Case Study in the Application of GRCSE:

Successful Stakeholder Engagement through Surfacing Program Objectives & Outcomes

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Initial Context

- Well-established, employer-sponsored masters program being converted to flexible, on-line delivery format
- Coursework converted following a program review
  - No major issues
- Capstone project conversion remained
  - Capstone project in previous face-to-face version well regarded
  - Comprised a scripted role-playing approach that required industry and academic staff to provide continuous interaction with the student groups
  - Management Committee looking for lower levels of industry and academic effort
  - Significant personal investment by working-level stakeholders evident

The Challenge

- Project Focus Group formed comprising industry and academic stakeholders
    - Met fortnightly but after several meetings convergence some way off

- It was hard to grasp the objectives of the Project
    - Planning publications written from many perspectives
    - Lots of undocumented stakeholder viewpoints
    - Lack of a framework to structure the educational objectives

- The issues
    - Industry concerned that the new academic team failed to appreciate the value of the unique, purpose-designed project format based on role playing against a scripted storyboard
    - New academic members concerned that technical aspects of design and technical de-risking needed to be strengthened
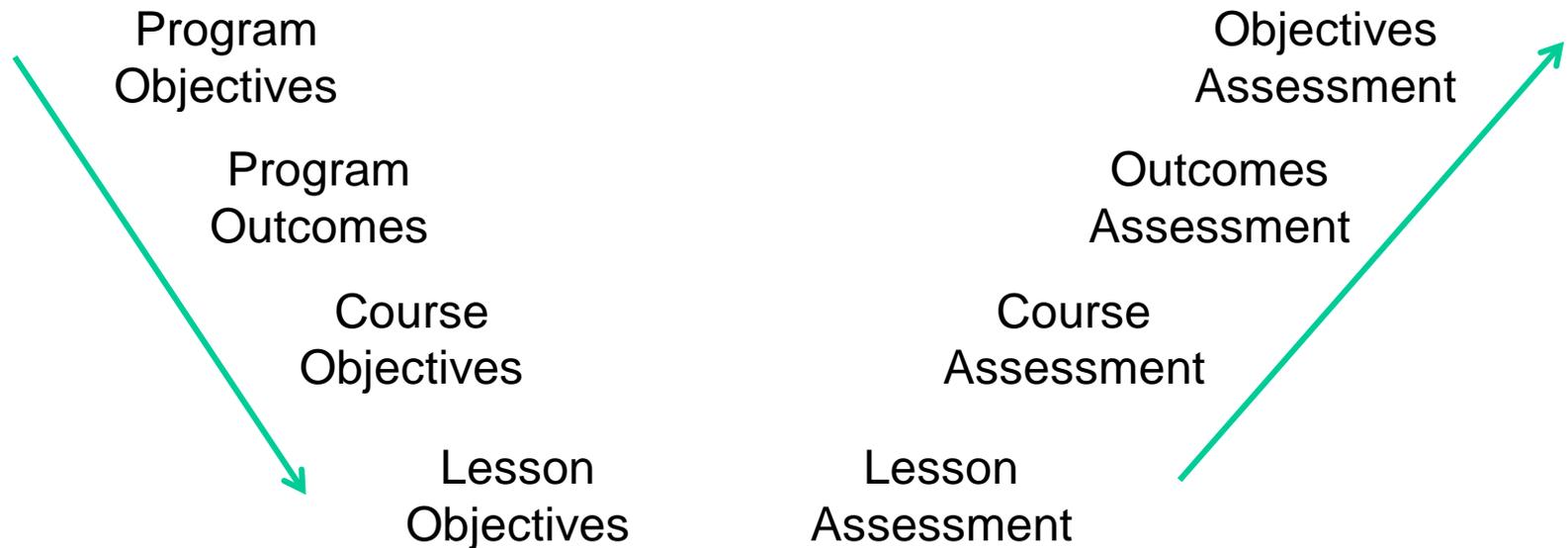   - Divergent views not being resolved

The Resolution Approach

- Happened to review GRCSE…
- Used the framework to direct the new Systems Integration Project design process

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Educational V-Model

(GRCSE v0.25)

The Project Component is 5/12 of the degree and covered 3 courses

Program Objectives

Objectives Assessment

Program Outcomes

Outcomes Assessment

Course Objectives

Course Assessment

Lesson Objectives

Lesson Assessment

Surfacing of Desired Educational Objectives and Outcomes

- Literature review
    - Program business cases
    - Face-to-face program documentation
    - Flexible delivery documentation
    - Course documentation
- Stakeholder workshop
- Synthesis of Objectives and Outcomes
- Stakeholder socialisation

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Program Objectives
(Capabilities Expected at Graduation + Five Years)

- Capacity to effectively analyse, design & implement feasible, suitable, supportable, affordable and integrated solutions to systems of products, services & enterprises
  - Have capacity to apply SI/SE coursework in realistic/applied environment
  - Develop ability to transform user needs into a quality engineering solution/design
  - Be able to formulate a complex 'systems of systems' military integration problem
  - Understand systems & SoS interactions & evaluate competing design concepts systematically
  - Know how to search for capabilities and limitations of military systems in diverse engineering settings
  - Understand ways in which integrated system can fail, assess likelihood of failure, and devise mitigation strategies against risk and failure

- Possess the educational foundation needed for leadership roles
  - Effectively lead a project from conception through development to production in a challenging environment
  - Communicate effectively in oral, written and newly developing modes and media
  - Appreciate professional ethics in decision-making and systems engineering practice
  - Demonstrate professionalism and capacity to grow professionally through continued learning

- Understand the need for cross-disciplinary and cross-organisational collaboration and coordination to define and deliver creative engineering solutions
  - Apply evaluation techniques to SoS problems too complex for a single individual
  - Successfully assume a variety of roles in multi-disciplinary teams of diverse membership
  - Prepare students for assignments related to research, design, development, acquisition, integration, maintenance, and life-cycle management of military systems

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High Level Student Outcomes
(At Graduation)

- Demonstrate attributes of leadership and team membership required by a professional systems engineer

    - Comprehend challenges of applying systems engineering to realistic problems as part of a multi-disciplinary team

    - Demonstrate abstract thinking, communication, team work, negotiation/influence, knowing when to ask/stop, etc.

    - Be effective member of multi-disciplinary team and effectively communicate both orally and in writing

    - Lead one area of systems development (e.g. project mgt, req. analysis, architecture, construction, QA)

- Demonstrate mastery of SE necessary to develop current and future product, service or enterprise

- Demonstrate the ability to perform SE activities in Military Systems Integration domain

- Achieve designated levels of competency for each SE topic within core foundation knowledge

- Achieve designated levels of competency for one foci within core extension & domain-specific knowledge

Student Outcomes:
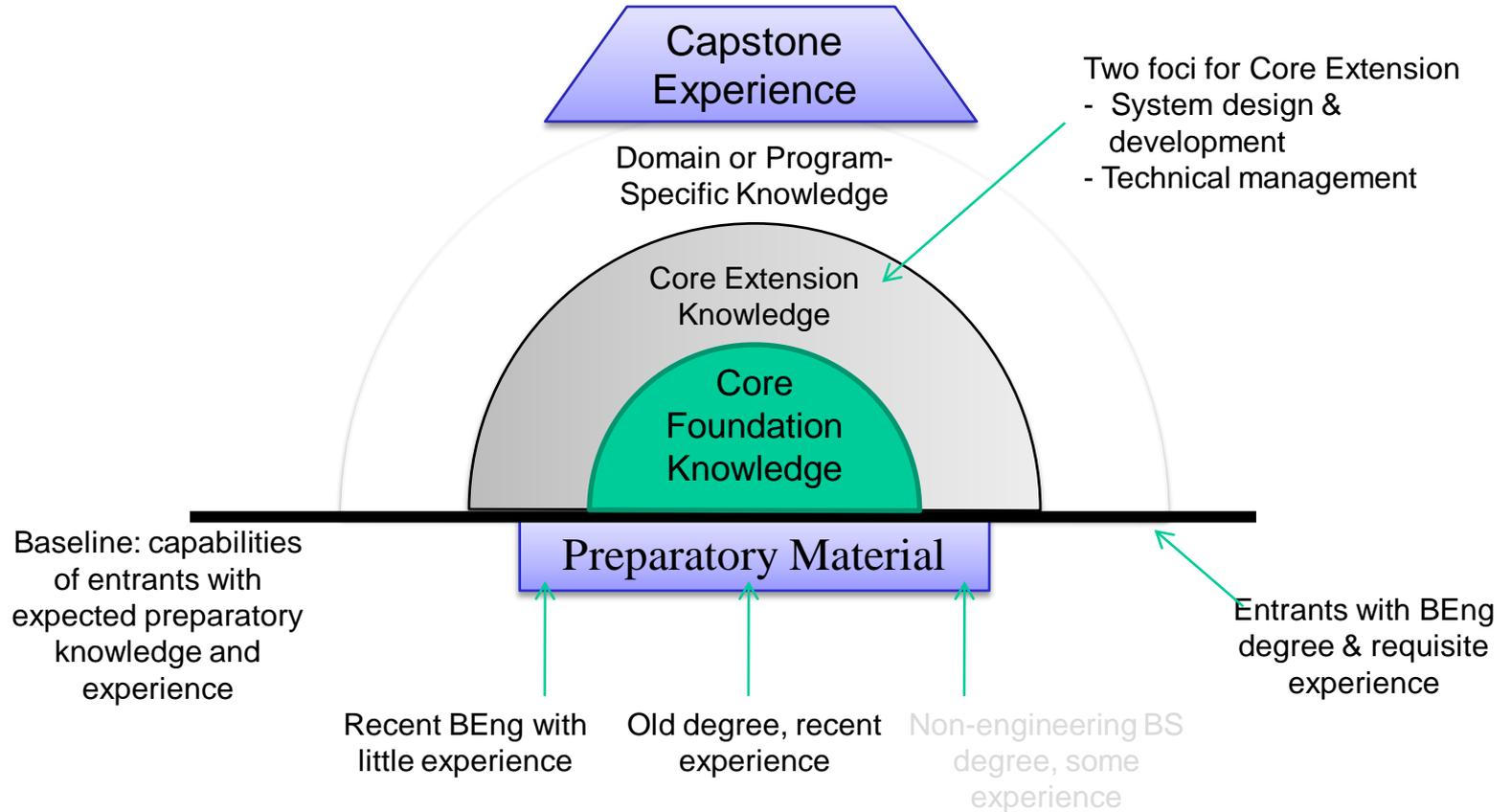## Specific Technical Skills

- Demonstrate ability to apply core SE analytical techniques
  - Performance analysis, safety analysis, supportability analysis, failure analysis, testability analysis, mathematical modelling, human factors, technical risk assessment, optimisation, etc.
- Be able to evaluate alternative system solutions and strategies
  - Relate different solutions to the identified problem
  - Identify relevant criteria so solutions are selected against holistic system perspective
- Be able to reconcile conflicting systems requirements within limitations of cost, time, knowledge, risk, existing systems and organisations
- Be able to learn new models, techniques & technologies as they emerge and appreciate necessity of continued professional development
- Comprehend relationships between SE and other disciplines and be able to articulate value proposition
- Demonstrate knowledge of professional ethics and their application in decision-making and SE practice

Industry Competency Profile

Systems Engineering Body of Knowledge	DSTO	DMO	Industry
Systems Thinking			
Systems concepts	**	**	***
Super-system capability issues	***	***	**
Enterprise and technology environment	**	***	***
Holistic Lifecycle view			
Determine and manage stakeholder requirements	**	****	***
System Design:			
Architectural design	***	**	***
Concept generation	***	**	***
Design for "-ilities"	**	*	***
Functional analysis	*	*	***
Interface Management	*	*	***
Maintaining Design Integrity	*	**	**
Modelling and Simulation	****	**	**
Select Preferred Solution	**	**	***
System Robustness	*	**	***
Integration & Verification	**	**	***
Validation	***	***	**
Transition to Operation	*	**	**
Systems Engineering Management			
Concurrent engineering	*	*	**
Enterprise Integration	*	**	***
Integration of specialisms	*	*	***
Lifecycle process definition	**	***	***
Planning, monitoring and controlling	*	***	***

Curriculum Architecture
(Used to Separate Objectives of Project from Coursework)

Capstone
Experience

Two foci for Core Extension
- System design &
  development
- Technical management

Domain or Program-
Specific Knowledge

Core Extension
Knowledge

Core
Foundation
Knowledge

Preparatory Material

Baseline: capabilities
of entrants with
expected preparatory
knowledge and
experience

Entrants with BEng
degree & requisite
experience

Recent BEng with
little experience

Old degree, recent
experience

Non-engineering BS
degree, some
experience

Result

- Industry spokesperson:

  "This is really good … This is the first time that I have been able to see how the design of the program, and individual courses and the project, flows down from what industry is wanting to achieve."

- Project design and implementation then proceeded smoothly with solid stakeholder buy-in.

Postscript

- First cohort of Project students now approaching completion

- Stakeholder engagement has remained strong and representatives present at all tutorials

- Project grading to be performed against course objectives and program outcomes

- GRCSE to inform university internal program review process