

# How INCOSE's Certification Program Has Evolved

## as a System of Systems

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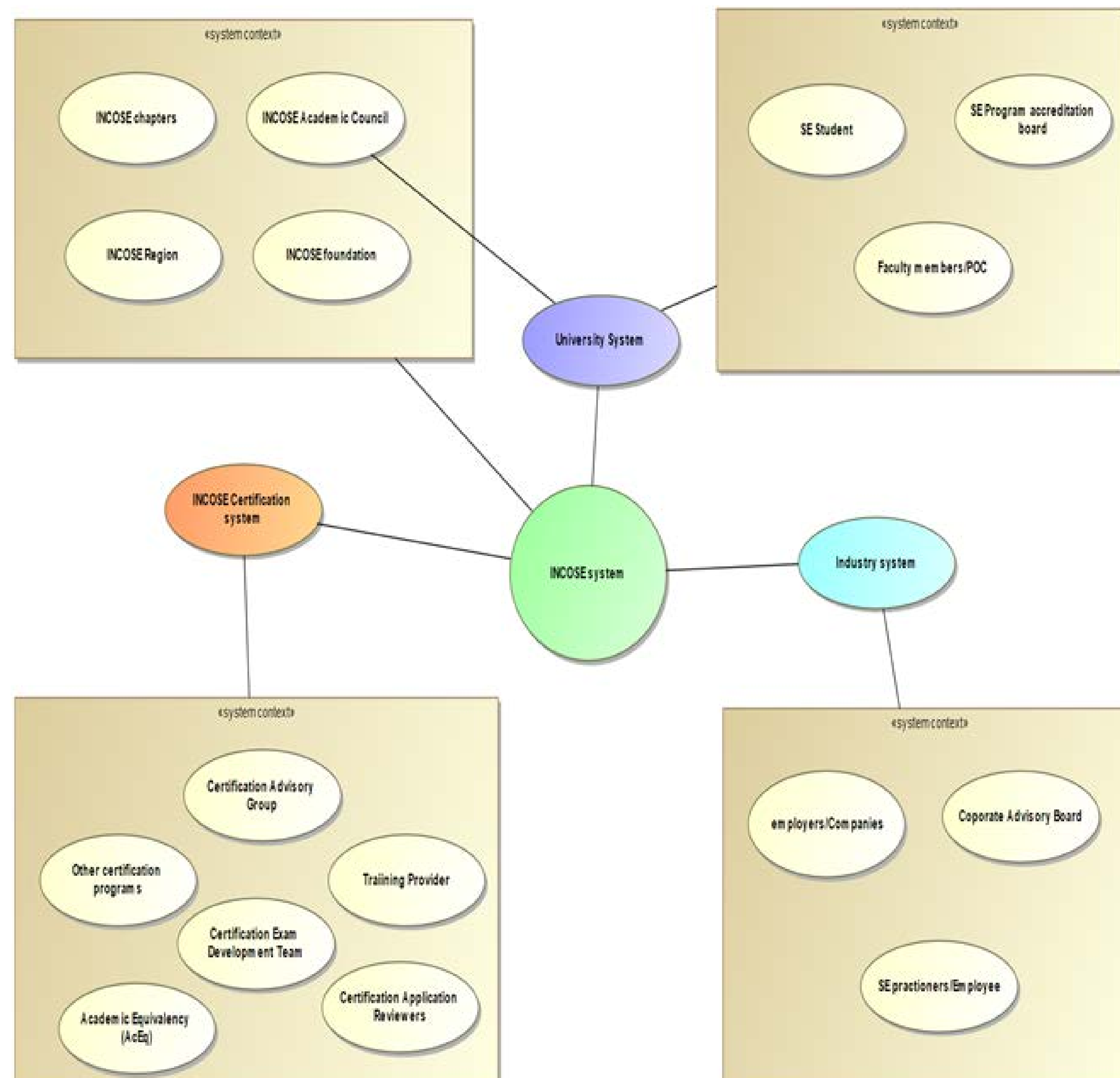
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### WHY IS INCOSE CERTIFICATION PROGRAM A SOS?

- A System of systems (SoS) is a system of interest (SOI) whose components are managerially and/or operationally independent system.
- The INCOSE certification program:
  - started as a subsystem of INCOSE with most of the capabilities reached internally
  - was geographically limited to USA
  - did not collaborate with many external systems
- The INCOSE Certification program is a SoS because:

Characteristics	Examples
It is composed of systems which are managerially and operationally independent and have their own purposes.	Technical operations have a primary purpose of producing technical documents and contributes to the certification program by producing the handbook and learning objectives.
The constituent systems are geographically distributed.	Universities, training providers, other equivalencies, INCOSE local chapters are geographically distributed.
Constituent systems are interdependent on each other to meet the objectives of the certification program.	Training providers base their courses on handbook and awareness of the learning objectives.
Its capabilities and constituents are evolving continuously.	Certifications provided were started with CSEP level, then ASEP and ESEP certifications were added.
It has emergent behaviour.	Universities increasingly teaching SE 501 courses using the INCOSE SE Handbook and joining the CAB so they can get Academic Equivalency.

### CONSTITUENT SYSTEMS



### CHALLENGES AS A SOS

Challenges	Examples
Constituent systems evolve asynchronously	The INCOSE handbook is updating from 4 <sup>th</sup> to 5 <sup>th</sup> edition, impacting other constituent systems like training providers, and universities
The constituent systems prioritize their own needs over the capabilities needed by the certification program.	Changes in Defense Acquisition University (DAU) certification program was not in compliance with the equivalency requirements of the certification program, which resulted in the modified courses not being equivalent to the INCOSE Certification program.
The certification program is not in control of the constituent system.	The certification program can object to the changes proposed in the handbook, propose changes but does not have authority to enforce changes.
Emergent behavior	Due to increase in the number of trainings to support the certification process, the quality of the certifications suddenly raised increasing the expectations of the reviewers from a certification application.

### ADVANTAGES OF SEEING CERTIFICATION PROGRAM AS A SOS

- Recognize and plan for the characteristics of a SoS, mitigating risks
- Use the multiple stakeholders for broader ideas and flexibility. Ex: When in-person knowledge exams were unavailable due to COVID, Academic Equivalencies remained a viable path to meet the knowledge requirement since many AcEq courses were taught exclusively online

### CONCLUSION & FUTURE WORK

- There is value in recognizing the certification program's SoS nature so that it can be more effectively managed.
- Some problems encountered by the certification program as a SoS can be solved by applying Model Based Systems Engineering (MBSE), this effort has been initiated.
- This case study can motivate other process-oriented organizations like the INCOSE Certification program as a SoS.
- They can especially benefit from understanding the capabilities that are needed by the organization and finding existing systems that can meet these capabilities.

### SOS ENGINEERING PRACTICES APPLIED

Understanding capability objectives	Documented in procedure
Understanding systems and relationships	Documented in procedures.
Developing & Evolving an SoS Architecture	Initiated development of the certification architecture.
Assessing Performance against Capability Objectives	Analysis performed regularly.
Monitoring & Assessing Changes	Have procedures/plans in place.
Addressing Requirements & Solution Options	Have procedures/plans in place.
Orchestrating Upgrades	Have procedures/plans in place.

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