

시스템엔지니어양성 및 SE 자격제도

2005. 5. 20

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- ✓ 배 경
- 시스템엔지니어 양성교육 현황
- INCOSE 시스템엔지니어 자격제도 소개
- KCOSE SE 자격제도 선결과제 및 향후추진
- 토 의

SE는 어떻게 적용되어 왔는가?

- 1970년대 : 중화학공업 육성기반 조성
 - 미국 1969년 Neil Armstrong 달 착륙
 - 일본 Toyota 자동차 및 Sony 전자 미국 진출
- 1980년대 : 국산부품 조립장비 및 개량장비 생산
 - 미국 우주항공사업 축소 및 시스템 엔지니어 중소기업분산
 - 일본 자동차 품질지수 향상 및 미국시장 30% 점유
- 1990년대 : 비교우위정책 극성시기 SE 적용 주창 시기
 - 미국 S/W엔지니어링과 SE의 접목으로 세계시장 탈환
 - 1994년 민관 겸용 SE표준 제정 및 SE협회(국내/국제) 설립

SE는 어떻게 적용되어 왔는가?

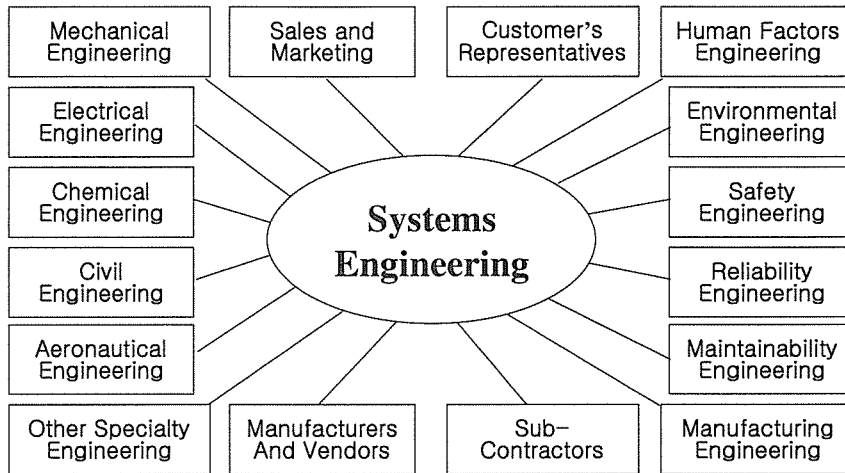
- 2000년대 : 다기능 복합시스템 SE 적용시도
 - 미국중심 세계경제와 중국 경쟁시장 출현 및 WTO IMF 충격
 - 고객중심 시스템 사고전환에 따라 2002년 KCOSE 설립 및 SE 적용시도

SE is "A way of thinking"

SE is "A way of doing business"

SE is "Enabling organized transition from need to product"

Systems Engineering



Systems Engineering Role

Role	Abbr.	Short Name
1	RO	Requirements Owner
2	SD	System Designer
3	SA	System Analyst
4	VV	Validation/Verification Engr.
5	LO	Logistics/Ops Engineer
6	G	Glue Among Subsystems
7	CI	Customer Interface
8	TM	Technical Manager
9	IM	Information Manager
10	PE	Process Engineer
11	CO	Coordinator
12	CA	Classified Ads SE

Systems Engineering Role (continue)

Reference	Role	RO	SD	SA	W	LO	G	CI	TM	IM	PE	CO
Bahill 94			σ	✓								
Beam 94		✓	✓	✓	✓	✓	✓					
Blanchard 94		✓	✓		✓	✓	✓					✓
Boehm 94			σ	σ			σ					
Dick 94		✓		σ				✓				
Fabrycky 94		✓	✓	σ	σ							
Friedman 94		✓		✓	✓	✓	✓		✓	✓	✓	
Grady 94		✓	✓	✓			σ	✓	✓		✓	
Hatley 94		σ	σ	σ								
Lacy 94		✓							σ		σ	
Lake 94		σ	✓	✓	σ	✓	✓	✓	✓	✓		✓
Mar 94		σ	σ	✓	σ				✓	σ		
Rechtin 94			σ	✓			✓	σ				
Sage 94		✓	✓	✓					✓	✓	σ	
Wymore 94		✓	✓	✓	✓	✓						
Bate 95(SE-CMM)		σ	σ	σ	σ		σ	✓	σ	✓	✓	σ
CAWG 95(SECAM)		σ	σ	σ	σ		σ	✓	σ	✓	σ	σ
DSMC 90		σ		✓	σ	σ	σ		σ	✓		✓
Matty 95		σ	σ					✓	σ			σ
Mckinney 95		σ	✓	σ			σ			✓		✓
Sheard 95		σ	✓		σ		σ	σ	✓			σ

σ = Primary Assumption,

✓ = Secondary Assumption

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KCOSE는 무엇을 하고 있는가?

- ◆ SE 이해 및 공감대 확산을 위한 관련 자료 발간
 - 시스템엔지니어링 입문(2002. 6) 등 4권 발간
 - 시스템엔지니어링 핸드북(2005. 7 예정)
- ◆ 시스템엔지니어링 교육 기회부여
 - SE Overview 외 4개 과정
- ◆ 시스템엔지니어링 워크숍 및 세미나
- ◆ 법인운영위원회 및 SE 적용사례발표회
- ✓ G2SEBOK(Guide to the Systems Engineering Body of Knowledge)
- ✓ SE 자격제도 시행준비

SE 자격제도 시행은 왜 필요한가 ?

- 시스템엔지니어링에 대한 산업체, 학계, 연구기관 및 정부기관 간의 공감대 형성 및 사회저변으로의 확대 기회 제공
- 시스템엔지니어링에 대해 체계적인 지식을 지닌 시스템엔지니어링 전문가 양성 필요
- 시스템엔지니어링 자격제도의 시행으로 SE에 대한 관심 및 한국시스템엔지니어링협회(KCOSE)의 위상 제고

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시스템엔지니어 양성은 ?

- ◆ 전 세계적으로 다양한 시스템엔지니어 양성과정 운용
 - Academic programs
 - Professional courses
- ◆ SE Academic Programs
 - 학사, 석사 및 박사과정
 - SE 및 SE Management
- ◆ 미국, 중국, 영국 등 약 14개국에서 SE Academic Program 활성화
 - 미국(44개 대학/기관), 중국(베이징대학 등 11개), 영국(Cranfield 대학 등 6개), ...

미국의 SE 교육/연구기관

구분	대학명
Center(2)	Air Force Institute of Technology, Arizona State Univ.
Division(2)	Massachusetts Institute of Technology, Penn State Univ. at Great Valley
Department (26)	Auburn Univ., Embry Riddle Aeronautical Univ., George Washington Univ., Oakland Univ., Ohio Univ., Portland State Univ., Rochester Institute of Technology, Southern Methodist Univ., Stevens Institute of Technology, Univ. of Alabama, Univ. of Central Florida, Univ. of Michigan-Dearborn, Univ. of Southern California, Virginia Polytechnic and State Univ., Boston Univ., George Mason Univ., Iowa State Univ., Ohio State Univ., Old Dominion Univ., Univ. of Virginia, Stanford Univ., Texas Tech Univ., Univ. of Arizona, Univ. of Houston, Univ. of Pennsylvania, Univ. of Texas at Arlington,
Program(12)	California Institute of Technology Industrial Relation Center, Case Western Reserve Univ., Georgia College and State Univ., National Technological Univ. Corp, Naval Postgraduate School, Southern Polytechnic State Univ., Univ. of Houston-Clear Lake, Cornell Univ., Johns Hopkins Univ., Univ. of Idaho, Univ. of Missouri-Rolla Univ., of Maryland
기타(2)	California State Univ., Colorado School of Mines

외국의 SE 단기과정은 ?

- ◆ INCOSE/Partner Hosted Training
 - INCOSE International Symposium
 - Systems & Software technology Conference
 - NDIA Systems Engineering Conference
 - 기타 regional conference

외국의 SE 단기과정은 ?

- ◆ Commercial Course listing
 - The Aerospace Institute
 - Center for Systems Management
 - Fothergill Limited
 - Honourcode, Inc
 - International Centers for Telecommunication Technology, Inc, (ICTT)
 - JOG Systems Engineering Inc.
 - Project Performance International(PPI)
 - Software productivity Consortium
 - Structured Technology Group

우리나라의 시스템엔지니어 양성은 ?

- ◆ 부진한 SE Academic Programs
 - 아주대 학위과정 개설
 - 국방대, 전북대, 서강대, 충북대 등 부분적으로 과목 개설
- ◆ KCOSE 시스템엔지니어링 실무교육과정
 - SE Overview 과정(4시간) : 협회 전문강사
 - SE에 대한 전반적 이해 증진
 - Public 15만원/개인 당
 - In-house 교육비용(20명 기준) : 120만원
 - SE 경영자과정(2시간) : 협회전문강사
 - CEO 및 경영자 대상
 - In-house 교육비용(20명 기준) : 100만원

우리나라의 시스템엔지니어 양성은 ?

- ◆ KCOSE 시스템엔지니어링 실무교육과정 (계속)
 - 시스템엔지니어링(2일간) : 민성기박사
 - SE 실무적용 능력의 구체적 터득(SE 프로세스 및 SE 관리)
 - Public 45만원/개인 당
 - In-house 교육비용(20명 기준) : 550만원
 - Requirements 엔지니어링(2일간) : 민성기 박사
 - Public 45만원/개인 당
 - In-house 교육비용(20명 기준) : 550만원

우리나라의 시스템엔지니어 양성은 ?

- KCOSE 시스템엔지니어링 실무교육과정 (계속)
 - 시스템엔지니어링(5일간) : 호주 PPI사 R. Halligan
 - 시스템엔지니어링과 관리기법
 - Public 176만원/개인 당
 - In-house 교육비용 : 별도 협의
 - 요건분석 및 규격서작성(5일간) : 호주 PPI사 R. Halligan
 - Public 176만원/개인 당
 - In-house 교육비용 : 별도협의
- 법인회원사 중심의 SE 적용사례발표회

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What is Certification?

- ◆ Certification is an occupational designation issued by an organization that provides confirmation of an individual's qualifications (specific knowledge and/or skill level) in a specified profession or occupational specialty.
- ◆ Certification is voluntary. That means it is neither a barrier nor a gate to entering or exiting a job.

Certificate ???

License ???

Certification – an Instrument for Realizing INCOSE Strategic Goals

- ◆ **Influence** – increase awareness among SE professionals, employers, and educators
- ◆ **Advance** – promulgate today's "State of the Art" to broaden the foundation for advancement
- ◆ **Growth** – certification should improve INCOSE membership retention and stimulate growth

INCOSE Top Five Priority

- Complete the classification of all existing INCOSE products and make them available to members on web.
- Implement the Guide to the Systems Engineering Body of Knowledge and populate it.
- Complete the INCOSE Technical Vision on the future of Systems Engineering.
- Revise the Systems Engineering Handbook, Version 3.
- Implement the Systems Engineering Certification Program

Requirements for Certified System Engineering Professional (CSEP)*

- SE Experience
 - 5 years minimum in multiple SE disciplines
 - Performing SE functions, but does not include time spent in receiving a technical education or teaching full time
- Distribution of Experience in SE Functional Areas

Amount of Experience Required	Maximum Depth	Maximum Width	Intermediate
5 years with Bachelor's degree, or equivalent, in technical field	3 years in any 1 area and 2 years in other areas	1 year in each of 3 areas and 2 years in other areas	Any combination between maximum depth and maximum width

SE Disciplines Qualifying for SE Experience

- ◆ Requirements Engineering
- ◆ Risk and Opportunity Management
- ◆ Baseline Control
- ◆ Technical Planning
- ◆ Technical Effort Assessment
- ◆ Design Development
- ◆ Qualification, Verification, and Validation
- ◆ Process Definition
- ◆ Tool Support
- ◆ Training
- ◆ System Integration
- ◆ Quality Assurance
- ◆ Specialty Engineering

Requirements for Certified System Engineering Professional (CSEP)*

◆ Education – Bachelor’s degree/equivalent in technical field

(Additional experience must be substituted for non-technical degree)

- 5 more years of engineering for non-technical Bachelor’s (total 10 years)
- 10 more years of engineering if no Bachelor’s degree (total 15 years)

❖ A copy of a college transcript or diploma is required to substantiate attainment of the degree

Requirements for Certified System Engineering Professional (CSEP)*

- ◆ **Recommendations from 3 System Engineering Colleagues/Peers/Managers**
- ◆ **Pass Certification Exam**
- ❖ **Application and Fee Submittals Required**
 - Application requires copy of degree transcript or diploma
 - Application fee is \$400 – discounted to \$300 for INCOSE members
 - Test fee is \$80 payable to Testing organization at time of exam.

INCOSE membership not required to participate in program

Basis of Knowledge for the Exam

- ◆ **Exam is based on INCOSE SE Handbook**
- ◆ **Current SE Handbook Version 2A is available on INCOSE web site**
- ◆ **SE Handbook version 3 is in development. Expected release is in 2006.**
- ◆ **Exam will be updated for SE Handbook Version 3**

Certification Examination

- **The certification examination is administered by an independent test organization**

- **The examination is two hours long**
 - **It consist of 120 multiple-choice questions**
 - **Each question will have about five possible answers of which three are correct**
 - **No credit is given for a partially correct answer to a question**

Requirements for CSEP 3-Year Renewal*

- **Continuing Education during Prior 3 Years - 120 PDUs**

- ❖ **Renewal Application and Fee Submittals**
 - **Must be submitted before current certification period ends**
 - **Continuing education log required**
 - **Fee is \$100 – discounted to \$50 for INCOSE members**

INCOSE membership not required to participate in program

Continuing Education Credits for Certification Renewal

Education Activity	Credit
1 College or unit semester hour	45 PDU
1 College or unit quarter hour	30 PDU
1 Continuing Education Unit (CEU)	10 PDU
1 Professional Development Hour (PDH)	1 PDU
1 hour of teaching of professional development coursework. Teaching credit is awarded for teaching a course/seminar for the first time only. Teaching does not apply to full-time faculty.	2 PDU
Authoring published papers, articles or books in any area relevant to practice	10 PDU
1 hour of participation in professional and technical society working groups/management	1 PDU
Patents	10 PDU
1 hour of professional development in coursework, seminars, or professional or technical presentation made at meetings, conventions, conferences, or exam preparation	1 PDU

Certification Program Features

◆ Certification Program Architecture

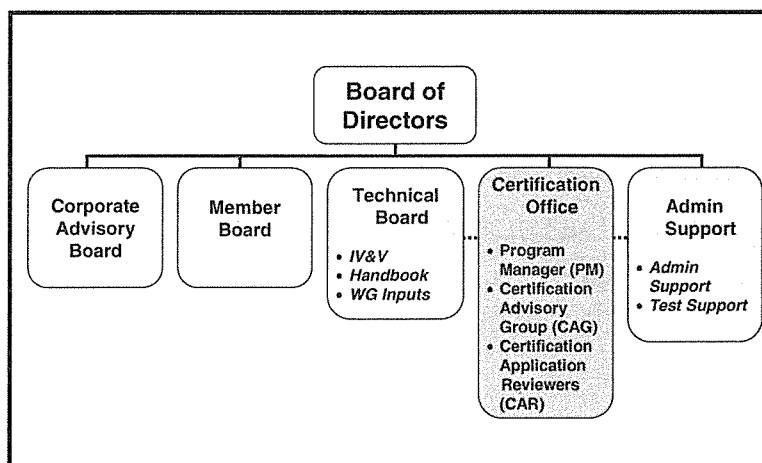
- Initially only one level: Certified Systems Engineering Professional (CSEP) (“Foundation Level”)
- Advanced and Specialty area levels of certification may be added later

Certification Program Features(Continue)

◆ Certification Program Operations

- Administration
 - Establish examination opportunities
 - Implement procedures for handling applications
 - Handle applications for certifications and renewals
- Management
 - Certification Advisory Group establishes policy and provides oversight to the Program
 - Program Manager implements policy/procedures, manages operations, reviews and approves applications
 - Certification Application Reviewers are a pool of CSEPs to review candidate qualifications

Certification Organization



Program Manager

- ◆ Establishes and Operates Program Office
- ◆ Appointed by INCOSE BOD to 2-year Renewable Term Based on Recommendation of CAG
- ◆ Establishes Program Procedures
- ◆ Develops Program Budget for INCOSE Approval
- ◆ Ensures Satisfactory Interfaces and Services to All Clients of the Certification Program
- ◆ Publicizes and Markets the Certification Program
- ◆ Monitors, Measures, and Reports on the Effectiveness of the Certification Process
- ◆ Maintains Records of All Certification Activities

Certification Advisory Group (CAG)

- ◆ Provides INCOSE Oversight to Certification Program Office
 - Represents INCOSE perspective and interests
 - Members appointed by BOD for 3 year terms (staggered)
 - Chair elected on annual basis by CAG members
- ◆ Establishes Certification Program Policy
- ◆ Identifies Qualified PM Candidates and Provides Recommendation to BOD for Appointment
- ◆ Evaluates and Reports Program Manager Performance to INCOSE BOD
- ◆ Monitors Program Metrics
- ◆ Provides Appeal Process for Contested Decisions
- ◆ Oversees Certification Examination Content

Certification Application Reviewers (CARs)

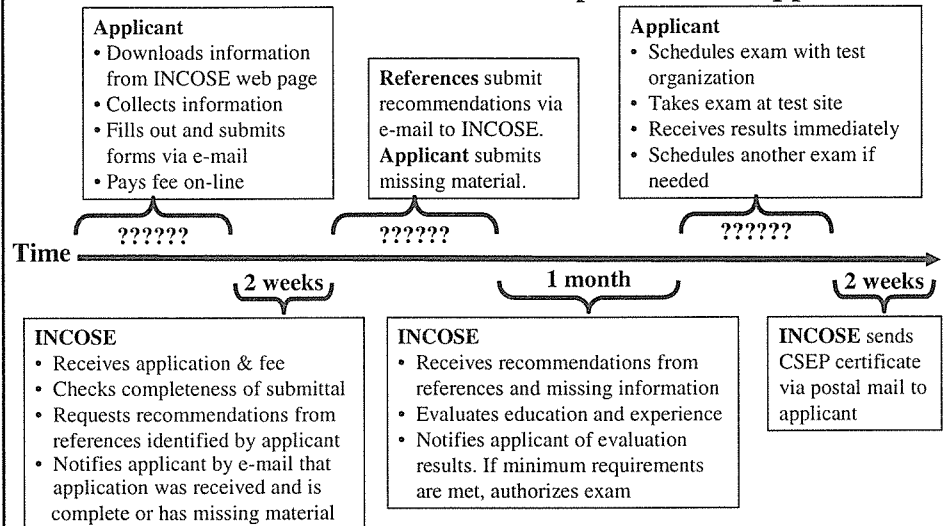
- ◆ Pool of CSEPs available for evaluation of applicants' technical credentials
- ◆ Applications assigned by PM to groups of CARs for review (min of 3 per application)
- ◆ Pool established by CAG based on following criteria
 - INCOSE member in good standing
 - Current CSEP status
 - At least 20 years of engineering experience
 - At least 10 years of systems engineering experience
 - Some experience in hiring/managing engineering/technical personnel is desired, but not required.
- ◆ Initial pool appointed by BOD
- ◆ Additional CARs selected by CAG

Certification Program Milestones

- ◆ Certification Program Development Authorized by BOD - IS 02
- ◆ Certification Exam Beta Tested – IS 03
- ◆ Certification Program Operational Plan Approved by BOD – IS 04
- ◆ Initial CAG and Acting Program Manager Appointed – September 2004
- ◆ Initial CSEPs Awarded – IW 05
- ◆ Certification Program Available to Public via INCOSE Web Page – March 2005

How Long Will It Take Me to Become Certified?

There is no one answer. Much depends on the applicant.



What Changes Might Be Coming?

- ◆ Selection of a Permanent Program Manager
- ◆ Online Submission of Applications and Renewals
- ◆ Update the Exam After SE Handbook Version 3 Is Introduced
- ◆ Review of Exam Training Programs
- ◆ Internationalize the Program (Multiple Languages)
- ◆ Multiple Levels of Certification

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KCOSE는 무엇을 해야 하는가?

- ◆ INCOSE를 포함한 관련 자격제도 검토
 - SE Experience
 - Education
 - Recommendations
 - Certification Exam
 - Renewal
 - Continuing Education

KCOSE는 무엇을 해야 하는가?

- SE 자격제도 시행을 위한 조직 구성
 - Administration
 - Management
- SE handbook 역서 발간
- SE 자격제도 시행에 대한 공감대 형성 및 사회저변 확대를 위한 산업체, 학계, 연구기관 및 정부기관의 적극적 참여 유도 방안 강구

SE 자격제도 향후 추진일정

- 자격제도 시행을 위한 선결과제 검토 : 2005. 5
- SE handbook 역서 발간 : 2005. 7
- 각 사안별 검토 및 SE 이사회 인준 : 2005. 6 - 8
- Certification Exam Beta Test 시행: 2005. 12
- SE자격제도 시행조직 발족 : 2006.1
- SE 자격시험안내 및 공고 : 2006. 1 - 6

2006년 SE Certification Program 시행

목 의

