GRCSE and GSwE2009: Educational Advancements to Support Government and Industry

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Outline

- Introduction
- State of Practice
- Industry/Government Needs
- Comparison/Contrast of GRCSE Approaches

Problem

- Lack of consistency in current programs in both SE and SwE
  - Lack of consistency makes it difficult for industry and government bodies to understand the expectations when hiring an individual with an master's degree in either SE or SwE
- This is a gap that may be filled by a set of recommendations designed to improve the overall state of master's programs in these areas

iSSEc Project Goals

- The iSSEc project has to:
  - Define the current state-of-the art in master's level education for their respective disciplines
  - Define industry and government needs in these areas
  - Identify gaps between the state of the art and needs which may be addressed by education
  - Incorporate ways to address these gaps in project products

Background

- Begun in May 2007 at Stevens Institute of Technology
- Sponsored by DoD Director of Systems and Software Engineering
- Three products planned:

1. A modern reference curriculum for a master's degree in software engineering that integrates an appropriate amount of systems engineering (GSwE2009)
2. A modern reference curriculum for a master's degree in systems engineering that integrates an appropriate amount of software engineering (GRCSE)
3. A truly interdisciplinary degree that is neither systems nor software engineering – it is both

Examining the State of Practice

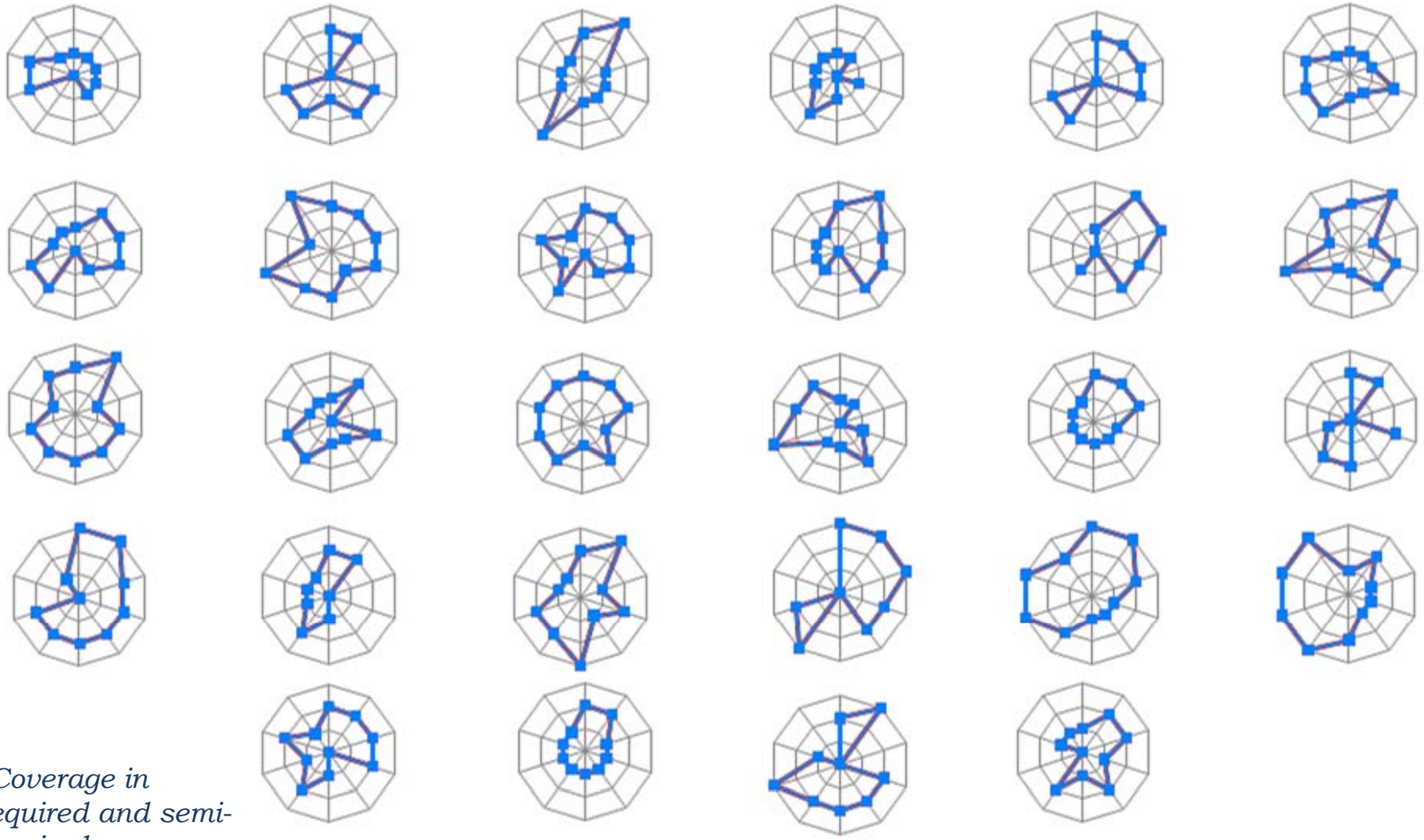
- Both Phase 1 and Phase 2 conducted surveys to determine the current state of master's level education in their respective fields
  - SwE Curriculum (2007) study surveyed 28 schools
  - SE Curriculum study (2010) surveyed 36 schools

- Both surveys collected:
  - Basic data about the university, program, etc.
  - The type of degree offered
  - Any specialized program focus
  - Thesis/Credit requirements
  - Required coursework
  - Entrance Requirements

School Survey Results

- Both surveys showed the same general pattern in SwE and SE:
  - Lack of consistency, structure and requirements degree programs
  - Several different types of degrees offered
  - Lack of consistency in entrance expectations
- Both are structured to allow tailoring at the program/university level while addressing shortcomings or inconsistencies in current programs

SWEBOK coverage* in 2007 across 28 SwE MS programs



**Coverage in required and semi-required courses*

SEBOK coverage* in 2010 across 36 SE MS programs

Top 10 Courses Identified within the Program	
Introduction to Systems Engineering	56%
Modeling and Simulation	53%
Project Management	38%
Systems Architecture and Design	38%
Systems Integration	34%
Systems Analysis	25%
Systems Management	25%
Systems Requirements Analysis	25%
Risk and Decision Analysis	25%
Probability and Statistical Analysis	19%

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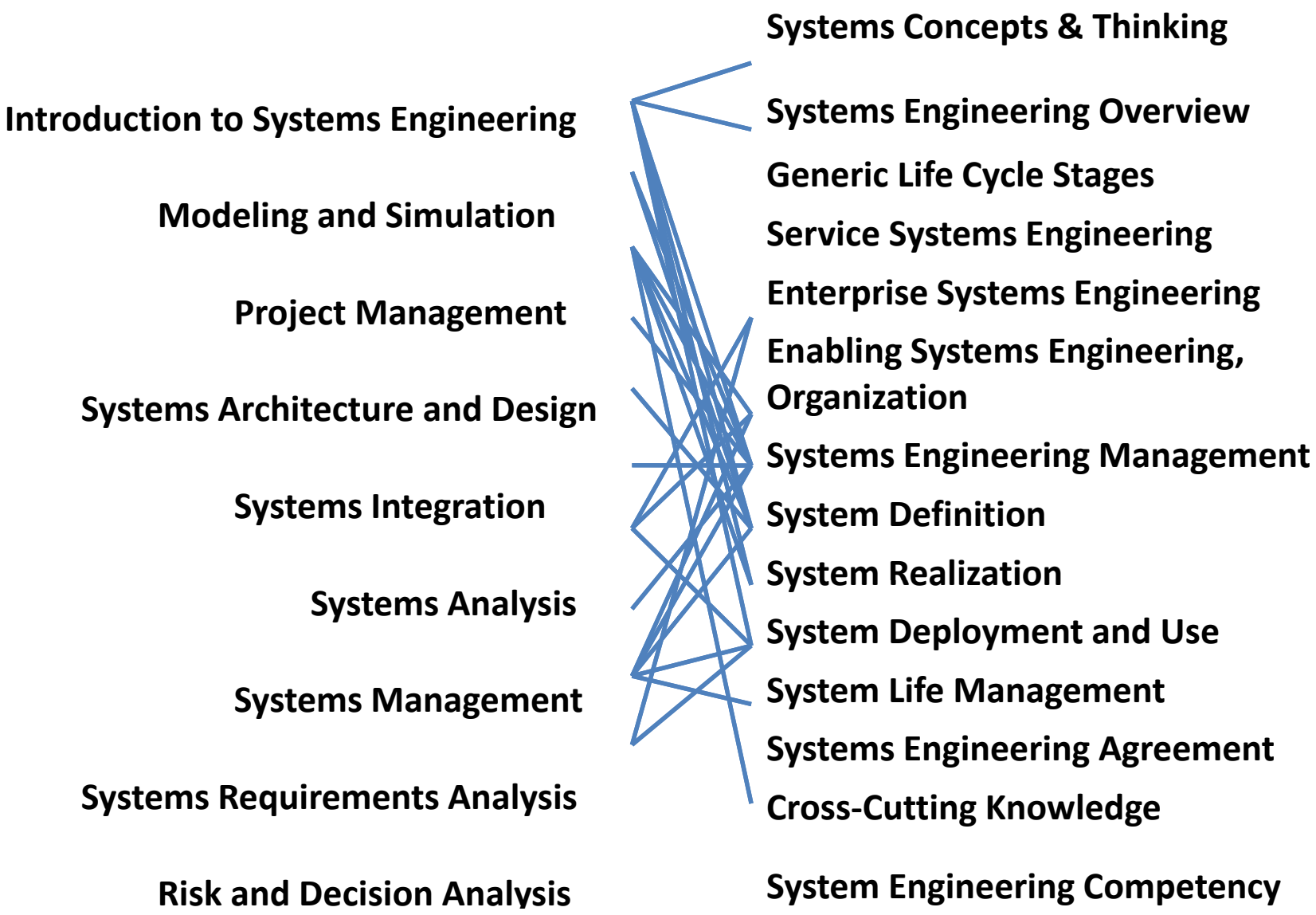

Industry & Government Needs

- Both GRCSE and GSwE2009 author teams include industry experts who could help identify areas requiring improvement
- OSD provided an overview of the gaps for both SwE and SE

A Common Approach

- Generic structure which provides:
  - recommendations as to student background upon program entry
  - a common set of foundational knowledge
  - a common framework for understanding the knowledge, skills, and abilities addressed by a program
- Neither curriculum prescribes exactly how a program should be structured

What does a Reference Curriculum cover?

- ***Guidance for Constructing and Maintaining the Reference Curriculum:*** the fundamental principles, assumptions, and context for the reference curriculum authors
- ***Objectives:*** *what a successful graduate should be able to contribute to a prospective employer within 2-3 years*
- ***Entrance Expectations:*** what students should be capable of and have experienced before they enter a graduate program
- ***Outcomes:*** what students should achieve by graduation, may vary depending on Objectives
- ***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, for different Objective/Outcomes

Phase 1 Graduate Software Engineering

1. Understand the current state of SwE graduate education (November 2007)
2. Create GSwE2009 0.25 (formerly GSwERC) with a small team, suitable for limited review (February 2008)
3. Publicize effort through conferences, papers, website, etc (continuous)
4. Create GSwE2009 0.50 (formerly GSwERC) suitable for broad community review and early adoption (October 2008)
5. Create GSwE2009 1.0 suitable for broad adoption (2009)
6. Transition stewardship to professional societies (2009)
7. Foster adoption world-wide (2009 and beyond)

Phase 1 Graduate Software Engineering

Graduate Software Engineering 2009 (GSwE2009): Curriculum Guidelines for Graduate Degree Programs in Software Engineering

GSwE2009 Companion Document: Comparisons of GSwE2009 to Current Master's Programs in Software Engineering

GSwE2009 Companion Document: Frequently Asked Questions on Implementing GSwE2009


iSSEc

Integrated Software & Systems Engineering Curriculum (iSSEc) Project

Graduate Software Engineering 2009(GSwE2009)

Curriculum Guidelines for
Graduate Degree Programs in Software Engineering

GSwE 2009

Version 1.0

September 30, 2009

Unlimited Global Distribution

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Endorsed by INCOSE, NDIA SE Division, Brazilian Computer Society

Originally sponsored by DoD. Now sponsored by the IEEE Computer Society and ACM

www.GSwE2009.org

GSwE2009 Release & Governance

- Version 1.0 was released to the international SwE community Sept. 30, 2009.
  - Delivered to US DoD OSD
  - Delivered to ACM EB, IEEE CS, INCOSE, and CAT
  - The document is available online at www.gswe2009.org/curriclum/recommendations/document.pdf
- **The ACM EB and IEEE CS have agreed to sponsor GSwE2009, and are now the GSwE2009 stewards**
- **INCOSE, the NDIA SE division, and the Brazilian Computer Society have endorsed GSwE2009**
- Author team is maintaining a small volunteer body to provide periodic updates of FAQ and comparisons materials with website support including forums, wikis, and other open collaboration structure.
- Implementation workshops at conferences, summer faculty workshops, and other activities would promote adoption. The CAT is currently seeking assistance from the NSF to support these workshops.

Phase 2 Graduate Systems Engineering (GRCSE)

- Unlike Software Engineering, Systems Engineering does not have an existing Body of Knowledge upon which a reference curriculum can be base.
- The Body of Knowledge and Curriculum Architecture for Systems Engineering (BKCASE) project will advance both BoK and Curriculum in parallel
- Even though the Department of Defense is the sponsor, it does not have any authority over the content of the products, nor are the products slanted towards defense systems development and acquisition
- A group of Volunteer authors do the bulk of the writing, and facilitate contribution and review from the wider community. A Core Team from Stevens and Naval Postgraduate School provide leadership, product integration, technical editing.

GRCSE Value Proposition

1. There is no authoritative source to guide universities in establishing the outcomes graduating students should achieve with a master's degree in SE, nor guidance on reasonable entrance expectations, curriculum architecture, or curriculum content.

2. This gap in guidance creates unnecessary inconsistency in student proficiency at graduation, makes it harder for students to select where to attend, and makes it harder for employers to evaluate prospective new graduates.

GRCSE is being created analogously to GSwE2009 – in fact, using GSwE2009 as the starting text

Version 0.25 expected in December 2010

GRCSE 0.25 Draft Contents

Title - Chapters
1. Introduction
2. Guidance for the construction and maintenance of GRCSE
3. Expected Objectives
4. Outcomes at Graduation
5. Expected student background
6. Curriculum architecture
7. Core body of knowledge (CorBOK)
8. Assessment
9. Anticipated GRCSE evolution

Title - Appendices
App A. Summary of Graduate SE-centric SE programs in 2010
App B. Bloom's taxonomy of educational objectives
App C. SE Competency Frameworks
App D. Assessment
References
Glossary
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Provides guidance on how to build a course, not specific courses.
Adaption and selective adoption expected and encouraged.

Similarities between GSwE2009 and GRCSE

- SE and SwE are distinct disciplines with rich body of knowledge, practice, and theory, drawing upon a common foundations from a wide variety of sources.
- Both SE & SwE curricula must appropriately recognize the inter-connections between them and other with science, management and engineering specialties, and make reference to appropriate Bodies of Knowledge in their own and related disciplines.
- The principal purpose of each is to provide tailorable recommendations for developing and improving curricula; NOT as a basis for accreditation.
- They are intended to be International in scope.
- Both describe professional degrees concentrated on enhancing the skills and knowledge of practicing systems engineers. They include some generic guidance on the expected skills and experience of students entering such a masters program.

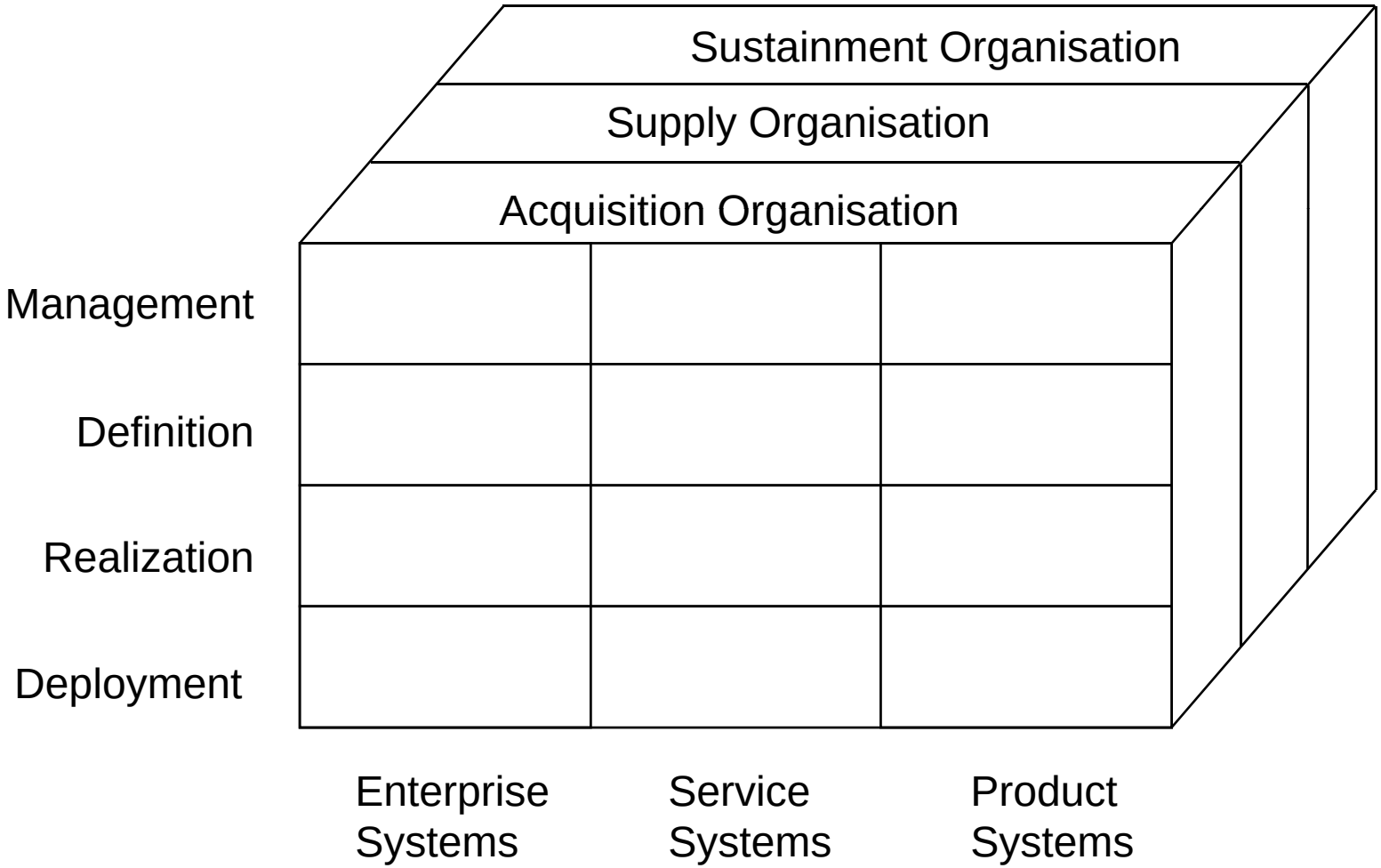
Similarities between GSwE2009 and GRCSE

- At the heart of each are the fundamental skills, attributes and knowledge that all graduates of SE/SWe masters degree program must possess, Blooms Taxonomy is used to identify appropriate levels of knowledge in different Knowledge Areas.
- These including technical and non technical skills, the application of both theory and practice and the ability to continue life long learning.
- Both go beyond expected knowledge to give a flexible architecture and significant guidance examples on how to build high quality programs.
- They attempt to respect the flexibility and uniqueness of existing programs and the need for university and domain specific content. Both cover the normal number of credits for a masters degree.
- They recognize the need to constantly review and update curriculum as both customer/student needs and knowledge and technology evolves.

Differences between GSwE2009 and GRCSE

- Systems Engineering has a very wide domain of application, often closely tied to domain practice, and can be used at many levels of an Enterprise.
- A section on Curriculum Objectives has been included in GRCSE to identify some of the roles Systems Engineering graduates might fulfill.
  - These roles will be defined by the type of Systems Engineering done and the kind of organization it is done in
  - Discussion of possible Systems Engineering Roles over page
- GRCSE provides guidance on the creation of Curricula for Professional Masters Programs. Thus it also will have Cognitive and Behavioural Outcomes to help produce Graduates able to conduct these roles within the extended enterprise.

Systems Engineering Roles: Influence on Objectives



Differences between GSwE2009 and GRCSE

- The current proposal (for GRCSE 0.25) is for a three levels of Knowledge/Outcomes:
  1. Core Knowledge, which all graduates must have
  2. Extended Core Knowledge, related to potential roles
  3. Elective or University Specific Knowledge
- Number 2 above is new to GRCSE, the exact roles and related Knowledge areas are still to be finalised.
- GRCSE will also tackle some of the wider education issues which GSwE2009 did not have time to consider

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Questions?

- For more information on GSwE2009, see: www.gswe2009.org

- For more information on GRCSE, see: www.bkcase.org

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Overview Information in 2010 across 36 SE MS programs

Program Focus	
General Systems Focus; Systems Engineering; Systems Architecture; Systems Design; Systems Management	66%
Domain Specific	34%
Requirements for Admission	
Accepted Undergraduate Degrees in one or more of the following areas	
Engineering	88%
Science/Physics/Mathematics	81%
Other	30%
Under Graduate Performance	
Average GPA 3.0	60%
No Requirement	28%
No Response	12%
Related Work Experience	
Average 3 years	40%
No Requirement	44%
Company Sponsored	16%