AC 2010-741: ASSOCIATE SYSTEMS ENGINEERING PROFESSIONAL (ASEP) CERTIFICATION: A CREDENTIAL TAILORED FOR STUDENTS AND JUNIOR ENGINEERS

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David D. Walden, CSEP, is co-owner and principal consultant for Sysnovation, LLC, a company he formed in 2006 that is focused on Systems Engineering consulting and education that is based out of Shakopee, Minnesota, USA. At Sysnovation, Mr. Walden has assisted numerous clients in Systems Engineering consulting and training/course development. He has served as an independent reviewer, major review (e.g., PDR, CDR) coordinator, Systems Engineering Subject Matter Expert (SME), and process consultant. He has created and taught numerous Systems Engineering courses and tutorials, including a distance learning on-line variant of a Systems Engineering Principles course. Previously, Mr. Walden was with General Dynamics Advanced Information Systems for 13 years and worked at McDonnell Aircraft Company for 10 years. Mr. Walden is currently the Program Manger of the International Council on Systems Engineering’s (INCOSE’s) Certification Program and also serves as the INCOSE liaison to ISO/IEC JTC1/SC7 Working Groups 10, 20, and 22. He holds the INCOSE Certified System Engineering Professional (CSEP) certification. He has an M.S. in Management of Technology (MOT) from the University of Minnesota, an M.S. in Electrical Engineering and an M.S. in Computer Science from Washington University in St. Louis, and a B.S. in Electrical Engineering from Valparaiso University in Indiana.
Associate Systems Engineering Professional (ASEP) Certification:  
A Credential Tailored for Students and Junior Engineers

Abstract

The International Council on Systems Engineering (INCOSE), the systems engineering professional society, recently initiated the Associate Systems Engineering Professional (ASEP) certification program. This credential is appropriate for systems engineering graduate students and junior systems engineers. It is designed to certify that an individual is knowledgeable about systems engineering fundamentals and standards of practice.

ASEP certification benefits both students and practicing engineers by verifying their understanding of systems engineering, furnishing a tangible professional development milestone, and providing a discriminator that can aid in career placement and advancement. Earning the ASEP credential requires that the candidate obtain an INCOSE membership and pass the INCOSE certification exam. No work experience is required to earn the ASEP certification. Maintaining the ASEP requires continuous membership in INCOSE and a documented record of participation in professional development activities. An ASEP-certified engineer can elevate their certification to the Certified Systems Engineering Professional (CSEP) after they have gained five years of professional systems engineering experience.

This certification advances the profession by endorsing and promoting a common framework for defining systems engineering best practices. The INCOSE certification exam is based on the INCOSE Systems Engineering Handbook V 3.2 which is based on ISO/IEC 15288: 2008, Systems and software engineering — System life cycle processes. The certification also provides value in encouraging systems engineering practitioners to maintain a sustained commitment to continuing professional development.

Professional Certifications

Certifications are credentials awarded by professional organizations to distinguish members of their profession who have documented their knowledge, experience and proficiency. Certifications are common in many fields, especially where there are limited opportunities for individuals to earn academic degrees in their professional discipline. Some of the most widely earned certifications recognize knowledge, skill and experience in fields such as project management, information technology, construction, education and various medical specialties. In some of these fields, certification is necessary to obtain gainful employment.

Most certifications are valid for some pre-determined length of time, typically 1 to 5 years. In order to renew a certification, individuals are often required to document their participation in continuing education activities or service to the profession.

Certifications provide value to the profession, professional organization, certified individuals, the organizations for which the individuals work, and the public. For a sponsoring professional organization, certifications help develop and mature the professional standard of practice, encourage continuing education among its members and promote awareness and adherence to the
professional code of ethics. For certified individuals, certification verifies an individual’s expertise, skill and knowledge as well as their commitment to professionalism and continuing education. It offers a meaningful professional development milestone and may help a person obtain employment or be promoted. For employers, certification can support hiring and promotion decisions, encourage both employee proficiency and professional development, and may aid in capturing new business. The public benefits from the increased professionalism that is inherent in a field that certifies its practitioners.

Student and junior certifications are designed to recognize individuals who have demonstrated knowledge but are not yet experienced or skilled. These certifications serve as an introduction to the profession, and the professional society, and offer many of the benefits described earlier.

With all these benefits, certifications are not substitutes for an academic degree, professional licensure, professional certificates or academic certificates. Academic degrees conferred by colleges and universities provide substantive evidence of both a comprehensive educational experience and in-depth study in the field of their major. While the requirements for certification may be similar to those required for professional licensure, licenses are granted by government agencies and are legal designations, whereas certifications are not legally recognized. Finally, academic certificates usually document the completion of a course or a series of courses that cover an aspect of an academic or professional discipline in detail.

Since organizational success results from a combination of good management, cost-efficient processes, a skilled, knowledgeable workforce and appropriate tools, certification provides an independent method of motivating, assessing and documenting the capabilities of members of the workforce.

**INCOSE Certifications**

INCOSE initiated the Certified Systems Engineering Professional (CSEP) certification in 2004 to certify professional systems engineers as knowledgeable, educated and experienced. The CSEP certification requires that engineers document that they have earned a bachelor degree in an engineering, physics, computer science or other technical discipline; have at least five years of professional systems engineering experience which is validated by at least three professional recommendations; and obtained a passing score on the certification exam. (It is possible for engineers who have not earned a technical Bachelor degree to substitute additional engineering experience to satisfy the education requirement.) Once an engineer has earned their CSEP credential, they must complete 120 professional development units (PDUs) every three years to maintain their certification. PDUs are awarded for continuing education and professional service activities such as completing college systems engineering courses, attending seminars and conferences, writing articles on relevant topics, participating in professional society activities and working groups.

In July 2008, INCOSE introduced two additional certifications, the Associate Systems Engineering Professional (ASEP) certification for junior engineers and students and the CSEP Acquisition (CSEP-Acq) certification for professionals that work in, or support, the U.S. Department of Defense acquisition environment. To obtain the ASEP certification, candidates
have to become a member of INCOSE and pass the same certification exam used for CSEP\textsuperscript{2, 4}. In addition to maintaining their INCOSE membership, ASEP-certified engineers are also required to earn professional development units to maintain their certification. They are required to complete 120 PDUs every five years to maintain their certification. The CSEP-Acquisition certification requires passing an exam based on chapter 4 of the Department of Defense Acquisition Guidebook in addition to satisfying the CSEP requirements\textsuperscript{5, 7}. A summary of the requirements for INCOSE certification are listed in Table 1.

<table>
<thead>
<tr>
<th>Certification</th>
<th>Education</th>
<th>Experience</th>
<th>Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASEP</td>
<td>None</td>
<td>None</td>
<td>INCOSE Certification Exam</td>
</tr>
<tr>
<td>CSEP</td>
<td>Bachelor degree in engineering or a technical discipline</td>
<td>Five years of professional systems engineering experience verified by at least three references</td>
<td>INCOSE Certification Exam</td>
</tr>
<tr>
<td>CSEP Acq</td>
<td>Bachelor degree in engineering or a technical discipline</td>
<td>Five years of professional systems engineering experience verified by at least three references</td>
<td>INCOSE Certification Exam and DoD Acquisition Handbook Exam</td>
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*Table 1. Summary of INCOSE certification requirements*

**Associate Systems Engineering Professional (ASEP)**

The Associate Systems Engineering Professional (ASEP) is designed for students and junior systems engineers and attests to their knowledge of systems engineering principles, techniques and standards of practice. Since most industrial and government entry-level systems engineering positions are filled by candidates with degrees other than systems engineering, an ASEP certification provides evidence that a job candidate is familiar with systems engineering principles and terminology. An engineer who successfully passed the INCOSE certification exam has demonstrated a comprehensive understanding of the principles and best practices used in product and system development.

**INCOSE Certification Exam**

CSEP and ASEP candidates must take and pass the same certification exam. While the INCOSE certification exam has been based on the INCOSE Systems Engineering Handbook, V3.1\textsuperscript{3}, which is consistent with the processes and terminology used in the international systems engineering standard ISO/IEC 15288:2002(E) – *Systems engineering – system life cycle processes*\textsuperscript{4}. In April 2010, INCOSE began the transition to the INCOSE Systems Engineering Handbook V 3.2\textsuperscript{1} which is based on ISO/IEC 15288: 2008, *Systems and software engineering — System life cycle*
processes. Until January 2011, the certification exam will test applicants on the material that is covered in both versions of the handbook. Thus, ASEP candidates can use either version of the SE handbook to prepare for the certification exam. Topics covered by the exam include scope definition, requirement definition, requirement management, system architecture and design, trade studies, specialty engineering (e.g., reliability, maintainability, human factors, system safety, etc.), system integration, verification, validation, and relevant project and enterprise management processes (e.g., planning, configuration management, risk management, subcontracting, etc.). In other words, it spans the principles and best practices that are used to develop products and systems.

The certification exam is a two-hour, closed-book, test consisting of 120 multiple-choice questions. The exam was originally validated by administering the exam to more than 60 systems engineers with varying levels of professional experience and analyzing the results to ensure that the exam is psychometrically sound. The passing score reflects the minimum level of knowledge expected from an engineer that has foundational level of professional systems engineering knowledge.

The certification exams are administered on-line at any of the more than 10,000 Prometric test facilities. Prometric personnel and facilities ensure the integrity of the testing process and environment. The Prometric web site provides the functionality that allows candidates to schedule their exam at a nearby location and at a time that is convenient.

The exam is scored in real time, so immediately after a candidate has completed their exam, they are informed as to whether they have passed or failed. Candidates do not receive their numerical score because INCOSE does not publish the passing score or exam pass rates.

INCOSE maintains and updates the certification exam by including unscored questions that can be compared to the responses to existing exam questions. If the unscored questions meet the statistical criteria for inclusion on the exam they will be used to replace existing questions; thereby ensuring the exam’s integrity over the long term.

There are a growing number of resources available for INCOSE certification applicants. The increasing interest in certification has led to a number of private companies and universities to develop certification preparation courses to help applicants review for the exam. While INCOSE has not endorsed exam preparation programs, an unscreened listing of organizations that provide certification materials and services can be found at the INCOSE web site. In addition, the lead author on this paper has offered a certification preparation course through the Division of Continuing Studies at Indiana University–Purdue University Fort Wayne that has led to more than a dozen new CSEP and ASEP certified engineers.

**Certification Costs**

Certification costs in the United States, as of December 2009, are shown in Table 2. It should be noted that discounted INCOSE membership rates are available for senior citizens ($55) and
Table 2. INCOSE certification costs

<table>
<thead>
<tr>
<th></th>
<th>INCOSE Membership</th>
<th>CSEP Non-member</th>
<th>ASEP</th>
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<tbody>
<tr>
<td><strong>INCOSE Membership</strong></td>
<td>$105</td>
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<td><strong>Application Fee</strong></td>
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<td>$150</td>
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<tr>
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<tr>
<td></td>
<td>(Hardcopy) $20</td>
<td>(Hardcopy) $60</td>
<td>(Hardcopy) $20</td>
</tr>
<tr>
<td><strong>Reexamination Fee</strong></td>
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<tr>
<td><strong>Renewal Fee</strong></td>
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<td>$150</td>
<td>$100</td>
</tr>
<tr>
<td></td>
<td>(Every three years)</td>
<td>(Every three years)</td>
<td>(Every five years)</td>
</tr>
</tbody>
</table>

Table 2. INCOSE certification costs

students ($20). Any revisions to this cost information will be published on the INCOSE certification website\(^\text{10}\).

Certification Status

As of December 2009, there were 443 active CSEPs, 64 CSEP-Acqs and 38 ASEPs. As with any new certification, this set of certified engineers represents the early adopters. As shown in Figure 1, the growth in the number of certified systems engineers is roughly exponential. The vast majority (88.5\%) of certified systems engineers are currently employed in the U.S. although efforts are underway to encourage foreign participation. The foreign certified engineers are primarily located in Sweden, India, Germany and France. A few companies have put together a business case for certification. These companies include Booz Allen Hamilton, Northrop Grumman, SAIC, BAE Systems, General Dynamics, and EADS.

Of the total number of ASEP-certified systems engineers, 34 of the 38 engineers are residents of the United States. As shown in Figure 2, the distribution of U.S. engineers show concentrations in Indiana, California, Virginia and Texas. The large percentage of ASEP engineers is currently located in Indiana. This is the result of the lead author’s encouragement of his students to become certified coupled with their participation in his non-credit certification prep course. Companies with the

![Figure 1. The growth of certified systems engineers](image-url)
largest number of ASEP-certified engineers include Booz Allen Hamilton, Ultra Electronics Underseas Sensor Incorporated (USSI), Northrop Grumman Corporation (NGC), SAIC, BAE Systems, and Logikos.

Certification Agreements

INCOSE has started to develop strategic agreements with universities, companies and organizations to encourage certification. Such agreements have provided opportunities for discounts on INCOSE certification application fees as well as simplified application procedures. For example, all systems engineers that work for INCOSE Corporate Advisory Board (CAB) member organizations are able to take advantage of the reduced member-discounted certification fees. Another example is the agreement that was recently signed with the School of Systems and Enterprises at Stevens Institute of Technology in Hoboken NJ that offers qualified graduate students and alumni a simplified application process and discounted group application and renewal fees. Additionally, specialized certifications such as the CSEP-Acq resulted from a strategic agreement with Defense Acquisition University. Organizations interested in exploring the possibility of an INCOSE certification agreement should contact the INCOSE Certification Program Office.

Conclusion

In conclusion, INCOSE has initiated the Associate Systems Engineering Professional (ASEP) certification to advance the careers of junior engineers and engineering students.

Earning the ASEP credential requires that the candidate obtain an INCOSE membership and pass the INCOSE certification exam. Maintaining the ASEP requires continued membership in INCOSE and a documented record of participation in professional development and service activities. The ASEP can be upgraded into the Certified Systems Engineering Professional (CSEP) credential after a candidate is able to document five years of professional systems engineering experience.

While the ASEP certification does not confer the depth of knowledge of an educational degree, it does benefits both practicing engineers and students by verifying their understanding of systems engineering, furnishing a tangible professional development milestone, and providing a discriminator that can aid in obtaining employment and career advancement. An ASEP-certified engineer has demonstrated that they are knowledgeable and trained in systems engineering fundamentals and standards of practice.
Bibliography

11. The INCOSE certification office can be reached at INCOSE Certification Program Office, 7670 Opportunity Rd #220, San Diego, CA 92111 or (858) 541-1725 / (800) 366-1164, or certification@incose.org.