Professional Development Short Course On:

CSEP Preparation

Instructor:

Eric Honour

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<th>Lesson 6 (cont’)</th>
<th>Lesson 7</th>
<th>Lesson 8</th>
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| 8:30-9:30  | Course Introduction  
  CSEP introduction  
  Intro to SE Handbook  
  Self-assessment quiz  
  CSEP application | | | | | Specialty Engineering Activities  
  Integrated logistic support  
  Specialty analyses:  
  EMC, environmental, mass properties, safety & health hazard, sustainment, training needs  
  Human systems integration  
  Modeling, simulation, prototyping | | After-Class Plan  
  Using the self-assessment  
  Study plans & methods  
  Test-taking | Course Summary |
1.2 CSEP Introduction

1.2.1 What is the CSEP?

What is the CSEP?

- Foundation level of a series of certifications granted by INCOSE in systems engineering
- Based on education, experience, references, and demonstrated knowledge by exam
- Recognized benefits
  - Formal, portable recognition
  - Discriminator in job market
  - Career competitive advantage

The INCOSE Certified Systems Engineering Professional (CSEP) is the foundation level of a series of certification offered by INCOSE. It has significant benefits to your career. The CSEP is based on experience, education, references, and an examination.

Requirements for Certification

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<th>Education</th>
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<th>Exam</th>
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<td>ASEP</td>
<td>None</td>
<td>Technical degree</td>
<td>None</td>
<td>CSEP</td>
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<tr>
<td>CSEP</td>
<td>5 years</td>
<td>Technical degree (or experience)</td>
<td>3 references</td>
<td>CSEP</td>
</tr>
<tr>
<td>CSEP + DOD Acq Guidebook</td>
<td>5 years</td>
<td>Technical degree (or experience)</td>
<td>3 references</td>
<td>CSEP + DOD Acq Guidebook</td>
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<td>TBD</td>
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<td>None</td>
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Focus of this course
### Application/Renewal Process

#### New application
- Fill out and submit application form
- Provide proof of education
- Have 3 people submit reference forms
- Sign ethics statement
- Pay INCOSE fee
  - ASEP: $150
  - CSEP: $400 ($300 mbr)*
- Schedule/pay exam
  - $80 US ($120 non-US, $165 Japan)
- Pass exam

#### Renewal
- 3 yrs CSEP, 5 yrs ASEP
- Do and log professional development activities
  - 12 CEUs or 120 hrs during renewal period
  - Courses, published papers, patents, presentations
- Fill out/submit renewal form
- Pay INCOSE fee
  - ASEP: $100
  - CSEP: $150 ($100 mbr)*

*Other fee structures exist for upgrade, CSEP-Acq

INCOSE establishes the application and renewal process for CSEP, summarized on this slide. Fees must be paid both to INCOSE (for the certification) and to the Prometric examination facility (for the examination service).
1.3 INCOSE Systems Engineering Handbook

1.3.1 Handbook Application

**SE Handbook Application**

- Consistent with ISO/IEC-15288 – an int’l standard that is a generic process description
- Handbook further elaborates the processes and activities
- Processes and activities do not supersede any int’l, national or local laws or regulations
- For commercial industry, handbook is a reference to practices and methods that have proven beneficial

The CSEP examination is based solely on the INCOSE Systems Engineering Handbook version 3.1, which is consistent with the international standard ISO/IEC 15288.

1.3.2 Contents and Organization

**SE Handbook v3.1**

- Ch. 1-3: Preliminary definitions, overview, life cycle stages
- Chapters 4-6: closely follow ISO/IEC-15288
  - Combination of Enterprise Processes and Agreement Processes into ch.6
However, the INCOSE handbook expands on the information in ISO/IEC 15288. Chapters 7-10 provide additional information that supports the standard processes. In addition, the handbook provides extensive appendices that expand even further, sometimes supporting the standard processes and sometimes further supporting the additional material of chapters 7-10.
1.5.2 Experience

Experience – Breadth & Depth

- Required 5 years of SE experience
- Without 4-yr degree in technical field
  - With other 4-yr degree, sub 10 yrs experience (5 yr SE)
  - With no 4-yr degree, sub 15 yrs experience (5 yr SE)
- CSEP requires both breadth and depth –
  - at minimum 5 yrs experience,
  - No more depth than 3 yr in any one area
  - Minimum 1 yr experience in at least 3 areas

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<th>Purpose: prove your experience qualifications, an important part of certification!</th>
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<td>So write it specifically for the reviewers - keep in mind what they need</td>
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<td>Risk and opportunity mgmt</td>
<td>Break your periods of employment, or significant changes of responsibility within the organization</td>
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<tr>
<td>Baseline control</td>
<td>Focus on SE responsibilities and experience</td>
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<td>Technical planning</td>
<td>Direct contributions to work efforts</td>
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<td>Technical effort assessment</td>
<td>Cite specific system products if possible</td>
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<td>Architecture/design development</td>
<td>Ex: authored, defined, planned SEMP, ConOps, VV Plan</td>
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<td>Qualification, verification, validation</td>
<td>Ex: “designed architecture,” “wrote requirements,” “guided design team of 20 people”</td>
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<td>Weaker: “involved in,” “contributed to,” “led an effort”</td>
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<td>Provide current contacts to people who can verify your efforts – supervisors are best, peers are okay</td>
</tr>
</tbody>
</table>

Obtaining the CSEP certification is more than just filling out the forms. You must convey your experience in such a way as to convince the INCOSE reviewers of your qualifications for the certification. Write your resume section to support the “experience areas of interest” to INCOSE. Have someone else review your resume as written.
3.1 Introduction

Life Cycles and Approaches

- Every man-made system has a life cycle. Define it:
  - To establish a framework for meeting the stakeholder needs in an orderly and efficient manner.
  - By defining stages with decision gates to determine readiness to move from one stage to the next.
- Skipping gates can greatly increase the risk.
- Role of systems engineer covers the entire life cycle for the system-of-interest:
  - Orchestrate the development of a solution from requirements determination through operations and system retirement.
  - Assure that domain experts are properly involved, that all advantageous opportunities are pursued, and that all significant risks are identified and mitigated.
- SE tasks usually concentrated at beginning, but both commercial and government recognize need for SE through the life span.

SEH chapter 3 concerns itself with representations of system life cycles and development approaches. It is based primarily on the language from ISO/IEC 15288.

Lesson Scope

- Core material: SEH Chapter 3
- Supporting material: None

Sources: SEH 3.1
3.2 Life Cycles and Stages

3.2.1 Aspects and Stages

<table>
<thead>
<tr>
<th>LIFE CYCLE STAGES</th>
<th>PURPOSE</th>
<th>DECISION GATES</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONCEPT</td>
<td>Identify stakeholders’ needs</td>
<td>Decision Options</td>
</tr>
<tr>
<td></td>
<td>Explore concepts</td>
<td>– Execute next stage</td>
</tr>
<tr>
<td></td>
<td>Propose viable solutions</td>
<td>– Continue this stage</td>
</tr>
<tr>
<td>DEVELOPMENT</td>
<td>Refine system requirements</td>
<td>– Go to a preceding stage</td>
</tr>
<tr>
<td></td>
<td>Create solution description</td>
<td>– Hold project activity</td>
</tr>
<tr>
<td></td>
<td>Build system</td>
<td>– Terminate project</td>
</tr>
<tr>
<td></td>
<td>Verify and validate system</td>
<td></td>
</tr>
<tr>
<td>PRODUCTION</td>
<td>Produce systems</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inspect and test [verify]</td>
<td></td>
</tr>
<tr>
<td>UTILIZATION</td>
<td>Operate system to satisfy users’ needs</td>
<td></td>
</tr>
<tr>
<td>SUPPORT</td>
<td>Provide sustained system capability</td>
<td></td>
</tr>
<tr>
<td>RETIREMENT</td>
<td>Store, archive, or dispose of system</td>
<td></td>
</tr>
</tbody>
</table>

Every project has three aspects to be considered: the business aspect (business case), the budget aspect (funding), and the technical aspect (product). The systems engineer creates technical solutions that are consistent with the business case and the funding constraints.

ISO/IEC 15288 defines six stages of a life cycle, shown in this table. Section 0 describes the six stages.
### 4.1 Introduction

Technical Processes: Introduction

- ISO/IEC 15288 technical processes

Enable systems engineers to coordinate the interactions between:
- engineering specialists
- systems stakeholders
- operators
- manufacturing

Lead to the creation of a full set of requirements that address:
- desired capabilities
- within the bounds of performance
- environment
- external interfaces
- design constraints

---

SEH chapter 4 is concerned with the Technical Processes that advance a system development from its infancy (concept) through delivery, utilization, and retirement. When considered along with its supporting information in chapters 7, 8 and the appendices, this is by far the largest SEH chapter.

---

### Lesson Scope

- Core material: SEH Chapter 4
- Supporting material
  - SEH App. I,J,K,N; Parts of SEH ch.7,8

---

**Sources:**
- SEH 4.1
Lessons 4 through 6 follow closely SEH chapters 4-6, mapping each process to a segment of the lesson. Each process in SEH chapters 4-6 follows a common format that includes:

- **Purpose**, a short statement of the purpose of the process,
- **Description**, including a context diagram that shows inputs, outputs, activities, controls and enablers for the process,
- **Inputs**, text to expand on the inputs in the context diagram,
- **Outputs**, text to expand on the outputs in the context diagram,
- **Process Activities**, text that describes the activities and how to do them, and
- **Common Approaches and Tips**, bullet points that provide heuristic information proven to help on many development programs.

In this course, we follow a similar format using similar text and figures. Much of the text on our slides is drawn directly from SEH to help you recognize the exact language and key phrases used in SEH. **Successfully passing the CSEP exam requires you to recognize the SEH language.**

When a basic process is expanded by further information in chapters 7, 8, or the appendices, our course expands the basic process by additional sections to summarize that information. In some cases, the expanded SEH information uses different language or different assumptions. Some appendices define additional processes and/or use...
Lesson 4: Technical Processes

Notes

a different format of presentation including (in addition to the above):

♦ Objective, a short statement of what is accomplished
♦ Participants, a list of the participating groups or organizations,
♦ Tools, a list of useful tools and methods, and
♦ Metrics, a list of possible measures.

Regardless of any inconsistencies between the base document and the appendices, however, the CSEP exam is based on the entire SEH including appendices.

Exam questions are randomized and do not include a reference to SEH sections. Therefore, you must be able to recognize any alternate forms of SEH language relating to each topic. In this course, we group all similar topics together to help you learn and recognize the entire scope of each process.

4.2 Stakeholder Requirements Definition

4.2.1 Context and Purpose

Stakeholder Requirements Definition

Purpose

- Elicit, negotiate, document and maintain stakeholders’ requirements for the system-of-interest within a defined environment

Inputs

- Stakeholders’ needs
- Project constraints

Activities

- Identify legitimate stakeholders
- Elicit requirements
- Define constraints
- Build scenarios and concept documents
- Resolve requirements problems
- Confirm and record requirements
- Establish and maintain traceability

Controls

- Agreements
- Project procedures & processes

Enablers

- Enterprise infrastructure
- Enterprise policies, processes & standards

Outputs

- System solution constraints
- Requirements Verification & Traceability Matrix
- Validation criteria
- Concept documents

Any system development starts with defining what it is supposed to do for the users and other stakeholders.

SOURCES:
SEH 4.2, 7.2.1, 7.2.3, 7.2.4, App.I.1, I.2
4.3 Requirements Analysis

4.3.1 Context and Purpose

**Requirements Analysis**

**Purpose**

- Review, assess, prioritize and balance all stakeholder and derived requirements (including constraints)
- Transform into a functional and technical view of a system description capable of meeting the stakeholders’ needs
- Can be expressed in a specification, set of drawings or any other means that provides effective communication.

**Inputs**

- Stakeholder requirements
- System solution constraints
- Requirements Verification & Traceability Matrix (RVTM)

**Activities**

- Define functional boundary
- Define performance requirements
- Identify architectural constraints
- Define non-functional requirements
- Maintain traceability and baseline integrity

**Outputs**

- Functional and non-functional requirements
- Performance requirements
- Architectural constraints
- Verification strategy and criteria
- Updated RVTM

**Controls**

- Natural and societal laws
- Project procedures & processes

**Enablers**

- Enterprise infrastructure
- Enterprise policies, processes & standards

The Requirements Analysis process converts the source requirements into a complete, coherent set of technical requirements statements.

4.3.2 Inputs, Outputs and Activities

**Stakeholder Requirements Definition**

**Inputs, Outputs**

**Inputs**

- Baseline documented during the Stakeholder Requirements Definition Process
- Applicable statutes, regulations, policies; operational use and environment; constraints; design & life cycle considerations

**Outputs**

- Technical description of characteristics to meet the stakeholder requirements
- Functional boundaries, interfaces
- Functional, performance, non-functional requirements
- Decisions documented in the information repository
- None of the above should dictate a solution, only WHAT the system will do, not how it will do it

Sources:

SEH 4.3, 7.2.6
App.I(intro), I.3
<table>
<thead>
<tr>
<th><strong>Requirements Analysis</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Activities</strong></td>
</tr>
<tr>
<td>- Define functional requirements</td>
</tr>
<tr>
<td>- Identify standards that must apply</td>
</tr>
<tr>
<td>- Define the system boundaries</td>
</tr>
<tr>
<td>- Define the interfaces</td>
</tr>
<tr>
<td>- Define the environmental conditions</td>
</tr>
<tr>
<td>- Define life-cycle and process requirements</td>
</tr>
<tr>
<td>- Define design considerations and constraints</td>
</tr>
<tr>
<td>- Define verification criteria</td>
</tr>
<tr>
<td>- Create traceability</td>
</tr>
</tbody>
</table>

Requirements Analysis firms up the technical requirements by detailed analysis and definition of the boundaries, interfaces, environment and other constraints to create functional, performance and non-functional requirements.

### 4.3.3 Common Approaches and Tips

<table>
<thead>
<tr>
<th><strong>Requirements Analysis</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Common Approaches and Tips</strong></td>
</tr>
<tr>
<td>- Integrated Product Teams with acquirer-supplier participation to get the necessary expertise</td>
</tr>
<tr>
<td>- Use FMECA or hazard analysis to identify the critical system level requirements.</td>
</tr>
<tr>
<td>- Use specially designed requirements management tools</td>
</tr>
<tr>
<td>- Begin from the very beginning to maintain requirements traceability.</td>
</tr>
<tr>
<td>- Avoid deriving requirements that are not consistent with other requirements or constraints.</td>
</tr>
<tr>
<td>- Create templates for constructing requirements statements.</td>
</tr>
</tbody>
</table>
Notes

4.3.4 Creating Functional/Performance Requirements

Requirements Definition Process

- Requirements form the basis for design, manufacture, test, and operations
- Each requirement carries a cost
  - It is essential that a complete, but minimum set of requirements be established early
  - Changes in requirements later in the development cycle can have a significant cost impact on the project, possibly resulting in cancellation
- Requirements analysis objectives:
  - Creates verifiable requirements that state user needs in appropriate terms to guide system concept development
  - Provides an understanding of the interactions between the various functions
  - Obtain a balanced set of requirements based on user objectives.

Requirements drive the entire project. Because requirements form the basis for all the processes and activities that follow, SE focuses on creating the best requirements available. Primary requirements are the functional requirements (what the system does) and the performance requirements (how well does it do it).

Functional/Performance Requirements

- At beginning, SE is concerned with user requirements – basic functions, quantifiable performance
  - Formally documented requirements that define the functions and interfaces, characterize the system
  - These requirements cover total system over its life cycle, including its support requirements
  - Primary SE activity through SRR, with significant support from design engineering
  - The customer is also a key stakeholder and validates the work as it progresses.
- Complex, time consuming task involving nearly all project areas in an interactive effort
  - Done early, since it forms the basis for all design, manufacturing, test, operations, maintenance, and disposal efforts
  - Determines the cost and schedule of the project
- Process is iterative for each phase
- Addressing non-functional requirements from the earliest stages is a good way to ensure that they are not forgotten and that they are satisfied
Establishing a total set of system requirements is a complex, time consuming task involving nearly all project areas in an interactive effort. The activities to create the functional/performance requirements include functional analysis, simulation, trade studies, and others that overlap the Architectural Design process.
8.2.1 Effective Study Methods

Effective Study Methods

- Know your strengths and weaknesses
  - Take as many sample exams as you can
  - Identify your weaknesses and work specifically on them
  - Establish a study plan/schedule: topics and weeks
- Know about the exam format
  - See the next section
  - Talk with those who have taken it
  - Practice with similar types of questions
- Test yourself as you go
  - Close your eyes, ask if you remember what you’ve read
  - Study with someone else; ask mutual questions

Notes

If you have many years of SE experience and good test-taking ability, it may be sufficient simply to read carefully through SEH. Be aware that fully reading SEH takes at least two long days. If your experience is not so long, then you will have to return to the study practices that worked well for you in school. Use this course as a study guide and index into the related sections of SEH.

Studying the Handbook

- Read the entire INCOSE Systems Engineering Handbook
  - Read every page, in detail (takes at least two long days!)
  - Seek to recognize the language and the relationships
  - Set aside differences from your own knowledge
  - Cross-reference similar sections to know their differences
- Use this course as a study guide
  - Similar topics are grouped together
  - Section headers show you which SEH sections apply
  - Do topical study by reading the related SEH sections
- Write it down
  - Make topical notes
  - Physically re-write the SEH information in bullet form, to force your mind to process it
# Mental Preparation

- Learn to be comfortable with your knowledge
  - Repeated self-testing, repeated checking
  - Celebrate each right answer
- Build your peace through visualization
  - Stop in the middle of study stress
  - Close your eyes, visualize a relaxing situation
  - When relaxed, imagine bringing the test into that situation; visualize comfort and success
- Choose to be positive in your speech and thoughts
  - “I can do this!”
  - Avoid negativity and negative people; “I always freeze up on tests”; “I need to pass this”; “I don't know enough”
- Physical exercise
  - A fit body helps your mind work better
  - Medical fact: sedentary people get less oxygen in the blood and to the brain
  - While studying, get 30 minutes of daily exercise

Some people also do not test well. Anxiety causes their knowledge to escape in the middle of an exam. They do not think well. It has even been shown that they do not breathe well during the exam, exhibiting shortness of breath or holding their breath for long periods. Medical tests show elevated pulse rates and blood pressure, and participants will complain of headaches, blurred vision, or other ailments.

Whether you are an extreme case of this or only mild, you too can pass this exam. Mental preparation can ease these symptoms by easing the anxiety.

Even if you test well, physical exercise is an element that is important. If you spend the week before the exam “cramming,” then your lack of exercise will significantly affect your body and the way you can use it during the exam. Exercise each day in the week before the exam, and you will do better on the exam.

## 8.2.2 Using the Sample Exams

We provide two sample exams in the appendices of this book, with separate answer guides for each. Each exam is 60 questions and, by the rules of the CSEP exam, should complete in one hour. Each exam covers topics that span SEH.

Use the two exams separately, the first one when you have been through all SEH topics and believe that you are ready to check your strengths and weaknesses, and the second one as a final check in the days before the exam. After each sample exam, look up the references before checking the answers. (Remember, these are study tools!) Then check all your answers and study where you are weak.
8.3 Test-Taking

8.3.1 The CSEP Exam Process and Tools

### CSEP Exam Process

- **Physical process at Prometric**
  - Arrive with your Prometric receipt and confirmation #
  - Picture ID to prove your identity
  - Empty pockets, leave everything in a Prometric locker
  - Enter exam room with only the locker key and your picture ID

- **CSEP examination timing, rules**
  - Tutorial on Prometric exam tools: up to 15 min
  - Examination time: up to 120 min
    - Can stop when you are complete
    - Can leave temporarily, but time continues
  - No penalty for wrong answers, so *answer every question*

### Approximate mix of question formats

<table>
<thead>
<tr>
<th>Choices</th>
<th>Percentage</th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>50%</td>
<td>Few</td>
</tr>
<tr>
<td>5</td>
<td>20%</td>
<td>Few</td>
</tr>
<tr>
<td>6</td>
<td>Few</td>
<td>30%</td>
</tr>
</tbody>
</table>

Here’s what to expect at the Prometric facility when you take the exam. The pool of exam questions varies in format and yours will be selected randomly. After a generous tutorial period with the software, you will have 120 minutes. Questions appear singly on the screen.

### Exam Screen Format

- During requirements analysis, requirements from a variety of sources and disciplines are analyzed to resolve conflicts. The human factors engineer is primarily responsible for which two types of requirements? (Choose two)
  - A. Human performance requirements
  - B. Human machine interfaces
  - C. Human habitability requirements
  - D. Human engineering design requirements

- Check boxes for multiple-answer questions
- Radio buttons for single-answer questions

- Go to other questions
- Mark this question for later review
- Go to review and ending
8.3.2 Strategies for Multiple-Choice Exams

Multiple-Choice Questions

- Each question comprises
  - The stem includes the situation, context, question
  - Detractor (wrong) answers
  - Correct answer(s)
- Detractors sound logical, may use information in the stem, may be correct in another context, but don’t answer this question
- Key is always to separate the correct answer(s) from the detractors

**Stem**

What is the purpose of the Enterprise Environment Management Process?

- A. To establish the direction and infrastructure necessary for the enterprise to take on a project
- B. To establish a set of proven and effective enterprise life cycle processes
- C. To establish and maintain a set of policies and procedures at the enterprise level that support the organization’s ability to acquire and supply products and services
- D. To initiate and sustain enterprise investments

**Answers**

- 3 detractors
- 1 correct

There is a general strategy that works for multiple-choice questions. Knowing this strategy can help keep your anxiety down and help you to find the right answer(s). The strategy starts with reading and rewording the question (the “stem”), without yet looking at the answers. Make sure you understand the question before starting to read the answers.

Evaluate the Question

- Read the stem
  - Without looking yet at the answers
- Reword the question
  - Do I understand the question?
  - "I want the reason-for-being stated in the SEH for one specific Process defined in the SEH."
- Predict an ideal answer
  - Don’t remember the exact wording, but it has to do with creating the environment and processes within which the enterprise can do its business

**Stem**

What is the purpose of the Enterprise Environment Management Process?

- 
- 
- 

**Answers**

- 
- 
- 

-
Question 1 of 60
Sample CSEP Examination
Source: SEH 9.4

Which of the following are among the most widely recognized human centered domains identified for consideration in the Human Systems Integration (HSI) process? (Choose three)
- A. Human Factors Engineering
- B. Health insurance and medical care
- C. Manpower and personnel
- D. Environmental continuing education
- E. Safety and occupational health

Question 2 of 60
Sample CSEP Examination
Source: SEH App.1.2

Which document is a functional definition and rationale from the user and customer perspective, describing what the system will do, not how it will do it?
- A. System Requirements Document (SRD)
- B. Statement of Work (SOW)
- C. Capabilities Design Document (CDD)
- D. Concept of Operations (ConOps)

Question 3 of 60
Sample CSEP Examination
Source: SEH 6.5.3

What is one input of the Resource Management Process?
- A. Enterprise training plan
- B. History of prior resource allocations
- C. Portfolio of active projects
- D. Enterprise resource plans

Question 4 of 60
Sample CSEP Examination
Source: SEH 6.6.3

What are three inputs of the Quality Management Process? (Choose three)
- A. Project assessments
- B. Enterprise quality management guidelines
- C. Quality plans from ongoing projects
- D. Tailoring trends
- E. Enterprise Quality Management authority

Question 5 of 60
Sample CSEP Examination
Source: SEH 6.8.5

What are three activities of the Supply Process? (Choose three)
- A. Manage Supply Process activities
- B. Negotiate agreement
- C. Inform all personnel as to which items are in short supply
- D. Develop and maintain Acquisition Plans, Strategies, Policies, Procedures to meet the enterprise goals and objectives and the needs of the project management and technical systems engineering organizations
- E. Select appropriate acquirers

Question 6 of 60
Sample CSEP Examination
Source: SEH 5.2.1

What is the purpose of the Project Planning Process?
- A. To establish the direction and infrastructure necessary to assess and control the progress of a project
- B. To plan the incorporation of stakeholder needs into the project
- C. To establish critical and desired system requirements
- D. To capture stakeholder’s requirements