey

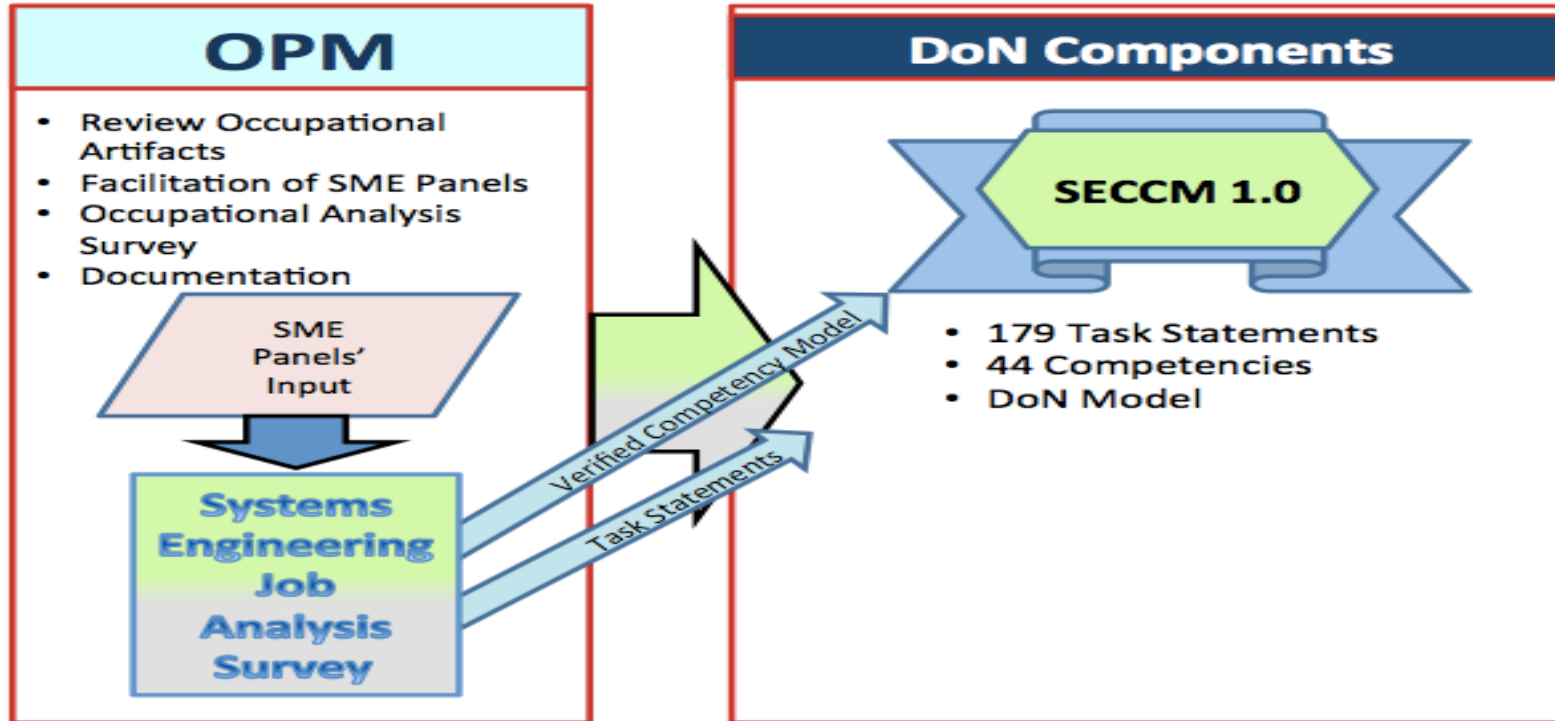
- Assess competency importance along with frequency and importance of tasks
- Analyze results to identify critical tasks and competencies

OPM Occupational Analysis Methodology-Survey



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US Department of the Navy's Survey Analysis: Critical Tasks



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Examples

No.	Task	GS-7	GS-9	GS-11	GS-12	GS-13	GS-14	GS-15
		Critical	Critical	Critical	Critical	Critical	Critical	Critical
127	Contributes to the strategic planning process by providing input on the feasibility of organizational goals.				√	√	√	√
128	Converts organization-wide strategies and policy direction into action items.				√	√	√	√
129	Complies with governing ethics and standards of conduct in engineering and business practices to ensure integrity across the acquisition life-cycle.	√	√	√	√	√	√	√
130	Demonstrates ethical practices by showing consistency among principles, practices, and behaviors.	√	√	√	√	√	√	√
131	Maintains the confidentiality of information.	√	√	√	√	√	√	√



Grade Level	Critical Tasks
GS-07	18
GS-09	19
GS-11	76
GS-12	165
GS-13	174
GS-14	175
GS-15	176

Career Development – Competency Gap Analysis



- A competency gap analysis includes establishing required proficiency levels, and determining employees' current proficiency levels.
- A gap exists when an employee's current proficiency level is below the required proficiency level.
- OPM conducted competency gap analyses for the DON systems engineering professionals

Career Development – Competency Gap Analysis



- OPM designed and administered an online questionnaire to gather current proficiency data
 - Two separate questionnaires were developed, one for supervisors and one for incumbents (employees)
 - Supervisors provided ratings of employees' required and current levels of proficiency for each competency
 - Employees provided ratings of their own proficiency
 - Respondents used generic benchmarks that have been used in competency gap analyses with other federal agencies



Example
of Survey
Questions

OPM Occupational Analysis Survey

EXAMPLE TASKS	IMPORTANCE RATING						
	GS-7	GS-9	GS-11	GS-12	GS-13	GS-14	GS-15
1 Contacts others orally to obtain information.	① 1 2 ● 4 5	① 1 2 ● 4 5	① 1 2 ● 4 5	① 1 2 ● 4 5	① 1 2 3 ● 5	① 1 2 3 ● 5	① 1 2 3 ● 5
2 Reads charts, graphs, diagrams, or tables.	① 1 2 ● 4 5	① 1 2 ● 4 5	① 1 2 ● 4 5	① 1 2 ● 4 5	① 1 2 ● 4 5	① 1 2 3 ● 5	① 1 2 3 ● 5

For the first task statement, Contacts others orally to obtain information, the supervisor indicated that the task was “Important” for GS-7, GS-9, GS-11, and GS-12 employees by selecting the option corresponding to 3 and “Very important” for GS-13, GS-14, and GS-15 employees by selecting the option corresponding to 4. For the second task statement, Reads charts, graphs, diagrams, or tables, the supervisor indicated that the task was Important for GS-7, GS-9, GS-11, GS-12, and GS-13 employees, and “Very important” for GS-14 and GS-15 employees.

Please rate all of the tasks listed, beginning on the next page, using the Importance scale.



Total Surveys Administered to US Department of the Navy	Incumbents		Supervisors	
	N	%	N	%
	3,995	100	645	100
Usable Responses	697	17.45	26	4.03

Career Path Modeling

- Career paths are established to guide employees, their supervisors, and the organization as a whole for employee development purposes
 - Example: career path models serve as a resource to employees seeking to further develop their professional skills and introduce employees to opportunities they may otherwise not know exist.
- OPM facilitated eight four-hour meetings with a focus group consisting of employee and supervisor SMEs to define career paths for Navy employees
- Paths inform employees of career progression options outlining a career lattice while identifying available enrichment activities, such as developmental assignments and training that are appropriate for employees at each level of the career path




US Department of the Navy's Survey Analysis: Critical Competencies/Results



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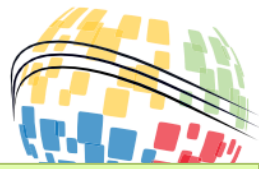
Grade Level	Critical Competencies
GS-07	2
GS-09	7
GS-11	6
GS-12	16
GS-13	36
GS-14	40
GS-15	43



Systems Engineering Competencies



SECCM 1.0



Technical Management

- Acquisition
- Risk Management
- Requirements Management
- Configuration Management
- Technical Assessment
- Data Management
- Software Engineering Management
- Decision Analysis
- Interface Management
- Technical Planning

Business Acumen

- Industry Awareness
- Organization
- Cost Estimating
- Proposal Process
- Supplier Management
- Negotiations
- Requirements Analysis
- Cost, Pricing and Rates/ Cost Management
- Financial Reporting and Metrics
- Business Strategy
- Industry Motivation, Incentives, Rewards

Analytical

- Transition
- Integration
- Design Considerations
- Tools and Techniques
- Stakeholders Requirements Definition
- Validation
- Verification
- Mission-Level Assessment
- Architecture Design
- Implementation

Professional

- Communication
- Leading High Performance Teams
- Personal Effectiveness/ Peer Interaction
- Problem Solving
- Professional Ethics
- Strategic Thinking
- Coaching & Mentoring
- Managing Stakeholders
- Mission and Results Focus
- Sound Judgment
- Continual Learning

Developing Supplemental Resources



SECCM User Guide



SECCM 1.0 Database

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Competency Number	Competency	ID	KSAs	Category	Cognitive Level	Affective Level
31.0	ROUND JUDGMENT	SECCM0001	Accept accountability for decisions	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0002	Accept responsibility for decisions	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0003	Accept responsibility for outcomes (positive or negative) of one's work	Professional	Value	Value
22.0	PROBLEM SOLVING	SECCM0004	Accept for change/innovation	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0005	Advocate problem resolution between differing parties including influential	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0006	Advocate responsible understanding and agreement about systems risk	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0007	Advocate responsible understanding and agreement about systems risk	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0008	Acknowledge others' contributions	Professional	Value	Value
22.0	PROBLEM SOLVING	SECCM0009	Acknowledge what is achieved and seek greater understanding from it	Professional	Value	Value
22.0	PROBLEM SOLVING	SECCM0010	Act as a consultant on business organization	Professional	Value	Value
22.0	PROBLEM SOLVING	SECCM0011	Act as an arbiter in change cases	Professional	Value	Value
22.0	PROBLEM SOLVING	SECCM0012	Act as an arbiter in change cases	Professional	Value	Value
7.0	VERIFICATION	SECCM0013	Act as an authority in the development of systems integration and verification strategies	Professional	Value	Value
8.0	VALIDATION	SECCM0014	Act as an authority in the development of validation strategies	Professional	Value	Value
25.0	LEADING HIGH-PERFORMANCE TEAM	SECCM0015	Act as an arbiter on InCose definitions and the implication of the organizational or employee problems	Professional	Value	Value
25.0	LEADING HIGH-PERFORMANCE TEAM	SECCM0016	Act as troubleshooter by discovering and eliminating causes of organizational or employee problems	Professional	Value	Value
24.0	PROFESSIONAL ETHICS	SECCM0017	Act consistently in a manner that conveys organizational, social, and moral values of the highest standard	Professional	Value	Value
28.0	COMMUNICATION	SECCM0018	Adapt communication methods and style based on the players involved	Professional	Value	Value
28.0	COMMUNICATION	SECCM0019	Adapt communication methods and style based on the players involved	Professional	Value	Value
22.0	PROBLEM SOLVING	SECCM0020	Adapt spatial and temporal boundaries as new information is discovered	Professional	Value	Value
22.0	PROBLEM SOLVING	SECCM0021	Adapt spatial and temporal boundaries as new information is discovered	Professional	Value	Value
22.0	PROBLEM SOLVING	SECCM0022	Adapt what is achieved and seek greater understanding from it	Professional	Value	Value
3.0	REQUIREMENTS ANALYSIS	SECCM0023	Address unarticulated requirements tacitly, including unrelated items	Business Acumen	Value	Value
24.0	PROFESSIONAL ETHICS	SECCM0024	Adhere to the team's expectations and guidelines	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0025	Adjust behavior	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0026	Adjust behavior to respect observed differences in others	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0027	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0028	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0029	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0030	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0031	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0032	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0033	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0034	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0035	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0036	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0037	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0038	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0039	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0040	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0041	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0042	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0043	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0044	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0045	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0046	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0047	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0048	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0049	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0050	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0051	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0052	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0053	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0054	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0055	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0056	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0057	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0058	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0059	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0060	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0061	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0062	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0063	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0064	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0065	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0066	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0067	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0068	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0069	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0070	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0071	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0072	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0073	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0074	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0075	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0076	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0077	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0078	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0079	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0080	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0081	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0082	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0083	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0084	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0085	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0086	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0087	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0088	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0089	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0090	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0091	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0092	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0093	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0094	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0095	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0096	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0097	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0098	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0099	Adjust message to the audience	Professional	Value	Value
30.0	PERSONAL EFFECTIVENESS/PEER	SECCM0100	Adjust message to the audience	Professional	Value	Value

Describes how to use the information for

- Job announcements
- **Position descriptions**
- Skill gap analyses
- Career development plans
- Career path models

Provides access to the following

- 44 competencies & 3,272 KSAs
- Overview of critical tasks
- Overview of critical competencies
- Critical tasks & critical competencies per GS-Level

Example: SECCM 1.0 Impact on Position Descriptions

Existing SE Position Descriptions could only “**Desire**” SE Competencies, Tasks, and KSA



- SECCM 1.0 can now be used as a resource to
 - “**Require**” SE Critical Competencies and Tasks for a position
 - Identify Critical Competencies and Tasks by GS level

*It is “**highly desired**” that the employee have the ability to...*

*The employee “**shall**” have the ability to...*

Questions?

Clifford Whitcomb, PhD
Naval Postgraduate School
Professor, Department of Systems Engineering
cawhitco@nps.edu

Rabia Khan
Naval Postgraduate School
Research Associate, Dept. of SE
rhkhan@nps.edu

Corina White
Naval Postgraduate School
Research Associate, Dept. of SE
white_corina@yahoo.com

Jessica Delgado
Naval Surface Warfare Center
Dahlgren Division
Jessica.delgado@navy.mil

Dana Grambow, PhD
Office of Personnel Management
Personnel Research Psychologist
Dana.grambow@opm.gov

