

# GRCSE Outline and Contributions

Tim Ferris

University of South Australia



# BKCASE Project and the Place of GRCSE



- BKCASE Project is developing two products
  - A guide to the SE body of knowledge (SEBoK)
    - To address the gap in the field – that there is no organised body of knowledge which represents a community consensus
    - There are many individual author presentations of SE
  - A reference curriculum for professional masters programs in SE
    - Professional masters programs educate people to commence service as practitioners
    - Provides guidance for the creation, selection and maintenance of programs
    - Some products of individuals – but this lacks the community consensus and consequent authority



# What is in GRCSE

- **Objectives:** what graduates should be able to contribute 3-5 years after graduation
- **Outcomes:** what students should achieve by graduation
- **Entrance Expectations:** what students should be capable of and have experienced before they enter a graduate program
- **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
- **Guidance for Stakeholders in SE Programs:** the content is designed to guide program developers, maintainers, employers, prospective students and others with an interest in SE programs
- **Assessment and Evaluation in SE Programs:** the approach and philosophy of assessment in SE

# What is NOT in GRCSE



- Not specific courses
- Not specific packaging
  -
- Adaptation and selective adoption expected, encouraged and essential
  - 
  - recommendations to suit
    - The recommendations in GRCSE are not suitable for simplistic 'cookie cutter' use
    - We recognize each university works in a particular market niche – needs difference
    - Universities can compete in the 50% of the program that is left entirely to their choice

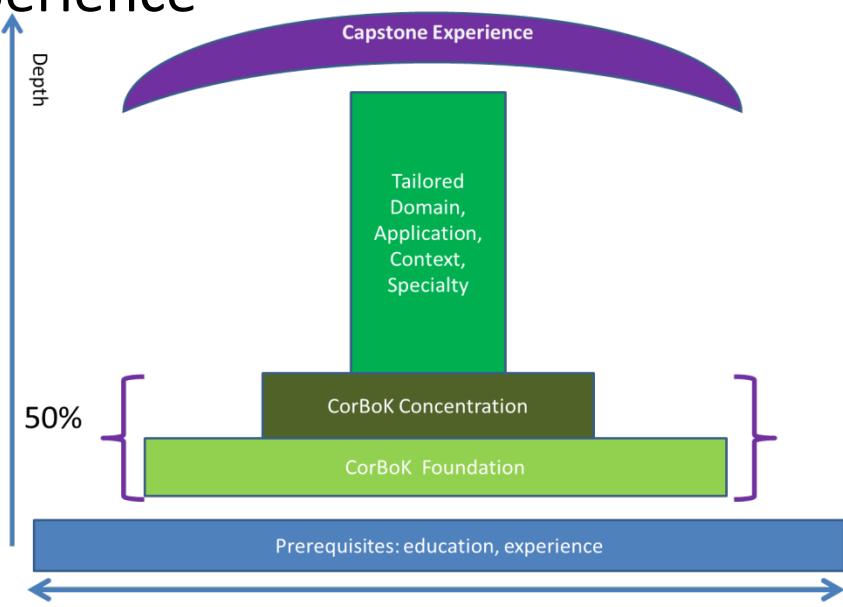
# Sections



Introduction	Guiding principles
Objectives	Existing program survey
Outcomes	Bloom's taxonomy
Entrance expectations	Outcomes/CorBoK mapping
Architecture	Assessment principles
CorBoK	Competency development
Implementation	Use cases
Assessment	
Maintenance	

# Chapter 5: Curriculum architecture

- Elements of GRCSE architecture
  - Preparatory knowledge
  - Foundation knowledge
  - Concentration knowledge
  - Domain-specific knowledge
  - Program-specific knowledge
  - Capstone experience

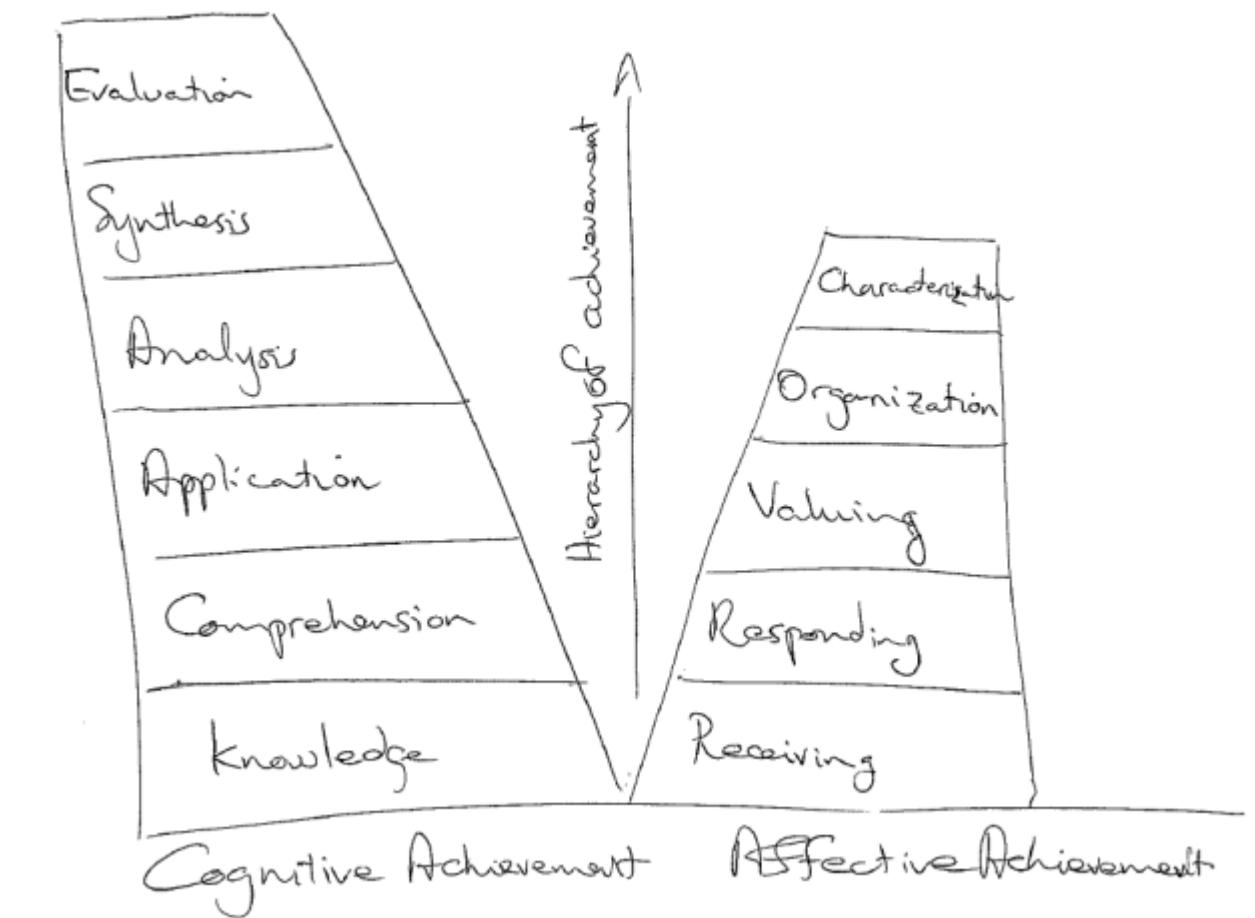


# Chapter 6: CorBoK (Core Body of Knowledge)



- CorBoK describes the level of achievement expected at the time of graduation for each of the knowledge areas described in terms of Bloom's taxonomy
  - CorBoK influence on 50% of program
  - CorBoK organisation
    - Foundation
    - + 2 example concentrations
      - SE Management (management of SE work)
      - System Design & Development (technical focus)

# Sketch of the Cognitive and Affective Levels



# Cognitive Domain – Description



Level	Sub-Level	Competency	Outcome Descriptors
Knowledge (K)	Knowledge of specifics Knowledge of terminology Knowledge of specific facts Knowledge of ways and means of dealing with specifics Knowledge of the universals and abstractions in a field	Ability to remember previously learned material. Test observation and recall of information; i.e., “bring to mind the appropriate information;” e.g., dates, events, places, knowledge of major ideas, and mastery of subject matter.	List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, and name (who, when, where, etc.).
Comprehension (CO)	Translation Interpretation Extrapolation	Ability to understand information and ability to grasp meaning of material presented; e.g., translate knowledge into new context, interpret facts, compare, ...	Summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, and extend.
Application (AP)	Application of methods and tools Use of common techniques and best practices	Ability to use learned material in new and concrete situations; e.g., use information, methods, concepts, and theories to solve problems.	Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, and discover.
Analysis (AN)	Analysis of elements Analysis of relationships Analysis of organizational principles	Ability to decompose learned material into constituent parts in order to understand structure of the whole.	Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, and infer.
Synthesis (S)	Production of a unique communication Production of a plan, or proposed set of operations Derivation of a set of abstract relations	Ability to put parts together to form a new whole. This involves the use of existing ideas to create new ones, generalizing from facts, relating knowledge from several areas, and predicting and drawing conclusions.	Combine, integrate, modify, rearrange, substitute, plan, create, design, invent, what-if analysis, compose, formulate, prepare, generalize, and rewrite.
Evaluation (EV)	Judgments in terms of internal evidence Judgments in terms of external criteria	Ability to pass judgment on value of material within a given context or purpose. This involves making comparisons and discriminating between ideas, assessing the value of theories, making choices based on reasoned arguments, verifying the value of evidence, and recognizing subjectivity.	Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, and summarize.

# Cognitive Domain – Assessment



Level	Example Competencies	Possible Assessment Tasks
Knowledge (K)	The student is able to recite the definitions of “system” and “emergence” and state the connection between them.	Simple test of ability to repeat standard definitions of “system” and “emergence”
Comprehension (CO)	The student is able to explain, in a very general way, the conditions under which a system development team might choose to use a waterfall (or iterative, incremental, or spiral) life cycle model.	An examination question asking for a description of the waterfall (or other) project model and when it would be suitable for use.
Application (AP)	Given the operational concept and requirements of a simple system along with a specified budget and required completion time, the student is able to choose (and to provide a rudimentary justification for the choice) a particular life cycle model to address the project; e.g., waterfall, iterative, incremental, or spiral.	An assignment or examination task presenting a project scenario and requiring the student to choose a project management model and justify the choice in relation to the specific characteristics of the scenario.
Analysis (AN)	Given a simple requirements document and a domain model for an application, the student is able to critique the domain model.	An assignment testing ability to discuss the implications of particular requirements in the context of a set of requirements.
Synthesis (S)	Given a detailed requirements document and a well-constructed domain model for a system, the student is able to design at least one basic architecture for the system. Given an operational concept, requirements, architecture, and detailed design documents for a system, the student is able to construct a complete implementation plan and provide a cogent argument that if the implementation of the architecture or detailed design is performed according to the plan, then the result will be a system that satisfies the requirements, fulfills the operational concept, and will be completed within the budget and schedule.	A task to propose an architecture for implementation of a system defined by a set of requirements. An assignment to develop and justify a project plan for implementing a particular system.
Evaluation (EV)	Given an operational concept, requirements, architecture, a detailed design, and an implementation plan, including budget and schedule, for a system, as well as a feasibility argument for the implementation plan, the student is able to assess the plan and to either explain why the feasibility argument is valid or why and where it is flawed with regard to any of the claims regarding implementation of the requirements, fulfillment of the operational concept, or the ability to be completed within budget and schedule.	An assignment to provide an assessment of the suitability and feasibility of a plan that is offered as a solution to a project need.

# Affective Domain – Description



Level	Sub-Level	Competency	Outcome Descriptors
Receiving (RC)	Awareness Willingness to receive Controlled or selected attention	The learner is aware of stimuli and is willing to attend to them. The learner may be able to control attention to the stimuli.	Focuses on and is aware of aesthetics, focuses on human values, is alert to desirable qualities, and shows careful attendance to input.
Responding (RS)	Acquiescence in responding Willingness to respond Satisfaction in response	The learner makes a conscious response to the stimuli related to the aesthetic or quality. At this level the learner expresses an interest in the aesthetic things.	Demonstrates willing compliance and obedience to regulations and rules, seeks broad-based information to act upon, and accepts responsibility and expresses pleasure for own situation.
Valuing (V)	Acceptance of a value Preference for a value Commitment	The learner recognizes worth in the subject matter.	Continuing desire to achieve, assumes responsibility for, seeks to form a view on controversial matters, devotion to principles, and faith in effectiveness of reason.
Organization (OR)	Conceptualization of a value Organization of a value system	The learner is able to organize a number of values into a system of values and can determine the inter-relationships of the values.	Identifies characteristics of an aesthetic, forms value-based judgments, and weighs alternative policies.
Characterization (CH)	Generalized set Characterization	The learner acts consistently with the systems of attitudes and values they have developed. The values and views are integrated into a coherent worldview.	Readiness to revise judgment in light of evidence, judges problems and issues on their merit (not recited positions), and develops a consistent philosophy of life.

# Affective Domain – Assessment



Level	Example Competencies	Possible Assessment Tasks
Receiving (RC)	The student accepts that customer or user perception of the quality of a system is the fundamental determinant of system quality.	An assignment to explain how customer or user perception of the system governs recognition of quality of the system.
Responding (RS)	The student learns how to ask questions to elicit the unstated desires of a stakeholder who is seeking a system development. The student is willing to try the SE approach on a small project.	An assignment to interview stakeholders to a project concerning the needs/requirements for the system under development. A project task for which SE methods are demanded, and a reflective journal requiring discussion of the usefulness of SE methods in doing the project.
Valuing (V)	The student believes it is important to provide system solutions that satisfy the range of stakeholder concerns in a manner that the stakeholders judge to be good. The student believes it is important to elicit a nuanced description of what stakeholders desire of a system in order to provide rich knowledge that can be used in the system solution development.	An assignment to show the value to a system developer's future business from the reputational effect of properly attending to stakeholder needs. An assignment in which the student analyses the impact on a case study project where there is evidence that needs/requirements elicitation was significantly inadequate in capturing the real interests of the stakeholders.
Organization (OR)	The student is able to organize a coherent framework of beliefs and understandings to support use of a SE method in a project. The student has a coherent framework for how to discuss system development with stakeholders and to incorporate the views of a variety of stakeholders in a balanced manner.	An assignment to propose and justify, through explaining the expected benefits, the use of particular SE methods and processes for a particular project. A project task with 'external' (to the academic department) stakeholders where the student must justify the method used to perform the project in terms of the expected benefit to the stakeholders.
Characterization (CH)	The student will routinely approach system development projects with a SE framework.	A practical examination requiring development of a system concept where there is a tempting, obvious given the student's background, solution to test what the student does under time pressure.

# Sample Table from CorBoK



Knowledge Area	Topic	Foundation	SEM	SDD
Life Cycle Models	Life Cycle Characteristics	Application		
	System Life Cycle Process Drivers and Choices	Application		
	Representing System Life Cycle Process Models: Iterative	Application		
	Representative System Life Cycle Process Models: Vee	Application		
	Integration of Process and Product Models	Application		
System Definition	Fundamentals of System Definition	Application		Analysis
	Mission Analysis and Stakeholders Requirements	Application		Analysis
	System Requirements	Application		Analysis
	Architectural Design	Application		Analysis
	System Analysis	Application		Analysis
System Realization	System Implementation	Application		Analysis
	System Integration	Application		Analysis
	System Verification and Validation	Application		Analysis
System Deployment and Use	System Deployment	Comprehension		Application
	Operation of the System	Comprehension		Application
	System Maintenance	Comprehension		Application
	Logistics	Comprehension		Application
SE Management	Planning	Comprehension	Analysis	
	Assessment and Control	Comprehension	Analysis	
	Risk Management	Comprehension	Analysis	
	Measurement	Comprehension	Analysis	
	Decision Management	Comprehension	Analysis	
	Configuration Management	Comprehension	Analysis	

# GRCSE Contributions to Reference Curricula



- Traditional reference curricula provide the elements of programs
  - Entrance expectations
  - Subject matter content to be taught
  - Outcomes (student achievement at graduation)
  - Levels of achievement expressed in the Cognitive domain (what students know)
- GRCSE contributions
  - Objectives
  - Affective Domain
  - Guidance on assessment methods
  - Guidance on program evaluation methods

# Objectives

- Objectives concern what graduates will be able to do 3-5 years after graduation
- GRCSE encourages program developers to identify objectives which are appropriate for their university's market niche
  - And provides some examples
- Objectives are included to focus program developers on ensuring the education design sets graduates up for success in their niche
  - Achieving objectives is based on outcomes and having the ability to benefit from experience



# Affective Domain



- The Affective Domain concerns education that transforms the values of the student
- Obvious areas of interest
  - Teamwork
  - Ethics
- Less obvious areas of interest in SE
  - In the cognitive domain students learn THAT taking a holistic view is good
  - But how do they work under pressure?
  - The affective domain goal is to develop them to default to taking an holistic view of the engineering task
  - Currently only in an appendix – future work

# Assessment Methods

- Students must be assessed to determine what they have learned
- GRCSE has a lengthy discussion of methods to assess student learning
- Includes advice about ways to assess various levels of learning achievement





# Program Evaluation Methods

- Universities need to ensure that their programs achieve their intended goals
- GRCSE provides guidance
- Methods include
  - Employer feedback about graduate performance
  - Graduate feedback with the benefit of hindsight following early career work
  - Graduate progression toward the objectives
  - Evidence that program outcomes are addressed
  - Direct feedback from Industry Advisory Committees

# One Stop Shop

- GRCSE is intended as a “one stop shop” for guidance in SE professional masters program development and use
- To improve the practice of SE through education in SE

