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A Description of the Defense Systems Engineering Career Competency Model

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Abstract

A defense-level systems engineering competency model for use in key human resource functions, such as hiring, promoting, and administering skill(s) gap assessments, and for career path modeling and development planning, has been verified for use by the DoD. The model was verified based on analysis of a survey administered by the U.S. Office of Personnel Management of 6,011 incumbents (or employees) and 1,519 supervisors in systems engineering across the Navy, Marine Corps, Army, Air Force, and the Missile Defense Agency. This paper presents a summary of the competencies and tasks of the

resulting defense systems engineering career competency model. A comparison of the competencies and tasks among the components surveyed is presented and analyzed. Conclusions are presented, along with recommendations for making the model easily and widely available for use.

Introduction

The Department of Defense (DoD) has established a competency-based approach to strategic workforce management. This approach includes assessing the critical skills and competencies needed now and in the future within the civilian workforce, along with strategies to bridge competency and skill gaps. A competency based approach supports strategic workforce planning and effective talent management. The specifications of 5 C.F.R 300A, *Employment Practices*, a federal regulations guide, require (1) a job analysis for selection and competitive promotions in federal employment, (2) compliance with the job-relatedness requirements of the *Uniform Guidelines on Employee Selection Procedures* (43FR38290), and (3) that resulting assessments target competencies required for the occupational position. The uniform guidelines are a set of principles designed to assist employers, labor organizations, employment agencies, and licensing/certification boards in complying with requirements prohibiting discriminatory employment practices.

The Deputy Assistant Secretary of the Navy (DASN) for Research, Development, Test and Evaluation (RDT&E) sponsored the development and verification of the Systems Engineering Career Competency Model (SECCM) through collaboration with the Naval Postgraduate School, Office of Personnel Management (OPM), Navy, Army, Air Force, Marine Corps, and Missile Defense Agency. The SECCM aligns with the Engineering (ENG) acquisition career field and the related ENG competency model. DASN RDT&E supported the SECCM development since the systems engineering career field does not have an occupational series (08XX), so definitions of and expectations for systems engineers vary. The newly verified SECCM provides the source for a consistent and verified definition of defense systems engineering competencies and tasks.

OPM administered the job analysis survey to 6,011 incumbents (or employees) and 1,519 supervisors across the DoD (OPM, 2016). Survey participants were asked to evaluate each competency and task on criteria such as frequency, importance, required immediately upon entry into the position, and need for training. Incumbents rated frequency of tasks and importance of competencies for themselves. Supervisors rated importance of the tasks and competencies for themselves, as well as the average importance for each task and competency for each grade level, GS-7, GS-9, GS-11, GS-12, GS-13, GS-14, and GS-15. This paper discusses the overall SECCM and analyzes the results across the Navy, Army, Air Force, and Missile Defense Agency.

For further information on the details of the development and uses of the SECCM, see Whitcomb et al. (2014), Whitcomb, White, et al. (2015, 2016), Whitcomb et al. (2016b), Khan et al. (2016), White et al. (2016), and Whitcomb et al. (2016a).

Systems Engineering Career Competency Model

Competency models in the DoD consist of competencies and tasks. Competencies are defined as measureable patterns of skills, knowledge, abilities, behaviors, and other characteristics which an individual needs to perform work. Tasks define the duties associated with an occupation, and they are linked to competencies during job analysis. The SECCM consists of 44 systems engineering competencies and 179 systems engineering tasks. This paper presents both the competencies and tasks but focuses on the competencies. Critical competencies are identified for systems engineers at the GS-07 to

GS-15 grade levels. In Table 1, the 44 SECCM competencies are categorized into four distinct units of competence, based on the current defense acquisition Engineering (ENG) Career Field Competency Model: technical management, business acumen, analytical, and professional.

Table 1. SECCM Competencies, Organized into Four ENG Model Categories

SYSTEMS ENGINEERING CAREER COMPETENCY MODEL			
Technical Management	**Business Acumen**	**Analytical**	**Professional**
Acquisition	Industry Awareness	Transition	Communication
Risk Management	Organization	Integration	Leading High Performance Teams
Requirements Management	Cost Estimating	Design Considerations	Personal Effectiveness/Peer Interaction
Configuration Management	Proposal Process	Tools and Techniques	Problem Solving
Technical Assessment	Supplier Management	Stakeholder Requirements Definition	Professional Ethics
Data Management	Negotiations	Validation	Strategic Thinking
Software Engineering Management	Cost, Pricing and Rates/Cost Management	Verification	Coaching & Mentoring
Decision Analysis	Financial Reporting and Metrics	Mission-Level Assessment	Managing Stakeholders
Interface Management	Business Strategy	Architecture Design	Mission and Results Focus
Technical Planning	Industry Motivation, Incentives, Rewards	Implementation	Sound Judgment
	Contract Negotiations	Engineering Disciplines	Continual Learning
		Requirements Analysis	

The 44 competencies and their respective descriptions are listed in Table 2.

Table 2. SECCM Competencies and Descriptions

No.	Competency	Description
1	MISSION-LEVEL ASSESSMENT	Collaborates with user community to assess mission areas end-to-end, across system and platform boundaries, to identify and close integration and interoperability (I&I) gaps in mission critical capabilities.
2	STAKEHOLDER REQUIREMENTS DEFINITION	Works with the user to establish and refine operational needs, attributes, and performance parameters based on established processes and ensures all relevant requirements and design considerations are addressed to establish a set of baseline capability requirements.
3	REQUIREMENTS ANALYSIS	Ensures the requirements derived from the stakeholder-designated capabilities are feasible and effective, and are analyzed, decomposed, and functionally detailed across the

No.	Competency	Description
		entire system.
4	ARCHITECTURE DESIGN	Creates and maintains architectural products throughout the life-cycle integrating hardware, software, and human elements; their processes; and related internal and external interfaces that meet user needs and optimize performance.
5	IMPLEMENTATION	Applies a methodical and disciplined approach for the specification, design, development, realization, technical management, operations, and/or retirement of a system.
6	INTEGRATION	Plans, manages, and executes the systems integration process to form higher-level elements and eventually the finished products.
7	VERIFICATION	Designs an evaluation strategy and process to assess the ability of the design solution to meet performance requirements and communicate capabilities, limitations, and risks.
8	VALIDATION	Designs an evaluation strategy and process to assess the ability of the design solution to meet operational capabilities (e.g., safety, suitability, effectiveness) and communicate capabilities, limitations, and risks.
9	TRANSITION	Supports operational and sustainment planning to ensure successful acceptance of the end item by the user community.
10	DESIGN CONSIDERATIONS	Assesses conformance of the design solution with policy, legal requirements, and technical tradeoffs.
11	TOOLS AND TECHNIQUES	Applies tools, techniques, and procedures to enable systems engineering practice.
12	DECISION ANALYSIS	Identifies and assesses aspects of alternative decisions (options), including the impact and implications of each, to select a course of action.
13	TECHNICAL PLANNING	Determines the scope of the technical effort required to develop, field, and sustain the system.
14	TECHNICAL ASSESSMENT	Applies formal review process, and develops and uses technical performance measures and other metrics to measure technical progress, review life-cycle costs, and assess requirements and the effectiveness of plans.
15	CONFIGURATION	Applies standard practices to establish and maintain consistency of a product or system's attributes with its

No.	Competency	Description
	MANAGEMENT	requirements, design, and operational information throughout the life-cycle, implementing configuration changes as needed.
16	REQUIREMENTS MANAGEMENT	Develops, documents, incorporates, tracks and revises requirements documents, and maintains traceability including justification for the development of and changes to requirements.
17	RISK MANAGEMENT	Provides input into and implements a Risk Management Plan encompassing risk identification, analysis, mitigation planning, mitigation plan implementation, and tracking throughout the life-cycle of the program.
18	DATA MANAGEMENT	Applies policies, procedures, and information technology to plan for, acquire, access, manage, maintain, protect, and use data of a technical nature to support the total life-cycle of the system.
19	INTERFACE MANAGEMENT	Ensures interface definition and compliance among the system elements, as well as with other systems, by implementing control processes and measures; ensures all internal and external interface requirement changes are properly documented and communicated.
20	SOFTWARE ENGINEERING MANAGEMENT	Determines software-related considerations to address architectures, requirements mapping, integration, technical data rights, cyber-security, and suitability for intended use throughout the life-cycle.
21	ACQUISITION	Applies knowledge of laws, regulations, policies, processes, and procedures related to the life-cycle management activities needed to acquire and sustain products and services.
22	PROBLEM SOLVING	Identifies problems, issues, or failures; determines accuracy and relevance of information; generates and evaluates alternative outcomes and possible solutions, and makes recommendations or decisions.
23	STRATEGIC THINKING	Formulates effective strategies, consistent with the long-term interests of the organization, to ensure the fulfillment of objectives, priorities, and plans.
24	PROFESSIONAL ETHICS	Maintains strict compliance to governing ethics and standards of conduct in engineering and business practices.

No.	Competency	Description
25	LEADING HIGH-PERFORMANCE TEAMS	Leads and builds teams by managing group processes, providing technical direction, and fostering commitment to the mission.
26	COMMUNICATION	Expresses facts and ideas both verbally and in writing taking into account the audience and nature of the information; listens to others, attends to nonverbal cues, and responds appropriately.
27	COACHING AND MENTORING	Actively participates in either providing or receiving feedback and opportunities to learn through formal and informal methods in order to develop and advance capabilities.
28	MANAGING STAKEHOLDERS	Identifies stakeholders; builds and manages effective relationships with all stakeholders; collaborates across boundaries and finds common ground with a widening range of stakeholders; utilizes contacts to build and strengthen internal support.
29	MISSION AND RESULTS FOCUS	Aligns goals and work efforts toward fulfillment of the overall organizational mission.
30	PERSONAL EFFECTIVENESS/PEER INTERACTION	Sets personal goals; displays initiative and commitment towards completing assignments; works and collaborates with peers.
31	SOUND JUDGMENT	Makes a decision or forms an opinion by identifying, discerning, and evaluating relevant information.
32	INDUSTRY AWARENESS	Applies knowledge of the defense environment and current and emerging industry capabilities to inform development and updates to acquisition strategies.
33	ORGANIZATION	Applies knowledge of how organizations are organized across products and services, one's role in the organization, and interactions among internal and external organizations to execute the systems engineering approach and strategy.
34	COST, PRICING AND RATES	Applies knowledge of cost management practices to assist in acquisition management, strategies, and technical oversight.
35	COST ESTIMATING	Applies knowledge of cost estimating requirements, methods, and key process elements to contribute to the preparation of cost estimates.

No.	Competency	Description
36	FINANCIAL REPORTING AND METRICS	Applies knowledge of financial reports and metrics to better enable program decisions.
37	BUSINESS STRATEGY	Applies knowledge of strategic planning, marketing, market research, and business development to contribute to the preparation of appropriate acquisition strategies and solicitations.
38	PROPOSAL PROCESS	Applies knowledge of the scope of work during the proposal planning and preparation process to support acquisition strategies and solicitations.
39	SUPPLIER MANAGEMENT	Applies knowledge of supply chain management to contribute to the preparation of acquisition strategies and solicitations and to provide necessary technical oversight.
40	INDUSTRY MOTIVATION, INCENTIVES, REWARDS	Applies knowledge of incentive based acquisitions, within the constraints of competition and cost, to contribute to the preparation of acquisition strategies and solicitations and to assess if technical award fee criteria are met.
41	NEGOTIATIONS	Communicates objectively with others to reach mutually acceptable solutions.
42	CONTINUAL LEARNING	Masters and applies new technical and business knowledge; recognizes own strengths and weaknesses; pursues self-development; seeks feedback from others and opportunities to master new knowledge.
43	ENGINEERING DISCIPLINES	Applies knowledge of multiple engineering disciplines and how they relate to each other and the system to achieve system performance.
44	CONTRACT NEGOTIATIONS	Applies knowledge of successful negotiations from both a government and business perspective to get the best value for the taxpayer and promote a fair profit to contribute to the preparation of appropriate acquisition strategies and solicitations.

The systems engineering tasks are listed in Table 3. More than one competency may be needed to accomplish a task. The tasks that are aligned under competencies are the ones with the most impact for the respective competency as determined by subject matter expert panels facilitated by OPM during the job analysis process. All tasks are identified as critical for systems engineering, although which tasks are critical changes with GS level.

Table 3. SECCM Tasks

No.	Task
MISSION-LEVEL ASSESSMENT	
1	Analyzes gaps between mission objectives, mission threads, existing or planned capabilities, and available funding to enable program decisions.
2	Analyzes mission-level requirements to determine if they are feasible across a program or enterprise (e.g., component, DoD, federal agencies, international coalitions).
3	Analyzes the solution space to identify potential solutions that meet mission requirements and leverage opportunities.
4	Conducts trade analysis to refine a proposed solution to meet mission requirements.
5	Contributes to the development of various scenarios for system use, functions, and performance in line with the Concept of Operations.
6	Contributes to the development of operational and top-level systems requirements that are traceable to mission-level requirements, feasible, complete, and verifiable.
7	Identifies and analyzes mission technical problems, issues, risks, and opportunities to enable informed program decisions.
STAKEHOLDER REQUIREMENTS DEFINITION	
8	Collaborates with stakeholders to set expectations and build consensus in regards to requirements throughout the system life-cycle.
9	Develops scenarios and use cases for systems that will provide services, capabilities, or platforms to end-users and other stakeholders.
10	Documents the intent, decisions, and rationale for end-user requirements to ensure traceability during the development and verification stages.
11	Analyzes capability needs, operational constraints, and technical limitations in collaboration with the stakeholders to derive system requirements and technical performance measures for system development.
12	Elicits stakeholder requirements to build a recommended list of potential system requirements.
13	Defines the constraints on a system solution that stem from existing agreements, interoperability, regulations, management decisions, and technical decisions.

No.	Task
14	Identifies the effectiveness and suitability requirements (e.g., HSI, ESOH, reliability, availability, maintainability) that correspond to anticipated operational and support scenarios and environments.
REQUIREMENTS ANALYSIS	
15	Analyzes the threat assessment to support a materiel or non-materiel solution.
16	Analyzes model, prototype, or system performance to identify and update requirements.
17	Assesses the impact of requirements changes on the solution and program.
18	Ensures end-user requirements are well-documented by collaborating with subject matter experts and other stakeholders.
19	Decomposes requirements across a system for allocation and traceability.
20	Develops specification documents for a system.
21	Prioritizes requirements for system upgrades for future enhancements in collaboration with stakeholders.
22	Establishes threshold and objective values for system requirements in collaboration with stakeholders.
23	Manages requirements for a system to include upgrades and future enhancements or pre-planned product improvements.
24	Resolves requirement conflicts in order to establish a complete, consistent, and traceable requirement set for the system of interest throughout the life-cycle of the system.
25	Defines and manages critical technical performance measures to monitor the system development.
26	Collaborates with the test and evaluation community and other stakeholders to ensure design is projected to comply with established measures of performance and measures of suitability.
27	Creates written design requirements for system performance specification.
28	Recommends revised operational requirements or design requirements to comply with government policy, regulations, and law.
ARCHITECTURE DESIGN	
29	Assesses the overall architecture to ensure it meets established requirements.

No.	Task
30	Designs architecture solution and products (e.g., DoDAF) that capture operational and systems requirements, including interfaces, interoperability, integration, and environments.
31	Creates solutions by building analytic models and conducting experiments.
32	Establishes the functional, allocated, and product baselines for use throughout the system life-cycle.
33	Formulates scalable and adaptable solutions to account for future needs.
34	Plans and executes the technical review process taking into account suitability of design attributes.
35	Manages the creation of architecture artifacts required for program integration.
36	Assesses concept feasibility to support architectural design tradeoffs.
37	Provides technical expertise and assessments during the analysis of alternatives process to determine the best materiel solution.
38	Identifies systems interfaces and interoperability concerns to achieve resolution.
IMPLEMENTATION	
39	Ensures a balanced system solution by managing the technical aspects and their impacts to or from cost and schedule throughout the life-cycle.
40	Analyzes opportunities for the reuse of existing products.
41	Provides technical input on the development strategy for acquiring, fielding, and sustaining a system.
42	Documents planning (e.g., Systems Engineering Plan, Test and Evaluation Master Plan), resource requirements, technical data, technical reviews, and analyses throughout the life-cycle.
43	Monitors manufacturing and quality assurance to identify and resolve issues, manage risks, and ensure adherence to specifications and requirements.
44	Tracks design considerations (e.g., boundaries, interfaces, standards) to ensure they are properly addressed in the technical baselines.
45	Plans for technology refresh including assessing technical readiness of proposed system changes.
46	Manages and/or oversees the manufacturing process to ensure timely and adequate implementation that is consistent and compliant with contract

No.	Task
	standards and requirements.
47	Identifies manufacturing and production process improvements to reduce life-cycle costs or increase reliability, performance, or quality.
48	Conducts or reviews manufacturing readiness assessment to baseline required industrial and manufacturing capability and maturity.
49	Verifies availability of industrial base to support critical technologies.
INTEGRATION	
50	Develops and implements an integration approach which includes identification of integration, interface, and interoperability requirements within operating conditions.
51	Plans and executes physical and functional configuration audits to verify that the as-released baseline meets requirements, and the product and its documentation align.
52	Identifies and evaluates integration and interoperability options for evolving systems, phasing out of legacy systems, or phasing in of new systems.
VERIFICATION	
53	Analyzes product verification outcomes for a system.
54	Verifies requirements traceability from the lowest to highest level of integration.
55	Develops and implements an approach/plan to verify requirements and performance using inspection, demonstration, analysis, and testing.
56	Verifies the system design meets requirements.
57	Conducts root cause analyses of problems noted during execution of the verification plan, and develops potential corrective actions to resolve.
58	Performs or oversees developmental testing for a system.
59	Prepares or reviews artifacts or evidence (e.g., test results, Plan of Actions, and Milestones) for stakeholder acceptance and certification.
VALIDATION	
60	Analyzes system validation outcomes to enable program decisions.
61	Conducts system validation activities (e.g., operational testing, limited user testing) according to the plans.

No.	Task
62	Prepares or reviews validation plans and procedures for a system, including identification of method and timing for each activity.
63	Tests system concepts and their feasibility using prototypes, builds, or experiments.
TRANSITION	
64	Analyzes the risks to successful production transition and program sustainment activities during preparation for production.
65	Develops a product transition plan for a system.
66	Conducts transition to fielding and sustainment activities according to plan.
67	Defines technical policies, processes, and procedures for an organization.
68	Coordinates with receiving sites to ensure they have the available personnel, skills, and product transition procedures to receive the end product for a system.
69	Reviews the adequacy of packaging material, handling equipment, storage facilities, and shipping services for a system.
DESIGN CONSIDERATIONS	
70	Performs safety analyses using data collection and modeling techniques.
71	Addresses reliability, maintainability, and availability as they relate to all elements of the system life-cycle.
72	Develops a safety plan for the system that complies with safety assurance strategies, policies, and standards for a system.
73	Mitigates the life-cycle cost drivers in system design to ensure a system is affordable across the life-cycle.
74	Assesses if available or imminent technology is sufficient to meet system requirements.
75	Incorporates cyber-security protection requirements during all stages of the system life-cycle.
76	Identifies and analyzes supply chain management risk areas to enable program decisions.
TOOLS AND TECHNIQUES	
77	Advises on the suitability and limitations of models and simulations.

No.	Task
78	Collects and applies real-world data for computer generated force-on-force modeling, mathematical modeling, physical modeling, scientific research, or statistical analysis.
79	Interprets the results of modeling and simulation scenarios based on current and future operational capabilities.
80	Defines the needs and the scope of modeling, simulation, and analysis activities across systems, adhering to and applying sound verification, validation, and accreditation (VV&A) practices.
81	Identifies and recommends the best value alternatives for systems.
DECISION ANALYSIS	
82	Conducts FRACAS (Failure Review and Corrective Action System) activities during the system life-cycle.
83	Provides technical input to program documentation (e.g., Work Breakdown Structure, Cost Analysis Requirements Document, life-cycle support plan) to guide program execution.
84	Provides technical expertise for the cost/benefit analysis process.
85	Defines or evaluates technical scope needed to estimate costs for a system.
86	Develops or reviews technical plans (e.g., Test and Evaluation Master Plan, Systems Engineering Plan, Information Support Plan, Configuration Management Plan) for a system to ensure integration with other organizational plans and processes.
87	Conducts trade studies to determine the most cost effective alternative.
TECHNICAL ASSESSMENT	
88	Evaluates the system and technical documentation against technical review entry and exit criteria.
89	Participates in program and milestone reviews to ensure critical technical requirements will be met.
90	Reviews contractor deliverables to ensure adherence with the contractual requirements.
91	Conducts process improvement throughout the system life-cycle.
92	Participates in independent review teams to provide unbiased technical opinion.

No.	Task
CONFIGURATION MANAGEMENT	
93	Analyzes changes to baselines to enable program decisions.
94	Conducts and maintains configuration management during the entire system life-cycle.
REQUIREMENTS MANAGEMENT	
95	Creates a tailored requirements management process based on standard systems engineering processes and key stakeholder needs to maintain a stable configuration of system and subsystem requirements.
96	Identifies, evaluates, and/or recommends changes to non-compliant technical parameters for a system.
97	Manages stakeholder requirements and maintains traceability to the sources of stakeholder need.
98	Translates and documents the system capability requirements into technical requirements for the system performance specification.
RISK MANAGEMENT	
99	Provides technical input on the Risk Management Plan encompassing risk identification, analysis, mitigation planning, mitigation plan implementation, and monitoring throughout the system life-cycle.
100	Recommends risk prioritization to support decision-making.
101	Develops or provides input on actionable risk mitigation plans or issue resolution strategies and monitoring metrics to be used across systems and programs.
DATA MANAGEMENT	
102	Provides recommendations for the identification of data rights for system technical data.
103	Develops strategies to conduct technical data management for a system.
INTERFACE MANAGEMENT	
104	Develops procedures for interface management of a system.
105	Performs interface management during all stages of the system life-cycle.
106	Identifies consequences of system changes to interfaces and interoperability.

No.	Task
107	Reviews the suitability and feasibility of interface management strategies for a system.
SOFTWARE ENGINEERING MANAGEMENT	
108	Determines software-related considerations, impacts, and risks that must be addressed as part of the systems engineering plan.
109	Evaluates the benefits and risks associated with using Commercial Off The Shelf (COTS) products.
110	Plans for or manages post-deployment operations and sustainment of software.
111	Provides input (e.g., elements of code, parameters) to software and/or system reliability models.
112	Facilitates the acquisition of software and information technology systems.
113	Verifies that the collection, migration, aggregation, and manipulation of legacy data are compatible with stakeholders' IT systems.
ACQUISITION	
114	Analyzes the impact of supportability strategies on system readiness/performance.
115	Explains technical, planning, and programmatic information in the Request for Proposal (RFP) during review, industry days, and contractor communications.
116	Specifies technical evaluation criteria for proposals to ensure acquisition program goals will be met by the selected contractor.
117	Evaluates proposals based on technical evaluation criteria to ensure acquisition program goals will be met by the selected contractor.
118	Provides technical input to the development schedule and Contract Data Requirements List (CDRL) to demonstrate progress during acquisition.
119	Contributes to the development of relationships between contractors, government, and the organization, in collaboration with integrated project teams (IPTs), to enhance the government's ability to monitor the contractor.
120	Prepares performance based work statements in accordance with procurement best practices.
PROBLEM SOLVING	
121	Defines problems at all levels (i.e., project, program, or enterprise).

No.	Task
122	Gathers information to gain greater understanding of the change (e.g., what, when, how, why) to diagnose the problem.
123	Questions assumptions and requests that are inconsistent with the mission, objectives, problems, or solutions.
STRATEGIC THINKING	
124	Anticipates new or changed demands for programs and services and seeks information to guide or take action.
125	Assesses organizational, political, operational, economic, and technical uncertainties to pinpoint opportunities that can be exploited in changing environments.
126	Collects technical, programmatic, and other historical data that is used to illustrate the evolution and change within a system.
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.
PROFESSIONAL ETHICS	
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.
132	Instills a climate of trust by demonstrating honesty and keeping commitments.
133	Integrates government ethics responsibilities with engineering and business practices.
134	Resolves acquisition-related dilemmas by prioritizing ethical values and considering how choices impact the welfare of others.
135	Takes action to stop and correct unethical behavior and practices.
LEADING HIGH-PERFORMANCE TEAMS	
136	Builds effective team performance by creating an environment of trust, respect, and commitment to mission.

No.	Task
137	Serves as an authority on technical aspects of life-cycle definitions and the implication on the project or program for other team members.
138	Assigns technical tasks or work assignments to other team members.
139	Communicates expertise, advice, and knowledge effectively for the purpose of broadening the proficiency of others and establishing cooperative relationships.
140	Creates an active network across technical groups, regulatory groups, and other stakeholders for information sharing, collaboration, and decision-making.
141	Establishes a collaborative and open work environment within the system's or program's team.
142	Leads teams by providing proactive and technical direction and motivation to ensure the proper application of systems engineering processes and the overall success of the technical management process.
143	Uses a variety of direct and indirect consensus-building techniques to overcome resistance and reach agreement on ideas, recommendations, and solutions.
144	Works with team leaders or team members to clarify team roles and responsibilities.
145	Works with team members to specify performance expectations (e.g., results, deliverables, deadlines, metrics).
COMMUNICATION	
146	Adapts communication methods and style based on the audience and the target objectives.
147	Uses a variety of media to effectively communicate information about a system.
148	Communicates complex ideas, problems, and solutions in ways that are easily understood (e.g., using examples, visualizations, analogies, mental models, animations, discovery maps, interactive displays, prototype demonstrations).
149	Facilitates an open and supportive environment through active listening, ensuring understanding, and providing and receiving constructive feedback.
150	Writes technical reports that communicate the results of a technical assessment and provide evidence-based recommendations for a system.
151	Prepares and delivers programmatic or technical briefings.

No.	Task
COACHING AND MENTORING	
152	Mentors personnel to develop their capabilities.
153	Provides training opportunities for practitioners in the field of systems engineering.
MANAGING STAKEHOLDERS	
154	Articulates shared goals, conflicting interests, and multiple views among the key stakeholder factions.
155	Builds consensus among multiple stakeholders by using a common framework of ideas and objectives.
156	Fosters relationships with key stakeholders to gain cooperation, promote openness to new ideas and recommendations, and receive feedback about priorities for systems engineering efforts.
MISSION AND RESULTS FOCUS	
157	Contributes to the creation of a shared vision and strategic goals that are aligned with the mission.
158	Prioritizes tasks based on the mission to achieve the desired results.
159	Develops and executes a systematic approach to maximize the probability of mission success.
160	Demonstrates knowledge of operational culture and mission environment through design and life-cycle planning.
PERSONAL EFFECTIVENESS/PEER INTERACTION	
161	Accepts responsibility and accountability for one's work.
162	Dedicates the appropriate time and energy to assignments or tasks to ensure no aspect of the work is neglected.
163	Encourages openness to innovative ideas from others.
164	Facilitates the resolution of conflict by employing incremental trust building strategies.
165	Modifies behavior to deal effectively with changes in the work environment.

No.	Task
166	Tailors personal interaction and facilitation approach to achieve results even when consensus is difficult to achieve due to interpersonal and organizational obstacles.
SOUND JUDGEMENT	
167	Accepts responsibility and accountability for one's decisions.
168	Makes evidence based decisions in work tasks.
169	Seeks out and uses appropriate information and subject matter expertise to make effective decisions that balance policy, systemic needs and risks, trade-offs, and creativity.
COST ESTIMATING	
170	Reviews cost estimates for subsystem elements.
171	Ensures system needs are adequately covered and properly time phased in the budget submission.
172	Evaluates resource management products to understand their implications for the system.
173	Provides technical input on the reconciliation of independent cost estimates with program office cost estimates.
174	Uses Work Breakdown Structure (WBS), Earned Value Management (EVM), or other performance tracking techniques as tools for tracking contractor performance.
SUPPLIER MANAGEMENT	
175	Provides technical evaluations of requests for modifications to contracts.
176	Ensures that system engineering best practices are considered by both contractor and government team members in the execution of the program.
CONTINUAL LEARNING	
177	Achieves and maintains certifications required for job responsibilities.
178	Maintains cognizance of evolving technology and changing engineering environments through continual learning.
179	Pursues personal development through training, certifications, and other continuous learning.

The verified SECCM competencies and tasks can be used for “high stakes” human resource (HR) functions like creating (and maintaining) position descriptions, creating job announcements, assessing job candidates, hiring, and providing a basis for employee performance assessments and ratings. For example, as a part of the hiring process, the HR specialist would work with the engineering hiring manager to create a job announcement for posting on USA Jobs. If an occupational series exists for the vacancy the HR specialist would use USA Staffing systems to access the respective 08XX series competencies and tasks that the hiring manager could use to create the job announcement. As no occupational series exists for systems engineering, the SECCM can be used as the source for required competencies and tasks for the vacancy associating them with the 0801 General Engineer series. The SECCM identifies critical competencies and tasks by GS level that facilitate defining the desired set of competencies and tasks for the GS level for the job. The SECCM has a consistent set of competencies and tasks across the DoD. OPM analyzed each component individually to gain some insight into differences in the utilization of systems engineers within the DoD.

Competency Model Analysis

The OPM SECCM analysis includes identification of the critical competencies for each component surveyed. The results for the number of critical competencies at each grade level for each component are listed in Table 4.

Table 4. SECCM Critical Competencies by Grade Level for Each Component

Grade Level	Critical Competencies			
	Navy	Army	Air Force	Missile Defense Agency
GS-07	2	1	3	4
GS-09	7	1	6	6
GS-11	6	1	19	7
GS-12	16	2	31	12
GS-13	36	39	34	23
GS-14	40	43	44	36
GS-15	43	44	44	42

This information is shown graphically in Figure 1.

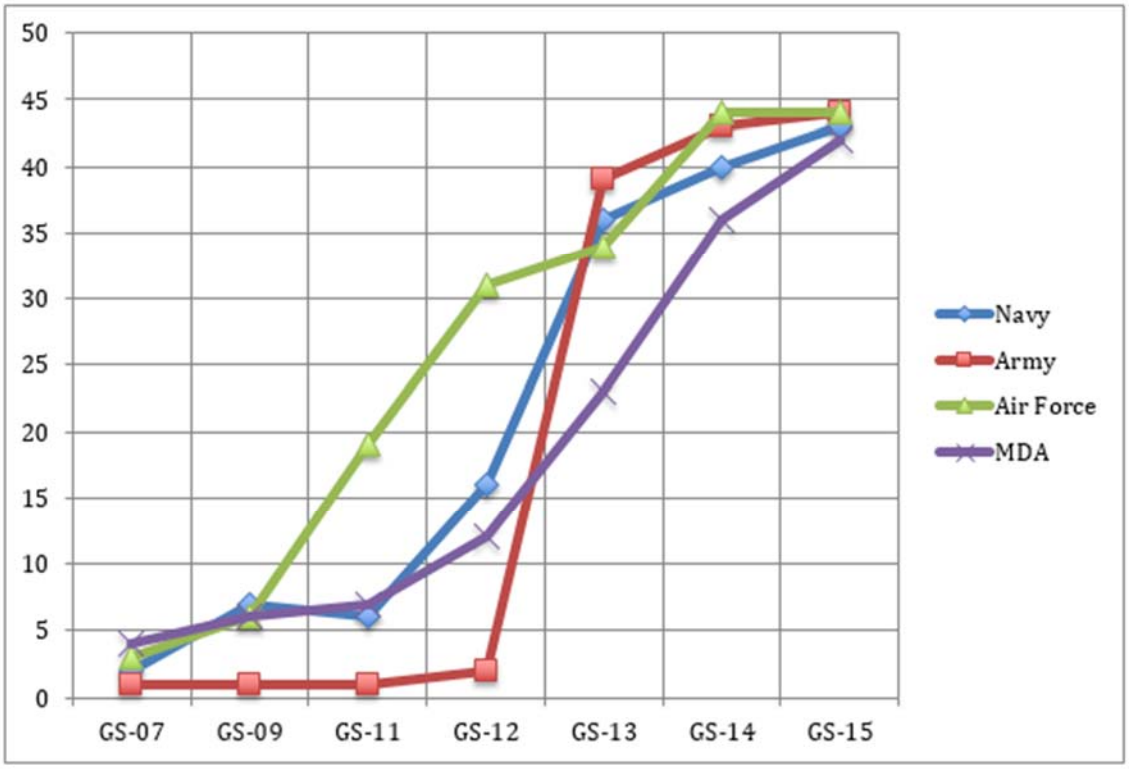

Figure 1. SECCM Critical Competencies by Grade Level for Each Component

The number of critical competencies increases with grade level for all service components. As an aside, the numbers of competencies by GS level does not indicate that all systems engineers at that level must have all of the competencies. It indicates what kinds of competencies are needed at which career levels by all systems engineers at a given level for a given component. Across all components, systems engineering competencies reach a significant number by the time an employee reaches the GS-13 level. The number of competencies required for a systems engineer reaches 34 to 39 by the GS-13 level for the Army, Navy, and Air Force and 23 for the MDA. The Army shows the most pronounced increase at GS-13, indicating that they might tend to use more senior people as their systems engineers. The Air Force shows that they expect systems engineers to develop some competencies earlier, with significant competencies by the GS-11 level. At the most senior levels at GS-14 and GS-15, almost all competencies are shown to be critical across all components.

Conclusion and Recommendations

For the first time, the DoD has a verified competency model for systems engineering. This is significant because a verified competency model is required when used for “high stakes” HR functions like creating (and maintaining) position descriptions, creating job announcements, assessing job candidates, hiring, and providing a basis for employee performance assessments and ratings. The SECCM consists of 44 systems engineering competencies and 179 systems engineering tasks. Critical competencies and tasks are identified for systems engineers at the GS-07 to GS-15 grade levels. It is recommended that the SECCM be widely distributed across the DoD using the USA Staffing system used by HR specialists. This is important until an occupational series for systems engineering can be

created. In addition, it is recommended that an occupational series for systems engineering be created. The Office of the Secretary of Defense has started the process to create an occupational series for systems engineering based in part on the SECCM. This process will take time, possibly on the order of years, as the series has to be reviewed and approved for use by government agencies in addition to the DoD.

References

Khan, R., Whitcomb, C., White, C., Grambow, D., & Delgado, J. (2016). The U.S. Department of Navy's Systems Engineering Career Competency Model: Identification of proficiency levels and career path modeling. In *Proceedings of the 26th Annual INCOSE International Symposium.* Edinburgh, Scotland.

Office of Personnel Management. (2016). *Occupational analysis and workforce planning for systems engineer position* [Technical report for the Assistant Secretary of the Navy Research, Development, and Acquisition Department of the Navy].

Whitcomb, C., Delgado, J., Khan, R., Alexander, J., White, C., Grambow, D., & Walter, P. (2015). The Department of the Navy Systems Engineering Competency Model. In *Proceedings of the Twelfth Annual Acquisition Research Symposium* (Vol. 1, pp. 271–288). Retrieved from http://www.acquisitionresearch.net/files/FY2015/NPS-AM-15-004.pdf

Whitcomb, C., Khan, R. H., & White, C. (2016a). Curriculum alignment use case for competency frameworks at the Naval Postgraduate School. In *26th Annual INCOSE International Symposium*. Edinburgh, Scotland.

Whitcomb, C., White, C., Khan, R., Grambow, D., Delgado, J., & Vélez, J. (2016b, May). Update on the Department of the Navy Systems Engineering Career Competency Model. In *Proceedings of the 13th Annual Acquisition Research Symposium.* Monterey, CA: Naval Postgraduate School.

White, C., Whitcomb, C. A., Khan, R. H., Grambow, D., Delgado, J., & Vélez, J. (2016). Development of a Systems Engineering Career Competency Model for the U.S. Department of Defense. In *Proceedings of the 26th Annual INCOSE International Symposium*. Edinburgh, Scotland.

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