Program Accreditation and the Graduate Reference Curriculum in Systems Engineering

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Agenda

- GRCSE Background
- Status of SE accreditation
- GRCSE elements related to accreditation
  - Objectives
  - Outcomes
  - CorBoK
- GRCSE and Accreditation
- Conclusion

Authors of GRCSE

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Why GRCSE?

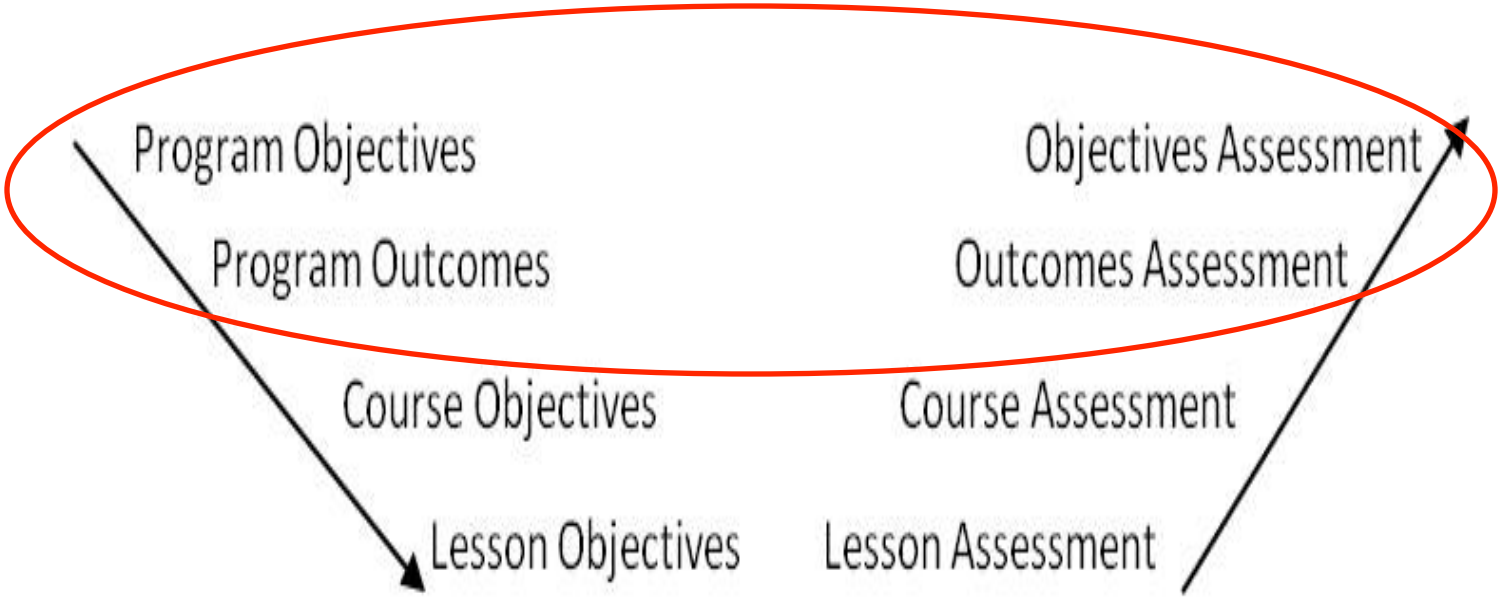
- Enable program developers and maintainers world-wide to improve existing graduate programs in SE from the viewpoint of universities, students, graduates, employers, and systems customers and users;
- Assist the development of new master's SE programs by providing guidelines on curriculum content and advice on how to implement those guidelines;
- Provide a framework to guide the deliberations of strategic advisory boards established to assist universities in the appropriate design of their programs;
- Support increased enrollment in SE programs by increasing the value of those programs to potential students and employers; and
- Assist in understanding the diversity of available SE educational programs and to assist prospective students and employers in gauging the suitability of a particular program for their individual purposes.

What is in GRCSE?

- ***Guidance for Constructing and Maintaining the Reference Curriculum:*** the fundamental principles, assumptions, and context for the reference curriculum authors
- ***Entrance Expectations:*** what students should be capable of and have experienced before they enter a graduate program
- ***Outcomes:*** what students should achieve by graduation
- ***Architecture:*** the structure of a curriculum to accommodate core material, university-specific material, and elective material
- ***Core Body of Knowledge:*** material that all students should master in a graduate SE program

Not specific courses. Not specific packaging. Adaptation and selective adoption expected and encouraged.

Scope


Program Objectives
Program Outcomes
Course Objectives
Lesson Objectives
Objectives Assessment
Outcomes Assessment
Course Assessment
Lesson Assessment

Disclaimer in GRCSE

GRCSE is **not** intended to be used to score, appraise, accredit, or certify programs for compliance. Phrases such as “GRCSE-compliant” are not used herein. Instead, the terms “satisfies GRCSE recommendations” or “aligns with GRCSE recommendations” periodically appear. Given the flexibilities built into GRCSE, the latter term is not rigidly defined, but is intended for a program that follows most GRCSE recommendations. (Pyster and Olwell, 2011)

Pressure for continuous improvement and external review

- Chittister and Haimes, 2011:
  - ABET, INCOSE, and IEEE should: "(a) harmonize and solidify the specific requirements for the accreditation of systems engineering programs in colleges and universities in the United States and abroad, and (b) guide the development of BoK requirements for any certification of systems engineers beyond the baccalaureate level. "
- Fabrycky (2012)
  - "…it may be necessary to provide worldwide academic certification of SE degree programs by participating in and going beyond accreditation as offered through the Accreditation Board for Engineering and Technology (ABET)."

More pressure

- Regional accrediting bodies are requiring external program review. For example:
  - WASC: All programs offered by the institution are subject to systematic program review. The program review process includes analyses of the achievement of the **program's learning objectives and outcomes**, program retention and completion, and, where appropriate, results of licensing examination and placement, and **evidence from external constituencies such as employers and professional organizations** (CFR 2.7).
  - The evaluation is conducted through a combination of self-evaluation, followed by peer-evaluation by reviewers external to the program or department and, usually, also **external to the organization. (WASC, 2009)**

Status of SE Accreditation Systems Centric

- US (ABET): 11/11 UG, 2/31 Grad (31% overall)
- UK: 1/? UG, 1/? Grad
- AUS: 1/? UG, 0/? Grad
- Canada: 0/? UG 0/? Grad
- Taiwan: 0/? UG, 0/? Grad
- Hong Kong: 1/? UG, O/? Grad
- Ireland: 0/? UG, 0/? Grad
- South Africa: 0/? UG, 0/? Grad

Summary

- Few accredited SE centric graduate programs worldwide
- The authors found no program specific criteria for SE anywhere
- No commonly accepted standard for external review.
- External review is upon us.

GRCSE Elements

- Entrance expectations
- Objectives
- Outcomes
- Core Body of Knowledge

These elements address a subset of the usual external review items; they are not sufficient.

Entrance expectations

- GRCSE sets entrance expectations aligned with current practice as determined by a survey of 33 programs from 10 countries.
  - The equivalent of an undergraduate degree in engineering, the natural sciences, mathematics, or computer science.
    - Specific knowledge required in basic knowledge and skills in mathematics, science, engineering fundamentals, computing, and general education
  - At least two years of practical experience in some aspect of SE
  - Demonstrated ability to effectively communicate technical information, both orally and in writing, in a program's language of instruction.

Objectives

- GRCSE recommends a process for setting program objectives.
- GRCSE provides examples from existing programs.
- GRCSE offers four sample objectives for tailoring.

Outcomes

- GRCSE recommends 13 program outcomes.
- Four are generic, and require tailoring by a program.
- About half the contact hours are addressed in the CorBok, and the rest is left for program choice.
- An integrative capstone experience is required.

Core Body of Knowledge

- The CorBoK assigns attainment goals for a program graduate to each of the topics in the SEBoK, using Bloom's taxonomy.
- This provides a common core knowledge base for all graduates of programs aligned with GRCSE.

GRCSE and Accreditation

- Accreditation and certification "*constitute a social–professional compact between the certifying professional entities and the public. In this compact, the professional accrediting and certifying entities assure the public of adherence to a scrupulous process, and that all required competencies, BoK, and experiences (as appropriate) have been met.*" *(Chittister and Haimes, 2011)*

GRCSE and external review

- GRCSE provides a comprehensive framework for external review, be it a periodic program review, an accreditation review, or a professional society endorsement.
- It is a useful source to set program criteria.

Conclusion

- Pressure for external review is increasing, including requirements by some regional accrediting bodies in US.
- External review assures the school, the student, and the employer that the program is meeting a published standard.
- GRCSE represents a multinational effort to set reference standards for systems engineering education.

(continued)

- However the community addresses external review, be it through accreditation, INCOSE certification or endorsement, or regional program reviews, GRCSE provides a framework and a substantial content set to guide the discussion.

Questions, Comments