Department of Defense

Modeling and Simulation Body of Knowledge (BOK)

This document cleared for public release (Distribution A) by
DoD Office of Security Review (Case No. 11-S-0058).

DoD Modeling and Simulation Body of Knowledge

Table of Contents

Introduction

This consolidated DoD M&S Body of Knowledge (BOK) was published in June 2008. It is the first time DoD developed and published a BOK. The development of the BOK, which was funded by the Modeling and Simulation Coordination Office (M&S CO), occurred during FY 07. During March-June 2007 the BOK was staffed with all the services and M&S Communities (Acquisition, Analysis, Experimentation, Planning, Testing and Training). This published BOK reflects the communities and services input and evaluations of M&S BOK content items, descriptors and usage levels.

This BOK provides standardized language and associated knowledge base for users, developers, managers and executive-level personnel to effectively apply M&S to DoD requirements. The awareness and application usage levels contained in this BOK are displayed by the services (Army, Navy, Air Force, Marine and Joint) and the following communities: Acquisition, Planning, Test & Evaluation, and Training. The management and executive levels contain a usage level that represents an average usage level across the services and communities.

Since this is first DoD BOK please consider this BOK to be a starting point for defining the core knowledge and skills that a member of the DoD M&S workforce performs. It is a living document that will require updating and expanding in future years. While this BOK covers knowledge areas, terms and activities it should be considered a departure point for when a more robust BOK that contains M&S professional reading lists, a collection of M&S related websites, general M&S information and more M&S professional developmental information is produced.

You are welcome to comment on this DoD Body of Knowledge. DoD Services and M&S Communities should post comments in wiki format on DTIC's Techipedia. Industry and academia should send comments to the MSIAC helpdesk, who will post them to Techipedia. By accepting comments from DoD Services, M&S Communities, academia, and industry, the intent is to improve this BOK as well as to keep the BOK up-to-date and relevant for the Department of Defense workforce.

When submitting a comment, please:

1. Reference the location that needs to be updated in the BOK (i.e. refer to a chart or page number), and describe the item that you are commenting upon.

2. Use terminology that is broad enough to apply to all M&S Communities instead of using terminology that is restricted to an individual Community.

DoD M&S Body of Knowledge (BOK) Methodology

The DoD M&S Workforce Body of Knowledge (BOK) comprises the core knowledge and skills that an M&S professional obtains at different levels throughout his or her career within any Service or functional community—analysis, acquisition, training, planning, experimentation, operations or testing.

Prior to the development of the DoD M&S BOK, several M&S BOK initiatives were undertaken by various organizations within the M&S community, reflecting what they believed to be the most important Knowledge, Skills and Abilities (KSAs) for their personnel. However, at the May 2007 Defense Modeling and Simulation Conference, the Joint/DoD M&S Workforce Development Working Group cited differences in the M&S BOKs between the DoD, the Services and the functional communities with respect to organizational structure, procedures and policies and functional requirements.

The Joint/DoD M&S Workforce Development Working Group members agreed that there was a need for one core M&S BOK that applies to all sectors of the DoD M&S workforce at the awareness, management and executive levels. Each Service and DoD community also had a need for a BOK that was geared specifically at the application level. Previous BOKs were designed as a "one BOK fits all" and were not organized into different levels of M&S usage.

The M&S BOK activities completed as part of this DoD M&S workforce study involved consolidating prior M&S BOK efforts into a coherent, unified listing of content items. This consolidation process was a necessary step in the development of a comprehensive M&S BOK that will involve the completion of additional BOK components, such as identifying references to key information resources (e.g., books, articles and research studies) needed to more clearly describe and define what is included in the M&S discipline.

As part of the BOK consolidation, nine separate BOK efforts were identified. Each of these BOK efforts were initiated and developed by individual DoD Services, academic institutions, trade organizations and multi-disciplinary groups. The study team reviewed and consolidated all nine BOKs into one. A major shortfall of previous BOKs was that elements were listed with no description of what was meant by the element in relationship to M&S. The resulting BOK that was produced from this consolidation identified content elements and developed associated descriptors so that no misunderstanding would occur about the elements.

An example of a content item and its associated descriptor is presented below. There are over 400 individual content items grouped according to pre-defined category headings (i.e., based on the BOK effort with which they were originally associated). Note that the descriptor in some cases can be quite detailed to help ensure that the content item being rated is (to the extent possible) clearly articulated for all respondents.

> ***BOK Content Item*** – *Mathematical model*
> ***Descriptor*** - A mathematical model is a symbolic model whose properties are expressed in mathematical symbols and relationships. Mathematical models are commonly used to quantify results, solve problems and predict behavior. A simple example of a mathematical model is the equation that represents a straight line: y=mx+b.

The directions associated with the consolidated BOK asked for a single summary input from each DoD Service and M&S functional community. A summary input consisted of four independent ratings for each content item related to the following four usage levels:

Awareness – Information all persons need to know about M&S
Application – Information needed to perform M&S functions
Management – Information needed to manage M&S programs
Executive – Information senior leadership needs to know about M&S

Individual ratings were based on the following scale taken from Bloom's taxonomy[1]:
1 - Knowledge: Recalls data or information
2 - Comprehension: Able to understand the meaning of data or information
3 - Application: Uses information in new situations; solves problems
4 - Analysis: Breaks down information and identifies components
5 - Synthesis: Uses old ideas to create new ones
6 - Evaluation: Compares and discriminates between ideas
7 - Does not apply
Thus, a given item would receive four ratings, one each for the four usage levels. Using the example BOK content item above, the four ratings might look like the following:

	Awareness	**Application**	**Management**	**Executive**
Mathematical Model	1	5	3	7

Due to the need for identifying a standard set of M&S competencies for the Management and Executive levels, all of the individual ratings (DoD Services and M&S functional) were combined, then averaged for a standard rating (7s were treated as a zero when computing averages). Based on the standardized rating, competencies were developed for both the Management and Executive levels. By design, individual Services and M&S functional areas were responsible for determining levels for both the Awareness and Application levels.

[1] http://www.coun.uvic.ca/learn/program/hndouts/bloom.html

KNOWLEDGE AREA	Description
Basic Concepts	
Understand historic perspective of M&S	
Historic Aspect of M&S	The M&S process was used long before the advent of computers and models and simulations have a long military history. The earliest models consisted of little more than lines drawn in the sand, with objects such as stones and twigs used to represent terrain features, fortifications, encampments and troops. Some of the earliest forms of M&S include Chaturanga, a four-sided Hindu game resembling chess; the Kings Game of the 1600s; the German game Kriegspiel; the Louisiana Maneuvers and REFORGER.
DoD/Military Simulations	
Policies and rules	Plan of action to guide decisions and actions
Modeling Concepts	
Model Types	
Model Definition	A model is a physical, mathematical or otherwise logical representation of a system, entity, phenomenon or process
Model Concept	Information (and amount) required to develop a model
Physical Models	A physical model is a model whose physical characteristics resemble the physical characteristics of the system being modeled. A simple example of a physical model is a plastic airplane you played with in grade school.
Mathematical Models	A mathematical model is a symbolic model whose properties are expressed in mathematical symbols and relationships. Mathematical models are commonly used to quantify results, solve problems and predict behavior. A simple example of a mathematical model is the equation that represents a straight line: y=mx+b.

KNOWLEDGE AREA	Description
Modeling Concepts	
Model Types	
Process Models	Process models are designed to replicate steps in a process or system. All process models allow users to define their processes, workflows or system dynamics. Other common processes that are modeled are information flow through a system and the manufacturing of parts using an assembly line.
Combination Models	The approach of combining models learned from multiple batches of data as opposed to the common practice of learning one model from all the available data (i.e., the data combination approach).
M&S Representation	
Systems	A system is a collection of components organized to accomplish a specific function or set of functions. System types are: (1) units; (2) weapons; (3) platforms; (4) sensors; (5) life support and (6) Command, Control, Communications, Computers and Intelligence (C4I). Systems are further categorized by operating environment which is divided into five areas: (1) individual; (2) air; (3) sea; (4) space and (5) ground.
Human Behavior	Human representation refers to the use of a computer-based model within a simulation that mimics either the action of a single human or the collective action of a team of humans. Human behavior representation can model any of the complicated facets of human behavior including ability to reason, ability to change the environment, reaction to comfort and discomfort, susceptibility to injury and illness, emotional responses, communication with others, ability to sense the environment and physical capabilities and limitations.

KNOWLEDGE AREA	Description
Modeling Concepts	
M&S Representation	
Natural Environment	Environmental representation is the authoritative representation of all or part of the natural or man-made environment, including permanent or semi-permanent man-made features. To replicate an environment, models and simulations need to address the four components of air, ocean, terrain and space, and all the elements within those components.
Modeling Process	
Modeling Process	Attempt to simulate an abstract model of a particular system, such as natural systems, human systems and new engineering technology.
Abstractions	(when applied to modeling) Process of generalization by reducing the information content of a concept or an observable phenomenon, typically in order to retain only information which is relevant for a particular purpose
Formalisms	(when applied to modeling) Method for capturing essence of thing or process; as an example, two data modeling formalisms are entity-attribute-relationship (EAR) models and object-relationship (OR) models
Design and Build Models	
Conduct Feasibility Assessments	A basic target analysis that provides an initial determination of the viability of a proposed target for special operations forces employment
Knowledge Engineering	A field within artificial intelligence that develops knowledge-based systems. Such systems are computer programs that contain large amounts of knowledge, rules and reasoning mechanisms to provide solutions to real-world problems.

KNOWLEDGE AREA	Description
Design and Build Models	
Simulation Concepts	
Simulation Definition	A method for implementing a model over time
Simulation Concept	Simulation is a technique used for testing, analysis or training, where the model represents a "real-world" system or concept.
Live Simulation	Live simulation involves real people operating real systems. Military training events using real equipment are live simulations. They are considered simulations because they are not conducted against a live enemy.
Virtual Simulation	Virtual simulations involve real people operating simulated systems. A video game or a cockpit mockup used to train pilots are examples of virtual simulation.
Constructive Simulation	Constructive simulations involve simulated people operating simulated systems. A constructive simulation is a computer program. For example, a military user may input data instructing a unit to move and to engage an enemy target. The constructive simulation determines the speed of movement, the effect of the engagement with the enemy and any battle damage that may occur.
Simulation Methods	Live simulation used for mission rehearsal, training, test and evaluation; virtual simulation used for exercise decision, motor control and communication skills; constructive simulation used to analyze concepts, predict possible outcomes and stress large organizations.
General Simulation Knowledge	
Mechanisms	A system of parts that operate or interact like those of a machine
Simulation Ethics	Application of simulations according to a proscribed set of moral concepts and judgments
Discrete Event	One of the chronological sequences of events that occur in the operation of a system
Continuous	A mathematical or computational model whose output variables change in a continuous manner

KNOWLEDGE AREA	Description
Design and Build Models	
General Simulation Knowledge	
Live/Virtual/Constructive	Categorization of simulation into live, virtual and constructive classes or divisions; together (LVC) indicates the integration of all three into a particular event or activity
Discrete Event Simulation	
Formalisms	(when applied to modeling) Method for capturing essence of thing or process; as an example, two data modeling formalisms are entity-attribute-relationship (EAR) models and object-relationship (OR) models
Implementation/structure/mechanics	(when applied to discrete event simulation)
Languages/tools	Software packages developed for use in conjunction with simulation applications (building and implementing models over time) with inherent capabilities that foster model building/implementation and related activities (i.e., data collection/visualization)
Worldviews	Broadly, a framework for generating various dimensions of human perception and experience; when applied to simulation it can denote the ability/need to trace the logic for how a computing approach is used to represent a given thing/process
Warm-up, steady state	Steady state is when there is a high probability of (smooth) continuous system functioning; however, this condition typically requires an initial transient state, warm-up period before it can be achieved.

KNOWLEDGE AREA	Description
Design and Build Models	
Continuous Simulation	
Systems Dynamics	An approach to understanding the behavior of complex systems over time that includes internal feedback loops that may or may not have direct cause and effect or time links
Solving DEs and PDEs (Differential Equations & Partial Differential Equations)	DEs are a mathematical equation for an unknown function of one or several variables which relates the values of the function itself and of its derivatives—used in science and technology, often to model/simulate a deterministic relationship. PDEs are used to formulate and solve problems that involve unknown functions of several variables, such as the propagation of sound, heat, fluid flow, etc., or more generally any process that is distributed in space and/or time.
Languages/tools	Very high level programming languages which facilitate modeling and simulation of systems characterized by ordinary and partial differential equations
Implementation/structure/mechanics	Continuous simulation normally requires that each operation be performed at every "tick" of a system clock. Typically, continuous simulations involve differential equations that give relationships for the rates of change of the state variables with time. If the differential equations are simple, they can be solved analytically to give the values of the state variables for all values of time. However, for most continuous simulations analytic solutions are not possible and numerical analysis techniques, e.g., Runge-Kutta integration, are used to integrate the differential equations numerically.
Underlying 'Science'	
Existence	State or fact of being

KNOWLEDGE AREA	Description
Design and Build Models	
Underlying 'Science'	
Referential designation	A technical blueprint of a system that is intended for others to copy. It contains the essential elements of the system; however, third parties may enhance or modify the design as required.
Abstraction/classification (verb and noun)	Abstraction is the process of generalization by reducing the information content of a concept or an observable phenomenon, typically in order to retain only information which is relevant for a particular purpose.
Representation/qualification (verb and noun)	Representation: an activity that stands as an equivalent of something; qualification: a condition or circumstance that must be met or complied with
Surrogacy operations	Surrogate operations can change the user identity or group identity of a process. Access control of each of these kinds of surrogate operations is established by applying authorization policy to the User and Group sub-types of the Surrogate resource type.
Referential inference	Referential inferences infer properties of specific individuals. The main primitive referential inferences are to prove a goal (possibly establishing a value for a variable) and to test if a variable has a value.

KNOWLEDGE AREA	Description
Design and Build Models	
Interoperability Concepts	
Concept of Interoperability	The ability of a model or simulation to provide services to, and accept services from, other models and simulations, and to use the services so exchanged to enable them to operate effectively together. An example of interoperability is the Air Force's Virtual Flag exercise that consists of constructive simulations and virtual stimulators that provide a synthetic environment for training forces. "Distributive Interactive Simulation is a government/industry initiative to define an infrastructure for linking simulations of various types at multiple locations to create realistic, complex virtual worlds for the simulation of highly interactive activities" [IEEE Std 1278.1-1995]. DIS integrates traditional simulator technologies with computer communication technologies to create a system that provides a common battlefield on which the various simulators can interact in active, real-time situations. [Little, 2002]. The Aggregate Level Simulation Protocol (ALSP) is a combination of software and protocols that allows disparate simulations to communicate with one another.
Interoperability Issues	Most M&S users still lack the services they desire. Many potential M&S applications (e.g., Command and Control Warfare (C2W), logistics, Operations Other Than War (OOTW), space systems, manufacturing and Command, Control, Communications, Computers & Intelligence (C4I)) have not been addressed adequately.
Understand domain concepts (7 surfboards)	
Identify M&S opportunities and challenges	
Opportunities	Opportunity(ies) that M&S provides a given unit
Challenges	Challenges of using M&S for a given unit

KNOWLEDGE AREA	Description
Design and Build Models	
M&S Organizations	
Identify key Joint/Service M&S organizations	
Organization	Organizational purpose, structure, responsibilities and contact information
Systems Theory	
Elements to Whole	Reduction of a given system into elements
Reductionism to Holism	Reduction of a given system into elements for multiple layers
Structure to Function	Functions of elements of a given system
Linear Hierarchy	Linear hierarchy for a given system
Network Hierarchy	Network hierarchy for a given system
Spatial Dimensions	Spatial dimensions of a system
Temporal Dimensions	Temporal dimensions of a system
Structural Dimensions	Structural dimensions of a system
Multi-Disciplined Simulations Specialist	
Operations	Functional area operations (7 surfboards)
Organization	Organizational elements
Systems	Workings, characteristics and composition of major simulation systems and relationships (interoperability) to other simulation systems
Modeling	
Design and build models	Model design techniques include conceptual models, declarative models, functional models, constraint models and multi-models
Feasibility assessment	A basic target analysis that provides an initial determination of the viability of a proposed target for special operations forces employment
Knowledge engineering	The building, maintaining and development of knowledge-based systems

KNOWLEDGE AREA	Description
Leadership and Organizational Management	
Change Management	Factors affecting the organization and the leader's ability to act as a catalyst for change in the M&S community, when needed, influencing, motivating and challenging subordinates
Workforce Professional Development	M&S strategies which maximize employee potential and foster high ethical standards in meeting the organization's vision, mission and goals
Leadership and Management Development	
Strategic Planning	Strategic planning process and how it relates to simulations management
Innovative Problem Solving	Ability to develop creative and innovative solutions to complex simulation management issues
Journeyman	
Contracting	Contracting process for M&S products and/or services
Supervisor, Manager, Sr. Tech. Specialist	
Technology	Broad-based technology concepts
Joint Operations	Joint philosophy, goals and doctrine
Manager	
International Operations	International M&S policy, objectives and capabilities
Senior Technical Specialist	
Technology Planning	Establishing critical technological needs and formulating programs to advance state-of-the-art

Technology Transition	Technology transition mechanisms in the materiel acquisition process

KNOWLEDGE AREA	Description
Develop Simulation Requirements	
Identify the requirement	
Need Assessment	Need assessment process for a given situation
Desired Outcomes	The desired outcomes to change the given situation based on the developed need assessment
Research Development & Acquisition Development Cycle	Phases of the RDA development cycle
ORD Development	Purpose and contents of the ORD
Validate the requirement	
Organizational Inputs	Inputs classified as supportable or non-supportable and modification of the requirement based on supportable inputs
Technical Review	Technical support review for the requirement
Organizational Input	Role of user organizations to validate new requirements
Spiral Development Process	Phases of the spiral development process
Scope the requirement	
User Perspective	Scope the requirement for a specific perspective
Resource Constraints	Resource matrix for given requirement
New M&S Application	
Identifying new capability	
New Organization or System	Process to create a new organization or system
New Mission Set	Development process for new mission sets
Validating new application	
Organizational Input	Role organizations have in developing a new capability
System Capability Input	New system capability development process
Documenting new application	
Documentation of Development	Key documents involved with development of a new application
Incorporate requirement into the RDA domain	
Cradle to Grave Concept	Role of the trainer throughout the life cycle of a new system

KNOWLEDGE AREA	Description
Technical Development of the Simulation	
Identify key programming aspects	
Technical Design	Conduct of the technical design process
Structure Design	Conduct of the structure design process
Translating Process	Conduct of the translating process
Collect data for programming	
Identify Sources	Different data sources and how to obtain them to support a given requirement
Data Management Plan	Development of a data management plan for a given requirement
Documentation	Required documentation for data collection
Convert data into programming language	
Characteristics of Languages	Differences (strengths and weaknesses) between various programming languages
Configuration Management	Aspects of configuration management
Documentation	Required documentation for configuration management
Computer Technology	
Software Engineering	The application of a systematic, disciplined, quantifiable approach to the development, operation and maintenance of software
SEI/CMU concepts, methods and implementation	Capability Maturity Model® Integration (CMMI) is a process improvement approach that provides organizations with the essential elements of effective processes. CMMI is created by the Software Engineering Institute (SEI).
Agents-based simulation, adaptive systems	Agent based model is a specific individual-based computational model for computer simulation extensively related to the theme in complex systems, emergence, Monte Carlo Method, computational sociology, multi- agent systems and evolutionary programming. An adaptive system is a system that is able to adapt its behavior according to changes in its environment or in parts of the system itself.

KNOWLEDGE AREA	Description
Prepare to Use Simulation	
Conduct developer VV&C	
VV&C Concept	VV&C elements & their definitions
Certification	Certification process
Documentation	Required documentation for VV&C
Conduct testing of simulation	
Assess Abilities	The process to assess abilities for testing
Establish Parameters	Parameters of simulation testing for a given scenario
Conduct user VV&A	
VV&A Concept	VV&A elements and their definitions
Accreditation	Accreditation process
Documentation	Required documentation for VV&A
Mathematics	
Continuous	In mathematics, a continuous function is a function for which, intuitively, small changes in the input result in small changes in the output. Otherwise, a function is said to be discontinuous.
Discrete	Discrete mathematics, also called finite mathematics or Decision Math, is the study of mathematical structures that are fundamentally discrete in the sense of not supporting or requiring the notion of continuity.
Steady-State	If a system is in steady state, then the recently observed behavior of the system will continue into the future. In stochastic systems, the probabilities that various different states will be repeated will remain constant.
Queuing Theory	Queuing theory is the mathematical study of waiting lines (or queues).

KNOWLEDGE AREA	Description
Prepare to Use Simulation	
Mathematics	
Dynamic	The dynamical system concept is a mathematical formalization for any fixed "rule" which describes the time dependence of a point's position in its ambient space. The mathematical models used to describe the swinging of a clock pendulum, the flow of water in a pipe and the numbers of fish each spring in a lake are examples of dynamical systems.
Discrete Event Simulation	In discrete event simulation, the operation of a system is represented as a chronological sequence of events. Each event occurs at an instant in time and marks a change of state in the system.
Numerical Analysis	Study of algorithms for the problems of *continuous mathematics* (as distinguished from discrete mathematics)
Linear algebra	Branch of mathematics concerned with the study of vectors, vector spaces (also called *linear spaces*), linear maps (also called *linear transformations*) and systems of linear equations. Vector spaces are a central theme in modern mathematics; thus, linear algebra is widely used in both abstract algebra and functional analysis. Linear algebra also has a concrete representation in analytic geometry and it is generalized in operator theory. It has extensive applications in the natural sciences and the social sciences, since nonlinear models can often be approximated by a linear one.
Boolean algebra	Boolean algebra is an algebraic structure that captures essential properties of both set operations and logic operations. Specifically, it deals with the set operations of intersection, union, complement and the logic operations of AND, OR and NOT. Boolean algebras are commonly studied in abstract algebra.

KNOWLEDGE AREA	Description
Prepare to Use Simulation	
Mathematics	
Ordinary differential equations	In mathematics, an ordinary differential equation (or ODE) is a relation that contains functions of only one independent variable and one or more of its derivatives with respect to that variable.
Partial differential equations	In mathematics, a partial differential equation (PDE) is a relation involving an unknown function of several independent variables and its partial derivatives with respect to those variables. Partial differential equations are used to formulate and solve problems that involve unknown functions of several variables, such as the propagation of sound or heat, electrostatics, electrodynamics, fluid flow, elasticity or more generally any process that is distributed in space or distributed in space and time. Completely distinct physical problems may have identical mathematical formulations.
Statistics	
Queuing theory	Queuing theory is the mathematical study of waiting lines (or queues).
Hypothesis testing	An algorithm or statistical approach that states the alternative to minimize certain risks
Variance reduction	Procedure used to increase the precision of the estimates that can be obtained for a given number of iterations
Design of experiments	Information-gathering attempts where variation is present, which may or may not be under the full control of the experimenter
Stochastic Processes/Statistics	
Queuing	An ordering of events or activities
Programmatic	
Technology	Broadly, the use and knowledge of tools and crafts and how it affects our ability to control and adapt to the world's changing environment
Production Tools	Broadly, a device, (computer) application or piece of equipment that provides an advantage when accomplishing a task

KNOWLEDGE AREA	Description
Prepare to Use Simulation	
Management	Broadly, the act of directing and controlling individuals/groups for the purpose of accomplishing a common goal
Marketing	Broadly, human activity aimed at satisfying individual/group needs and wants through exchange processes
Specific Simulations and Attributes	
Assess each simulation	
Hierarchy of Simulations	Hierarchy of simulations with examples for each level
Assessment Process	Simulation assessment process
Identify specific simulations	
Application Description	
History	Historic development aspect of the simulation and the impact on current capabilities
Current Usage	Current use of the simulation
Other Usage	Positive and negative use of the simulation
Technical Description	
Interoperability with other simulations	
ALSP, DIS & HLA	Historic aspect of interoperability in relationship to ALSP, DIS & HLA
DIS Concept	Concept of DIS and its capabilities and limitations
ALSP Concept	Concept of ALSP and its capabilities and limitations

KNOWLEDGE AREA	Description
Specific Simulations and Attributes	
HLA Concept	Concept of HLA and its capabilities and limitations
Air Force Simulations	Key simulations for the Air Force with capabilities, limitations and interoperability concerns
Army Simulations	Key simulations for the Army with capabilities, limitations and interoperability concerns
Navy Simulations	Key simulations for the Navy with capabilities, limitations and interoperability concerns
Marine Simulations	Key simulations for the Marines with capabilities, limitations and interoperability concerns
Joint Simulations	Key Joint simulations with capabilities, limitations and interoperability concerns
Interoperability with real-world equipment	
C4I Systems	C4I systems that require simulation feed and their capabilities, issues and interoperability to other C4I systems
Weapon Systems	Weapon systems that require simulation feed and their capabilities, issues and interoperability concerns
Specific Simulation Applications	
Develop strategy to meet requirement	
Develop an M&S Support Architecture	M&S architecture development with a given scenario to develop an M&S architecture
Documentation	Required documentation for an M&S architecture
Identify simulations to meet requirement	
Psychology	
Neural level modeling	Computing paradigm that attempts to mimic cortical (brain) structures

KNOWLEDGE AREA	Description
Specific Simulation Applications	
Computer Science	
Data structures	A data structure is a way of storing data in a computer so that it can be used efficiently.
Computer architecture/organization	Computer architecture is the conceptual design and fundamental operational structure of a computer system.
File management	A computer program that provides a user interface to work with file systems. Also called a file browser.
Database systems	A system or software designed to manage a database and run operations on the data requested by numerous clients
Computer networks	Multiple computers connected together using a telecommunication system for the purpose of communicating and sharing resources
Parallel computing	The simultaneous execution of the same task (split up and specially adapted) on multiple processors in order to obtain results faster
Artificial intelligence	Intelligence as exhibited by an artificial (man-made, non-natural, manufactured) entity
Education	
Learning theories	Explanations regarding human learning processes; how to-be-learned material is perceived, cognitively encoded in short- and long-term memory and retrieved independently or as part of other activities (e.g., decision making, problem solving, etc.)

KNOWLEDGE AREA	Description
Specific Simulation Applications	
Industrial Engineering	
Linear programming	Optimization problems in which the object function and the constraints are all linear
Dynamic programming	A method of solving problems exhibiting the properties of overlapping sub-problems and optimal substructure and is considered to be the basis of systems analysis
Nonlinear optimization	The process of solving one or more equalities and inequalities (constraints) over a set of unknown real variables, along with an objective function to be maximized or minimized, where some of the constraints or the objective function is nonlinear
Sensitivity analysis	The study of how the variation in the output of a model (numerical or otherwise) can be apportioned, qualitatively or quantitatively, to different sources of variation
M&S Abstraction Techniques/representational schemas	
Static/dynamic	Static: model of a system in which there is no change; Dynamic: model of a system characterized by continuous change, activity or progress
Descriptive/normative/prescriptive	Descriptive: model used to depict the behavior or properties of an existing system; Normative: model that makes use of a familiar situation to represent a less familiar one; Prescriptive: model used to convey the required behavior or properties of a proposed system
Scalar/vector/manifold	Scalar: a physical quantity which can be represented by a real number, having magnitude but not direction; Vector: a quantity having magnitude and direction; Manifold: mathematical objects that allow more complicated structures to be expressed and understood in terms of relatively well-understood properties of simpler spaces

KNOWLEDGE AREA	Description
Specific Simulation Applications	
M&S Abstraction Techniques/representational schemas	
Syntax/semantics	Syntax: the study of the patterns of formation of sentences and phrases from words; Semantics: study of the relations of words and their meanings
Distribution of evaluation: in space; in time	
Types of Representation	
Mathematical	A transformation of one set into another that preserves in the second set the operations between the members of the first set
Partial differential equations and boundary value	Boundary value refers to a problem containing a differential equation together with a set of additional restraints, called the boundary conditions.
Problems	Questions that can be answered with the help of mathematics formal meaning (proofs)
Structural	A representation of the physical or logical structure of a system; for example, a representation of a computer network as a set of boxes connected by communication lines
Diagrammatic	Graphic representation of an algebraic or geometric relationship; a plan, sketch, drawing or outline designed to demonstrate or explain how something works or to clarify the relationship between the parts of a whole
Petri Nets	A calculating chart with scales that contain values of three or more mathematical variables
Finite element	A method for solving partial differential equations, applicable to a wide range of physical and engineering problems
Nomograph	A calculating chart with scales that contain values of three or more mathematical variables
Process	The procedural steps of a task, event or activity performed by a system

Event trace	Method of software diagnostics, collects data throughout the processing of an event to verify correct operation throughout the execution of the event

KNOWLEDGE AREA	Description
Specific Simulation Applications	
Types of Representation	
State transition	Change from one state (condition/configuration) to another in a system, component or simulation
Information	Knowledge derived from study, experience or instruction. A collection of facts or data
Taxonomic	Pertaining to the practice and science of classification. Taxonomies are composed of taxonomic units known as taxa (singular taxon) and are frequently hierarchical in structure.
Classificatory (UML static)	The classification of items in a Unified Modeling Language static representation based on class diagrams of modeled environments
Data	Individual facts, statistics or items of information; a body of facts; information
M&S Uses (Classes)	
Extrapolation /interpolation-in-time	Interpolation: estimation of a value of data based on an established set of collected data within the data range. Extrapolation: estimation of a value of data based on an established set of collected data outside of the data range. Extrapolation/ interpolation-in-time would use a time criteria as the aforementioned collected data values.
Extrapolation /interpolation-in-space	Interpolation: estimation of a value of data based on an established set of collected data within the data range. Extrapolation: estimation of a value of data based on an established set of collected data outside of the data range. Extrapolation/ interpolation-in-space would use spatial analysis data as the aforementioned collected data values.

KNOWLEDGE AREA	Description
Developing the Training Environment	
Identify training objectives	
Training Design	Elements of the training design process
Organizational Perspective	Training need evaluation for an organization
Training Audience	Determination of the training audience
Primary Training Objectives	Primary training objectives development for a given scenario
Secondary Training Objectives	Secondary training objectives development for a given scenario
Design a architecture based on objectives	
Single vs. Multiple Sites	Architecture implications for either a single site or distributed to multiple sites
Communication	Basic concepts of communication design to support an M&S event
Security	Basic concepts of security and issues with multi-layer security design to support an M&S event
Refine objectives with defined outcomes	
Time Constraints	The impact that time will have on meeting established objectives based on a scenario
Resource Constraints	The impact that other resources will have on meeting established objectives based on a scenario
Simulation in the Training Environment	
Define observation process	
Alignment of Objectives	Outcome development and alignment to establish objectives
Structure of Observation	Data requirements development to measure desired outcomes
Develop timeline structure for integration	
Exercise Timeline	Key events required for the conduct of an exercise and the time resource associated with each event

KNOWLEDGE AREA	Description
Simulation in the Training Environment	
Develop timeline structure for integration	
Technical Timeline	Technical aspects of an exercise and the time resource associated with each event
Support Timeline	Support aspects required for the conduct of an exercise and the time resource associated with each event
Conduct pre-integration activities	
Initial Research	Initial research for support of an M&S exercise event
IPR Concept	Purpose and outcomes desired from an IPR
Design of Simulation Event	Determination of which simulation or mix of simulation would support a given event
Facility Support	Facility support required to support a given M&S exercise
Scenario Development	Scenario development based on a given set of objectives and guidance
Support Activities	Support activities required to run an exercise
Pre-training	Need and requirement to conduct pre-training prior to an exercise
Documentation	Elements of an Exercise Control Plan and Simulation Control Plan and how to compose them
Conduct integration activities	
Cell Functions	Role and functions of cells in the conduct of an exercise
Exercise Flow	Purpose of each aspect of an exercise
Observation of Training Environment	
Collect observations	
Collection Plan	Collection plan development for a given scenario
Analysis	Data analysis to support the desired outcomes and doctrine
Supporting Materials	Development of supporting materials for feedback based on data analysis
Documentation	Documentation of results and supporting materials for feedback

KNOWLEDGE AREA	Description
Observation of Training Environment	
Provide feedback based upon observations	
Formal AAR Process	Conduct and participation in a formal AAR process
Informal Process	Conduct and participation in an informal AAR process
Final Report	Types of final reports and the materials they contain
M&S Related Assets	
Notations	A system of figures or symbols used in a specialized field to represent numbers, quantities, tones or values
Syntactic specifications and conventions	Of, or relating to, or conforming to the rules of syntax, or the use of a language or set of words
Semantic specifications and conventions	Of, pertaining to, or arising from the different meanings of words or other symbols
M&S Related Perspectives	
Enterprise	A systematic activity or a project undertaken or to be undertaken
Business Practice	Those behaviors in a business that reflect how a particular organization or business conducts its day-to-day operations
Economics of M&S	Return on investment of M&S based on quantifiable and non-quantifiable benefits. To achieve warfighter ROI, the M&S must be credible, and users must accept the validity of the representation of tactical performance.

KNOWLEDGE AREA	Description
M&S Related Perspectives	
Market Model	A defined model representation of a specific subdivision of a population considered as buyers or users of a particular product or service
Products	Something produced by human or mechanical effort or by a natural process; a direct result; a consequence
Services	Activities that call directly for time and effort rather than for a concrete end product
Buyers	A person who buys; purchaser
Sellers	A person who sells; salesperson or vendor
Business Case	A business case is a structured proposal for business change that is justified in terms of costs and benefits. It is a typical prerequisite for the initiation of a large project and is explicitly required by many project management methodologies.
Cost-benefit	Pertaining to an analysis or study of the actual cost of a project in relation to the potential benefits that will come from it
Enterprise Infrastructure	Broadly, those elements that enable people and systems to exchange information and execute transactions
Professional Development	Skill acquisition and maintenance in support of a particular career path
Enterprise Process	An entire business system, including all core and support processes needed for an organization to achieve its critical success objectives
Enterprise Tools	Broadly, a device, (computer) application or piece of equipment that provides an organization or its employees an advantage toward achieving its stated critical success objectives

KNOWLEDGE AREA	Description
M&S Related Disciplines	
Graph Theory	The study of graphs, mathematical structures used to model pairwise relations between objects from a specified collection
Logic	The study of the principles and criteria of valid inference and demonstration used extensively in the fields of artificial intelligence and computer science
Relations	In mathematics, expressions that show equality and non-equality, such as "=" and "<"; in logic, a property or predicate ranging over more than one argument
Inference	The act or process of deriving a conclusion based solely on what one already knows
Management	
Enterprise Management	A set of management processes, tools, systems, etc. developed to assist an organization in achieving its stated critical success objectives
Corporate institutional development	Building and maintaining institutional, economic and cultural viability of an organization as it faces a changing business environment
Enterprise operations	Processes and systems that work together or independently to assist an organization in achieving its stated critical success objectives
Evaluation Design	
Develop measurement of outcomes	
Baseline Establishment	Determination of the baseline for a given situation or organization prior to the M&S application
Measurement Alignment to Objectives	MOE and MOP development based upon objectives
Tractability Documentation	Tractability matrix development for evaluation

KNOWLEDGE AREA	Description
Evaluation Design	
Develop evaluation methodology and tools	
Technical Evaluation Methodology	Methods and topics examined in a technical evaluation
Application Evaluation Methodology	Methods and topics examined in an application evaluation
Develop description of evaluation methods	
Quantitative Methods	Methods and issues in conducting a quantitative evaluation for M&S
Qualitative Methods	Methods and issues in conducting a qualitative evaluation for M&S
Develop resources to conduct the evaluation	
Resource Scoping	Resource determination for evaluation through a cost analysis
Issues with Resource Constraints	Issues and impact of resource constraints for evaluation
Execution of Evaluation	
Develop timelines for the evaluation	
Pre-Collection Timeline Development	Determination of the impact that resource constraint has on evaluation based on a given time frame
Post Collection Timeline Development	Determination of the impact that resource constraint has on evaluation based on a given time frame
Execute the evaluation	
Collection Methodology	Methodologies for data collection and determination of a data collection methodology for a given scenario
Documentation of Collection	Documentation of evaluation data

KNOWLEDGE AREA	Description
Assessment of Evaluation	
Compile evaluation data	
Correlation Approach for Data	Data correlation process and development
Tracking Data Collection Coverage	Data tracking for a given evaluation and verification of data coverage
Analyze the evaluation data	
Alignment of Data to Outcomes	Process for aligning data to measurement of outcomes
Secondary Source Development	Concept and issues with secondary source information
Convert analysis results to an action plan	
Develop Analysis Relationships	Relational analysis development to support conclusions
Develop New or Modified Requirements	Development of a new or modified requirement based on conclusions and data
M&S Modification	
Determining Need to Change a Simulation	
Identify shortfalls in simulation	
Application Design Flaws	Concept of application design flaws and analysis of a simulation work around
Technical Design Flaws	Concept of technical design flaws and analysis of a technical flaw
Develop requirements to rectify the shortfalls	
Application Requirements	Reevaluation of an established requirement to an application shortfall
Technical Requirements	Reevaluation of a simulation capability to a technical shortfall
Validate requirements to rectify the shortfalls	
Organizational Review	Organizational structure to review shortfalls
Technical Review	Structure to review technical shortfalls

KNOWLEDGE AREA	Description
Technical Changes of the Simulation	
Collect data to rectify the shortfalls	
Focused Data Collection	Data review and creation of a modified focus collection plan for data shortfalls
Alignment to other Data	Verification of correlation with new data and old data
Convert data into programming language	
Convert Data	Challenges and issues with converting data
Data Insertion into Simulation	
Soft Computing	
Decision Trees	In operations research, specifically in decision analysis, a decision tree is a decision support tool that uses a graph or model of decisions and their possible consequences, including chance event outcomes, resource costs and utility. A decision tree is used to identify the strategy most likely to reach a goal. Another use of trees is as a descriptive means for calculating conditional probabilities.
Dynamic Programming	In computer science, dynamic programming is a method of solving problems exhibiting the properties of overlapping sub-problems and optimal substructure that takes much less time than naive methods.
Emergent Behavior	An emergent behavior or emergent property can appear when a number of simple entities (agents) operate in an environment, forming more complex behaviors as a collective. If emergence happens over disparate size scales, then the reason is usually a causal relation across different scales. In other words, there is often a form of top-down feedback in systems with emergent properties. These are two of the major reasons why emergent behavior occurs: intricate causal relations across different scales and feedback.

KNOWLEDGE AREA	Description
Soft Computing	
Fractals	A rough or fragmented geometric shape that can be subdivided in parts, each of which is (at least approximately) a reduced-size copy of the whole
Fuzzy Logic	Fuzzy logic is derived from fuzzy set theory dealing with reasoning that is approximate rather than precisely deduced from classical predicate logic.
Genetic Algorithms	A genetic algorithm (or GA) is a search technique used in computing to find true or approximate solutions to optimization and search problems.
Human Cognition	Human cognition is the study of how the human brain thinks.
Knowledge-Based Systems	A computer system that is programmed to imitate human problem solving by means of artificial intelligence and reference to a database of knowledge on a particular subject
Logistic Networks	A supply chain, logistics network or supply network is a coordinated system of organizations, people, activities, information and resources involved in moving a product or service in physical or virtual manner from supplier to customer.
Neural Nets	A neural network, also known as a parallel distributed processing network, is a computing paradigm that is loosely modeled after cortical structures of the brain. It consists of interconnected processing elements called nodes or neurons that work together to produce an output function.

KNOWLEDGE AREA	Description
Soft Computing	
Petri Nets	A Petri net (also known as a place/transition net or P/T net) is one of several mathematical representations of discrete distributed systems. As a modeling language, it graphically depicts the structure of a distributed system as a directed bipartite graph with annotations.
Simulated Annealing	Simulated annealing (SA) is a generic probabilistic meta-algorithm for the global optimization problem, namely locating a good approximation to the global optimum of a given function in a large search space.
Swarms	The study of collective behavior in decentralized, self-organized systems.
Conduct VV&C of modified simulation	
VV&C Modification	Conduct of a modified VV&C
Convert language into another language	
Resource Implications	Cost implications of language conversions or translators
Implications of Conversion	Implications of conversion to functionality of the simulation
Assessment of Changes to a Simulation	
Conduct testing of modified simulation	
Alpha Testing Modification	Conduct of an Alpha Test and review of an Alpha test plan
Beta Testing Simulation	Conduct of a Beta Test and review of a Beta test plan
Conduct user VV&A of modified simulation	
VV&A Modification in Simulation	Conduct of a modified VV&A
Documentation of Modification	Documentation for VV&A modification

KNOWLEDGE AREA	Description
M&S Development and Use Life Cycle	
Retirement	Removal of a system from active use/service due to culmination of useful period of service
M&S Related Concepts	
visualization for information representation	Simulation or simulators that represent analog functioning; for example, an analog circuit simulation used to design and test complex analog circuits
digital simulation	Simulation or simulators that represent functioning using programming (software) code in a manner that mimics real-world equipment, events, processes, etc.
human-in-the-loop simulation	Simulation and simulators that employ one or more human operators in direct control of the simulation/simulator or in some key support function (e.g., decision making)
hardware-in-the-loop simulation	Simulation and simulators that employ one or more pieces of operational equipment (to include computer hardware) within the simulation/simulator system
software-in-the-loop simulation	Simulation and simulators that employ one or more elements of operational software (computer programming code) within the simulation/simulator system
composability	A system design principle that deals with the inter-relationships of components, each of which are considered self-contained and stateless, and that can be (re-)combined to test/satisfy specific user requirements
community of practice	Refers to the process of social learning that occurs when people who have a common interest in some subject or problem collaborate over an extended period to share ideas, find solutions and build innovations
professional certification	A method used to signify that a person is qualified to perform a job based on key knowledge, skills and/or experience

KNOWLEDGE AREA	Description
simulation asset management	Tasks and decisions employed to capture, catalog and coordinate use of key resources (e.g., equipment, HW/SW, personnel, etc.) related to simulations/simulators
economics of simulation	The study of how simulation/simulators are developed and used, to include evaluations related to effective usage, cost-benefit analysis, return on investment (ROI), etc.
sensors	A type of transducer that can be direct-indicating; for example, a mercury thermometer, or paired with an indicator or display; for example as part of a digital metal detector system
Web-enabled simulations	A simulation/simulator that can be accessed using standard Internet (Web) connectivity and associated data I/O protocols in combination with off-the-shelf hardware/software components
simulation tools (AcslXtreme,etc)	Generally, a modeling, execution (simulation) and analysis environment that can be used to mimic a specified type of system or process (e.g., continuous, dynamic, analog, etc.)
bioinformatics	Computational biology used in applied mathematics, statistics, computer science, artificial intelligence, chemistry and biochemistry to solve biological problems usually on the molecular level
wearable computing	Class of computer/computing HW/SW that can be readily attached to the human body directly or as apparel and that provide one or more of a host of functions useful for work, leisure and entertainment
augmented reality/mixed reality	A field of computer research which deals with the combination of real-world and computer-generated data/the merging of real-world and virtual reality to produce new environments where physical and digital objects can co-exist and interact in real time, to include augmented reality

KNOWLEDGE AREA	Description
biometrics	The study of methods for uniquely recognizing humans based upon one or more intrinsic physical or behavioral traits
biosensors	A device for the detection of an analyte that combines a biological component with a physicochemical detector component
neural networks	Also known as a parallel distributed processing network, is a computing paradigm that is loosely modeled after cortical structures of the brain and consists of interconnected processing elements called nodes or neurons that work together to produce an output function
data mining	The process of searching large volumes of data for patterns using tools that search for element/component commonality (e.g., classification, clustering, key words, etc.)
authoring systems	Any development tool suitable for developing a useable computer-based application; for example, computer based training (CBT), HTML code for viewing on the Internet, modeling/simulation applications, computer/Internet-based tests/surveys, etc.
grid and cluster computing	Grid computing: a computing model that treats all resources as a collection of manageable entities with common interfaces to such functionality as lifetime management, discoverable properties and accessibility via open protocols; Cluster computing: a group of tightly coupled computers that work together closely so that in many respects they can be viewed as though they are a single computer
distributed high performance computing	A method of computer processing in which different parts of a program run simultaneously on two or more computers that communicate with each other over a network—a type of parallel computing designed to enhance computational power
optical computing	A computer that uses photons, rather than electrons, to manipulate, store and transmit data

KNOWLEDGE AREA	Description
Microeletromechanical systems (MEMS)	Referred to as micro machines, the technology of the very small (from a micrometer to millimeter), and merges at the nanoscale into nanotechnology
Micro-opto-mechanical systems (MOMS)	Micro system that combines optical and mechanical functions without the use of electronic devices or signals
RF MEMS	MEMS-based sensor that specifically deals with radio frequency signals (RF)—that portion of the electromagnetic spectrum in which electromagnetic waves can be generated by alternating current which is fed to an antenna
BioMEMS	MEMS-based sensor that specifically deals with biological signals/functions; for example, blood pressure sensors
photonics	The science and technology of generating, controlling and detecting photons, particularly in the visible light and near infra-red spectrum
microfluidics	The science and technology relating to the behavior, precise control and manipulation of microliter andnano liter volumes of fluids
teraherz technology	1012 Hz, corresponding to wavelength (e.g., of sound, radiation, etc.) and capabilities/applications based on this capability; for example, imaging techniques and ultra-precise timing devices
rational unified process (RUP)	An iterative (adaptable) software development process framework that can be tailored; for example by a software project team, by selecting the elements of the process that are appropriate for their needs
UML	A general purpose, standardized specification (modeling) language for object modeling that includes a graphical notation used to create an abstract model of a system

KNOWLEDGE AREA	Description
Shlaer-Mellor method of structured modeling	One of a number of object-oriented analysis/design methods developed in 1980s in response to perceived weaknesses in the existing structured analysis and structured design (SASD) techniques in use primarily by software engineers
real-time object oriented modeling (ROOM)	Technique whereby the actor or the software machine is the central component—can be used in conjunction with UML. ROOM diagrams illustrate both the structural and behavior aspects of the actor.
model driven architecture (MDA)	A software design approach sponsored by Object Management Group that supports several standards, such as UML, XMI and others
IDEF0 & IDEF1x (ER diagrams)	Functional modeling language(s) sponsored by the Air Force capable of capturing various organizational enterprise operations/functions (IDEF0) and related information requirements (IDEF1x), such as key elements of an invoice
Gane-Sarson data flow modeling	Structured analysis of how information/data flows through a system/process that can be used to automate parts or all of that system—approach uses various techniques, such as data flow diagrams, decision trees, decision tables and structured English
Coad/Yourdon structured information modeling	Widely used object-oriented (OO) modeling approach broken into three iterative steps: analysis (OOA), design (OOD) and programming (OOP)
test & training enabling architecture (TENA)	Program established in 2002 for developing the foundation that will allow DoD ranges, labs and facilities to be interoperable by 2010
CORBA IDL (interface definition language)	A JAVA-based technology for handling objects interacting on different platforms across a network (distributed objects) that is based on CORBA, an industry-standard distributed object model architecture
phenomenon algorithm specification	A mathematical procedure serving for a computation or construction (the computation of some function) used to represent a given system, process, etc.

KNOWLEDGE AREA	Description
common software component development	Historically, refers to development of component ware—software designed to work a component of a larger application
finite element method	Finding approximate solution of partial differential equations (PDE) as well as of integral equations, such as the heat transport equation
hybrid simulation: e.g., combined CS/DES/FEM	Combining multiple modeling/simulation approaches within a unified approach—an example could be combining analytical, continuous and discrete event modeling/simulation into a multi-level (hybrid) approach that uses different modeling/simulation approaches when dealing with varying levels/abstractions
surrogate key	In a database, a unique identifier for either an entity in the modeled world or an object in the database—the surrogate key is not derived from application data
hybrid models	An assemblage of one or more physical and one or more numerical, consistently-scaled, substructures
DES example	Information desk at an airport—estimation of the expected average delay in queue of arriving customers, where the delay in queue of a customer is the length of the time interval from the instant of his arrival at the facility to the instant he begins being served
DES components	System state, simulation clock, event list, statistical counters, initialization routine, timing routine, event routine, library routines, report generator, main program
modeling issues in hybrid simulations	Time events, state events, changes in simulation model, re-initialization, event iteration, chattering, Dirac pulses
complex adaptive systems (CAS)	Natural systems (e.g., brains, immune systems, ecologies, societies) and artificial systems (parallel and distributed computing systems, artificial intelligence systems, artificial neural networks, evolutionary programs) are characterized by apparently complex behaviors that emerge as a result of often nonlinear spatio-temporal interactions among a large number of component systems at different levels of organization.

KNOWLEDGE AREA	Description
complexity and CAS modeling	CAS is the operational model of the complexity paradigm.
complexity and chaos	Complexity: The interaction of many parts, giving rise to difficulties in linear or reductionist analysis due to the nonlinearity of the inherent circular causation and feedback effects. Chaos: A system whose long-term behavior is unpredictable, tiny changes in the accuracy of the starting value rapidly diverge to anywhere in its possible state space. There can, however, be a finite number of available states, so statistical prediction can still be useful.
CAS modeling methods	StarLogo and NetLogo used in labs and classrooms. The three main components of the CAS modeling environment are turtles, patches and the observer. The individual agents in the system are called turtles, although they can represent any kind of agent, from a molecule to a person. The environment in which the turtles operate is divided into patches. The third component, the observer, can issue commands that affect both patches and turtles. The observer also conducts maintenance and documentation of the turtle world.
CAS modeling case studies	Economies, ecologies, weather, traffic, social organizations, cultures, the brain
composability theory	Composability has been defined as the capability to select and assemble simulation components in various combinations into valid simulation systems to satisfy specific user requirements. Composability theory explains how an executing federation can provide imperfect results.
hierarchical simulation	A model of information in which data are represented as trees of records connected by pointers.
SEI/CMU concepts, methods & implementation	Integration of Software-Intensive Systems (ISIS) including identifying indicators of success in interoperability, understanding optimal

KNOWLEDGE AREA	Description
	technologies and methods, identifying solutions for semantic interoperability, addressing organizational and programmatic issues and using the SEI Evolutionary Process for Integrating COTS-based systems (EPIC) in the adoption and integration of a COTS product. Performance Critical Systems (PCS) applies predictive modeling techniques to performance and dependability problems in real-time embedded systems.
solving DEs and PDEs	Differential Equations and Partial Differential Equations. DEs define the relationship between an unknown function and its derivative; numerical methods are required to find the function defined by the differential equation(s). The simplest method of solving such equations is known as the Euler method, the estimate of the next value yi+1 given the current value yi is yi+1 = yi + h f(yi). A PDE is a differential equation in which the unknown function is a function of multiple independent variables and their partial derivatives.
finite element analysis/PDE	Finite element methods represent a powerful and general class of techniques for the approximate solution of partial differential equations. Mesh generation and algebraic solver are two important aspects of the finite element methodology.
visualization for information representation	Branch of computer graphics and user interface design concerned with presenting data to users by means of interactive or animated digital images in order to improve understanding of the data being presented
IG techniques	New fundamental alternatives to raster imaging.

KNOWLEDGE AREA	Description
	Improvements include improved user interface, 4 x increases in display performance for large images, lower memory footprint for large images, improved performance for drawings with a large number of images, better support for monochrome images and new methods for creating and manipulating image entities.
deployment model	Model that simulates the reception, staging, onward movement and integration (RSOI) of military personnel and equipment
execution model	A model that specifies the behavior of a computer system to the extent that it is relevant to correct execution of application programs. Explicitly describes the actions involved in the execution of a program by the specified computer system.
component model	Component software architecture from Microsoft, which defines a structure for building program routines (objects) that can be called up and executed in a Windows environment
information model	An information model is an organizational framework that is used to categorize information resources.
product line architecture & development	The structural properties for building a group of related systems (i.e., product line), typically the components and their interrelationships. The inherent guidelines about the use of components must capture the means for handling required variability among the systems. (Sometimes called a reference architecture)
data mining languages	PERL, Visual Basic®, Scripting Edition, XML
data mining using simulation	The act of analyzing a database or data warehouse and searching for new facts based on the data. For example, a supermarket may mine its customer data and find that 87% of people who buy tuna in a can also buy orange juice at the same time.
CROM	Simulation of the operation of a Control ROM
C2IEDM	Command and Control Information Exchange Data Model. Enables coalition information sharing and multi-security-level networking. Has been endorsed as the foundation for the both

KNOWLEDGE AREA	Description
	Army and Marine Corps information exchange standard for Battle Command.
microelectromechanic systems (MEMS)	Micron-scale structures that transduce signals between electronic and mechanical forms—the miniaturization of electronics
Popkin's Systems Architect	The first fully integrated enterprise tool set to support the wide array of industry standards used in modeling and architecture projects worldwide
ERWin Data Modeler	Data modeling solution for creating and maintaining databases, data warehouses and enterprise data models
Component X	Free plug-in for the REALbasic Development Environment which provides high quality, fast, cross-platform consistent graphics functions
CADM	Core Architecture Data Model or Computer-Aided Design and Manufacturing
architecture views	Representations of the overall architecture that is meaningful to one or more stakeholders in the system. The architect chooses and develops a set of views that will enable the architecture to be communicated to, and understood by, all the stakeholders and enable them to verify that the system will address their concerns.
operational (process) architecture	The structural design of general process systems that applies to fields such as computers (software, hardware, networks, etc.), business processes (enterprise architecture, policy and procedures, logistics, project management, etc.) and any other process system of varying degrees of complexity
activity modeling	The act of developing an accurate description of the activities performed by a system
information exchange model	An XML-based metadata registry being adopted by US federal agencies for the precise exchange of information

KNOWLEDGE AREA	Description
IDEF 1X	IDEF semantic modeling, a product of the Integrated Computer-Aided Manufacturing (ICAM) initiative of the United States Air Force. A method for designing relational databases with syntax designed to support the semantic constructs necessary in developing a conceptual schema. A conceptual schema is a single integrated definition of the enterprise data that is unbiased toward any single application and independent of its access and physical storage.
LADAR/IR	Laser Detection and Ranging/Infrared. A high-resolution method for collecting enough detail to identify targets, such as tanks.
degeneracy tests	Check that model works for extreme cases
M&S Development and Use Life Cycle	
logical variable	A variable that can hold one of the logical values is a logical variable and is one of the basic structures in logic programming. The object is referred to by a name starting with a capital letter.
integer variable	Variables that must take an integer value (0, 1, 2 ...).
real variable	In mathematics, a function of a real variable is a mathematical function whose domain is the real line. More loosely, a function of a real variable is sometimes taken to mean any function whose domain is a subset of the real line.
state variable	A variable that defines one of the characteristics of a system, component or simulation. The values of all such variables define the state of the system, component or simulation.
initial condition	The values assumed by the variables in a system, model or simulation at the beginning of some specified duration of time. Contrast with: boundary condition, final condition.
steady state	A situation in which a model, process or device exhibits stable behavior independent of time
data fusion	The integration of data and knowledge collected from disparate sources by different methods into a consistent, accurate and useful whole

KNOWLEDGE AREA	Description
fractal	An irregular or fragmented geometric shape that can be repeatedly subdivided into parts, each of which is a smaller copy of the whole. Fractals are used in computer modeling of natural structures that do not have simple geometric shapes, such as clouds, mountainous landscapes and coastlines.
Phong Lighting Model	One of the most common lighting models in computer graphics, developed in 1973. Local illumination model, which means only direct reflections are taken into account. Light that bounces off more than one surface before reaching the eye is not accounted for.
Z-buffer	The management of image depth coordinates in three-dimensional (3-D) graphics, usually done in hardware, sometimes in software. Also known as depth buffering.
computable	A function that can be computed by an algorithm
NP complete	The complexity class of decision problems for which answers can be checked for correctness, given a certificate, by an algorithm whose run time is polynomial in the size of the input (that is, it is NP) and no other NP problem is more than a polynomial factor harder. Informally, a problem is NP-complete if answers can be verified quickly, and a quick algorithm to solve this problem can be used to solve all other NP problems quickly.
evolutionary computation	A development in computer science that contains building, applying and studying algorithms based on natural selection. EC is conducted with the help of evolutionary algorithms.
portable simulation systems	High-technology simulation systems that enable tactical units to conduct training close to home or while deployed
eye-point	An alternative to the computer mouse that allows a person using a computer to click links, highlight text and scroll simply by looking at the screen and tapping a key on the keyboard. Uses standard eye-tracking hardware—a specialized computer screen with a high-definition camera and infrared lights.

KNOWLEDGE AREA	Description
Field-of-View (FOV)	The angular extent of the observable world that is seen at any given moment
euler attitude angles	A set of three angles used to describe the orientation of an entity as a set of three successive rotations about three different orthogonal axes (x, y and z).
fitness landscape	Used to visualize the relationship between genotypes (or phenotypes) and reproductive success. Fitness landscapes are often conceived of as ranges of mountains. A list of destination addresses.
predator-prey modeling	A system in which there are two populations known as the predator and the prey. The model states that the prey will grow at a certain rate, but will also be eaten at a certain rate because of predators. The predators will die at a certain rate but will then grow by eating prey. First predator-prey model was introduced in the 1920s by American biophysicist Alfred Lotka and Italian mathematician Vito Volterra—known as the Lotka-Volterra Pred-Prey Model.
principle of competitive exclusion (Gause's principle)	Two species competing for the limited resources can only co-exist if they inhibit the growth of competing species less than their own growth. Where one species eliminates the other is known as competitive exclusion, or Gause's Principle.
inductive modeling	Finding the rule with the cause and the effect. Founded on the model-based reasoning paradigm pioneered at NASA and MIT, inductive modeling combines ideas from many other technologies—including simulations, data modeling, expert systems and object-oriented modeling—to apply artificial intelligence to very complex systems such as data networking environments. Inductive techniques include system identification and parameter estimation.
multicast	A transmission mode in which a single message is sent to selected multiple (but not necessarily all) network destinations; i.e., one-to-many.

KNOWLEDGE AREA	Description
interest management	Filtering data that is of no interest to a given client. Interest management is a one-step process: data flows in from the network and is either rejected or accepted.
time warp	Synchronizes parallel simulation processes via rollback and event cancellation. Allows simulationist to process events without worrying about messages that will arrive later and to detect out-of-order execution and recover using roll-back.
dependent variables	The output of a function derived from independent variables.
effects based modeling	An approach whereby technologies are evaluated by their potential to produce intended and unintended effects and then developing research plans to address gaps in understanding
lazy evaluation	Delaying a computation until such time as the result of the computation is known to be needed.
differential games	A branch of the mathematical theory of control, the subject of which is control in conflict situations. Involve players with opposing goals—one who wishes to maximize a given quantity and one who wishes to minimize it.
white-box and black-box models	Black-box model: A model whose inputs, outputs and functional performance are known, but whose internal implementation is unknown or irrelevant; for example, a model of a computerized change-return mechanism in a vending machine, in the form of a table that indicates the amount of change to be returned for each amount deposited. Syn: input/output model. White-box model: A model whose internal implementation is known and fully visible; for example, a model of a computerized change-return mechanism in a vending machine, in the form of a diagram of the circuits and gears that make the change
behavior diagrams	A type of diagram that depicts behavioral features of a system or business process. Includes activity, state machine and use case diagrams, as well as

KNOWLEDGE AREA	Description
	four interaction diagrams (communication, interaction overview, sequence and timing).
functional analysis	The branch of mathematics, specifically of analysis, concerned with the study of spaces of functions. It has its historical roots in the study of transformations, such as the Fourier transform, and in the study of differential and integral equations.
replicated validation	Multiple simulation runs to validate data
priority queue data structure	A data structure useful in problems where you need to rapidly and repeatedly find and remove the largest element from a collection of values. An everyday example of a priority queue is the to-do list of tasks waiting to be performed that most of us maintain to keep ourselves organized.
conservative time management	A mechanism that prevents a federate from processing messages out of time stamp order
optimistic time management	A mechanism that uses a recovery mechanism to erase the effects of out-of-order event processing
predictive contracts	Work in conjunction with data management interest-based services to reduce the message traffic between federates in distributed simulations (example: dead reckoning)
big/little endian data formats	Indicate which bytes are most significant in multi-byte data types and describe the order in which a sequence of bytes is stored in a computer's memory. In a big-endian system, the most significant value in the sequence is stored at the lowest storage address (i.e., first). In a little-endian system, the least significant value in the sequence is stored first.

Summary BOK Ratings for Awareness Usage Levels

KNOWLEDGE AREA	AWARENESS LEVEL							
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**							
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*T&E*	*Train*
Basic Concepts								
Understand historic perspective of M&S								
Historic Aspect of M&S	1	1	1	1	7	1	7	7
DoD/Military Simulations								
Policies and rules	1	1	1	3	7	1	7	7
Modeling Concepts								
Model Types								
Model Definition	1	1	2	1	1	1	1	1
Model Concept	1	1	2	7	1	1	1	7
Physical Models	1	1	2	1	1	2	1	1
Mathematical Models	1	1	2	1	1	2	1	1
Process Models	1	1	2	7	1	2	1	1
Combination Models	1	1	1	7		2	1	1
M&S Representation								
Systems	1	1	2	1	1	2	1	1
Human Behavior	1	1	2	1	1	2	1	1
Natural Environment	1	1	2	1	1	2	1	1
Modeling Process								
Modeling Process	1	1	1	1	1	1	7	1
Abstractions	7	7	1	1	1	1	7	1

KNOWLEDGE AREA	AWARENESS LEVEL							
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**							
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*T&E*	*Train*
Formalisms	7	7	1	1	1	1	7	1
Design and Build Models								
Conduct Feasibility Assessments	7	1	1	1	1	1	7	1
Knowledge engineering	7	1	1	1	1	1	7	1
Simulation Concepts								
Simulation Definition	1	1	2	1	1	2	1	1
Simulation Concept	1	1	2	2	1	2	1	1
Live Simulation	1	1	2	2	7	2	7	1
Virtual Simulation	1	1	2	2	7	2	7	1
Constructive Simulation	1	1	2	2	7	2	7	1
Simulation Methods	1	1	2	2	7	2	7	1
General Simulation Knowledge								
Mechanisms	1	7	1	2	7	1	7	1
Simulation Ethics	1	1	1	2	7	1	7	1
Discrete Event	1	1	1	2	1	1	7	1
Continuous	1	1	1	2	1	1	7	1
Live/Virtual/Constructive	1	1	2	2	1	2	7	1
Discrete Event Simulation								
Formalisms	7	7	1	2	7	1	7	7
Implementation/structure/mechanics	7	7	1	2	7	1	7	7
Languages/tools	1	7	1	2	1	1	7	1
Worldviews	7	7	1	2	7	1	7	7
Warm-up, steady state	1	7	1	2	7	1	7	7
Continuous Simulation								
Systems Dynamics	1	7	1	7	7	1	7	7
Solving DEs and PDEs (Differential Equations & Partial Differential Equations)	7	7	7	7	7	1	7	7
Continuous Simulation								

KNOWLEDGE AREA	AWARENESS LEVEL							
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**							
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*T&E*	*Train*
Languages/tools	7	7	7	7	1	1	7	7
Implementation/structure/mechanics	7	7	7	7	7	1	7	7
Underlying 'Science'								
Existence	7	7	7		7		7	7
Referential designation	7	7	7	1	7	1	7	7
Abstraction/classification (verb and noun)	7	7	7	1	7	1	7	7
Representation/qualification (verb and noun)	7	7	7	1	7	1	7	7
Surrogacy operations	7	7	7	1	7	1	7	7
Referential inference	7	7	7	1	7	1	7	7
Interoperability Concepts								
Concept of Interoperability	2	2	2	1	1	1	1	7
Interoperability Issues	2	2	2	1	7	2	7	7
Understand domain concepts (7 surfboards)								
Identify M&S opportunities and challenges								
Opportunities	1	1	2	1	2	2	1	7
Challenges	1	1	2	1	2	2	1	7
M&S Organizations								
Identify key Joint/Service M&S organizations								
Organization			1	1	1	2		7
Systems Theory								
Elements to Whole	1	7	1	1	7	3	7	7
Reductionism to Holism	7	7	7	1	7	2	7	7
Structure to Function	1	7	1	1	7	2	7	7
Linear Hierarchy	1	7	1	1	7	1	7	7
Network Hierarchy	1	7	1	1	7	1	7	7
Spatial Dimensions	7	7	7	1	7	1	7	7

KNOWLEDGE AREA	AWARENESS LEVEL							
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**							
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*T&E*	*Train*
Temporal Dimensions	7	7	7	1	7	1	7	7
Structural Dimensions	7	7	7	1	7	1	7	7
Multi-Disciplined Simulations Specialist								
Operations	1	1	1	1	7	2	1	7
Organization	1	1	1	1	7	2	1	7
Systems	1	1	1	1	7	2	1	7
Modeling								
Design and build models	1	1	1	1	7	1	7	7
Feasibility assessment	7	1	1	1	7	1	7	7
Knowledge engineering	7	1	1	1	7	1	7	7
Leadership and Organizational Management								
Change Management	7	1	1	1	7	1	1	7
Workforce Professional Development	7	1	1	1	7	2	1	7
Leadership and Management Development								
Strategic Planning	7	1	1	1	7	1	7	7
Innovative Problem Solving	7	1	1	1	7	1	7	
Journeyman								
Contracting	7	1	1	1	7	1	7	7
Supervisor, Manager, Sr. Tech. Specialist								
Technology	7	1	1	1	7	2	7	7
Joint Operations	7	1	1	1	7	2	7	7
Manager								

KNOWLEDGE AREA	AWARENESS LEVEL							
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**							
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*T&E*	*Train*
International Operations	7	1	1	1	7	2	7	7
Senior Technical Specialist								
Technology Planning	7	1	1	1	7	2	7	7
Technology Transition	7	1	1	1	7	2	7	7
Develop Simulation Requirements								
Identify the requirement								
Need Assessment	1	1	1	2	1	2	1	7
Desired Outcomes	1	1	1	2	1	2	1	7
RDA Development Cycle	1	7	1	3	1	2	1	7
ORD Development	1	7	1	2	1	2	1	7
Validate the requirement								
Organizational Inputs	1	7	2	1	1	2	1	7
Technical Review	1	7	2	7	1	2	1	7
Organizational Input	1	7	2	3	1	2	1	7
Spiral Development Process	1	1	2	2	1	2	1	7
Scope the requirement								
User Perspective	1	1	2	2	1	2	1	7
Resource Constraints	1	1	2	1	7	2	1	7
New M&S Application								
Identifying new capability								
New Organization or System	1	7	2	3	1	2	1	7
New Mission Set	1	7	2	1	1	2	1	7
Validating new application								

KNOWLEDGE AREA	AWARENESS LEVEL							
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**							
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*T&E*	*Train*
Organizational Input	1	7	2	3	1	2	1	7
System Capability Input	1	7	2	3	1	2	1	7
Documenting new application								
Documentation of Development	1	1	2	2	1	2	1	7
Incorporate requirement into the RDA domain								
Cradle to Grave Concept	1	1	1	2	1	2	7	7
Technical Development of the Simulation								
Identify key programming aspects								
Technical Design	7	1	1	1	1	1	7	7
Structure Design	7	1	1	1	1	1	7	7
Translating Process	7	1	1	1	1	1	7	7
Collect data for programming								
Identify Sources	1	7	1	7	1	1	7	7
Data Management Plan	1	7	1	7	1	1	7	7
Documentation	1	7	1	7	1	1	7	7
Convert data into programming language								
Characteristics of Languages	1	7	1	7	1	1	7	7
Technical Development of the Simulation								
Convert data into programming language								
Configuration Management	1	7	1	7	1	1	7	
Documentation	1	7	1	7	1	1	7	7
Computer Technology								
Software Engineering	7	1	1	7	1	1	7	7

KNOWLEDGE AREA	AWARENESS LEVEL							
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**							
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*T&E*	*Train*
SEI/CMU concepts, methods and implementation	7	1	1	7	1	1	7	7
Agents-based simulation, adaptive systems	7	1	1	7	1	1	7	7
Prepare to Use Simulation								
Conduct developer VV&C								
VV&C Concept	1	1	1	7	1	2	7	7
Certification	1	7	1	7	1	2	7	7
Documentation	1	7	1	7	1	2	7	7
Conduct testing of simulation								
Assess Abilities	1	7	1	7	1	2	7	7
Establish Parameters	1	7	1	7	1	2	7	7
Conduct user VV&A								
VV&A Concept	1	1	2	7	1	2	7	7
Accreditation	1	1	2	7	1	2	7	7
Documentation	1	1	2	7	1	2	7	7
Prepare to Use Simulation								
Mathematics								
Continuous	1	7	1	7	1	7	7	7
Discrete	1	7	1	7	7	7	7	7
Steady-State	1	7	1	7	1	7	7	7
Queuing Theory	1	7	1	7	1	7	7	7
Dynamic	1	7	1	7	1	7	7	7
Discrete Event Simulation	1	7	1	7	1	7	7	7
Numerical Analysis	1	7	7	7	7	7		7

KNOWLEDGE AREA	AWARENESS LEVEL							
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**							
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*T&E*	*Train*
Linear algebra	1	7	7	7	7	7	7	7
Boolean algebra	7	7	7	7	1	7	7	7
Ordinary differential equations	7	7	7	7	7	7	7	7
Partial differential equations	7	7	7	7	7	7	7	7
Statistics								
Queuing theory	1	7	7	7	1	7	7	7
Hypothesis testing	7	7	7	7	1	7	7	7
Variance reduction	7	7	7	7	1	7	7	7
Design of experiments	7	7	7	7	1	7	7	7
Stochastic Processes/Statistics								
Queuing	1	7	1	7	1	7	7	7
Programmatic								
Technology	1	1	1	2	1	2	2	7
Production Tools	1	1	1	2	1	2	2	7
Management	1	1	1	2	1	2	2	7
Marketing	7	1	1	2	1	2	2	7
Specific Simulations and Attributes								
Assess each simulation								
Hierarchy of Simulations	1	1	1	1	1	1	2	7
Assessment Process	1	1	1	1	1	2	1	7
Identify specific simulations								
Application Description								
History	1	1	1	7	1	2	2	7
Current Usage	1	1	1	2	1	2	2	7
Other Usage	1	1	1	2	1	2	2	7
Technical Description								

KNOWLEDGE AREA	AWARENESS LEVEL							
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**							
Component	***Army***	***Navy***	***AF***	***Marine***	***Joint***	***Acq***	***T&E***	***Train***
Language	1	7	1	7	1	1	3	7
Specifications	1	1	1	7	1	1	7	7
Interoperability with other simulations								
ALSP, DIS & HLA	1	1	2	1	1	2	3	7
DIS Concept	1	1	1	7	1	1	3	7
ALSP Concept	1	1	1	7	1	1	3	7
HLA Concept	1	1	1	7	1	1	3	7
Air Force Simulations	1	1	1	7	1	1	3	7
Army Simulations		1	1	7				
Navy Simulations	1	1	1	7	1	1	3	7
Marine Simulations	1	1	1	7	1	1	3	7
Joint Simulations	1		1		1	2	3	7
Interoperability with real world equipment								
C4I Systems	1	1	1	1	1	2	2	7
Specific Simulations and Attributes								
Interoperability with real world equipment								
Weapon Systems	1		1		1	2	2	7
Develop strategy to meet requirement								
Develop a M&S Support Architecture	1	7	1	7		1	2	7
Documentation	1		1		1	1	2	7
Identify simulations to meet requirement								
Psychology								
Neural level modeling	7	7	7	7		1	7	7

KNOWLEDGE AREA	AWARENESS LEVEL							
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**							
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*T&E*	*Train*
Specific Simulation Applications								
Computer Science								
Data structures	1	7	1	7	1	3	7	7
Computer architecture/organization	1	7	1	7	1	1	7	7
File management	1	7	1	7	1	3	7	7
Database systems	1	7	1	7	1	3	7	7
Computer networks	1	7	1	7	1	2	7	7
Parallel computing	1	7	1	7	1	1	2	7
Artificial intelligence	1		1		1	2	2	7
Education								
Learning theories	1		1		1	2	7	7
Industrial Engineering								
Linear programming	7	7	7	7	1	1	7	7
Specific Simulation Applications								
Industrial Engineering								
Dynamic programming	7	7	7	7	1	1	7	7
Nonlinear optimization	7	7	7	7	1	1	7	7
Sensitivity analysis	7	7	7	7		1	7	7
M&S Abstraction Techniques/representational schemas								
Static/dynamic	7	7	7	7	1	1	7	7
Descriptive/normative/prescriptive	7	7	7	7	1	1	7	7
Scalar/vector/manifold	7	7	7	7	1	1	7	7

KNOWLEDGE AREA	AWARENESS LEVEL							
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**							
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*T&E*	*Train*
Syntax/semantics	7	7	7	7		1	7	7
Distribution of evaluation: in space; in time	7		7		1	2		
Types of Representation								
Mathematical	1	7	1	7	1	7	7	7
Partial differential equations and boundary value	1	7	7	7	1	7	7	7
Problems	1	7	7	7	1	7	7	7
Structural	1	7	1	7	1	7	7	7
Diagrammatic	7	7	1	7	1	7	7	7
Petri Nets	7	7	7	7	1	7	7	7
Finite element		7	7	7	1	7	7	7
Nomograph	7	7	7	7	1	7	7	7
Process	1	7	1	7	1	7	7	7
Event trace	1	7	7	7	1	7	7	7
Specific Simulation Applications								
Types of Representation								
State transition	1	7	1	7	1	7	7	7
Information	1	7	7	7	1	7	7	7
Taxonomic	1	7	7	7	1	7	7	7
Classificatory (UML static)	7	7	7	7	1	7	7	7
Data	1	7	1	7	1	7	7	7
M&S Uses (Classes)								
Extrapolation / interpolation-in-time	7	7	7	7	1	7	7	7
Extrapolation / interpolation-in-space	7	7	7	7	1	7	7	7
Developing the Training Environment								
Identify training objectives								

KNOWLEDGE AREA	AWARENESS LEVEL							
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**							
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*T&E*	*Train*
Training Design	1	1	2	2	1	1	2	7
Organizational Perspective	1	7	2	2	1	1	2	7
Training audience	1	7	2	2	1	1	2	7
Primary Training Objectives	1	7	2	2	1	1	2	7
Secondary Training Objectives	1	7	2	2		1	2	7
Design a architecture based on objectives								
Single vs Multiple Sites	1	7	1	1	1	1	2	7
Communication	1	7	1	1	1	1	2	7
Security	1	7	1	1		1	2	7
Refine objectives with defined outcomes								
Time Constraints	1	7	1	2	1	1	2	7
Resource Constraints	1	7	1	2	1	1	2	7
Simulation in the Training Environment								
Define observation process								
Alignment of Objectives	1	7	1	1	1	1	7	7
Structure of Observation	1	7	1	1		1	7	7
Develop timeline structure for integration								
Exercise Timeline	1	7	1	2	1	1	7	7
Technical Timeline	1	7	1	2	1	1	7	7
Support Timeline	1	7	1	2	1	1	7	7
Conduct pre-integration activities								
Initial Research	1	7	1	7	1	1	7	7
IPR Concept	1	7	1	1	1	1	7	7
Design of Simulation Event	1	7	1	7	1	1	7	7
Facility Support	1	7	1	2	1	1	7	7
Scenario Development	1	7	1	2	1	1	7	7

KNOWLEDGE AREA	AWARENESS LEVEL							
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**							
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*T&E*	*Train*
Support Activities	1	7	1	2	1	1	7	7
Pre-training	1	7	1	3	1	1	7	7
Documentation	1	7	1	2		1	7	7
Conduct integration activities								
Cell Functions	1	7	1	3	1	1	7	7
Exercise Flow	1	7	1	3		1	7	7
Observation of Training Environment								
Collect observations								
Collection Plan	1	7	1	3	1	7	7	7
Analysis	1	7	1	1	1	7	7	7
Observation of Training Environment								
Supporting Materials	1	7	1	1	1	7	7	7
Documentation	1	7	1	1	1	7	7	7
Provide feedback based upon observations								
Formal AAR Process	1	1	1	2		2	7	7
Informal Process	1	7	1	3		2	7	7
Final Report	1	7	1	3		2	7	7
M&S Related Assets								
Notations	7	7	7	7	1	7	7	7
Syntactic specifications and conventions	7	7	7	7	1	7	7	7
Semantic specifications and conventions	7	7	7	7	1	7	7	7

KNOWLEDGE AREA	AWARENESS LEVEL							
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**							
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*T&E*	*Train*
M&S Related Perspectives								
Enterprise	7	1	1	7	1	7	7	7
Business Practice	7	1	1	7	1	7	7	7
Economics of M&S	1	1	2	2	1	7	7	7
Market Model	1	1	1	7	1	7	7	7
Products	1	1	1	7	1	7	7	7
Services	1	1	1	7	1	7	7	7
Buyers	1	1	1	7	1	7	7	7
Sellers	1	1	1	7	1	7	7	7
Business Case	1	1	1	7	1	7	7	7
M&S Related Perspectives								
Cost-benefit	1	1	2	2	1	7	7	7
Enterprise Infrastructure	7	1	1	7	1	7	7	7
Professional Development	1	1	1	7	1	7	1	7
Enterprise Process	7	1	1	7	1	7	1	7
Enterprise Tools	7	1	1	7	1	7	1	7
M&S Related Disciplines								
Graph Theory	1	7	7	7	1	1	7	7
Logic	1	7	7	7	1	1	7	7
Relations	1	7	7	7	1	1	7	7
Inference	1	7	7	7	1	1	7	7
Management								

KNOWLEDGE AREA	AWARENESS LEVEL							
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**							
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*T&E*	*Train*
Enterprise Management	1	1	1	7	1	1	1	7
Corporate institutional development	1	1	1	7	1	1	1	7
Enterprise operations	1	1	1	7	1	1	1	7
Evaluation Design								
Develop measurement of outcomes								
Baseline Establishment	1	7	1	2	1	7	7	7
Measurement Alignment to Objectives	1	1	1	4	1	7	7	7
Tractability Documentation	1	7	1	2	1	7	7	7
Evaluation Design								
Develop evaluation methodology and tools								
Technical Evaluation Methodology	7	7	1	7	1	7	7	7
Application Evaluation Methodology	7	7	1	7	1	7	7	7
Develop description of evaluation methods								
Quantitative Methods	7	1	1	7	1	7	7	7
Qualitative Methods	7	1	1	7	1	7	7	7
Develop resources to conduct the evaluation								
Resource Scoping	7	7	1	2	1	7	7	7
Issues with Resource Constraints	7	7	1	2	1	7	7	7
Execution of Evaluation								
Develop timelines for the evaluation								
Pre-Collection Timeline Development	7	7	1	2	1	7	7	7

KNOWLEDGE AREA	AWARENESS LEVEL							
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**							
Component	***Army***	***Navy***	***AF***	***Marine***	***Joint***	***Acq***	***T&E***	***Train***
Post Collection Timeline Development	7	7	1	2	1	7	7	7
Execute the evaluation								
Collection Methodology	1	7	1	7	1	7	7	7
Documentation of Collection	1	7	1	7	1	7	7	7
Assessment of Evaluation								
Compile evaluation data								
Correlation Approach for Data	1	7	1	7	1	7	7	7
Tracking Data Collection Coverage	1	7	1	7	1	7	7	7
Analyze the evaluation data								
Alignment of Data to Outcomes	7	7	1	7	1	7	7	7
Secondary Source Development	7	7	1	7	1	7	7	7
Convert analysis results to an action plan								
Develop Analysis Relationships	7	7	1	7	1	7	7	7
Develop New or Modified Requirements	7	7	1	7	1	7	7	7
M&S Modification								
Determining Need to Change a Simulation								
Identify shortfalls in simulation								
Application Design Flaws	1	7	1	7	1	7	7	7
Technical Design Flaws	1	7	1	7	1	7	7	7
Develop requirements to rectify the shortfalls								
Application Requirements	7	7	1	7	1	7	7	7
Technical Requirements	7	7	1		1	7	7	7
Validate requirements to rectify the shortfalls								

KNOWLEDGE AREA	AWARENESS LEVEL							
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**							
Component	***Army***	***Navy***	***AF***	***Marine***	***Joint***	***Acq***	***T&E***	***Train***
Organizational Review	7	7	1	7	1	7	7	7
Technical Review	7	7	1	7	1	7	7	7
Technical Changes of the Simulation								
Collect data to rectify the shortfalls								
Focused Data Collection	7	7	7	1	1	7	7	7
Alignment to other Data	7	7	7	1	1	7	7	7
Convert data into programming language								
Convert Data	7	7	7	7	1	7	1	7
Data Insertion into Simulation	1	7	7		1	7		7
Soft Computing								
Decision Trees	1	7	1	1	1	7	7	7
Dynamic Programming	1	7	7	7	1	7	7	7
Emergent Behavior	7	7	7	1	1	7	7	7
Fractals	7	7	7	7	1	7	7	7
Fuzzy Logic	7	7	7	7	1	7	7	7
Genetic Algorithms	1	7	7	7	1	7	7	7
Human Cognition	7	7	1	7	1	7	7	7
Knowledge-Based Systems	1	7	1	7	1	7	7	7
Logistic Networks	1	7	1	2	1	7	7	7
Neural Nets	7	7	7	7	1	7	7	7
Petri Nets	7	7	7	7	1	7	7	7
Simulated Annealing	7	7	7	7	1	7	7	7
Swarms	7	7	7	7	1	7	7	7
Conduct VV&C of modified simulation								
VV&C Modification	1	7	1	7	1	7	7	7
Convert language into another language								

KNOWLEDGE AREA	AWARENESS LEVEL							
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**							
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*T&E*	*Train*
Resource Implications	7	7	7	7	1	7	7	7
Implications of Conversion	7	7	7	7	1	7	7	7
Assessment of Changes to a Simulation								
Conduct testing of modified simulation								
Alpha Testing Modification	1	7	1	1	1	7	7	7
Beta Testing Simulation	1	7	1	1	1	7	2	7
Conduct user VV&A of modified simulation								
VV&A Modification in Simulation	1	7	2	2	1	7	2	7
Documentation of Modification	1	7	2	2	1	7	7	7
M&S Development and Use Life Cycle								
Retirement	1	1	1	2	1	2	1	7
M&S Related Concepts								
analog simulation	1	1	1	1	7	7	7	7
digital simulation	1	1	1	1	1	7	7	7
human-in-the-loop simulation	1	1	2	2	1	2	7	7
hardware-in-the-loop simulation	1	1	2	2	1	2	7	7
software-in-the-loop simulation	1	1	2	2	1	7	7	7
composability	1	1	1	7	7	7	7	7
community of practice	1	1	1	1	1	2	7	7
professional certification	1	1	2	2	7	7	7	7
simulation asset management	1	1	1	7	1	7	7	7
economics of simulation	1	1	2	2	1	2	7	7
sensors	1	1	1	7	1	7	7	7
web-enabled simulations	1	1	1	1	1	7	7	7

KNOWLEDGE AREA	AWARENESS LEVEL							
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**							
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*T&E*	*Train*
simulation tools (AcslXtreme,etc)	1	1	1	7	1	7	7	7
bioinformatics	7	7	7	7	1	7	7	7
wearable computing	1	7	1	7	1	7	7	7
augmented reality / mixed real	7	1	1	2	1	7	7	7
biometrics	1	7	7	2	1	7	7	7
biosensors	7	7	7	2	1	7	7	7
neural networks	7	1	1	7	1	7	7	7
data mining	1	1	1	7	1	7	2	7
authoring systems	1	1	1	7	1	7	7	7
grid and cluster computing	7	1	1	7	1	7	7	7
distributed high performance computing	7	1	1	7	1	7	7	7
optical computing	7	7	7	7	1	7	7	7
Microeletromechanical systems MEMS	7	7	7	7	1	7	7	7
Micro-opto-mechanical systems MOMS	7	7	7	7	1	7	7	7
RF MEMS	7	7	7	7	1	7	7	7
BioMEMS	7	7	7	7	1	7	7	7
photonics	7	7	7	7	1	7	7	7
microfluidics	7	7	7	7	1	7	7	7
teraherz technology	7	7	7	7	1	7	7	7
RUP (rational unified process)	7	7	7	7	1	7	7	7
UML	7	1	7	7	1	7	7	7
Shlaer-Mellor method of structured modeling	7	7	7	7	1	7	7	7
ROOM (real time object oriented modeling)	7	7	7	7	1	7	7	7
MDA (model driven architectures)	7	7	7	7	1	7	7	7
IDEF0 & IDEF1x (ER diagrams)	7	7	7	7	1	7	7	7
Gane-Sarson data flow modeling	7	7	7	7	1	7	7	7
Coad/Yourdon structured information modeling	7	7	7	7	1	7	7	7
TENA (test & training enabling architecture	7	1	7	7	1	7	7	7
CORBA IDL (interface definition language)	7	1	7	7	1	7	7	7
phenomenon algorithm specification	7	7	7	7	1	7	7	7

KNOWLEDGE AREA	AWARENESS LEVEL							
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**							
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*T&E*	*Train*
common software component development	7	1	7	7	1	7	7	7
finite element method	7	1	7	7	1	7	7	7
hybrid simulation: e.g., combined CS/DES/FEM	7	1	7	7	1	7	7	7
surrogate key	7	7	7	7	1	7	7	7
hybrid models	7	7	7	7	1	7	7	7
DES example	7	1	7	2	1	7	7	7
DES components	7	7	7	7	1	7	7	7
modeling issues in hybrid simulations	7	7	7	7	1	7	7	7
complex adaptive systems (CAS)	7	1	7	7	1	7	7	7
complexity and CAS modeling	7	1	7	7	1	7	7	7
complexity and chaos	7	1	7	7	1	7	7	7
CAS modeling methods	7	1	7	7	1	7	7	7
CAS modeling case studies	7	1	7	7	1	7	7	7
composability theory	1	1	1	7	1	7	7	7
hierarchical simulation	1	1	1	7	1	7	7	7
SEI/CMU concepts, methods & implementation	7	7	7	7	1	7	7	7
solving DEs and PDEs	7	7	7	7	1	7	7	7
finite element analysis/PDE	7	7	7	7	1	7	7	7
visualization for information representation	7	1	1	7	1	7	7	7
IG techniques	7	1	7	7	1	7	7	7
deployment model	1	1	1	1	1	7	7	7
execution model	1	1	1	7	1	7	7	7
component model	1	1	1	7	1	7	7	7
information model	1	1	1	7	1	7	7	7
product line architecture & development	7	1	1	7	1	7	7	7
data mining languages	7	1	1	7	1	7	7	7
data mining using simulation	1	1	1	7	1	7	7	7
CROM	7	7	7	7	1	7	7	7
C2IEDM	7	7	7	7	1	7	7	7

KNOWLEDGE AREA	AWARENESS LEVEL							
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**							
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*T&E*	*Train*
microelectromechanic systems (MEMS)	7	7	7	X	1	7	7	7
Popkin's Systems Architect	7	7	7	7	1	7	7	7
ERWin Data Modeler	7	7	7	7	1	7	7	7
Component X	7	7	7	7	1	7	7	7
CADM	7	7	7	7	1	7	7	7
architecture views	7	7	7	2	1	7	7	7
operational (process) architecture	7	7	7	2	1	7	7	7
activity modeling	7	7	7	1	1	7	7	7
information exchange model	7	7	7	7	1	7	7	7
IDEF 1X	7	7	7	7	1	7	7	7
LADAR/IR	7	7	7	2	1	7	7	7
degeneracy tests	7	7	7	7	1	7	7	
logical variable	7	1	1	7	1	7	7	7
integer variable	7	1	1	2	1	7	7	7
real variable	7	1	1	7	1	7	7	7
state variable	1	1	1	7	1	7	7	7
initial condition	7	1	1	7	1	7	7	7
steady state	1	1	1	7	1	7	7	7
data fusion	7	1	1	7	1	7	7	7
fractal	7	1	7	7	1	7	7	7
Phong Lighting Model	7	1	7	7	1	7	7	7
Z-buffer	7	1	7	7	1	7	7	7
computable	7	1	7	7	1	7	7	
NP complete	7	1	7	7	1	7	7	7
evolutionary computation	7	1	7	7	1	7	7	7
portable simulation systems	7	1	1	3	1	7	7	7
eye-point	7	1	1	7	1	7	7	7
Field-of-View (FOV)	7	1	2	2	1	7	7	7
euler attitude angles	7	1	7	7	1	7	7	7
fitness landscape	7	1	7	7	1	7	7	7

KNOWLEDGE AREA	AWARENESS LEVEL							
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**							
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*T&E*	*Train*
predator-prey modeling	7	1	7	7	1	7	7	7
principle of competitive exclusion (Gause's principle)	7	1	7	7	1	7	7	7
inductive modeling	7	1	7	7	1	7	7	7
multicast	7	1	1	7	1	7	7	7
interest management	7	1	7	7	1	7	7	7
time warp	7	1	7	7	1	7	7	7
dependent variables	7	1	1	7	1	2	7	7
effects based modeling	7	1	1	7	1	2	7	7
lazy evaluation	7	1	7	7	1	7	7	7
differential games	7	1	7	7	1	7	7	7
white-box and black-box models	1	1	1	7	1	7	7	7
behavior diagrams	7	1	1	7	1	7	7	7
functional analysis	1	1	1	7	1	7	7	7
replicated validation	7	1	1	7	1	2	7	7
priority queue data structure	7	1	7	7	1	7	7	7
conservative time management	7	1	7	7	1	7	7	7
optimistic time management	7	1	7	7	1	7	7	7
predictive contracts	7	1	7	7	1	7	7	7
big/little endian data formats	7	1	7	7	1	7	7	7

Summary BOK Ratings for Application Usage Levels

KNOWLEDGE AREA	APPLICATION LEVEL								
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or informatio **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**								
Component	***Army***	***Navy***	***AF***	***Marine***	***Joint***	***Acq***	***Plan***	***T&E***	***Train***
Basic Concepts									
Understand historic perspective of M&S									
Historic Aspect of M&S	3	3	2	7	1	1	2	1	7
DoD/Military Simulations									
Policies and rules	5	5	3	3	3	3	2	7	6
Modeling Concepts									
Model Types									
Model Definition	4	4	6	2	6	3	2	3	6
Model Concept	4	4	6	4	6	3	2	6	6
Physical Models	4	4	6	4	6	3	2	6	6
Mathematical Models	4	4	6	4	6	3	2	6	6
Process Models	4	4	6	4	6	3	2	6	6
Combination Models	4	4	6	3		4	2	6	6
M&S Representation									
Systems	5	5	6	4	6	4	3	6	6
Human Behavior	5	5	6	4	6	4	3	6	6
Natural Environment	5	5	6	4	6	4	3	6	6
Modeling Process									
Modeling Process	5	5	6	4	6	3	2	6	6
Abstractions	5	5	6	4	6	3	2	6	6
Formalisms	5	5	6	4	6	3	2	6	6
Design and Build Models									

KNOWLEDGE AREA	APPLICATION LEVEL								
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or informatio **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**								
Component	***Army***	***Navy***	***AF***	***Marine***	***Joint***	***Acq***	***Plan***	***T&E***	***Train***
Conduct Feasibility Assessments	5	5	5	4	6	3	2	6	6
Knowledge engineering	5	5	5	4	6	3	2	6	6
Simulation Concepts									
Simulation Definition	6	6	6	4	6	3	3	2	6
Simulation Concept	5	5	6	2	6	3	3	1	6
Live Simulation	6	6	6	2	2	3	3	2	6
Virtual Simulation	6	6	6	2	2	3	3	2	6
Constructive Simulation	6	6	6	2	2	3	3	1	6
Simulation Methods	6	6	6	2	6	3	3	5	6
General Simulation Knowledge									
Mechanisms	5	5	5	2	6	5	2	5	6
Simulation Ethics	4	4	6	2	2	5	2	2	6
Discrete Event	5	5	6	2	6	5	2	2	6
Continuous	5	5	6	2	6	5	2	2	6
Live/Virtual/Constructive	6	6	6	2	6	5	2	6	6
Discrete Event Simulation									
Formalisms	5	5	6	2	6	5	3	6	6
Implementation/structure/mechanics	5	5	6	2	6	5		5	6
Languages/tools	5	5	6	2	6	5	3	6	6
Worldviews	5	5	6	2	6	5	3	6	6
Warm-up, steady state	5	5	6	2	6	5	3	5	6
Continuous Simulation									
Systems Dynamics	5	5	6	4	6	5	2	5	6
Solving DEs and PDEs (Differential Equations & Partial Differential Equations)	5	5	5	4	6	5	2	5	6
Continuous Simulation									
Languages/tools	5	5	6	4	6	5	2	5	6
Implementation/structure/mechanics	5	5	6	4	6	5	2	5	6

KNOWLEDGE AREA	APPLICATION LEVEL								
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or informatio **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**								
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*Plan*	*T&E*	*Train*
Underlying 'Science'									
Existence	4	4	4		4		7	2	7
Referential designation	4	4	4	4	6	5	7	5	6
Abstraction/classification (verb and noun)	4	4	4	4	6	5	7	5	6
Representation/qualification (verb and noun)	4	4	4	4	6	5	7	5	6
Surrogacy operations	4	4	4	4	6	5	7	5	6
Referential inference	4	4	4	4	6	5	7	5	6
Interoperability Concepts									
Concept of Interoperability	6	6	6	4	6	5	6	5	6
Interoperability Issues	6	6	6	4	6	5	6	5	6
Understand domain concepts (7 surfboards)									
Identify M&S opportunities and challenges									
Opportunities			4	1	6	5	3	6	7
Challenges			4	1	6	5	3	6	7
M&S Organizations									
Identify key Joint/Service M&S organizations									
Organization				1	2	3	1		6
Systems Theory									
Elements to Whole	3	3	4	3	6	5	7	6	7
Reductionism to Holism	3	3	4	3	6	5	7	6	7
Structure to Function	3	3	4	3	6	5	7	6	7
Linear Hierarchy	3	3	4	3	6	5	7	6	7
Network Hierarchy	3	3	4	3	6	5	7	6	7
Spatial Dimensions	3	3	4	3	6	5	7	6	7
Temporal Dimensions	3	3	4	3	6	5	7	6	7
Structural Dimensions	3	3	4	3	6	5	7	6	7

KNOWLEDGE AREA	APPLICATION LEVEL								
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**								
Component	***Army***	***Navy***	***AF***	***Marine***	***Joint***	***Acq***	***Plan***	***T&E***	***Train***
Multi-Disciplined Simulations Specialist									
Operations	3	3	5	1	6	3	6	2	6
Organization	3	3	5	1	4	2	6	2	6
Systems	4	4	5	3	6	3	6	2	6
Modeling									
Design and build models	2	2	6	4	6	5	6	6	6
Feasibility assessment	2	2	6	4	6	5	6	6	6
Knowledge engineering	2	2	6	4	6	5	6	6	6
Leadership and Organizational Management									
Change Management	2	2	4	1	2	7	6	6	2
Workforce Professional Development	2	2	4	1	2	3	6	6	2
Leadership and Management Development									
Strategic Planning	1	1	3	4	2	1	6	2	2
Innovative Problem Solving	3	3	6	3	2	3	6	2	
Journeyman									
Contracting	2	2	3	3	2	1	6	2	2
Supervisor, Manager, Sr. Tech. Specialist									
Technology	3	3	6	3	6	4	6	2	6
Joint Operations	3	3	5	3	3	4	6	2	6
Manager									
International Operations	2	2	5	3	2	3	6	2	6

KNOWLEDGE AREA	APPLICATION LEVEL								
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**								
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*Plan*	*T&E*	*Train*
Senior Technical Specialist									
Technology Planning	3	3	4	3	2	5	6	6	6
Technology Transition	3	3	4	3	2	5	6	6	3
Develop Simulation Requirements									
Identify the requirement									
Need Assessment	3	3	5	4	6	3	6	6	7
Desired Outcomes	3	3	5	4	6	3	6	6	6
RDA Development Cycle	3	3	4	3	6	3	7	6	7
ORD Development	3	3	4	4	6	3	7	6	7
Validate the requirement									
Organizational Inputs	3	3	3	4	6	3	7	6	3
Technical Review	3	3	3	4	6	3	7	6	3
Organizational Input	4	4	3	3	6	3	7	6	2
Spiral Development Process	3	3	6	3	6	3	7	6	2
Scope the requirement									
User Perspective	6	6	5	4	6	3	6	6	6
Resource Constraints	3	3	5	3	6	3	1	6	2
New M&S Application									
Identifying new capability									
New Organization or System	3	3	3	3	6	3	6	6	1
New Mission Set	3	3	3	3	6	3	6	6	1
Validating new application									
Organizational Input	3	3	3	4	6	3	7	6	1
System Capability Input	3	3	3	3	6	3	7	6	2
Documenting new application									
Documentation of Development	5	5	6	4	6	3	7	6	3
Incorporate requirement into the RDA domain									

KNOWLEDGE AREA	APPLICATION LEVEL								
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or informatio **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**								
Component	***Army***	***Navy***	***AF***	***Marine***	***Joint***	***Acq***	***Plan***	***T&E***	***Train***
Cradle to Grave Concept	3	3	4	3	3	4	7	2	6
Technical Development of the Simulation									
Identify key programming aspects									
Technical Design	5	5	6	5	6	4	7	6	5
Structure Design	5	5	6	5	6	4	7	6	5
Translating Process	5	5	6	5	6	4	7	6	5
Collect data for programming									
Identify Sources	5	5	4	4	6	4	1	6	6
Data Management Plan	5	5	4	4	6	4	7	6	6
Documentation	5	5	5	3	6	4	7	6	6
Convert data into programming language									
Characteristics of Languages	6	6	6	4	6	4	7	6	6
Configuration Management	6	6	6	4	6	4	7	6	
Documentation	6	6	6	3	6	4	7	6	6
Computer Technology									
Software Engineering	6	6	6	5	6	4	7	6	6
SEI/CMU concepts, methods and implementation	6	6	6	3	6	4	7	6	4
Agents-based simulation, adaptive systems	5	5	6	6	6	4	7	6	6
Prepare to Use Simulation									
Conduct developer VV&C									
VV&C Concept	4	4	5	3	6	4	7	6	6
Certification	5	5	5	3	6	4	7	6	6
Documentation	5	5	5	3	6	4	7	6	6
Conduct testing of simulation									

KNOWLEDGE AREA	APPLICATION LEVEL								
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or informatio **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**								
Component	***Army***	***Navy***	***AF***	***Marine***	***Joint***	***Acq***	***Plan***	***T&E***	***Train***
Assess Abilities	5	5	4	3	6	4	7	6	6
Establish Parameters	5	5	5	4	6	4	7	6	6
Conduct user VV&A									
VV&A Concept	6	6	5	3	6	4	7	6	6
Accreditation	6	6	5	3	6	4	7	6	4
Documentation	6	6	5	3	6	4	7	6	6
Mathematics									
Continuous	5	5	5	3	6	3	7	6	2
Discrete	5	5	5	3	6	3	7	6	2
Steady-State	5	5	5	3	6	3	7	6	2
Queuing Theory	5	5	5	3	6	3	7	6	2
Dynamic	5	5	5	3	6	3	7	6	2
Discrete Event Simulation	5	5	5	3	6	3	7	6	2
Numerical Analysis	5	5	5	3	6	3	7		2
Linear algebra	5	5	5	3	6	3	7	6	2
Boolean algebra	5	5	5	3	6	3	7	6	2
Ordinary differential equations	5	5	5	3	6	3	7	6	2
Partial differential equations	5	5	5	3	6	3	7	6	2
Statistics									
Queuing theory	5	5	5	3	6	3	7	6	2
Hypothesis testing	5	5	6	3	6	3	7	6	2
Variance reduction	5	5	5	3	6	3	7	6	2
Design of experiments	5	5	6	3	6	4	7	6	2
Stochastic Processes/Statistics									
Queuing	5	5	5	3	6	3	7	6	2
Programmatic									
Technology	5	5	6	5	5	3	2	1	2
Production Tools	5	5	6	5	5	3	2	1	2
Management	2	2	4	2	4	3	2	1	2
Marketing	2	2	3	2	4	3	2	1	2

KNOWLEDGE AREA	APPLICATION LEVEL								
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**								
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*Plan*	*T&E*	*Train*
Specific Simulations and Attributes									
Assess each simulation									
Hierarchy of Simulations	4	4	5	6	6	4	2	6	6
Assessment Process	5	5	4	3	6	3	2	6	6
Identify specific simulations									
Application Description									
History	2	2	3	4	6	2	3	6	6
Current Usage	3	3	3	3	6	2	2	6	6
Other Usage	4	4	3	4	6	2	3	6	6
Technical Description									
Language	3	3	6	6	6	3	2	6	6
Specifications	4	4	5	6	6	3	2	6	6
Interoperability with other simulations									
ALSP, DIS & HLA	4	4	4	3	6	3	7	6	6
DIS Concept	4	4	5	6	6	3	7	6	6
ALSP Concept	4	4	5	6	6	3	7	6	6
HLA Concept	4	4	5	6	6	3	7	6	6
Air Force Simulations	1	1	3	4	6	3	3	6	6
Army Simulations			3	4	6		3		
Navy Simulations	1	1	3	6	6	3	3	6	6
Marine Simulations	1	1	3	4	6	3	3	6	6
Joint Simulations	4	4				3	3	6	6
Interoperability with real world equipment									
C4I Systems	6	6	3	3	6	4	3	6	6
Weapon Systems	6	6			6	4	3	6	6

KNOWLEDGE AREA	APPLICATION LEVEL								
Rating Legend	1 - **Knowledge**: Recalls data or information 2 - **Comprehension**: Able to understand the meaning of data or informatio 3 - **Application**: Uses information in new situations; solves problems 4 - **Analysis**: Breaks down information and identifies components 5 - **Synthesis**: Uses old ideas to create new ones 6 - **Evaluation**: Compares and discriminates between ideas **7 - Does not apply**								
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*Plan*	*T&E*	*Train*
Develop strategy to meet requirement									
Develop a M&S Support Architecture	4	4	5	4	6	3	7	6	6
Documentation	5	5			6	3	7	6	6
Identify simulations to meet requirement									
Psychology			5	3					
Neural level modeling	4	4			6	3	7	6	6
Specific Simulation Applications									
Computer Science									
Data structures	6	6	6	3	6	5	1	6	6
Computer architecture/organization	6	6	6	3	6	5	1	6	6
File management	6	6	6	3	6	5	1	6	6
Database systems	6	6	6	3	6	5	1	6	6
Computer networks	6	6	6	3	6	5	1	6	6
Parallel computing	6	6	6	5	6	5	1	6	6
Artificial intelligence	6	6			6	5	1	6	6
Education									
Learning theories	3	3			6	4	7	6	4
Industrial Engineering									
Linear programming	5	5	5	3	6	3	7	6	6
Industrial Engineering									
Dynamic programming	5	5	5	3	6	3	7	6	6
Nonlinear optimization	5	5			6	3	7	6	6
Sensitivity analysis	6	6	6	5	6	5	1	6	6
M&S Abstraction Techniques/representational schemas									
Static/dynamic	6	6	5	3	6	3	7	6	6
Descriptive/normative/prescriptive	6	6	5	3	6	3	7	6	6
Scalar/vector/manifold	6	6	5	3	6	3	7	6	6

KNOWLEDGE AREA	APPLICATION LEVEL								
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**								
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*Plan*	*T&E*	*Train*
Syntax/semantics	6	6	5	3	6	3	7	6	6
Distribution of evaluation: in space; in time	6	6				3	7		
Types of Representation									
Mathematical	5	5	5	3	6	3	1	6	6
Partial differential equations and boundary value	6	6	5	3	6	3	1	6	6
Problems	5	5	5	3	6	3	1	6	6
Structural	5	5	5	3	6	3	1	6	6
Diagrammatic	5	5	5	3	6	3	1	6	6
Petri Nets	5	5	5	3	6	3	1		6
Finite element	5	5	5	3	6	3	1	6	6
Nomograph	5	5	5	3	6	3	1	6	6
Process	5	5	5	3	6	3	1	6	6
Event trace	5	5	5	3	6	3	1	6	6
State transition	5	5	5	3	6	3	1	6	6
Information	5	5	5	3	6	3	1	6	6
Taxonomic	5	5	5	3	6	3	1	6	6
Classificatory (UML static)	5	5	5	3	6	3	1	6	6
Data	5	5	5	3	6	3	1	6	6
M&S Uses (Classes)									
Extrapolation / interpolation-in-time	5	5	5	3	6	3	7	6	6
Extrapolation / interpolation-in-space	5	5	5	3	6	3	7	6	6
Developing the Training Environment									
Identify training objectives									
Training Design	2	3	3	4	6	3	6	6	6
Organizational Perspective	3	3	3	3	6	3	6	6	6
Training audience	6	3	3	4	6	3	6	6	6
Primary Training Objectives	6	3	3	4	6	3	6	6	6
Secondary Training Objectives	6	3	3	5	6	3	6	6	6

KNOWLEDGE AREA	APPLICATION LEVEL								
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or informatio **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**								
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*Plan*	*T&E*	*Train*
Design a architecture based on objectives									
Single vs Multiple Sites	6	3	3	4	6	3	6	6	6
Communication	6	3	3	4	6	3	6	6	6
Security	6	3	3	4	6	3	2	6	6
Refine objectives with defined outcomes									
Time Constraints	5	3	3	4	6	3	6	6	6
Resource Constraints	4	3	3	4	6	3	6	6	6
Simulation in the Training Environment									
Define observation process									
Alignment of Objectives	4	3	3	4	6	3	6	6	6
Structure of Observation	4	3	3	4	6	3	6	6	6
Develop timeline structure for integration									
Exercise Timeline	3	4	4	3	6	3	6	6	6
Technical Timeline	3	5	5	4	6	3	6	6	6
Support Timeline	3	4	4	3	6	3	6	6	6
Conduct pre-integration activities									
Initial Research	3	4	4	3	6	3	6	6	6
IPR Concept	2	4	4	3	6	3	6	6	6
Design of Simulation Event	3	4	4	4	6	3	6	6	6
Facility Support	3	4	4	3	6	3	6	6	6
Scenario Development	3	4	4	3	6	3	6	6	6
Support Activities	3	4	4	3	6	3	6	6	6
Pre-training	3	3	3	3	6	3	6	6	6
Documentation	4	3	3	3	6	3	6	6	6
Conduct integration activities									
Cell Functions	4	3	3	3	6	3	6	6	6
Exercise Flow	4	3	3	3	6	3	6	6	6

KNOWLEDGE AREA	APPLICATION LEVEL								
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or informatio **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**								
Component	***Army***	***Navy***	***AF***	***Marine***	***Joint***	***Acq***	***Plan***	***T&E***	***Train***
Observation of Training Environment									
Collect observations									
Collection Plan	4	5	4	5	6	3	6	6	6
Analysis	4	4	4	4	6	3	6	6	6
Supporting Materials	4	3	4	3	6	3	6	6	6
Documentation	4	3	3	3	6	3	6	6	6
Provide feedback based upon observations									
Formal AAR Process	4	3	4	3	6	3	6	6	6
Informal Process	4	3	4	3	6	3	6	6	6
Final Report	4	3	4	3	6	3	6	6	6
M&S Related Assets									
Notations	4	3	3	3	6	3	6	6	6
Syntactic specifications and conventions	4	3	3	3	6	3	6	6	6
Semantic specifications and conventions	4	3	3	3	6	3	6	6	6
M&S Related Perspectives									
Enterprise	1	2	3	2	6	3	6	6	4
Business Practice	3	2	3	2	6	3	6	6	4
Economics of M&S	4	3	3	3	6	3	6	6	4
Market Model	4	2	3	2	6	3	6	6	4
Products	4	2	3	2	6	3	6	6	4
Services	3	2	3	2	6	3	6	6	4
Buyers	4	2	3	2	6	3	6	6	4
Sellers	1	2	3	2	6	3	6	6	4
Business Case	4	2	3	2	6	3	6	6	4

KNOWLEDGE AREA	APPLICATION LEVEL								
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**								
Component	***Army***	***Navy***	***AF***	***Marine***	***Joint***	***Acq***	***Plan***	***T&E***	***Train***
Cost-benefit	4	3	3	3	6	3	6	6	4
Enterprise Infrastructure	4	3	3	3	6	3	6	6	4
Professional Development	4	3	3	3	6	3	6	6	4
Enterprise Process	4	3	3	3	6	3	6	6	4
Enterprise Tools	4	3	3	3	6	3	6	6	4
M&S Related Disciplines									
Graph Theory	4	4	5	4	6	3	6	6	6
Logic	4	4	5	4	6	3	6	6	6
Relations	4	4	5	4	6	3	6	6	6
Inference	4	4	5	4	6	3	6	6	6
Management									
Enterprise Management	3	3	3	3	6	3	6	6	6
Corporate institutional development	3	3	3	3	6	3	6	6	6
Enterprise operations	3	3	3	3	6	3	6	6	6
Evaluation Design									
Develop measurement of outcomes									
Baseline Establishment	5	5	3	3	6	3	6	6	6
Measurement Alignment to Objectives	5	5	3	4	6	3	6	6	6
Tractability Documentation	5	5	3	3	6	3	6	6	6
Develop evaluation methodology and tools									
Technical Evaluation Methodology	5	5	3	3	6	3	6	6	6
Application Evaluation Methodology	5	5	3	3	6	3	6	6	6

KNOWLEDGE AREA	APPLICATION LEVEL								
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or informatior **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**								
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*Plan*	*T&E*	*Train*
Develop description of evaluation methods									
Quantitative Methods	5	5	4	3	6	3	6	6	6
Qualitative Methods	5	5	4	3	6	3	6	6	6
Develop resources to conduct the evaluation									
Resource Scoping	3	3	3	3	6	3	6	6	6
Issues with Resource Constraints	3	3	3	3	6	3	6	6	6
Execution of Evaluation									
Develop timelines for the evaluation									
Pre-Collection Timeline Development	3	3	3	3	6	3	6	6	6
Post Collection Timeline Development	3	3	3	3	6	3	6	6	6
Execute the evaluation									
Collection Methodology	5	5	3	3	6	3	6	6	6
Documentation of Collection	5	5	3	3	6	3	6	6	6
Assessment of Evaluation									
Compile evaluation data									
Correlation Approach for Data	5	5	3	3	6	3	4	6	6
Tracking Data Collection Coverage	5	5	3	3	6	3	4	6	6
Analyze the evaluation data									
Alignment of Data to Outcomes	5	5	3	3	6	3	6	6	6
Secondary Source Development	5	5	3	3	6	3	6	6	6
Convert analysis results to an action plan									
Develop Analysis Relationships	6	6	3	3	6	3	6	6	6
Develop New or Modified Requirements	6	6	3	3	6	3	6	6	6

KNOWLEDGE AREA	APPLICATION LEVEL								
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or informatio **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**								
Component	*Army*	*Navy*	*AF*	*Marine*	*Joint*	*Acq*	*Plan*	*T&E*	*Train*
M&S Modification									
Determining Need to Change a Simulation									
Identify shortfalls in simulation									
Application Design Flaws	4	4	3	3	6	3	4	6	6
Technical Design Flaws	6	6	3	3	6	3	4	6	6
Develop requirements to rectify the shortfalls									
Application Requirements	4	4	3	3	6	3	3	6	6
Technical Requirements	6	6	3		6	3	3	6	6
Validate requirements to rectify the shortfalls									
Organizational Review	3	3	3	3	6	3	3	6	2
Technical Review	4	4	3	3	6	3	1	6	6
Technical Changes of the Simulation									
Collect data to rectify the shortfalls	6	6							
Focused Data Collection	3	3	3	4	6	3	7	6	6
Alignment to other Data	5	5	3	4	6	3	7	6	6
Convert data into programming language									
Convert Data	5	5	3	4	6	3	7	6	6
Data Insertion into Simulation	5	5	4		6	3	7		6
Soft Computing									
Decision Trees	5	5	3	3	6	3	7	6	6
Dynamic Programming	5	5	4	3	6	3	7	6	6
Emergent Behavior	5	5	4	3	6	3	7	6	6
Fractals	5	5	3	3	6	3	7	6	6

KNOWLEDGE AREA	APPLICATION LEVEL								
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or informatior **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**								
Component	***Army***	***Navy***	***AF***	***Marine***	***Joint***	***Acq***	***Plan***	***T&E***	***Train***
Fuzzy Logic	5	5	4	3	6	3	7	6	6
Genetic Algorithms	5	5	4	3	6	3	7	6	6
Human Cognition	5	5	4	3	6	3	7	6	6
Knowledge-Based Systems	5	5	4	3	6	3	7	6	6
Logistic Networks	5	5	4	3	6	3	7	6	6
Neural Nets	5	5	4	3	6	3	7	6	6
Petri Nets	5	5	3	3	6	3	7	6	6
Simulated Annealing	5	5	3	3	6	3	7	6	6
Swarms	5	5	3	3	6	3	7	6	6
Conduct VV&C of modified simulation									
VV&C Modification	5	5	3	3	6	3	7	6	6
Soft Computing									
Convert language into another language									
Resource Implications	4	4	3	3	6	3	7	6	6
Implications of Conversion	4	4	3	3	6	3	7	6	6
Assessment of Changes to a Simulation									
Conduct testing of modified simulation									
Alpha Testing Modification	5	5	3	4	6	3	7	6	6
Beta Testing Simulation	5	5	3	4	6	3	7	6	6
Conduct user VV&A of modified simulation									
VV&A Modification in Simulation	6	6	3	3	6	3	7	6	6
Documentation of Modification	6	6	3	3	6	3	7	6	6
M&S Development and Use Life Cycle									
Retirement	3	3	3	4	6	3	7	6	6

KNOWLEDGE AREA	APPLICATION LEVEL								
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**								
Component	***Army***	***Navy***	***AF***	***Marine***	***Joint***	***Acq***	***Plan***	***T&E***	***Train***
M&S Related Concepts									
analog simulation	4	1	1	3	6	3	6	7	6
digital simulation	4	1	1	3	6	3	6	7	6
human-in-the-loop simulation	4	1	1	3	6	3	6	7	6
hardware-in-the-loop simulation	4	1	1	3	6	3	6	7	6
software-in-the-loop simulation	4	1	1	3	6	3	6	7	6
composability	4	1	1	3	6	3	6	7	6
community of practice	3	1	1	2	6	3	6	7	6
professional certification	2	1	1	2	6	3	6	7	6
simulation asset management	4	1	1	3	6	3	6	7	6
economics of simulation	3	1	1	3	6	3	6	7	6
sensors	4	1	1	3	6	3	6	7	6
web-enabled simulations	5	1	1	4	6	3	6	7	6
simulation tools (AcslXtreme,etc)	6	1	1	6	6	3	6	7	6
bioinformatics	4	7	7	3	6	3	6	7	6
wearable computing	3	7	7	3	6	3	6	7	6
augmented reality / mixed real	4	1	1	3	6	3	6	7	6
biometrics	3	7	7	3	6	3	6	7	6
biosensors	3	7	7	3	6	3	6	7	6
neural networks	3	1	1	3	6	3	6	7	6
data mining	4	1	1	3	6	3	6	7	6
authoring systems	3	1	1	3	6	3	6	7	6
grid and cluster computing	3	1	1	3	6	3	6	7	6
distributed high performance computing	3	1	1	3	6	3	6	7	6
optical computing	3	7	7	3	6	3	6	7	6
Microeletromechanical systems MEMS	3	7	7	3	6	3	6	7	6
Micro-opto-mechanical systems MOMS	3	7	7	3	6	3	6	7	6
RF MEMS	3	7	7	3	6	3	6	7	6

KNOWLEDGE AREA	APPLICATION LEVEL							
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or informatio **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**							
Component	***Army***	***Navy***	***AF***	***Marine***	***Joint***	***Acq***	***Plan***	***T&E***	***Train***
BioMEMS	3	7	7	3	6	3	6	7	6
photonics	3	7	7	3	6	3	6	7	6
microfluidics	3	7	7	3	6	3	6	7	6
teraherz technology	3	7	7	3	6	3	6	7	6
RUP (rational unified process)	3	7	7	3	6	3	6	7	6
UML	4	1	1	3	6	3	6	7	6
Shlaer-Mellor method of structured modeling	4	7	7	3	6	3	6	7	6
ROOM (real time object oriented modeling)	3	7	7	3	6	3	6	7	6
MDA (model driven architectures)	3	7	7	3	6	3	6	7	6
IDEF0 & IDEF1x (ER diagrams)	1	7	7	2	6	3	6	7	6
Gane-Sarson data flow modeling	4	7	7	3	6	3	6	7	6
Coad/Yourdon structured information modeling	3	7	7	3	6	3	6	7	6
TENA (test & training enabling architecture	4	1	1	3	6	3	6	7	6
CORBA IDL (interface definition language)	3	1	1	3	6	3	6	7	6
phenomenon algorithm specification	3	7	7	3	6	3	6	7	6
common software component development	3	1	1	3	6	3	6	7	6
finite element method	4	1	1	3	6	3	6	7	6
hybrid simulation: e.g., combined CS/DES/FEM	4	1	1	3	6	3	6	7	6
surrogate key	3	7	7	3	6	3	6	7	6
hybrid models	4	7	7	3	6	3	6	7	6
DES example	2	1	1	3	6	3	6	7	6
DES components	2	7	7	3	6	3	6	7	6
modeling issues in hybrid simulations	4	7	7	3	6	3	6	7	6
complex adaptive systems (CAS)	2	1	1	3	6	3	6	7	6
complexity and CAS modeling	2	1	1	3	6	3	6	7	6

KNOWLEDGE AREA	APPLICATION LEVEL								
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or informatio **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**								
Component	***Army***	***Navy***	***AF***	***Marine***	***Joint***	***Acq***	***Plan***	***T&E***	***Train***
complexity and chaos	3	1	1	3	6	3	6	7	6
CAS modeling methods	3	1	1	3	6	3	5	7	6
CAS modeling case studies	3	1	1	3	6	3	6	7	6
composability theory	4	1	1	3	6	3	6	7	6
hierarchical simulation	4	1	1	3	6	3	6	7	6
SEI/CMU concepts, methods & implementation	3	7	7	3	6	3	6	7	6
solving DEs and PDEs	3	7	7	3	6	3	6	7	6
finite element analysis/PDE	3	7	7	3	6	3	6	7	6
visualization for information representation	3	1	1	3	6	3	6	7	6
IG techniques	3	1	1	3	6	3	6	7	6
deployment model	4	1	1	3	6	3	6	7	6
execution model	4	1	1	3	6	3	6	7	6
component model	4	1	1	3	6	3	6	7	6
information model	4	1	1	3	6	3	6	7	6
product line architecture & development	3	1	1	3	6	3	6	7	6
data mining languages	3	1	1	3	6	3	6	7	6
data mining using simulation	3	1	1	3	6	3	6	7	6
CROM	3	7	7	3	6	3	6	7	6
C2IEDM	3	7	7	3	6	3	6	7	6
microelectromechanic systems (MEMS)	3	7	7		6	3	6	7	6
Popkin's Systems Architect	3	7	7	3	6	3	6	7	6
ERWin Data Modeler	3	7	7	3	6	3	6	7	6
Component X	3	7	7	3	6	3	6	7	6
CADM	3	7	7	3	6	3	6	7	6
architecture views	3	7	7	3	6	3	6	7	6
operational (process) architecture	3	7	7	3	6	3	6	7	6
activity modeling	3	7	7	3	6	3	6	7	6
information exchange model	3	7	7	3	6	3	6	7	6
IDEF 1X	3	7	7	2	6	3	6	7	6

KNOWLEDGE AREA	APPLICATION LEVEL								
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or informatior **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**								
Component	***Army***	***Navy***	***AF***	***Marine***	***Joint***	***Acq***	***Plan***	***T&E***	***Train***
LADAR/IR	3	7	7	2	6	3	6	7	6
degeneracy tests	3	7	7	3	6	3	6	7	
logical variable	3	1	1	3	6	3	6	7	6
integer variable	3	1	1	3	6	3	6	7	6
real variable	3	1	1	3	6	3	6	7	6
state variable	3	1	1	3	6	3	6	7	6
initial condition	3	1	1	3	6	3	6	7	6
steady state	3	1	1	3	6	3	6	7	6
data fusion	3	1	1	3	6	3	6	7	6
fractal	3	1	1	3	6	3	6	7	6
Phong Lighting Model	3	1	1	3	6	3	6	7	6
Z-buffer	3	1	1	3	6	3	6	7	6
computable	3	1	1	3	6	3	6	7	
NP complete	3	1	1	3	6	3	6	7	6
evolutionary computation	3	1	1	3	6	3	6	7	6
portable simulation systems	3	1	1	3	6	3	6	7	6
eye-point	3	1	1	3	6	3	6	7	6
Field-of-View (FOV)	3	1	1	3	6	3	6	7	6
euler attitude angles	3	1	1	3	6	3	6	7	6
fitness landscape	3	1	1	3	6	3	6	7	6
predator-prey modeling	3	1	1	3	6	3	6	7	6
principle of competitive exclusion (Gause's principle)	3	1	1	3	6	3	6	7	6
inductive modeling	3	1	1	3	6	3	6	7	6
multicast	3	1	1	3	6	3	6	7	6
interest management	3	1	1	3	6	3	6	7	6
time warp	3	1	1	3	6	3	6	7	6
dependent variables	3	1	1	3	6	3	6	7	6
effects based modeling	3	1	1	3	6	3	6	7	6
lazy evaluation	3	1	1	3	6	3	6	7	6
differential games	3	1	1	3	6	3	6	7	6
white-box and black-box models	3	1	1	3	6	3	6	7	6
behavior diagrams	3	1	1	3	6	3	6	7	6

KNOWLEDGE AREA	APPLICATION LEVEL								
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or informatior **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**								
Component	***Army***	***Navy***	***AF***	***Marine***	***Joint***	***Acq***	***Plan***	***T&E***	***Train***
functional analysis	3	1	1	3	6	3	6	7	6
replicated validation	3	1	1	3	6	3	6	7	6
priority queue data structure	3	1	1	3	6	3	6	7	6
conservative time management	3	1	1	3	6	3	6	7	6
optimistic time management	3	1	1	3	6	3	6	7	6
predictive contracts	3	1	1	3	6	3	6	7	6
big/little endian data formats	3	1	1	4	6	3	6	7	6

Summary BOK Ratings for Management Usage Levels

KNOWLEDGE AREA	MANAGEMENT LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
Basic Concepts		
Understand historic perspective of M&S		
Historic Aspect of M&S	1.33	1
DoD/Military Simulations		
Policies and rules	4.34	4
Modeling Concepts		
Model Types		
Model Definition	2.36	2
Model Concept	2.69	3
Physical Models	2.91	3
Mathematical Models	2.91	3
Process Models	2.47	2
Combination Models	2.41	2
M&S Representation		
Systems	2.80	3
Human Behavior	2.36	2
Natural Environment	2.36	2
Modeling Process		
Modeling Process	2.47	2
Abstractions	2.03	2
Formalisms	2.03	2

KNOWLEDGE AREA	MANAGEMENT LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
Design and Build Models		
Conduct Feasibility Assessments	2.67	3
Knowledge engineering	1.90	2
Simulation Concepts		
Simulation Definition	2.56	3
Simulation Concept	2.46	2
Live Simulation	2.52	3
Virtual Simulation	2.52	3
Constructive Simulation	2.40	2
Simulation Methods	2.52	3
General Simulation Knowledge		
Mechanisms	1.78	2
Simulation Ethics	2.77	3
Discrete Event	2.34	2
Continuous	2.35	2
Live/Virtual/Constructive	2.52	3
Discrete Event Simulation		
Formalisms	2.11	2
Implementation/structure/mechanics	2.16	2
Languages/tools	2.11	2
Worldviews	2.11	2
Warm-up, steady state	2.11	2
Continuous Simulation		
Systems Dynamics	4.00	4
Solving DEs and PDEs (Differential Equations & Partial Differential Equations)	2.22	2
Languages/tools	1.56	2
Implementation/structure/mechanics	1.78	2

KNOWLEDGE AREA	MANAGEMENT LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
Underlying 'Science'		
Existence	1.30	1
Referential designation	1.78	2
Abstraction/classification (verb and noun)	1.78	2
Representation/qualification (verb and noun)	1.75	2
Surrogacy operations	1.56	2
Referential inference	1.67	2
Interoperability Concepts		
Concept of Interoperability	2.63	3
Interoperability Issues	3.12	3
Understand domain concepts (7 surfboards)		
Identify M&S opportunities and challenges		
Opportunities	3.00	3
Challenges	3.00	3
M&S Organizations		
Identify key Joint/Service M&S organizations		
Organization	2.71	3
Systems Theory		
Elements to Whole	2.50	3
Reductionism to Holism	2.50	3
Structure to Function	2.50	3
Linear Hierarchy		
Network Hierarchy	1.49	1
Spatial Dimensions	1.49	1
Temporal Dimensions	1.49	1

KNOWLEDGE AREA	MANAGEMENT LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
Structural Dimensions	1.49	1
Multi-Disciplined Simulations Specialist		
Operations	3.11	3
Organization	3.34	3
Systems	3.23	3
Modeling		
Design and build models	2.44	2
Feasibility assessment	2.75	3
Knowledge engineering	2.75	3
Leadership and Organizational Management		
Change Management	5.11	5
Workforce Professional Development	4.49	4
Leadership and Management Development		
Strategic Planning	3.89	4
Innovative Problem Solving	3.52	4
Journeyman		
Contracting	4.01	4
Supervisor, Manager, Sr. Tech. Specialist		
Technology	3.67	4
Joint Operations	3.90	4

KNOWLEDGE AREA	MANAGEMENT LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
Manager		
International Operations	3.88	4
Senior Technical Specialist		
Technology Planning	5.22	5
Technology Transition	5.22	5
Develop Simulation Requirements		
Identify the requirement		
Need Assessment	3.90	4
Desired Outcomes	3.67	4
RDA Development Cycle	3.56	4
ORD Development	3.56	4
Validate the requirement		
Organizational Inputs	4.40	4
Technical Review	4.67	5
Organizational Input	4.20	4
Spiral Development Process	4.40	4
Scope the requirement		
User Perspective	4.40	4
Resource Constraints	4.50	5
New M&S Application		
Identifying new capability		
New Organization or System	4.40	4
New Mission Set	4.60	5
Validating new application		

KNOWLEDGE AREA	MANAGEMENT LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
Organizational Input	5.30	5
System Capability Input	4.90	5
Documenting new application		
Documentation of Development	3.70	4
Incorporate requirement into the RDA domain		
Cradle to Grave Concept	4.60	5
Technical Development of the Simulation		
Identify key programming aspects		
Technical Design	3.40	3
Structure Design	3.20	3
Translating Process	3.20	3
Collect data for programming		
Identify Sources	3.90	4
Data Management Plan	3.90	4
Documentation	4.10	4
Convert data into programming language		
Characteristics of Languages	2.70	3
Configuration Management	3.56	4
Documentation	3.00	3
Computer Technology		
Software Engineering	2.60	3
SEI/CMU concepts, methods and implementation	2.50	3
Agents-based simulation, adaptive systems	2.70	3

KNOWLEDGE AREA	MANAGEMENT LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
Prepare to Use Simulation		
Conduct developer VV&C		
VV&C Concept	4.20	4
Certification	4.20	4
Documentation	3.80	4
Conduct testing of simulation		
Assess Abilities	3.20	3
Establish Parameters	3.70	4
Conduct user VV&A		
VV&A Concept	4.20	4
Accreditation	4.20	4
Documentation	3.70	4
Mathematics		
Continuous	2.30	2
Discrete	2.30	2
Steady-State	2.30	2
Queuing Theory	2.30	2
Dynamic	2.30	2
Discrete Event Simulation	2.30	2
Numerical Analysis	2.11	2
Linear algebra	1.90	2
Boolean algebra	2.30	2
Ordinary differential equations	1.90	2
Partial differential equations	1.80	2
Statistics		
Queuing theory	2.10	2
Hypothesis testing	2.30	2

KNOWLEDGE AREA	MANAGEMENT LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
Variance reduction	2.30	2
Design of experiments	2.60	3
Stochastic Processes/Statistics		
Queuing	2.20	2
Programmatic		
Technology	3.50	4
Production Tools	3.50	4
Management	5.20	5
Marketing	4.40	4
Specific Simulations and Attributes		
Assess each simulation		
Hierarchy of Simulations	3.90	4
Assessment Process	4.10	4
Identify specific simulations		
Application Description		
History	2.50	3
Current Usage	2.50	3
Other Usage	2.90	3
Technical Description		
Language	2.50	3
Specifications	2.60	3
Interoperability with other simulations		
ALSP, DIS & HLA	3.20	3
DIS Concept	3.00	3

KNOWLEDGE AREA	MANAGEMENT LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
ALSP Concept	3.00	3
HLA Concept	3.00	3
Air Force Simulations	3.00	3
Army Simulations	3.25	3
Navy Simulations	3.00	3
Marine Simulations	3.00	3
Joint Simulations	3.00	3
Interoperability with real world equipment		
C4I Systems	3.10	3
Weapon Systems	3.00	3
Specific Simulation Applications		
Develop strategy to meet requirement		
Develop a M&S Support Architecture	4.00	4
Documentation	4.50	5
Identify simulations to meet requirement		
Psychology		
Neural level modeling	3.00	3
Computer Science		
Data structures	2.00	2
Computer architecture/organization	2.38	2
File management	2.00	2
Database systems	2.60	3
Computer networks	2.60	3
Parallel computing	2.70	3
Artificial intelligence	2.70	3
Education		

KNOWLEDGE AREA	MANAGEMENT LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
Learning theories	3.50	4
Industrial Engineering		
Linear programming	2.30	2
Industrial Engineering		
Dynamic programming	2.20	2
Nonlinear optimization	2.75	3
Sensitivity analysis	3.50	4
M&S Abstraction Techniques/representational schemas		
Static/dynamic	2.20	2
Descriptive/normative/prescriptive	2.20	2
Scalar/vector/manifold	2.20	2
Syntax/semantics	2.20	2
Distribution of evaluation: in space; in time	3.00	3
Types of Representation		
Mathematical	2.30	2
Partial differential equations and boundary value	1.90	2
Problems	1.90	2
Structural	2.50	3
Diagrammatic	2.50	3
Petri Nets	2.11	2
Finite element	2.10	2
Nomograph	1.90	2
Process	2.50	3
Event trace	2.50	3
State transition	2.50	3
Information	3.10	3
Taxonomic	2.40	2
Classificatory (UML static)	2.30	2

KNOWLEDGE AREA	MANAGEMENT LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
Data	3.20	3
M&S Uses (Classes)		
Extrapolation / interpolation-in-time	2.30	2
Extrapolation / interpolation-in-space		
Developing the Training Environment		
Identify training objectives		
Training Design	3.30	3
Organizational Perspective	3.30	3
Training audience	3.30	3
Primary Training Objectives	3.10	3
Secondary Training Objectives	3.20	3
Design a architecture based on objectives		
Single vs Multiple Sites	3.50	4
Communication	3.50	4
Security	3.50	4
Refine objectives with defined outcomes		
Time Constraints	4.20	4
Resource Constraints	4.20	4
Simulation in the Training Environment		
Define observation process		
Alignment of Objectives	3.60	4
Structure of Observation	3.60	4
Develop timeline structure for integration		
Exercise Timeline	3.10	3
Technical Timeline	3.20	3

KNOWLEDGE AREA	MANAGEMENT LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
Support Timeline	3.10	3
Conduct pre-integration activities		
Initial Research	2.90	3
IPR Concept	3.60	4
Design of Simulation Event	4.20	4
Facility Support	3.50	4
Scenario Development	4.10	4
Support Activities	4.10	4
Pre-training	4.00	4
Documentation	3.80	4
Conduct integration activities		
Cell Functions	4.00	4
Exercise Flow	4.20	4
Observation of Training Environment		
Collect observations		
Collection Plan	3.90	4
Analysis	3.70	4
Supporting Materials	3.60	4
Documentation	3.50	4
Provide feedback based upon observations		
Formal AAR Process	3.33	3
Informal Process	3.33	3
Final Report	3.33	3

KNOWLEDGE AREA	MANAGEMENT LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
M&S Related Assets		
Notations	2.70	3
Syntactic specifications and conventions	2.50	3
Semantic specifications and conventions	2.50	3
M&S Related Perspectives		
Enterprise	3.60	4
Business Practice	4.00	4
Economics of M&S	4.40	4
Market Model	3.70	4
Products	3.50	4
Services	3.50	4
Buyers	3.40	3
Sellers	3.40	3
Business Case	4.90	5
Cost-benefit	5.60	6
Enterprise Infrastructure	4.00	4
Professional Development	5.30	5
Enterprise Process	5.30	5
Enterprise Tools	4.90	5
M&S Related Disciplines		
Graph Theory	3.20	3
Logic	3.20	3

KNOWLEDGE AREA	MANAGEMENT LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
Relations	3.60	4
Inference	3.60	4
Management		
Enterprise Management	5.30	5
Corporate institutional development	5.30	5
Enterprise operations	5.30	5
Evaluation Design		
Develop measurement of outcomes		
Baseline Establishment	3.70	4
Measurement Alignment to Objectives	3.30	3
Tractability Documentation	3.30	3
Develop evaluation methodology and tools		
Technical Evaluation Methodology	3.20	3
Application Evaluation Methodology	3.00	3
Develop description of evaluation methods		
Quantitative Methods	3.00	3
Qualitative Methods	3.10	3
Develop resources to conduct the evaluation		
Resource Scoping	3.40	3
Issues with Resource Constraints	3.40	3
Execution of Evaluation		
Develop timelines for the		

KNOWLEDGE AREA	MANAGEMENT LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
evaluation		
Pre-Collection Timeline Development	3.30	3
Post Collection Timeline Development	3.20	3
Execute the evaluation		
Collection Methodology	3.30	3
Documentation of Collection	3.10	3
Assessment of Evaluation		
Compile evaluation data		
Correlation Approach for Data	3.00	3
Tracking Data Collection Coverage	3.00	3
Analyze the evaluation data		
Alignment of Data to Outcomes	3.30	3
Secondary Source Development	3.20	3
Convert analysis results to an action plan		
Develop Analysis Relationships	3.20	3
Develop New or Modified Requirements	3.30	3
M&S Modification		
Determining Need to Change a Simulation		
Identify shortfalls in simulation		
Application Design Flaws	3.20	3
Technical Design Flaws	3.00	3
Develop requirements to rectify the shortfalls		
Application Requirements	3.30	3
Technical Requirements	3.00	3

KNOWLEDGE AREA	MANAGEMENT LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
Validate requirements to rectify the shortfalls		
Organizational Review	3.40	3
Technical Review	3.00	3
Technical Changes of the Simulation		
Collect data to rectify the shortfalls		
Focused Data Collection	3.00	3
Alignment to other Data	3.00	3
Convert data into programming language		
Convert Data	2.90	3
Data Insertion into Simulation	3.14	3
Soft Computing		
Decision Trees	2.30	2
Dynamic Programming	2.30	2
Emergent Behavior	2.30	2
Fractals	2.10	2
Fuzzy Logic	2.20	2
Genetic Algorithms	2.20	2
Human Cognition	2.20	2
Knowledge-Based Systems	2.30	2
Logistic Networks	2.40	2
Neural Nets	2.20	2
Petri Nets	2.00	2
Simulated Annealing	2.00	2
Swarms	2.20	2
Conduct VV&C of modified simulation		

KNOWLEDGE AREA	MANAGEMENT LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
VV&C Modification	3.30	3
Soft Computing		
Convert language into another language		
Resource Implications	3.30	3
Implications of Conversion	3.30	3
Assessment of Changes to a Simulation		
Conduct testing of modified simulation		
Alpha Testing Modification	3.60	4
Beta Testing Simulation	3.60	4
Conduct user VV&A of modified simulation		
VV&A Modification in Simulation	3.30	3
Documentation of Modification	3.30	3
M&S Development and Use Life Cycle		
Retirement	3.60	4
M&S Related Concepts		
analog simulation	2.90	3
digital simulation	3.00	3
human-in-the-loop simulation	2.90	3
hardware-in-the-loop simulation	2.90	3
software-in-the-loop simulation	2.90	3
composability	2.80	3
community of practice	3.20	3

KNOWLEDGE AREA	MANAGEMENT LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
professional certification	2.80	3
simulation asset management	3.40	3
economics of simulation	3.50	4
sensors	2.20	2
web-enabled simulations	3.40	3
simulation tools (AcslXtreme,etc)	3.50	4
bioinformatics	2.70	3
wearable computing	2.70	3
augmented reality / mixed real	2.80	3
biometrics	2.80	3
biosensors	2.60	3
neural networks	2.70	3
data mining	2.90	3
authoring systems	2.70	3
grid and cluster computing	2.40	2
distributed high performance computing	2.60	3
optical computing	2.50	3
Microeletromechanical systems MEMS	1.90	2
Micro-opto-mechanical systems MOMS	1.90	2
RF MEMS	1.90	2
BioMEMS	1.90	2
photonics	1.60	2
microfluidics	1.60	2
teraherz technology	1.60	2
RUP (rational unified process)	1.70	2
UML	2.40	2
Shlaer-Mellor method of structured modeling	1.70	2
ROOM (real time object oriented	1.80	2

KNOWLEDGE AREA	MANAGEMENT LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
modeling)		
MDA (model driven architectures)	2.10	2
IDEF0 & IDEF1x (ER diagrams)	2.00	2
Gane-Sarson data flow modeling	1.80	2
Coad/Yourdon structured information modeling	2.00	2
TENA (test & training enabling architecture	2.60	3
CORBA IDL (interface definition language)	2.40	2
phenomenon algorithm specification	2.20	2
common software component development	2.30	2
finite element method	1.80	2
hybrid simulation: e.g., combined CS/DES/FEM	2.00	2
surrogate key	2.00	2
hybrid models	2.00	2
DES example	2.20	2
DES components	2.30	2
modeling issues in hybrid simulations	2.20	2
complex adaptive systems (CAS)	2.20	2
complexity and CAS modeling	2.20	2
complexity and chaos	2.20	2
CAS modeling methods	2.20	2
CAS modeling case studies	2.20	2
composability theory	2.30	2
hierarchical simulation	2.00	2
SEI/CMU concepts, methods & implementation	2.00	2
solving DEs and PDEs	2.10	2

KNOWLEDGE AREA	MANAGEMENT LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
finite element analysis/PDE	2.00	2
visualization for information representation	2.20	2
IG techniques	2.10	2
deployment model	2.80	3
execution model	2.30	2
component model	2.20	2
information model	2.20	2
product line architecture & development	1.90	2
data mining languages	1.90	2
data mining using simulation	2.40	2
CROM	1.80	2
C2IEDM	2.90	3
microelectromechanic systems (MEMS)	2.00	2
Popkin's Systems Architect	2.00	2
ERWin Data Modeler	2.00	2
Component X	2.00	2
CADM	2.00	2
architecture views	2.60	3
operational (process) architecture	2.20	2
activity modeling	2.00	2
information exchange model	2.00	2
IDEF 1X	2.00	2
LADAR/IR	2.22	2
degeneracy tests	2.00	2
logical variable	2.20	2
integer variable	2.20	2
real variable	2.20	2
state variable	2.20	2
initial condition	2.20	2

KNOWLEDGE AREA	MANAGEMENT LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
steady state	2.20	2
data fusion	2.20	2
fractal	2.00	2
Phong Lighting Model	1.80	2
Z-buffer	1.80	2
computable	2.00	2
NP complete	1.80	2
evolutionary computation	2.00	2
portable simulation systems	2.30	2
eye-point	2.20	2
Field-of-View (FOV)	2.20	2
euler attitude angles	1.80	2
fitness landscape	1.80	2
predator-prey modeling	2.20	2
principle of competitive exclusion (Gause's principle)	2.20	2
inductive modeling	2.20	2
multicast	2.40	2
interest management	2.00	2
time warp	1.80	2
dependent variables	2.40	2
effects based modeling	2.40	2
lazy evaluation	2.00	2
differential games	2.20	2
white-box and black-box models	2.20	2
behavior diagrams	2.20	2
functional analysis	2.20	2
replicated validation	2.40	2
priority queue data structure	2.20	2
conservative time management	2.00	2
optimistic time management	2.00	2

KNOWLEDGE AREA	MANAGEMENT LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
predictive contracts	2.00	2
big/little endian data formats	2.25	2

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
Basic Concepts	
Understand historic perspective of M&S	
Historic Aspect of M&S	Recognize the impact of modeling and simulation key concepts from a historical perspective.
DoD/Military Simulations	
Policies and rules	Analyze and comply with DoD M&S directives and policies when planning or implementing M&S activities.
Modeling Concepts	
Model Types	
Model Definition	Describe the term "model" and identify its application to M&S.
Model Concept	Prepare and organize the information and apply the amount, needed to develop a model.
Physical Models	Apply physical models to M&S programs and activities.
Mathematical Models	Apply mathematical models to M&S programs and activities.
Process Models	Discuss the term "process model" and its application to M&S.
Combination Models	Discuss the term "combination model" and its application to M&S.
M&S Representation	
Systems	Use a systems approach to identify critical parts of a system and determine their correct level of representation.
Human Behavior	Discuss how human behavior is represented in M&S applications and the issues associated with its representation.
Natural Environment	Discuss how the natural environment is represented in M&S applications and the issues associated with its representation.
Modeling Process	
Modeling Process	Describe in general terms how a model is developed, designed and built.
Abstractions	Describe the abstraction process and its application to M&S.
Formalisms	Describe formalism methods and their application to M&S.
Design and Build Models	
Conduct Feasibility Assessments	Develop and employ a feasibility assessment to determine the viability of a proposed target for special operations forces

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
	employment.
Knowledge engineering	Describe the concept of knowledge engineering and its application to M&S.
Simulation Concepts	
Simulation Definition	Use simulation as a method for implementing a model over time.
Simulation Concept	Identify the information and the amount needed to develop a simulation.
Live Simulation	Apply live simulation within M&S programs and activities.
Virtual Simulation	Apply virtual simulation within M&S programs and activities.
Constructive Simulation	Discuss the characteristics and issues associated with constructive simulation.
Simulation Methods	Use simulation methods to solve problems, including building new simulations when appropriate.
General Simulation Knowledge	
Mechanisms	Recognize mechanism as a system of parts that operate or interact like those of a machine.
Simulation Ethics	Develop and employ simulation strategies which foster high ethical standards in meeting an organization's vision, mission and goals.
Discrete Event	Recognize discrete event as one of the chronological sequence of events that occur in the operation of a system.
Continuous	Recognize continuous simulation as a mathematical or computational model whose output variables change in a continuous manner.
Live/Virtual/Constructive	Employ all three types of simulation (live, virtual and constructive) within a particular event or activity.
Discrete Event Simulation	
Formalisms	Describe formalism methods and their application to M&S.
Implementation/structure/mechanics	Describe the implementation, structure and mechanics of a given discrete event simulation.
Languages/tools	Explain how languages and tools are used in simulation applications.
Worldviews	Explain how world views are used within the simulation development process.
Warm-up, steady state	Explain the meaning of the term "steady state."
Continuous Simulation	
Systems Dynamics	Describe how systems dynamics applies to continuous simulation.
Solving DEs and PDEs (Differential Equations & Partial Differential Equations)	Explain how differential equations and partial differential equations are used within a continuous simulation.

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
Languages/tools	Describe the languages and tools used within a continuous simulation.
Implementation/structure/mechanics	Describe how to construct and execute simulations of both deterministic and stochastic discrete event and continuous simulations.
Underlying 'Science'	
Existence	Define existence as the state or fact of being.
Referential designation	Describe the concept of referential designation and how it applies to M&S.
Abstraction/classification (verb and noun)	Describe the concept of abstraction and how it applies to M&S.
Representation/qualification (verb and noun)	Describe the concept of representation and how it applies to M&S.
Surrogacy operations	Describe the concept of surrogacy operations and how it applies to M&S.
Referential inference	Describe the concept of referential inference and how it applies to M&S.
Interoperability Concepts	
Concept of Interoperability	Demonstrate the concept of interoperability and the processes to achieve digital interoperability.
Interoperability Issues	Solve interoperability issues inherent in the technology approaches that allow simulations to work together.
Understand domain concepts (7 surfboards)	
Identify M&S opportunities and challenges	
Opportunities	Use models appropriately within M&S programs and activities.
Challenges	Interpret a model's strengths, limitations and weaknesses.
M&S Organizations	
Identify key Joint/Service M&S organizations	
Organization	Interpret the mission, structure and services provided by key Joint/Service M&S organizations.
Systems Theory	
Elements to Whole	Identify elements and layers of a system.
Reductionism to Holism	Arrange a given system into elements for multiple layers.
Structure to Function	Identify the functions for each element within a system.
Linear Hierarchy	Recognize the linear hierarchy for a given system.
Network Hierarchy	Recognize the network hierarchy for a given system
Spatial Dimensions	Identify the spatial dimensions of a system.

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
Temporal Dimensions	Identify the temporal dimensions of a system.
Structural Dimensions	Identify the structural dimensions of a system.
Multi-Disciplined Simulations Specialist	
Operations	Demonstrate the steps and issues involved with the M&S development process as it applies to the functional areas of analysis, acquisition, experimentation, testing and evaluation, planning and training.
Organization	Develop the critical elements of a system and determine their correct level of representation.
Systems	Develop the workings, characteristics and composition of major simulation systems and their relationships (interoperability) to other simulation systems.
Modeling	
Design and build models	Describe how a model is generally designed, developed and built (model development process).
Feasibility assessment	Interpret how well a model or simulation serves its intended purpose.
Knowledge engineering	Apply knowledge engineering principles to build, maintain and develop knowledge-based systems.
Leadership and Organizational Management	
Change Management	Plan and manage change in the M&S community and act as a catalyst to influence, motivate and challenge subordinates to accept change.
Workforce Professional Development	Analyze and appraise M&S strategies which maximize employee potential and foster high ethical standards in meeting the organization's vision, mission and goals.
Leadership and Management Development	
Strategic Planning	Analyze the strategic planning process and how it relates to simulations management.
Innovative Problem Solving	Analyze creative and innovative solutions to complex simulation management issues.
Journeyman	

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
Contracting	Examine the contracting process for M&S products and/or services.
Supervisor, Manager, Sr. Tech. Specialist	
Technology	Analyze critical technological needs and formulate programs to advance state-of-the-art technologies.
Joint Operations	Analyze Joint philosophy, goals and doctrine.
Manager	
International Operations	Analyze international M&S policy, objectives and capabilities.
Senior Technical Specialist	
Technology Planning	Prepare technical project/program planning, direction and execution.
Technology Transition	Organize acceptance of technology transition within an organization.
Develop Simulation Requirements	
Identify the requirement	
Need Assessment	Analyze a need assessment for a simulation requirement.
Desired Outcomes	Analyze the results of a set of data and compare to the desired outcomes.
RDA Development Cycle	Categorize the phases of the RDA development cycle.
ORD Development	Appraise the purpose and contents of an Operational Requirements Document (ORD).
Validate the requirement	
Organizational Inputs	Classify organizational inputs as supportable or non-supportable and modify the requirement based on supportable inputs.
Technical Review	Prepare a technical support review for the requirement.
Organizational Input	Analyze the role of user organizations in validating new requirements.
Spiral Development Process	Discriminate the phases of the spiral development process.
Scope the requirement	
User Perspective	Analyze the requirement from a user's perspective.
Resource Constraints	Design a resource matrix for given requirement to identify resource constraints.

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
New M&S Application	
Identifying new capability	
New Organization or System	Analyze critical components of a system or organization and deduce their correct level of representation within a simulation.
New Mission Set	Create a mission set for a new M&S application.
Validating new application	.
Organizational Input	Design a new M&S application based on organizational input
System Capability Input	Design a new system capability for an M&S application.
Documenting new application	Examine proper documentation for an M&S event.
Documentation of Development	Analyze critical components of a system or organization and deduce their correct level of representation within a simulation.
Incorporate requirement into the RDA domain	
Cradle to Grave Concept	Design the life cycle of a new system based on a cradle to grave concept.
Technical Development of the Simulation	
Identify key programming aspects	
Technical Design	Apply process components in the technical design of a simulation.
Structure Design	Apply process components in the structure design of a simulation.
Translating Process	Apply current simulation knowledge to new and unique simulation applications.
Collect data for programming	
Identify Sources	Appraise the source(s) of data used and ensure it is appropriate for use.
Data Management Plan	Compare and contrast appropriate data collection techniques.
Documentation	Categorize sources of data to build a database.
Convert data into programming language	
Characteristics of Languages	Generalize differences (strengths and weakness) between various programming languages.
Configuration Management	Examine the principles and practices of configuration management as applied to modeling and simulation.
Documentation	Develop required documentation for configuration management.
Computer Technology	

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
Software Engineering	Apply software engineering concepts for the development, operation and maintenance of software.
SEI/CMU concepts, methods and implementation	Apply the Software Engineering Institute (SEI) Capability Maturity Model® Integration (CMMI) concepts and methods to the software engineering process for a simulation.
Agents-based simulation, adaptive systems	Use agent-based simulation and adaptive system concepts in the simulation development process.
Prepare to Use Simulation	
Conduct developer VV&C	
VV&C Concept	Analyze Verification, Validation & Certification (VV&C) elements and their uses.
Certification	Analyze the certification process of a simulation.
Documentation	Examine required documentation for VV&C of a simulation.
Conduct testing of simulation	
Assess Abilities	Develop a process to assess abilities during simulation testing.
Establish Parameters	Calculate simulation testing parameters.
Conduct user VV&A	
VV&A Concept	Analyze Verification, Validation & Accreditation procedures that support the development of cost-effective M&S applications.
Accreditation	Analyze the accreditation process of a simulation.
Documentation	Examine required documentation for VV&A of a simulation.
Mathematics	
Continuous	Explain continuous functions and their role in M&S development.
Discrete	Explain discrete functions and their role in M&S development.
Steady-State	Explain the term "steady state" and its role in M&S development.
Queuing Theory	Explain the concept of queuing theory and its role in M&S development.
Dynamic	Explain the concept of dynamic simulation and its role in simulation development.
Discrete Event Simulation	Explain the concept of discreet event simulation and its role in simulation development.
Numerical Analysis	Describe numerical analysis and how it is used to solve problems of continuous mathematics (as distinguished from discrete mathematics).

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
Linear algebra	Explain the concept of Linear algebra and its uses in simulation development.
Boolean algebra	Explain the concept of Boolean algebra and its uses in simulation development.
Ordinary differential equations	Explain the concept of Ordinary differential equations and their use in simulation development.
Partial differential equations	Explain the concept of Partial differential equations and their use in simulation development.
Statistics	
Queuing theory	Explain the concept of Queuing Theory and its use in simulation development.
Hypothesis testing	Explain Hypothesis testing and how it is used to minimize risks.
Variance reduction	Explain Variance reduction and how it is used to increase the precision of the estimates that can be obtained for a given number of iterations.
Design of experiments	Employ experiments as an Information-gathering attempt where variation is present, which may or may not be under the full control of the experimenter.
Stochastic Processes/Statistics	
Queuing	Describe queing and its relationship to simulation events or activities.
Programmatic	
Technology	Analyze M&S tools and their ability to control and adapt to the world's changing environment.
Production Tools	Analyze devices, computer applications or other equipment to determine if they provide an advantage when accomplishing a task.
Management	Manage others in one-to-one or group situations.
Marketing	Analyze individual/group needs and wants through exchange processes.
Specific Simulations and Attributes	
Assess each simulation	
Hierarchy of Simulations	Classify simulations according to a hierarchy and provide examples for each level.
Assessment Process	Analyze the assessment process for a given simulation.
Identify specific simulations	
Application Description	
History	Relate the development history of a simulation and generalize its impact on current capabilities.

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
Current Usage	Use a simulation and its supporting tools for proper application to the functional areas of analysis, acquisition, training, testing and evaluation, experimentation and planning.
Other Usage	Use a simulation and its supporting tools for proper applications for areas other than its intended purpose.
Technical Description	
Language	Apply appropriate programming languages to simulation applications.
Specifications	Develop technical specifications for hardware according to their implications to a simulation.
Interoperability with other simulations	
ALSP, DIS & HLA	Apply Aggregate Level Simulation Protocol (ALSP), Distributed Interactive Simulation (DIS) and High Level Architecture (HLA) to M&S applications.
DIS Concept	Apply DIS to M&S applications according to its capabilities and limitations.
ALSP Concept	Apply ALSP to M&S applications according to its capabilities and limitations.
HLA Concept	Apply HLA to M&S applications according to its capabilities and limitations.
Air Force Simulations	Apply key simulations for the Air Force according to their capabilities, limitations and interoperability concerns.
Army Simulations	Apply key simulations for the Army according to their capabilities, limitations and interoperability concerns.
Navy Simulations	Apply key simulations for the Navy according to their capabilities, limitations and interoperability concerns.
Marine Simulations	Apply key simulations for the Marines according to their capabilities, limitations and interoperability concerns.
Joint Simulations	Apply key Joint simulations according to their capabilities, limitations and interoperability concerns.
Interoperability with real world equipment	
C4I Systems	Employ C4I systems within associated M&S systems.
Weapon Systems	Employ weapon systems that require simulation feed according to their capabilities, issues and interoperability concerns.
Specific Simulation Applications	
Develop strategy to meet requirement	

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
Develop a M&S Support Architecture	Develop simulation architecture to meet objectives.
Documentation	Identify required documentation for a M&S architecture.
Identify simulations to meet requirement	
Psychology	
Neural level modeling	Describe neural level modeling and its application to M&S.
Computer Science	
Data structures	Use a data structure to store data in a computer so that it can be used efficiently.
Computer architecture/organization	Apply computer architecture/ organization concepts to a given simulation.
File management	Use appropriate file management practices to organize data.
Database systems	Use a database system to manage a database and run operations on the data as requested by clients.
Computer networks	Use computer networks to communicate and share resources.
Parallel computing	Apply parallel computing processes in order to obtain simulation results faster.
Artificial intelligence	Use artificial intelligence processes as required by a given simulation.
Education	
Learning theories	Compare and contrast learning theories to determine the best way to present to-be-learned material to a particular target group or individual.
Industrial Engineering	
Linear programming	Describe the linear programming process.
Dynamic programming	Describe the dynamic programming process.
Nonlinear optimization	Describe the process of nonlinear optimization.
Sensitivity analysis	Apply the process of sensitivity analysis.
M&S Abstraction Techniques/representational schemas	
Static/dynamic	Describe static and dynamic models and how they are represented within a simulation.
Descriptive/normative/prescriptive	Describe descriptive, normative and prescriptive models and how they are represented within a simulation.
Scalar/vector/manifold	Describe the terms "scalar, vector and manifold" and how they relate to representation in M&S.
Syntax/semantics	Describe the terms "syntax" and "semantics" and their role in M&S representational schemas.
Distribution of evaluation: in space; in time	Apply principles from the distribution of evaluation (in space-time) procedure to a complete (operationally derived) data set, in order to develop a computational model that is based on an aggregate distribution of the complete performance data.

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
Types of Representation	
Mathematical	Describe mathematical representation as it is demonstrated in M&S.
Partial differential equations and boundary value	Describe the relationship between partial differential equations and boundary value and representation.
Problems	Explain how problems can be represented within a simulation.
Structural	Apply the concept of structural representation in a given simulation.
Diagrammatic	Apply the concept of diagrammatic representation in a given simulation.
Petri Nets	Explain the term Petri nets and how they are demonstrated within a simulation.
Finite element	Explain the term finite element and how it is demonstrated within a simulation.
Nomograph	Explain the term nomograph and how it is used within a simulation.
Process	Apply representational techniques to model the procedural steps of a task, event or activity performed by a system.
Event trace	Apply event trace methods throughout the processing of a simulation to use correct operation throughout the execution of the event.
State transition	Use state transition representation methods to show change from one state (condition/configuration) to another in a system, component or simulation.
Information	Use facts or data derived from study, experience or instruction within a simulation.
Taxonomic	Discuss the concept of taxonomic classification and its uses in simulation.
Classificatory (UML static)	Discuss the concept of a Unified Modeling Language.
Data	Develop individual facts, statistics or items of information; a body of facts or information.
M&S Uses (Classes)	
Extrapolation / interpolation-in-time	Discuss interpolation: estimation of a value of data based on an established set of collected data, within the data range. Discuss extrapolation: estimation of a value of data based on an established set of collected data, outside of the data range. Extrapolation/interpolation-in-time would express a time criteria as the aforementioned collected data values.
Extrapolation / interpolation-in-space	Discuss interpolation: estimation of a value of data based on an established set of collected data, within the data range. Discuss extrapolation: estimation of a value of data based on an established set of collected data, outside of the data range.

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
	Extrapolation/interpolation-in-space would express spatial analysis data as the aforementioned collected data values.
Developing the Training Environment	
Identify training objectives	
Training Design	Develop training objectives for an M&S event.
Organizational Perspective	Develop training needs from an organizational perspective.
Training audience	Develop the demographic characteristics, values and needs of the training audience for whom an M&S event is intended.
Primary Training Objectives	Develop primary event objectives for a given scenario.
Secondary Training Objectives	Develop secondary event objectives for a given scenario.
Design a architecture based on objectives	
Single vs Multiple Sites	Analyze the architecture implications for either a single site or multiple site simulation distribution.
Communication	Analyze the communication components needed for an M&S event.
Security	Analyze the security and issues with multi-layer security design for an M&S event.
Refine objectives with defined outcomes	
Time Constraints	Appraise the impact that time will have in terms of established objectives.
Resource Constraints	Appraise the impact that resource constraints will have in terms of established objectives.
Simulation in the Training Environment	
Define observation process	
Alignment of Objectives	Analyze the outcomes of a simulation to appraise objectives.
Structure of Observation	Analyze the outcomes of a simulation with an appropriate observation methodology.
Develop timeline structure for integration	
Exercise Timeline	Develop timeline for integrating simulation within a training exercise and relate the time resource associated with each event.
Technical Timeline	Develop a timeline for integrating the technical aspects of an exercise and relate the time resource associated with each event.
Support Timeline	Develop a timeline for integrating the support aspects required for the conduct of an exercise and relate the time resource associated with each event.

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
Conduct pre-integration activities	
Initial Research	Prepare research to develop support requirements for an M&S exercise event.
IPR Concept	Analyze the outcomes from an In-Process Review (IPR).
Design of Simulation Event	Deduce which simulation or mix of simulations is required for a given event.
Facility Support	Deduce the facility support required for a simulation event.
Scenario Development	Analyze a scenario based on a given set of objectives.
Support Activities	Deduce support activities required to for an exercise.
Pre-training	Deduce pre-training requirements for a simulation exercise.
Documentation	Compare elements of an Exercise Control Plan and Simulation Control Plan.
Conduct integration activities	
Cell Functions	Examine the role and functions of cells in an exercise.
Exercise Flow	Analyze components of the exercise flow.
Observation of Training Environment	
Collect observations	
Collection Plan	Appraise a collection plan for the After Action Review (AAR) process.
Analysis	Analyze a training event for simulation impact.
Supporting Materials	Analyze supporting materials for feedback based on data analysis.
Documentation	Analyze documentation for report results.
Provide feedback based upon observations	
Formal AAR Process	Use a formal After-Action Review (AAR) process.
Informal Process	Use an informal After-Action Review (AAR) process.
Final Report	Organize the exercise material to be incorporated into final report.
M&S Related Assets	
Notations	Develop a system of figures or symbols used in a specialized field to illustrate numbers, quantities, tones or values.
Syntactic specifications and conventions	Illustrate use of, or relationship to, or employment of the rules of syntax, or the use of a language or set of words.

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
Semantic specifications and conventions	Illustrate use of, or relationship to, or development from the different meanings of words or other symbols.
M&S Related Perspectives	
Enterprise	Examine a systematic activity or a project undertaken or to be undertaken.
Business Practice	Differentiate those behaviors in a business that reflect how a particular organization or business conducts its day to day operations.
Economics of M&S	Calculate the Return on Investment (ROI) of M&S based on quantifiable and non-quantifiable benefits.
Market Model	Analyze a defined model representation of a specific subdivision of a population considered as buyers or users of a particular product or service.
Products	Analyze something produced by human or mechanical effort or by a natural process; a direct result; a consequence.
Services	Analyze activities that call directly for time and effort rather than for a concrete end product.
Buyers	Illustrate a person who buys; purchaser.
Sellers	Illustrate a person who sells; salesperson or vendor.
Business Case	Design a structured proposal for business change that is assembled in terms of costs and benefits.
Cost-benefit	Assess an analysis or study of the actual cost of a project and evaluate the potential benefits.
Enterprise Infrastructure	Analyze broadly, those elements that enable people and systems to exchange information and execute transactions.
Professional Development	Formulate a process for skill acquisition and maintenance in managing a particular career path.
Enterprise Process	Plan an entire business system, including all core and support processes needed for an organization's critical success objectives.
Enterprise Tools	Document broadly, a device, (computer) application or piece of equipment that provides an organization or its employees an advantage toward its stated critical success objectives.
M&S Related Disciplines	
Graph Theory	Apply the study of graphs, mathematical structures used to model pairwise relations between objects from a specified collection.
Logic	Apply the study of the principles and criteria of valid inference

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
	and illustration for use extensively in the fields of artificial intelligence, and computer science.
Relations	Appraise in mathematics, expressions that show equality and non-equality such as "=" and "<"; appraise in logic a property or predicate ranging over more than one argument.
Inference	Analyze the act or process of deducing a conclusion based solely on what one already knows.
Management	
Enterprise Management	Design a set of management processes, tools, systems, etc. for an organization to manage its stated critical success objectives.
Corporate institutional development	Synthesize building and maintaining institutional, economic and cultural viability of an organization as it faces a changing business environment.
Enterprise operations	Create processes and systems that work together or independently to assist an organization in managing its stated critical success objectives.
Evaluation Design	
Develop measurement of outcomes	
Baseline Establishment	Appraise the baseline prior to an M&S application.
Measurement Alignment to Objectives	Apply a Measure of Effectiveness (MOE) measurement system.
Tractability Documentation	Develop a tractability matrix for evaluation.
Develop evaluation methodology and tools	
Technical Evaluation Methodology	Apply technical evaluation methodologies for a simulation.
Application Evaluation Methodology	Apply application evaluation methodologies for a simulation.
Develop description of evaluation methods	
Quantitative Methods	Apply quantitative methods for a simulation evaluation.
Qualitative Methods	Apply qualitative methods for a simulation evaluation.
Develop resources to conduct the evaluation	
Resource Scoping	Develop resource determination for evaluation through a cost analysis.
Issues with Resource Constraints	Illustrate resource constraint impacts on a simulation evaluation.
Execution of Evaluation	

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
Develop timelines for the evaluation	
Pre-Collection Timeline Development	Develop pre-collection evaluation activity timeline that takes into account pre-defined time and resource constraints.
Post Collection Timeline Development	Develop post-collection evaluation activity timeline that takes into account pre-defined time and resource constraints.
Execute the evaluation	
Collection Methodology	Apply evaluation data collection methodologies.
Documentation of Collection	Develop evaluation data for a given simulation.
Assessment of Evaluation	
Compile evaluation data	
Correlation Approach for Data	Develop evaluation of simulation data.
Tracking Data Collection Coverage	Relate data coverage and tracking for a given evaluation.
Analyze the evaluation data	
Alignment of Data to Outcomes	Relate evaluation data to measurement of outcomes.
Secondary Source Development	Develop secondary sources of evaluation data.
Convert analysis results to an action plan	
Develop Analysis Relationships	Employ relational analysis development to support conclusions.
Develop New or Modified Requirements	Develop simulation requirements based on supportable inputs.
M&S Modification	
Determining Need to Change a Simulation	
Identify shortfalls in simulation	
Application Design Flaws	Illustrate the need for a simulation work around based on application design flaws.
Technical Design Flaws	Employ solutions to technical design flaws in the simulation.
Develop requirements to rectify the shortfalls	
Application Requirements	Develop an established requirement to an application shortfall.
Technical Requirements	Develop a simulation capability to a technical shortfall.
Validate requirements to rectify the shortfalls	
Organizational Review	Develop organizational structure to review shortfalls.
Technical Review	Develop structure to review technical shortfalls.

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
Technical Changes of the Simulation	
Collect data to rectify the shortfalls	
Focused Data Collection	Employ data review and apply a modified focus collection plan for data shortfalls.
Alignment to other Data	Illustrate correlation of new data and old data.
Convert data into programming language	
Convert Data	Reconstruct data analysis results to an action plan.
Data Insertion into Simulation	Transfer given datum or data set into sample simulation environment.
Soft Computing	
Decision Trees	Discuss the concept of decision trees and how they apply to simulation development.
Dynamic Programming	Discuss the concept of dynamic programming and how it applies to simulation development.
Emergent Behavior	Discuss the concept of emergent behavior and how it applies to simulation development.
Fractals	Discuss the term fractals and how it applies to M&S.
Fuzzy Logic	Discuss the term fuzzy logic and how it applies to M&S.
Genetic Algorithms	Discuss the term genetic algorithm and how it applies to M&S.
Human Cognition	Discuss the concept of human cognition and how it is represented within M&S.
Knowledge-Based Systems	Discuss the concept of knowledge-based systems and how they apply to M&S.
Logistic Networks	Discuss the concept of logistic networks and how they apply to M&S.
Neural Nets	Discuss the term neural nets and how it applies to M&S.
Petri Nets	Discuss the concept of Petri nets and how they are used within M&S.
Simulated Annealing	Discuss the term simulated annealing and how it applies to M&S.
Swarms	Discuss the concept of swarms and how it applies to M&S.
Conduct VV&C of modified simulation	
VV&C Modification	Conduct a modified Verification, Validation & Certification of a simulation.
Convert language into another language	
Resource Implications	Interpret the cost implications of language conversions or

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
	translators.
Implications of Conversion	Interpret the implications of conversion to the functionality of a given simulation.
Assessment of Changes to a Simulation	
Conduct testing of modified simulation	
Alpha Testing Modification	Analyze results of an Alpha Test for required modifications to a simulation.
Beta Testing Simulation	Analyze results of a Beta Test to ensure simulation meets requirements.
Conduct user VV&A of modified simulation	
VV&A Modification of Simulation	Conduct Verification, Validation & Accreditation (VV&A) of a modified simulation.
Documentation of Modification	Prepare documentation for VV&A modification.
M&S Development and Use Life Cycle	
Retirement	Analyze a system to ensure its timely removal from active use or service due to culmination of useful period of service.
M&S Related Concepts	
analog simulation	Use simulation or simulators that represent analog functioning, for example, an analog circuit simulation used to design and test complex analog circuits.
digital simulation	Use digital simulation to represent functions in a manner that mimics real-world equipment, events, processes, etc.
human-in-the-loop simulation	Use human-in-the-loop simulation and simulators that employ one or more human operators in direct control of the simulation/simulator or in some key support function (e.g., decision making).
hardware-in-the-loop simulation	Use hardware-in-the-loop simulation and simulators that employ one or more pieces of operational equipment (to include computer hardware) within the simulation/simulator system.
software-in-the-loop simulation	Use software-in-the-loop simulation and simulators that employ one or more elements of operational software (computer programming code) within the simulation/simulator system.
composability	Apply composability design principles to simulation development.
community of practice	Organize a community of practice to share ideas, find solutions

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
	and build innovations.
professional certification	Obtain professional certification of simulation expertise based on key knowledge, skills and/or experience.
simulation asset management	Apply simulation asset management tasks and decisions to capture, catalog and coordinate use of key resources (e.g., equipment, HW/SW, personnel, etc.) related to simulations/simulators.
economics of simulation	Analyze the economics of a given simulation, to include evaluation of effective usage, cost-benefit analysis, return on investment (ROI), etc.
sensors	Discuss the role of sensors as they apply to simulation.
web-enabled simulations	Develop Web-enabled simulations that can be accessed using standard Internet (Web) connectivity and associated data I/O protocols in combination with off-the-shelf hardware/software components.
simulation tools (AcslXtreme,etc)	Distinguish the type of simulation tool used to mimic a specified type of system or process (e.g., continuous, dynamic, analog, etc.).
bioinformatics	Apply bioinformatics within simulations.
wearable computing	Use wearable computing devices that provide one or more of a host of functions useful for work, leisure and entertainment.
augmented reality / mixed reality	Use augmented or mixed reality to merge real-world and computer-generated data.
biometrics	Use biometrics within a simulation to recognize humans based upon one or more intrinsic physical or behavioral traits.
biosensors	Use biosensors to detect analytes that combine a biological component with a physicochemical detector component.
neural networks	Use neural networks within a simulation to produce an output function.
data mining	Use data mining techniques within simulation to search for element/component commonality (e.g., classification, clustering, key words, etc.).
authoring systems	Use authoring systems to develop useable computer-based applications, such as computer-based training (CBT), HTML code for viewing on the Internet, modeling/simulation applications, computer/Internet based tests/surveys, etc.
grid and cluster computing	Explain grid and cluster computing and how they are used within a simulation.
distributed high performance computing	Use distributed high performance computing techniques to enhance computational power of a simulation.
optical computing	Use optical computing to manipulate, store and transmit data.
Microeletromechanical systems	Describe microelectromechanical systems (MEMS) as the

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
(MEMS)	technology of the very small (from a micrometer to millimeter), and merged at the nanoscale into nanotechnology.
Micro-opto-mechanical systems (MOMS)	Discuss micro-opto-mechanical systems (MOMS) and how they are used within a simulation.
RF MEMS	Describe Radio Frequency (RF) MEMS as a MEMS-based sensor that specifically deals with radio frequency signals (RF)—that portion of the electromagnetic spectrum in which electromagnetic waves can be generated by alternating current which is fed to an antenna.
BioMEMS	Describe BioMEMS as a MEMS-based sensor that specifically deals biological signals/functions; for example, blood pressure sensors.
photonics	Describe photonics as the science and technology of generating, controlling and detecting photons, particularly in the visible light and near infra-red spectrum.
microfluidics	Describe microfluidics as the science and technology relating to the behavior, precise control and manipulation of microliter and nanoliter volumes of fluids.
teraherz technology	Describe teraherz technology as 10^{12} Hz, corresponding to wavelength (e.g., of sound, radiation, etc.), and capabilities/applications based on this capability – for example, imaging techniques and ultra-precise timing devices.
rational unified process (RUP)	Describe the Rational Unified Process (RUP) as an iterative (adaptable) software development process framework that can be tailored, for example by a software project team, by selecting the elements of the process that are appropriate for their needs.
UML	Describe the Unified Modeling Language (UML) as a general purpose, standardized specification (modeling) language for object modeling that includes a graphical notation used to create an abstract model of a system.
Shlaer-Mellor method of structured modeling	Describe the Shlaer-Mellor method of structured modeling as one of a number of object-oriented analysis/design methods developed in 1980s in response to perceived weaknesses in the existing structured analysis and structured design (SASD) techniques in use primarily by software engineers.
real-time object oriented modeling (ROOM)	Describe Real-time Object Oriented Modeling (ROOM) as a technique whereby the actor or the software machine is the central component—c can be used in conjunction with UML, ROOM diagrams illustrate both the structural and behavior aspects of the actor.
model driven architectures (MDA)	Describe Model Driven Architecture (MDA) as a software design approach sponsored by Object Management Group that

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
	supports several standards, such as UML, XMI and others.
IDEF0 & IDEF1x (ER diagrams)	Describe IDEFo and IDEF1x as functional modeling language(s) sponsored by the Air Force capable of capturing various organizational enterprise operations/functions (IDEF0) and related information requirements (IDEF1x), such as key elements of an invoice.
Gane-Sarson data flow modeling	Describe the Gane-Sarson data flow modeling process as a structured analysis of how information/data flows through a system/process that can be used to automate parts or all of that system using various techniques, such as data flow diagrams, decision trees, decision tables and structured English.
Coad/Yourdon structured information modeling	Describe the Coad/Yourdon structured information modeling process as a widely used object-oriented (OO) modeling approach broken into three iterative steps: analysis (OOA), design (OOD) and programming (OOP).
test & training enabling architecture (TENA)	Use the Test & Training Enabling Architecture (TENA) within a simulation to allow interoperability between DoD ranges, labs and facilities.
CORBA IDL (interface definition language)	Describe the CORBA Interface Definition Language (IDL) as a JAVA-based technology for handling objects interacting on different platforms across a network (distributed objects) that is based on CORBA, an industry standard distributed object model architecture.
phenomenon algorithm specification	Explain the phenomenon algorithm specification procedure and how it is used to represent a given system, process, etc.
common software component development	Describe common software component development as development of componentware—software designed to work a component of a larger application.
finite element method	Explain that the finite element method is used to find approximate solutions of partial differential equations (PDE) as well as of integral equations, such as the heat transport equation.
hybrid simulation: e.g., combined CS/DES/FEM	Explain that hybrid simulation combines multiple modeling/simulation approaches within a unified approach – an example could be combining analytical, continuous, and discrete-event modeling/simulation into a multi-level (hybrid) approach that uses different modeling/simulation approaches when dealing with varying levels/abstractions.
surrogate key	Describe the surrogate key as a unique identifier in a database for either an entity in the modeled world or an object in the database.
hybrid models	Describe hybrid models as an assemblage of one or more

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
	physical and one or more numerical, consistently-scaled, substructures.
DES example	Explain a DES example as an Information desk at an airport and theestimation of the expected average delay in queue of arriving customers, where the delay in queue of a customer is the length of the time interval from the instant of his arrival at the facility to the instant he begins being served.
DES components	Describe DES components as system state, simulation clock, event list, statistical counters, initialization routine, timing routine, event routine, library routines, report generator, main program.
modeling issues in hybrid simulations	Discuss modeling issues in hybrid simulations including time events, state events, changes in simulation model, reinitialization, event iteration, chattering and Dirac pulses.
complex adaptive systems (CAS)	Describe Complex Adaptive Systems (CAS) as natural systems (e.g., brains, immune systems, ecologies, societies) and artificial systems (parallel and distributed computing systems, artificial intelligence systems, artificial neural networks, evolutionary programs) characterized by apparently complex behaviors that emerge as a result of often nonlinear spatio-temporal interactions among a large number of component systems at different levels of organization.
complexity and CAS modeling	Describe CAS modeling as the operational model of the complexity paradigm.
complexity and chaos	Describe Complexity as the interaction of many parts, giving rise to difficulties in linear or reductionist analysis due to the nonlinearity of the inherent circular causation and feedback effects. Describe Chaos as a system whose long term behavior is unpredictable, tiny changes in the accuracy of the starting value rapidly diverge to anywhere in its possible state space.
CAS modeling methods	Describe CAS modeling methods as StarLogo and NetLogo used in labs and classrooms with three main components of turtles, patches and the observer. The individual agents in the system are called turtles, although they can represent any kind of agent from a molecule to a person. The environment in which the turtles operate is divided into patches. The third component, the observer, can issue commands that affect both patches and turtles. The observer also conducts maintenance and documentation of the turtle world.
CAS modeling case studies	Describe CAS modeling case studies for economies, ecologies, weather, traffic, social organizations, cultures and the brain.

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
composability theory	Describe Composability as the capability to select and assemble simulation components in various combinations into valid simulation systems to satisfy specific user requirements and composability theory as the explanation of how an executing federation can provide imperfect results.
hierarchical simulation	Describe hierarchical simulation as a model of information in which data are represented as trees of records connected by pointers.
SEI/CMU concepts, methods & implementation	Explain SEI/CMU concepts, methods and implementation as the integration of Software-Intensive Systems (ISIS) including identifying indicators of success in interoperability, understanding optimal technologies and methods, identifying solutions for semantic interoperability, addressing organizational and programmatic issues and using the SEI Evolutionary Process for Integrating COTS-based systems (EPIC) in the adoption and integration of a COTS product.
solving DEs and PDEs	Explain differential equations and partial differential equations. DEs define the relationship between an unknown function and its derivative. Numerical methods are required to find the function defined by the differential equation(s). A PDE is a differential equation in which the unknown function is a function of multiple independent variables and their partial derivatives.
finite element analysis/PDE	Explain finite element analysis/PDE which represents a powerful and general class of techniques for the approximate solution of partial differential equations. Mesh generation and algebraic solver are two important aspects of the finite element methodology.
visualization for information representation	Explain visualization for information representation as a branch of computer graphics and user interface design concerned with presenting data to users, by means of interactive or animated digital images in order to improve understanding of the data being presented.
IG techniques	Explain IG techniques as new fundamental alternatives to raster imaging. Improvements include improved user interface, a 4x increase in display performance for large images, lower memory footprint for large images, improved performance for drawings with a large number of images, better support for monochrome images and new methods for creating and manipulating image entities.

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
deployment model	Apply a deployment model, a model that simulates the reception, staging, onward movement and integration (RSOI) of military personnel and equipment.
execution model	Describe an execution model which specifies the behavior of a computer system to the extent that it is relevant to correct execution of application programs. Explicitly describes the actions involved in the execution of a program by the specified computer system.
component model	Describe the component model software architecture from Microsoft, which defines a structure for building program routines (objects) that can be called up and executed in a Windows environment.
information model	Describe an information model as an organizational framework that is used to categorize information resources.
product line architecture & development	Explain product line architecture & development as the structural properties for building a group of related systems (i.e., product line), typically the components and their interrelationships. The inherent guidelines about the use of components must capture the means for handling required variability among the systems. (Sometimes called reference architecture).
data mining languages	Describe the various data mining languages such as PERL, Visual Basic®, Scripting Edition, XML
data mining using simulation	Explain data mining using simulation as the act of analyzing a database or data warehouse and searching for new facts based on the data.
CROM	Describe CROM as the simulation of the operation of a Control ROM.
C2IEDM	Apply the Command and Control Information Exchange Data Model which enables coalition information sharing and multi-security-level networking.
microelectromechanic systems (MEMS)	Describe microelectromechanic systems (MEMS as micron-scale structures that transduce signals between electronic and mechanical forms - the miniaturization of electronics.
Popkin's Systems Architect	Explain Popkin's Systems Architect as the first fully integrated enterprise tool set to support the wide array of industry standards used in modeling and architecture projects worldwide.
ERWin Data Modeler	Explain ERWin Data Modeler as a data modeling solution for creating and maintaining databases, data warehouses and enterprise data models.
Component X	Define Component X as a free plug in for the REALbasic

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
	Development Environment which provides high quality, fast, cross-platform consistent graphics functions.
CADM	Define and explain CADM as Core Architecture Data Model or Computer-Aided Design and Manufacturing and its use in developing models.
architecture views	Apply architecture views as representations of the overall architecture that are meaningful to one or more stakeholders in the system. The architect chooses and develops a set of views that will enable the architecture to be communicated to, and understood by, all the stakeholders and enable them to verify that the system will address their concerns.
operational (process) architecture	Explain operational (process) architecture as the structural design of general process systems and applies to fields such as computers (software, hardware, networks, etc.), business processes (enterprise architecture, policy and procedures, logistics, project management, etc.) and any other process system of varying degrees of complexity.
activity modeling	Define activity modeling as the act of developing an accurate description of the activities performed by a system.
information exchange model	Explain the information exchange model as an XML-based metadata registry being adopted by U.S. federal agencies for the precise exchange of information.
IDEF 1X	Explain IDEF semantic modeling as a method for designing relational databases with syntax designed to support the semantic constructs necessary in developing a conceptual schema. A conceptual schema is a single integrated definition of the enterprise data that is unbiased toward any single application and independent of its access and physical storage.
LADAR/IR	Define Laser Detection and Ranging/Infrared as a high-resolution method for collecting enough detail to identify targets.
degeneracy tests	Explain degeneracy tests as tests that check that the model works for extreme cases.
logical variable	Define a logical variable as a variable that can hold one of the logical values and is one of the basic structures in logic programming. The object is referred to by a name starting with a capital letter.
integer variable	Define integer variable as variables that must take an integer value (0, 1, 2...).
real variable	Define real variable as a mathematical function whose domain is the real line. More loosely, a function of a real variable is sometimes taken to mean any function whose domain is a

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
	subset of the real line.
state variable	Describe state variable as a variable that defines one of the characteristics of a system, component or simulation. The values of all such variables define the state of the system, component or simulation.
initial condition	Describe initial condition as the values assumed by the variables in a system, model, or simulation at the beginning of some specified duration of time.
steady state	Explain steady state as a situation in which a model, process, or device exhibits stable behavior independent of time.
data fusion	Explain data fusion as the integration of data and knowledge collected from disparate sources by different methods into a consistent, accurate and useful whole.
fractal	Explain fractal as an irregular or fragmented geometric shape that can be repeatedly subdivided into parts, each of which is a smaller copy of the whole. Fractals are used in computer modeling of natural structures that do not have simple geometric shapes such as clouds, mountainous landscapes and coastlines.
Phong Lighting Model	Describe Phong Lighting Model as one of the most common lighting models in computer graphics. Local illumination model, which means only direct reflections are taken into account. Light that bounces off more than one surface before reaching the eye is not accounted for.
Z-buffer	Describe Z-buffer as the management of image depth coordinates in three-dimensional (3-D) graphics, usually done in hardware, sometimes in software. Also known as depth buffering.
computable	Explain the concept of computable as a function that can be computed by an algorithm.
NP complete	Explain NP Complete as the class of decision problems for which answers can be checked for correctness, given a certificate, by an algorithm whose run time is polynomial in the size of the input (that is, it is *NP*) and no other NP problem is more than a polynomial factor harder.
evolutionary computation	Explain evolutionary computation as a development in computer science that contains building, applying and studying algorithms based on natural selection. EC is conducted with the help of evolutionary algorithms.
portable simulation systems	Describe portable simulation systems as high-technology simulation systems that enable tactical units to conduct training close to home or while deployed.

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
eye-point	Explain eye-point as an alternative to the computer mouse that allows a person using a computer to click links, highlight text and scroll simply by looking at the screen and tapping a key on the keyboard. Uses standard eye-tracking hardware-a specialized computer screen with a high-definition camera and infrared lights.
Field-of-View (FOV)	Explain Field-of-View (FOV) as the angular extent of the observable world that is seen at any given moment.
euler attitude angles	Explain the concept of euler attitude angles as a set of three angles used to describe the orientation of an entity as a set of three successive rotations about three different orthogonal axes (x, y, and z).
fitness landscape	Explain the concept of fitness landscape as it is used to visualize the relationship between genotypes (or phenotypes) and reproductive success.
predator-prey modeling	Describe predator-prey modeling as a system in which there are two populations known as the predator and the prey. The model states that the prey will grow at a certain rate, but will also be eaten at a certain rate because of predators. The predators will die at a certain rate but will then grow by eating prey.
principle of competitive exclusion (Gause's principle)	Explain the principle of competitive exclusion (Gause's principle as two species competing for the limited resources can only co-exist if they inhibit the growth of competing species less than their own growth. Where one species eliminates the other is known as competitive exclusion, or Gause's Principle.
inductive modeling	Describe inductive modeling as finding the rule with the cause and the effect. Inductive Modeling combines ideas from many other technologies — including simulations, data modeling, expert systems and object-oriented modeling — to apply artificial intelligence to very complex systems such as data networking environments. Inductive techniques include system identification and parameter estimation.
multicast	Describe multicast as a transmission mode in which a single message is sent to selected multiple (but not necessarily all) network destinations; i.e., one-to-many.
interest management	Describe interest management as the filtering of data that is of no interest to a given client. Interest management is a one-step process: data flows in from the network and is either rejected or accepted.
time warp	Explain the concept of time warp which synchronizes parallel simulation processes via rollback and event cancellation

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
dependent variables	Explain dependent variables as the output of a function derived from independent variables.
effects based modeling	Explain effects based modeling as an approach whereby technologies are evaluated by their potential to produce intended and unintended effects and then developing research plans to address gaps in understanding.
lazy evaluation	Explain lazy evaluation as the delaying of a computation until such time as the result of the computation is known to be needed.
differential games	Explain differential games, a branch of the mathematical theory of control, the subject of which is control in conflict situations. Demonstrate Involvement of players with opposing goals - one which wishes to maximize a given quantity and one who wishes to minimize it.
white-box and black-box models	Describe a Black-box model whose inputs, outputs and functional performance are known, but whose internal implementation is unknown or irrelevant. Describe a White-box model whose internal implementation is known and fully visible.
behavior diagrams	Describe behavior diagrams and how they are used in simulation to depict behavioral features of a system or business process.
functional analysis	Describe functional analysis as the branch of mathematics, and specifically of analysis, concerned with the study of spaces of functions.
replicated validation	Explain the value of replicated validation which involves multiple simulation runs to validate data.
priority queue data structure	Explain how priority queue data structure as being is useful in problems where you need to rapidly and repeatedly find and remove the largest element from a collection of values.
conservative time management	Describe conservative time management as a mechanism that prevents a federate from processing messages out of time stamp order.
optimistic time management	Describe optimistic time management as a mechanism that uses a recovery mechanism to erase the effects of out-of-order event processing.
predictive contracts	Describe how predictive contracts work in conjunction with data management interest-based Services to reduce the message traffic between federates in distributed simulations.
big/little endian data formats	Describe big/little endian data formats and explain which bytes are most significant in multi-byte data types and describe the order in which a sequence of bytes is stored in a computer's

KNOWLEDGE AREA	MANAGEMENT LEVEL COMPETENCIES
	memory.

Summary BOK Ratings for Executive Usage Levels

KNOWLEDGE AREA	EXECUTIVE LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
Basic Concepts		
Understand historic perspective of M&S		
Historic Aspect of M&S	1.00	1
DoD/Military Simulations		
Policies and rules	3.50	4
Modeling Concepts		
Model Types		
Model Definition	1.70	2
Model Concept	1.50	2
Physical Models	1.70	2
Mathematical Models	1.60	2
Process Models	1.60	2
Combination Models	2.22	2
M&S Representation		
Systems	1.60	2
Human Behavior	1.50	2
Natural Environment	1.50	2
Modeling Process		
Modeling Process	1.60	2
Abstractions	1.40	1
Formalisms	1.40	1

KNOWLEDGE AREA	EXECUTIVE LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
Design and Build Models		
Conduct Feasibility Assessments	1.70	2
Knowledge engineering	1.30	1
Simulation Concepts		
Simulation Definition	1.60	2
Simulation Concept	1.70	2
Live Simulation	1.67	2
Virtual Simulation	1.67	2
Constructive Simulation	1.67	2
Simulation Methods	1.89	2
General Simulation Knowledge		
Mechanisms	1.30	1
Simulation Ethics	1.56	2
Discrete Event	1.40	1
Continuous	1.50	2
Live/Virtual/Constructive	1.89	2
Discrete Event Simulation		
Formalisms	1.60	2
Implementation/structure/mechanics	2.33	2
Languages/tools	1.33	1
Worldviews	1.40	1
Warm-up, steady state	1.33	1
Continuous Simulation		
Systems Dynamics	1.25	1
Solving DEs and PDEs (Differential Equations & Partial Differential Equations)	1.25	1
Languages/tools	1.20	1
Implementation/structure/mechanics	1.25	1

KNOWLEDGE AREA	EXECUTIVE LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
Underlying 'Science'		
Existence	1.00	1
Referential designation	1.33	1
Abstraction/classification (verb and noun)	1.33	1
Representation/qualification (verb and noun)	1.33	1
Surrogacy operations	1.00	1
Referential inference	1.00	1
Interoperability Concepts		
Concept of Interoperability	2.11	2
Interoperability Issues	2.22	2
Understand domain concepts (7 surfboards)		
Identify M&S opportunities and challenges		
Opportunities	2.00	2
Challenges	2.00	2
M&S Organizations		
Identify key Joint/Service M&S organizations		
Organization	2.14	2
Systems Theory		
Elements to Whole	1.20	1
Reductionism to Holism	1.00	1
Structure to Function	1.00	1
Linear Hierarchy	1.00	1
Network Hierarchy	1.00	1
Spatial Dimensions	1.00	1

KNOWLEDGE AREA	EXECUTIVE LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
Temporal Dimensions	1.00	1
Structural Dimensions	1.00	1
Multi-Disciplined Simulations Specialist		
Operations	2.40	2
Organization	2.60	3
Systems	2.20	2
Modeling		
Design and build models	1.20	1
Feasibility assessment	1.33	1
Knowledge engineering	1.33	1
Leadership and Organizational Management		
Change Management	3.78	4
Workforce Professional Development	3.78	4
Leadership and Management Development		
Strategic Planning	3.50	4
Innovative Problem Solving	2.67	3
Journeyman		
Contracting	2.50	3
Supervisor, Manager, Sr. Tech. Specialist		
Technology	2.60	3
Joint Operations	3.20	3

KNOWLEDGE AREA	EXECUTIVE LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
Manager		
International Operations	3.11	3
Senior Technical Specialist		
Technology Planning	3.22	3
Technology Transition	3.25	3
Develop Simulation Requirements		
Identify the requirement		
Need Assessment	2.70	3
Desired Outcomes	2.44	2
RDA Development Cycle	2.22	2
ORD Development	2.11	2
Validate the requirement		
Organizational Inputs	2.10	2
Technical Review	2.30	2
Organizational Input	2.30	2
Spiral Development Process	2.40	2
Scope the requirement		
User Perspective	1.90	2
Resource Constraints	2.20	2
New M&S Application		
Identifying new capability		
New Organization or System	2.60	3
New Mission Set	2.60	3
Validating new application		
Organizational Input	3.10	3

KNOWLEDGE AREA	EXECUTIVE LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
System Capability Input	2.90	3
Documenting new application		
Documentation of Development	2.00	2
Incorporate requirement into the RDA domain		
Cradle to Grave Concept	2.50	3
Technical Development of the Simulation		
Identify key programming aspects		
Technical Design	1.40	1
Structure Design	1.30	1
Translating Process	1.30	1
Collect data for programming		
Identify Sources	1.20	1
Data Management Plan	1.10	1
Documentation	1.10	1
Prepare to Use Simulation		
Conduct developer VV&C		
VV&C Concept	1.70	2
Certification	1.60	2
Documentation	1.50	2
Conduct testing of simulation		
Assess Abilities	1.20	1
Establish Parameters	1.20	1
Conduct user VV&A		
VV&A Concept	1.60	2

KNOWLEDGE AREA	EXECUTIVE LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
Accreditation	1.50	2
Documentation	1.30	1
Programmatic		
Technology	1.90	2
Production Tools	1.90	2
Management	3.40	3
Marketing	2.80	3
Specific Simulations and Attributes		
Assess each simulation		
Hierarchy of Simulations	1.90	2
Assessment Process	1.70	2
Identify specific simulations		
Application Description		
History	1.70	2
Current Usage	1.70	2
Other Usage	1.90	2
Technical Description		
Language	1.00	1
Specifications	1.10	1
Interoperability with other simulations		
ALSP, DIS & HLA	2.20	2
DIS Concept	1.80	2
ALSP Concept	1.80	2
HLA Concept	1.80	2
Air Force Simulations	1.50	2

KNOWLEDGE AREA	EXECUTIVE LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
Army Simulations	1.50	2
Navy Simulations	1.50	2
Marine Simulations	1.50	2
Joint Simulations	1.75	2
Interoperability with real world equipment		
C4I Systems	1.80	2
Weapon Systems	1.50	2
Specific Simulation Applications		
Develop strategy to meet requirement		
Develop a M&S Support Architecture	1.50	2
Documentation	1.30	1
Identify simulations to meet requirement		
Education		
Learning theories	1.75	2
Developing the Training Environment		
Identify training objectives		
Training Design	1.70	2
Organizational Perspective	1.70	2
Training audience	1.70	2
Primary Training Objectives	1.70	2
Secondary Training Objectives	1.70	2
Design a architecture based on objectives		

KNOWLEDGE AREA	EXECUTIVE LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
Single vs Multiple Sites	1.30	1
Communication	1.40	1
Security	1.40	1
Refine objectives with defined outcomes		
Time Constraints	2.50	3
Resource Constraints	2.80	3
Simulation in the Training Environment		
Define observation process		
Alignment of Objectives	1.44	1
Structure of Observation	1.33	1
Develop timeline structure for integration		
Exercise Timeline	1.60	2
Technical Timeline	1.70	2
Support Timeline	1.70	2
Conduct pre-integration activities		
Initial Research	1.30	1
IPR Concept	2.50	3
Design of Simulation Event	2.40	2
Facility Support	2.20	2
Scenario Development	2.40	2
Support Activities	2.30	2
Pre-training	2.10	2
Documentation	1.80	2
Conduct integration activities		

KNOWLEDGE AREA	EXECUTIVE LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
Cell Functions	2.70	3
Exercise Flow	2.33	2
Observation of Training Environment		
Collect observations		
Collection Plan	1.70	2
Analysis	1.40	1
Supporting Materials	1.40	1
Documentation	1.44	1
Provide feedback based upon observations		
Formal AAR Process	2.00	2
Informal Process	1.78	2
Final Report	1.89	2
M&S Related Perspectives		
Enterprise	2.50	3
Business Practice	2.90	3
Economics of M&S	3.20	3
Market Model	2.70	3
Products	2.70	3
Services	2.30	2
Buyers	2.30	2
Sellers	2.20	2
Business Case	3.00	3
Cost-benefit	3.50	4
Enterprise Infrastructure	3.10	3
Professional Development	3.80	4
Enterprise Process	3.60	4

KNOWLEDGE AREA	EXECUTIVE LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
Enterprise Tools	3.50	4
M&S Related Disciplines		
Graph Theory	1.40	1
Logic	1.40	1
Relations	1.80	2
Inference	1.80	2
Management		
Enterprise Management	3.30	3
Corporate institutional development	3.30	3
Enterprise operations	3.30	3
Evaluation Design		
Develop measurement of outcomes		
Baseline Establishment	1.80	2
Measurement Alignment to Objectives	1.80	2
Tractability Documentation	1.40	1
Develop evaluation methodology and tools		
Technical Evaluation Methodology	1.20	1
Application Evaluation Methodology	1.20	1
Develop description of evaluation methods		
Quantitative Methods	1.20	1
Qualitative Methods	1.30	1

KNOWLEDGE AREA	EXECUTIVE LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
Develop resources to conduct the evaluation		
Resource Scoping	1.70	2
Issues with Resource Constraints	1.70	2
Execution of Evaluation		
Develop timelines for the evaluation		
Pre-Collection Timeline Development	1.10	1
Post Collection Timeline Development	1.10	1
Execute the evaluation		
Collection Methodology	1.20	1
Documentation of Collection		
Convert analysis results to an action plan		
Develop Analysis Relationships	1.40	1
Develop New or Modified Requirements	1.30	1
M&S Modification		
Determining Need to Change a Simulation		
Identify shortfalls in simulation		
Application Design Flaws	1.00	1
Technical Design Flaws	1.00	1
Develop requirements to rectify the shortfalls		
Application Requirements	1.00	1
Technical Requirements	1.11	1
Validate requirements to rectify the shortfalls		

KNOWLEDGE AREA	EXECUTIVE LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
Organizational Review	1.90	2
Technical Review	1.60	2
Technical Changes of the Simulation		
Collect data to rectify the shortfalls		
Focused Data Collection	1.00	1
Alignment to other Data	1.00	1
Convert data into programming language		
Convert Data	1.17	1
Data Insertion into Simulation	1.00	1
Soft Computing		
Decision Trees	1.00	1
Logistic Networks	1.10	1
Conduct VV&C of modified simulation		
VV&C Modification	1.20	1
Soft Computing		
Convert language into another language		
Resource Implications	1.00	1
Implications of Conversion	1.00	1
Assessment of Changes to a Simulation		
Conduct testing of modified simulation		
Alpha Testing Modification	1.30	1

KNOWLEDGE AREA	EXECUTIVE LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
Beta Testing Simulation	1.60	2
Conduct user VV&A of modified simulation		
VV&A Modification in Simulation	1.70	2
Documentation of Modification	1.40	1
M&S Development and Use Life Cycle		
Retirement	1.80	2
M&S Related Concepts		
analog simulation	1.60	2
digital simulation	1.60	2
human-in-the-loop simulation	2.00	2
hardware-in-the-loop simulation	2.00	2
software-in-the-loop simulation	2.00	2
composability	1.60	2
community of practice	2.00	2
professional certification	1.90	2
simulation asset management	1.90	2
economics of simulation	3.00	3
sensors	1.00	1
web-enabled simulations	1.40	1
simulation tools (AcslXtreme,etc)	1.30	1
bioinformatics	1.10	1
wearable computing	1.30	1
augmented reality / mixed real	1.30	1
biometrics	1.30	1
biosensors	1.20	1
neural networks	1.30	1

KNOWLEDGE AREA	EXECUTIVE LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
data mining	1.40	1
authoring systems	1.20	1
grid and cluster computing	1.10	1
distributed high performance computing	1.30	1
optical computing	1.00	1
TENA (test & training enabling architecture	1.20	1
Corba Interface Definition Language (IDL)	1.80	2
phenomenon algorithm specification	1.40	1
common software component development	1.40	1
DES components	1.29	1
modeling issues in hybrid simulations	1.60	2
complex adaptive systems (CAS)	1.40	1
complexity and CAS modeling	1.40	1
complexity and chaos	1.50	2
CAS modeling methods	1.40	1
CAS modeling case studies	1.50	2
visualization for information representation	1.20	1
deployment model	1.60	1
execution model	1.17	1
component model	1.17	1
information model	1.29	1
data mining using simulation	1.33	1
C2IEDM	1.50	2
architecture views	1.10	1
operational (process) architecture	1.29	1
activity modeling	1.20	1

KNOWLEDGE AREA	EXECUTIVE LEVEL	
Rating Legend	**1 - Knowledge**: Recalls data or information **2 - Comprehension**: Able to understand the meaning of data or information **3 - Application**: Uses information in new situations; solves problems **4 - Analysis**: Breaks down information and identifies components **5 - Synthesis**: Uses old ideas to create new ones **6 - Evaluation**: Compares and discriminates between ideas **7 - Does not apply**	
	MEAN	**VALUE**
information exchange model	1.60	2
LADAR/IR	1.33	1
logical variable	1.00	1
integer variable	1.33	1
real variable	1.20	1
state variable	1.20	1
initial condition	1.20	1
steady state	1.20	1
data fusion	1.20	1
portable simulation systems	1.50	2
eye-point	1.20	1
field-of-view (FOV)	1.33	1
predator-prey modeling	1.20	1
Principle of competitive exclusion (Gause's principle)	1.20	1
inductive modeling	1.20	1
multicast	1.17	1
dependent variables	1.00	1
effects based modeling	1.00	1
differential games	1.20	1
white-box and black-box models	1.17	1
behavior diagrams	1.20	1
functional analysis	1.20	1
replicated validation	1.33	1
priority queue data structure	1.20	1

KNOWLEDGE AREA	EXECUTIVE LEVEL COMPETENCIES
Basic Concepts	
Understand historic perspective of M&S	
Historic Aspect of M&S	Recognize the impact of modeling and simulation key concepts from a historical perspective.
DoD/Military Simulations	
Policies and rules	Analyze and comply with DoD M&S directives and policies when planning or implementing M&S activities.
Modeling Concepts	
Model Types	
Model Definition	Describe the term "model" and identify its application to M&S.
Model Concept	Describe the information and the amount needed to develop a model.
Physical Models	Describe physical models and how they support M&S programs and activities.
Mathematical Models	Describe mathematical models and how they support M&S programs and activities.
Process Models	Describe the term "process model" and its application to M&S.
Combination Models	Describe the term "combination model" and its application to M&S.
M&S Representation	
Systems	Explain a systems approach to identify critical parts of a system and determine their correct level of representation.
Human Behavior	Discuss how human behavior is represented in M&S applications and the issues associated with its representation.
Natural Environment	Discuss how the natural environment is represented in M&S applications and the issues associated with its representation.
Modeling Process	
Modeling Process	Describe in general terms how a model is developed, designed and built.
Abstractions	Recall the abstraction process and its application to M&S.
Formalisms	Recall formalism methods and their application to M&S.

KNOWLEDGE AREA	EXECUTIVE LEVEL COMPETENCIES
Design and Build Models	
Conduct Feasibility Assessments	Review a feasibility assessment to determine the viability of a proposed target for special operations forces employment.
Knowledge engineering	Recall the concept of knowledge engineering and its application to M&S.
Simulation Concepts	
Simulation Definition	Explain simulation as a method for implementing a model over time.
Simulation Concept	Select the information and the amount needed to develop a simulation.
Live Simulation	Describe live simulation within M&S programs and activities.
Virtual Simulation	Describe virtual simulation within M&S programs and activities.
Constructive Simulation	Describe the characteristics and issues associated with constructive simulation.
Simulation Methods	Describe simulation methods to solve problems, including building new simulations when appropriate.
General Simulation Knowledge	
Mechanisms	Recognize mechanism as a system of parts that operate or interact like those of a machine.
Simulation Ethics	Select simulation strategies which foster high ethical standards in meeting an organization's vision, mission and goals.
Discrete Event	Recognize discrete event as one of the chronological sequence of events that occur in the operation of a system.
Continuous	Describe continuous simulation as a mathematical or computational model whose output variables change in a continuous manner.
Live/Virtual/Constructive	Classify all three types of simulation (live, virtual and constructive) within a particular event or activity.
Discrete Event Simulation	
Formalisms	
Implementation/structure/mechanics	Recall the implementation, structure and mechanics of a given discrete event simulation.
Interoperability Concepts	
Concept of Interoperability	Describe the concept of interoperability and the processes to achieve digital interoperability.
Interoperability Issues	Explain interoperability issues inherent in the technology approaches that allow simulations to work together.
Understand domain concepts (7 surfboards)	

KNOWLEDGE AREA	EXECUTIVE LEVEL COMPETENCIES
Identify M&S opportunities and challenges	
Opportunities	Classify models appropriately within M&S programs and activities.
Challenges	Interpret a model's strengths, limitations and weaknesses.
M&S Organizations	
Identify key Joint/Service M&S organizations	
Organization	Interpret the mission, structure and services provided by key Joint/Service M&S organizations.
Multi-Disciplined Simulations Specialist	
Operations	Demonstrate the steps and issues involved with the M&S development process as it applies to the functional areas of analysis, acquisition, experimentation, testing and evaluation, planning and training.
Organization	Develop the critical elements of a system and determine their correct level of representation.
Systems	Describe the workings, characteristics and composition of major simulation systems and their relationships (interoperability) to other simulation systems.
Modeling	
Design and build models	Recall how a model is generally designed, developed and built (model development process).
Feasibility assessment	Identify how well a model or simulation serves its intended purpose.
Knowledge engineering	Identify knowledge engineering principles to build, maintain and develop knowledge-based systems.
Leadership and Organizational Management	
Change Management	Appraise change in the M&S community and act as a catalyst to influence, motivate and challenge subordinates to accept change.
Workforce Professional Development	Examine M&S strategies which maximize employee potential and foster high ethical standards in meeting the organization's vision, mission and goals.
Leadership and Management	

KNOWLEDGE AREA	EXECUTIVE LEVEL COMPETENCIES
Development	
Strategic Planning	Analyze the strategic planning process and how it relates to simulations management.
Innovative Problem Solving	Apply creative and innovative solutions to complex simulation management issues.
Journeyman	
Contracting	Apply the contracting process for M&S products and/or services.
Supervisor, Manager, Sr. Tech. Specialist	
Technology	Develop critical technological needs and formulate programs to advance state-of-the-art technologies.
Joint Operations	Apply Joint philosophy, goals and doctrine.
Manager	
International Operations	Apply international M&S policy, objectives and capabilities.
Senior Technical Specialist	
Technology Planning	Prepare technical project/program planning, direction and execution.
Technology Transition	Organize acceptance of technology transition within an organization.
Develop Simulation Requirements	
Identify the requirement	Schedule a need assessment for a simulation requirement.
Need Assessment	Generalize the results of a set of data and relate to the desired outcomes.
Desired Outcomes	Describe the phases of the RDA development cycle.
RDA Development Cycle	Describe the purpose and contents of an Operational Requirements Document (ORD).
ORD Development	
Validate the requirement	Classify organizational inputs as supportable or non-supportable and modify the requirement based on supportable inputs.
Organizational Inputs	Review a technical support review for the requirement.
Technical Review	Review the role of user organizations in validating new requirements.
Organizational Input	Review the phases of the spiral development process.
Spiral Development Process	Schedule a need assessment for a simulation requirement.
Scope the requirement	

KNOWLEDGE AREA	EXECUTIVE LEVEL COMPETENCIES
User Perspective	Review the requirement from a user's perspective.
Resource Constraints	Interpret a resource matrix for given requirement to identify resource constraints.
New M&S Application	
Identifying new capability	
New Organization or System	Illustrate critical components of a system or organization and develop their correct level of representation within a simulation.
New Mission Set	Apply a mission set for a new M&S application.
Validating new application	
Organizational Input	Develop a new M&S application based on organizational input.
System Capability Input	Develop a new system capability for an M&S application.
Documenting new application	
Documentation of Development	Describe proper documentation for an M&S event.
Incorporate requirement into the RDA domain	
Cradle to Grave Concept	Illustrate the life cycle of a new system based on a cradle to grave concept.
Technical Development of the Simulation	
Identify key programming aspects	
Technical Design	List process components in the technical design of a simulation.
Structure Design	List process components in the structure design of a simulation.
Translating Process	Match current simulation knowledge to new and unique simulation applications.
Collect data for programming	
Identify Sources	Identify the source(s) of data used and ensure it is appropriate for use.
Data Management Plan	List appropriate data collection techniques.
Documentation	Name sources of data to build a database.
Prepare to Use Simulation	
Conduct developer VV&C	
VV&C Concept	Explain Verification, Validation & Certification (VV&C) elements and their uses.
Certification	Describe the certification process of a simulation.
Documentation	Recall required documentation for VV&C of a simulation.
Conduct testing of simulation	
Assess Abilities	Define a process to assess abilities during simulation testing.

KNOWLEDGE AREA	EXECUTIVE LEVEL COMPETENCIES
Establish Parameters	Define simulation testing parameters.
Conduct user VV&A	
VV&A Concept	Explain Verification, Validation & Accreditation procedures that support the development of cost-effective M&S applications.
Accreditation	Describe the accreditation process of a simulation.
Documentation	Recall required documentation for VV&A of a simulation.
Programmatic	
Technology	Classify M&S tools and their ability to control and adapt to the world's changing environment.
Production Tools	Review devices, computer applications or other equipment to determine if they provide an advantage when accomplishing a task.
Management	Employ others in one-to-one or group situations.
Marketing	Generalize individual/group needs and wants through exchange processes.
Specific Simulations and Attributes	
Assess each simulation	Classify simulations according to a hierarchy and provide examples for each level.
Hierarchy of Simulations	Describe the assessment process for a given simulation.
Assessment Process	
Identify specific simulations	
Application Description	Describe the development history of a simulation and generalize its impact on current capabilities.
History	Describe a simulation and its supporting tools for proper application to the functional areas of analysis, acquisition, training, testing and evaluation, experimentation and planning.
Current Usage	Classify simulations according to a hierarchy and provide examples for each level.
Other Usage	Describe a simulation and its supporting tools for proper applications for areas other than its intended purpose.
Technical Description	
Language	Identify appropriate programming languages to simulation applications.
Specifications	Identify technical specifications for hardware according to their implications to a simulation.
Interoperability with other simulations	

KNOWLEDGE AREA	EXECUTIVE LEVEL COMPETENCIES
ALSP, DIS & HLA	Describe Aggregate Level Simulation Protocol (ALSP), Distributed Interactive Simulation (DIS) and High Level Architecture (HLA) to M&S applications.
DIS Concept	Demonstrate DIS to M&S applications according to its capabilities and limitations.
ALSP Concept	Demonstrate ALSP to M&S applications according to its capabilities and limitations.
HLA Concept	Demonstrate HLA to M&S applications according to its capabilities and limitations.
Air Force Simulations	Demonstrate key simulations for the Air Force according to their capabilities, limitations and interoperability concerns.
Army Simulations	Demonstrate key simulations for the Army according to their capabilities, limitations and interoperability concerns.
Navy Simulations	Demonstrate key simulations for the Navy according to their capabilities, limitations and interoperability concerns.
Marine Simulations	Demonstrate key simulations for the Marines according to their capabilities, limitations and interoperability concerns.
Joint Simulations	Demonstrate key Joint simulations according to their capabilities, limitations and interoperability concerns.
Interoperability with real-world equipment	
C4I Systems	Locate C4I systems within associated M&S systems.
Weapon Systems	Describe weapon systems that require simulation feed according to their capabilities, issues and interoperability concerns.
Specific Simulation Applications	
Develop strategy to meet requirement	
Develop a M&S Support Architecture	Identify simulation architecture to meet objectives.
Documentation	Identify required documentation for M&S architecture.
Education	
Learning theories	Classify learning theories to determine the best way to present to-be-learned material to a particular target group or individual.
Developing the Training Environment	
Identify training objectives	
Training Design	Describe training objectives for an M&S event.
Organizational Perspective	Describe training needs from an organizational perspective.
Training audience	Describe the demographic characteristics, values and needs of

KNOWLEDGE AREA	EXECUTIVE LEVEL COMPETENCIES
	the training audience for whom an M&S event is intended.
Primary Training Objectives	Review primary event objectives for a given scenario.
Secondary Training Objectives	Review secondary event objectives for a given scenario.
Design a architecture based on objectives	
Single vs. Multiple Sites	Identify the architecture implications for either a single site or multiple site simulation distribution.
Communication	List the communication components needed for an M&S event.
Security	List the security and issues with multi-layer security design for an M&S event.
Refine objectives with defined outcomes	
Time Constraints	Schedule the impact that time will have in terms of established objectives.
Resource Constraints	Relate the impact that resource constraints will have in terms of established objectives.
Simulation in the Training Environment	
Define observation process	
Alignment of Objectives	Identify the outcomes of a simulation to appraise objectives.
Structure of Observation	List the outcomes of a simulation with an appropriate observation methodology.
Develop timeline structure for integration	
Exercise Timeline	Describe the timeline for integrating simulation within a training exercise and relate the time resource associated with each event.
Technical Timeline	Describe the timeline for integrating the technical aspects of an exercise and relate the time resource associated with each event.
Support Timeline	Describe the timeline for integrating the support aspects required for the conduct of an exercise and relate the time resource associated with each event.
Conduct pre-integration activities	
Initial Research	Identify research to develop support requirements for an M&S exercise event.
IPR Concept	Solve the outcomes from an In-Process Review (IPR).
Design of Simulation Event	Locate which simulation or mix of simulations is required for a given event.
Facility Support	Describe the facility support required for a simulation event.

KNOWLEDGE AREA	EXECUTIVE LEVEL COMPETENCIES
Scenario Development	Review a scenario based on a given set of objectives.
Support Activities	Describe support activities required to for an exercise.
Pre-training	Describe pre-training requirements for a simulation exercise.
Documentation	Describe elements of an Exercise Control Plan and Simulation Control Plan.
Conduct integration activities	
Cell Functions	Apply the role and functions of cells in an exercise.
Exercise Flow	Describe components of the exercise flow.
Observation of Training Environment	
Collect observations	
Collection Plan	Review a collection plan for the After Action Review (AAR) process.
Analysis	Identify a training event for simulation impact.
Supporting Materials	Arrange supporting materials for feedback based on data analysis.
Documentation	Label documentation for report results.
Provide feedback based upon observations	
Formal AAR Process	Explain a formal After-Action Review (AAR) process.
Informal Process	Explain an informal After-Action Review (AAR) process.
Final Report	Review the exercise material to be incorporated into final report.
M&S Related Perspectives	
Enterprise	Prepare a systematic activity or a project undertaken or to be undertaken.
Business Practice	Generalize those behaviors in a business that reflect how a particular organization or business conducts its day to day operations.
Economics of M&S	Illustrate the Return on Investment (ROI) of M&S based on quantifiable and non-quantifiable benefits.
Market Model	Apply a defined model representation of a specific subdivision of a population considered as buyers or users of a particular product or service.
Products	Apply something produced by human or mechanical effort or by a natural process; a direct result; a consequence.
Services	Describe activities that call directly for time and effort rather than for a concrete end product.

KNOWLEDGE AREA	EXECUTIVE LEVEL COMPETENCIES
Buyers	Describe a person who buys; purchaser.
Sellers	Describe a person who sells; salesperson or vendor.
Business Case	Develop a structured proposal for business change that is assembled in terms of costs and benefits.
Cost-benefit	Examine an analysis or study of the actual cost of a project and calculate the potential benefits.
Enterprise Infrastructure	Employ those elements that enable people and systems to exchange information and execute transactions.
Professional Development	Diagram a process for skill acquisition and maintenance in managing a particular career path.
Enterprise Process	Diagram an entire business system, including all core and support processes needed for an organization's critical success objectives.
Enterprise Tools	Analyze a device, (computer) application or piece of equipment that provides an organization or its employees an advantage toward its stated critical success objectives.
M&S Related Disciplines	
Graph Theory	Recall the study of graphs, mathematical structures used to model pairwise relations between objects from a specified collection.
Logic	Recall the study of the principles and criteria of valid inference and illustration for use extensively in the fields of artificial intelligence, and computer science.
Relations	Recall in mathematics, expressions that show equality and non-equality such as "=" and "<"; appraise in logic a property or predicate ranging over more than one argument.
Inference	Analyze the act or process of deducing a conclusion based solely on what one already knows.
Management	
Enterprise Management	Employ a set of management processes, tools, systems, etc., for an organization to manage its stated critical success objectives.
Corporate Institutional Development	Organize building and maintaining the institutional, economic and cultural viability of an organization as it faces a changing business environment.
Enterprise Operations	Employ processes and systems that work together or independently to assist an organization in managing its stated critical success objectives.

KNOWLEDGE AREA	EXECUTIVE LEVEL COMPETENCIES
Evaluation Design	
Develop measurement of outcomes	
Baseline Establishment	Review the baseline prior to an M&S application.
Measurement Alignment to Objectives	Describe a Measure of Effectiveness (MOE) measurement system.
Tractability Documentation	Review a tractability matrix for evaluation.
Develop evaluation methodology and tools	
Technical Evaluation Methodology	List technical evaluation methodologies for a simulation.
Application Evaluation Methodology	List application evaluation methodologies for a simulation.
Develop description of evaluation methods	
Quantitative Methods	Identify quantitative methods for a simulation evaluation.
Qualitative Methods	Identify qualitative methods for a simulation evaluation.
Develop resources to conduct the evaluation	
Resource Scoping	Explain resource determination for evaluation through a cost analysis.
Issues with Resource Constraints	Explain resource constraint impacts on a simulation evaluation.
Execution of Evaluation	
Develop timelines for the evaluation	
Pre-Collection Timeline Development	Identify a pre-collection evaluation activity timeline that takes into account pre-defined time and resource constraints.
Post Collection Timeline Development	Identify a post-collection evaluation activity timeline that takes into account pre-defined time and resource constraints.
Execute the evaluation	
Collection Methodology	List evaluation data collection methodologies.
Documentation of Collection	
Assessment of Evaluation	
Convert analysis results to an action plan	
Develop Analysis Relationships	Identify relational analysis development to support conclusions.

KNOWLEDGE AREA	EXECUTIVE LEVEL COMPETENCIES
Develop New or Modified Requirements	Identify simulation requirements based on supportable inputs.
M&S Modification	
Determining Need to Change a Simulation	
Identify shortfalls in simulation	
Application Design Flaws	Identify the need for a simulation work around based on application design flaws.
Technical Design Flaws	Identify solutions to technical design flaws in the simulation.
Develop requirements to rectify the shortfalls	
Application Requirements	Identify an established requirement to an application shortfall.
Technical Requirements	Identify a simulation capability to a technical shortfall.
Validate requirements to rectify the shortfalls	
Organizational Review	Review organizational structure for shortfalls.
Technical Review	Review technical structure for shortfalls.
Technical Changes of the Simulation	
Collect data to rectify the shortfalls	
Focused Data Collection	Explain data review and identify data shortfalls in a modified focus collection plan.
Alignment to other Data	Explain correlation of new data and old data.
Convert data into programming language	
Convert Data	
Data Insertion into Simulation	Identify given datum or data set developed for a sample simulation environment.
Soft Computing	
Decision Trees	Explain the concept of decision trees and how they apply to simulation development.
Logistic Networks	Explain the concept of logistic networks and how they apply to M&S.
Conduct VV&C of modified simulation	
VV&C Modification	Explain a modified Verification, Validation & Certification of a

KNOWLEDGE AREA	EXECUTIVE LEVEL COMPETENCIES
	simulation.
Convert language into another language	
Resource Implications	Identify the cost implications of language conversions or translators.
Implications of Conversion	Identify the implications of conversion to the functionality of a given simulation.
Assessment of Changes to a Simulation	
Conduct testing of modified simulation	
Alpha Testing Modification	Identify results of an Alpha Test for required modifications to a simulation.
Beta Testing Simulation	Interpret results of a Beta Test to ensure simulation meets requirements.
Conduct user VV&A of modified simulation	
VV&A Modification in Simulation	Explain Verification, Validation & Accreditation (VV&A) of a modified simulation.
Documentation of Modification	Identify documentation for VV&A modification.
M&S Development and Use Life Cycle	
Retirement	Review a system to ensure its timely removal from active use or service due to culmination of useful period of service.
M&S Related Concepts	
analog simulation	Describe simulation or simulators that represent analog functioning, for example, an analog circuit simulation used to design and test complex analog circuits.
digital simulation	Describe digital simulation to represent functions in a manner that mimics real-world equipment, events, processes, etc.
human-in-the-loop simulation	Describe human-in-the-loop simulation and simulators that employ one or more human operators in direct control of the simulation/simulator or in some key support function (e.g., decision making).
hardware-in-the-loop simulation	Describe hardware-in-the-loop simulation and simulators that employ one or more pieces of operational equipment (to include computer hardware) within the simulation/simulator system.
software-in-the-loop simulation	Describe software-in-the-loop simulation and simulators that employ one or more elements of operational software (computer

KNOWLEDGE AREA	EXECUTIVE LEVEL COMPETENCIES
	programming code) within the simulation/simulator system.
composability	Describe composability design principles as they relate to simulation development.
community of practice	Select a community of practice to share ideas, find solutions and build innovations.
professional certification	Explain professional certification of simulation expertise based on key knowledge, skills and/or experience.
simulation asset management	Describe simulation asset management tasks and decisions that capture, catalog and coordinate use of key resources (e.g., equipment, HW/SW, personnel, etc.) related to simulations/simulators.
economics of simulation	Apply the economics of a given simulation, to include evaluation of effective usage, cost-benefit analysis, return on investment (ROI), etc.
sensors	Recall the role of sensors as they apply to simulation.
web-enabled simulations	Identify web-enabled simulations that can be accessed using standard Internet (web) connectivity and associated data I/O protocols in combination with off-the-shelf hardware/software components.
simulation tools (AcslXtreme,etc)	Distinguish the type of simulation tool used to mimic a specified type of system or process (e.g., continuous, dynamic, analog, etc.).
bioinformatics	Identify bioinformatics within simulations.
wearable computing	Identify wearable computing devices that provide one or more of a host of functions useful for work, leisure and entertainment.
augmented reality / mixed reality	Recognize augmented or mixed reality to merge real-world and computer-generated data.
biometrics	Identify biometrics within a simulation used to recognize humans based upon one or more intrinsic physical or behavioral traits.
biosensors	Identify biosensors used to detect analytes that combine a biological component with a physicochemical detector component.
neural networks	Identify neural networks within a simulation used to produce an output function.
data mining	Recognize data mining techniques within simulations to search for an element/component commonality (e.g., classification, clustering, key words, etc.)
authoring systems	Define authoring systems as they are used to develop useable computer-based applications, such as computer-based training (CBT), HTML code for viewing on the Internet, modeling/simulation applications, computer/Internet-based

KNOWLEDGE AREA	EXECUTIVE LEVEL COMPETENCIES
	tests/surveys, etc.
grid and cluster computing	Define grid and cluster computing and how it is used within a simulation.
distributed high performance computing	Recognize distributed high performance computing techniques as a means to enhance the computational power of a simulation.
optical computing	Use optical computing to manipulate, store and transmit data.
test & training enabling architecture (TENA)	Define the Test & Training Enabling Architecture (TENA) within a simulation as a method for achieving interoperability between DoD ranges, labs and facilities.
Corba Interface Definition Language (IDL)	Describe the CORBA Interface Definition Language (IDL) as a JAVA-based technology for handling objects interacting on different platforms across a network (distributed objects) that is based on CORBA, an industry-standard distributed object model architecture.
phenomenon algorithm specification	Recognize the phenomenon algorithm specification procedure and how it is used to represent a given system, process, etc.
common software component development	Identify common software component development as development of componentware -- software designed to work a component of a larger application.
DES components	Identify DES components as system state, simulation clock, event list, statistical counters, initialization routine, timing routine, event routine, library routines, report generator, main program.
modeling issues in hybrid simulations	Discuss modeling issues in hybrid simulations including time events, state events, changes in simulation model, reinitialization, event iteration, chattering and Dirac pulses.
complex adaptive systems (CAS)	Identify Complex Adaptive Systems (CAS) as natural systems (e.g., brains, immune systems, ecologies, societies) and artificial systems (parallel and distributed computing systems, artificial intelligence systems, artificial neural networks, evolutionary programs) characterized by apparently complex behaviors that emerge as a result of often nonlinear spatio-temporal interactions among a large number of component systems at different levels of organization.
complexity and CAS modeling	Identify CAS modeling as the operational model of the complexity paradigm.
complexity and chaos	Describe Complexity as the interaction of many parts, giving rise to difficulties in linear or reductionist analysis due to the nonlinearity of the inherent circular causation and feedback effects. Describe Chaos as a system whose long term behavior is unpredictable, tiny changes in the accuracy of the starting value rapidly diverge to anywhere in its possible state space.
CAS modeling methods	Recognize CAS modeling methods as StarLogo and NetLogo

KNOWLEDGE AREA	EXECUTIVE LEVEL COMPETENCIES
	used in labs and classrooms with three main components of turtles, patches and the observer. The individual agents in the system are called turtles, although they can represent any kind of agent from a molecule to a person. The environment in which the turtles operate is divided into patches. The third component, the observer, can issue commands that affect both patches and turtles. The observer also conducts maintenance and documentation of the turtle world.
CAS modeling case studies	Describe CAS modeling case studies for economies, ecologies, weather, traffic, social organizations, cultures and the brain.
visualization for information representation	Identify visualization for information representation as a branch of computer graphics and user interface design concerned with presenting data to users, by means of interactive or animated digital images in order to improve understanding of the data being presented.
deployment model	Define a deployment model as a model that simulates the reception, staging, onward movement and integration (RSOI) of military personnel and equipment.
execution model	Recognize an execution model specifies the behavior of a computer system to the extent that it is relevant to correct execution of application programs. Explicitly describes the actions involved in the execution of a program by the specified computer system.
component model	Identify the component model software architecture from Microsoft, which defines a structure for building program routines (objects) that can be called up and executed in a Windows environment.
information model	Define an information model as an organizational framework that is used to categorize information resources.
data mining using simulation	Identify data mining using simulation as the act of analyzing a database or data warehouse and searching for new facts based on the data.
C2IEDM	Describe the Command and Control Information Exchange Data Model which enables coalition information sharing and multi-security-level networking.
architecture views	Define architecture views as representations of the overall architecture that are meaningful to one or more stakeholders in the system. The architect chooses and develops a set of views that will enable the architecture to be communicated to, and understood by, all the stakeholders and enable them to verify that the system will address their concerns.
operational (process) architecture	Define operational (process) architecture as the structural design

KNOWLEDGE AREA	EXECUTIVE LEVEL COMPETENCIES
	of general process systems and applies to fields such as computers (software, hardware, networks, etc.), business processes (enterprise architecture, policy and procedures, logistics, project management, etc.) and any other process system of varying degrees of complexity.
activity modeling	Define activity modeling as the act of developing an accurate description of the activities performed by a system.
information exchange model	Explain the information exchange model as an XML-based metadata registry being adopted by U.S. federal agencies for the precise exchange of information.
LADAR/IR	Define Laser Detection and Ranging/Infrared as a high-resolution method for collecting enough detail to identify targets.
logical variable	Define a logical variable as a variable that can hold one of the logical values and is one of the basic structures in logic programming. The object is referred to by a name starting with a capital letter.
integer variable	Define integer variable as variable that must take an integer value (0, 1, 2,...).
real variable	Define real variable as a mathematical function whose domain is the real line. More loosely, a function of a real variable is sometimes taken to mean any function whose domain is a subset of the real line.
state variable	Define state variable as a variable that defines one of the characteristics of a system, component or simulation. The values of all such variables define the state of the system, component or simulation.
initial condition	Define initial condition as the values assumed by the variables in a system, model or simulation at the beginning of some specified duration of time.
steady state	Define steady state as a situation in which a model, process or device exhibits stable behavior independent of time.
data fusion	Define data fusion as the integration of data and knowledge collected from disparate sources by different methods into a consistent, accurate and useful whole.
portable simulation systems	Describe portable simulation systems as high-technology simulation systems that enable tactical units to conduct training close to home or while deployed.
eye-point	Recognize eye-point as an alternative to the computer mouse that allows a person using a computer to click links, highlight text and scroll simply by looking at the screen and tapping a key on the keyboard. Uses standard eye-tracking hardware-a specialized computer screen with a high-definition camera and

KNOWLEDGE AREA	EXECUTIVE LEVEL COMPETENCIES
	infrared lights.
field-of-view (FOV)	Define Field-of-View (FOV) as the angular extent of the observable world that is seen at any given moment.
predator-prey modeling	Recognize predator-prey modeling as a system in which there are two populations known as the predator and the prey. The model states that the prey will grow at a certain rate, but will also be eaten at a certain rate because of predators. The predators will die at a certain rate but will then grow by eating prey.
Principle of competitive exhaustion (Gause's principle)	Recognize the principle of competitive exclusion (Gause's principle as two species competing for the limited resources can only co-exist if they inhibit the growth of competing species less than their own growth. Where one species eliminates the other is known as competitive exclusion, or Gause's Principle.
inductive modeling	Recognize inductive modeling as finding the rule with the cause and the effect. Inductive Modeling combines ideas from many other technologies — including simulations, data modeling, expert systems and object-oriented modeling — to apply artificial intelligence to very complex systems such as data networking environments. Inductive techniques include system identification and parameter estimation.
multicast	Define multicast as a transmission mode in which a single message is sent to selected multiple (but not necessarily all) network destinations; i.e., one-to-many.
dependent variables	Define dependent variables as the output of a function derived from independent variables.
effects based modeling	Define effects based modeling as an approach whereby technologies are evaluated by their potential to produce intended and unintended effects and then developing research plans to address gaps in understanding.
differential games	Recognize differential games as a branch of the mathematical theory of control, the subject of which is control in conflict situations.
white-box and black-box models	Recognize a Black-box model whose inputs, outputs and functional performance are known, but whose internal implementation is unknown or irrelevant. Recognize a White-box model whose internal implementation is known and fully visible.
behavior diagrams	Recognize how behavior diagrams are used in simulation to depict behavioral features of a system or business process.
functional analysis	Identify functional analysis as the branch of mathematics, and specifically of analysis, concerned with the study of spaces of

KNOWLEDGE AREA	EXECUTIVE LEVEL COMPETENCIES
	functions.
replicated validation	Recognize the value of replicated validation which involves multiple simulation runs to validate data.
priority queue data structure	Recognize how priority queue data structure is useful in problems where you need to rapidly and repeatedly find and remove the largest element from a collection of values.