



## NDIA 10853 Panel: In search of the Principles of SE (BKCASE)

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Head of SE Defence Academy of the UK





## Panel

- **Rick Adcock**, Cranfield Defence and Security at the UK Defence Academy
- **Don Gelosh**, ODDR&E/SE
- **Dr Rich Freeman**, Air Force Centre for Systems Engineering
- **Dr Barry Boehm**, Centre for Software Engineering

## What is BKCASE?

- Project led by Stevens Institute of Technology and Naval Postgraduate School who are creating two primary products:
  - Body of Knowledge in systems engineering (SEBoK)
  - Graduate Reference Curriculum in Systems Engineering (GRCSE)
- Started in September 2009 and will run through 2012
- Intended for world-wide use
- Not intended to be used directly for accreditation

Call for Authors, Subject Matter Experts, Reviewers and Early Adopters

**What is BKCASE?**


BKCASE (pronounced "Bookcase") is the acronym for the Body of Knowledge and Curriculum to Advance Systems Engineering. The project began in 2009 with a Systems Engineering Body of Knowledge (SEBoK) and was the effort to develop a Graduate Reference Curriculum for Systems Engineering (GRCSE), pronounced "Gracie").

The ideal outcome is that the SEBoK will be supported worldwide by the Systems Engineering community as the authoritative BoK for the SE discipline and that the GRCSE will receive the same global recognition and serve as the authoritative guidance for graduate degree programs in SE. A leading group of over 20 academic engineers from across the world have volunteered as authors with many more joining as subject matter experts and reviewers to collaborate over a three year period and submit the SEBoK and GRCSE in 2012. We are seeking additional authors, subject matter experts, and reviewers. International products (versions 0.25 and 0.50) will be finalized for comment in 2010 and 2011.

The SEBoK team invites you to learn more about our project. Please access our frequently updated website ([www.bkcase.org](http://www.bkcase.org)) to gain a more detailed overview of the project. We are seeking direct support across many domains from systems engineering practitioners, researchers, managers, top-level customers, certifiers, workforce development professionals, educators, and current and potential students. We encourage and welcome feedback from the community on our project efforts; please contact the team leaders through [bkcase@stevens.edu](mailto:bkcase@stevens.edu).

**Project Lead Institutions**

**STEVENS**  
Institute of Technology



NAVAL POSTGRADUATE SCHOOL

**Organizational Partnerships**


- Department of Defense
- International Council on Systems Engineering (INCOSE)
- Institute of Electrical and Electronics Engineers (IEEE) Systems Council
- Institute of Electrical and Electronics Engineers (IEEE) Computer Society Educational Activities Board
- National Defense Industrial Association (NDIA) Systems Engineering Division

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**Current project inquiries:**  
[bkcase@stevens.edu](mailto:bkcase@stevens.edu)

For more information please visit our website at [WWW.BKCASE.ORG](http://WWW.BKCASE.ORG)

## BKCASE Vision and Objectives



**Vision**

“Systems Engineering competency models, certification programs, textbooks, graduate programs, and related workforce development initiatives around the world align with BKCASE.”

**Objectives**

1. Create a SEBoK that is globally recognized by the SE community as the authoritative BoK for the SE discipline.
2. Create a graduate reference curriculum for SE (GRCSE – pronounced “Gracie”) that is globally recognized by the SE community as the authoritative guidance for graduate programs in SE.
3. Facilitate the global alignment of related workforce development initiatives with SEBoK and GRCSE.
4. Transfer stewardship of SE BoK and GRCSE to INCOSE and the IEEE after BKCASE publishes version 1.0 of those products, including possible integration into their certification, accreditation, and other workforce development and education initiatives.

# Agenda



- Questions:
  - Why should DoD (and other nations) be interested in a Systems Engineering BoK?
  - What is the value of Systems Engineering (in Defence)?
  - How does Systems Engineering relate to other disciplines?
  - What Systems Engineering skills do we need to make this happen?

### System

**Definition**  
A system is a set of interconnected elements that form an integrated whole with a specified purpose and that can be used to achieve a goal or function.

**Characteristics**  
- Can be used and sustained in all of its environments  
- Delivers outputs or services needed by End users

## Principles of Systems Engineering

The Stages

Production → Utilisation/Support → Retirement

### Systems

External System Issues  
Outcomes which emerge due to interaction with other systems

Levels of Resolution  
A System, in its environment, with related Systems  
Made up of Sub-Systems  
Continuing for ever?

ACTIVITY	Process
Requirements Analysis	High activity at start, decreasing over time
System Architecture	High activity in early stages, decreasing
System Implementation	High activity in later stages, increasing
Integration & Verification	High activity in middle stages, decreasing
Transition & Validation	High activity in middle stages, decreasing
Use, Support Disposal	High activity in later stages, increasing
Project Management	High activity in early stages, decreasing

### Systems Engineering Knowledge Areas (SEBoK 0.25)

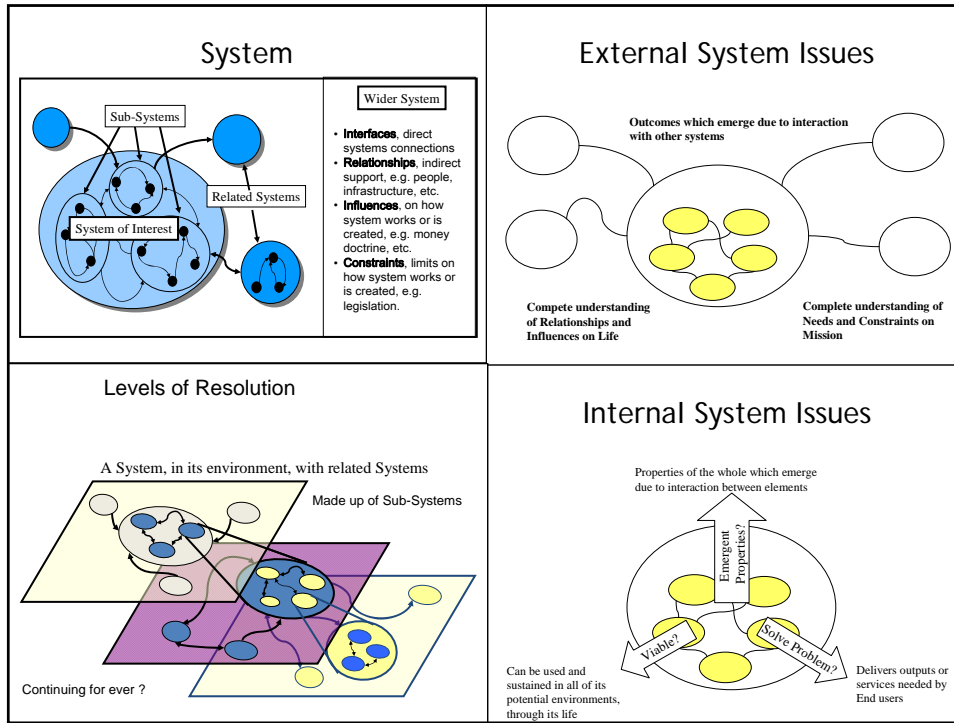
**Application**

### Types of System People


**People & Skills**

Practitioner  
Supervised Practitioner  
Awareness

3



## Systems Thinking



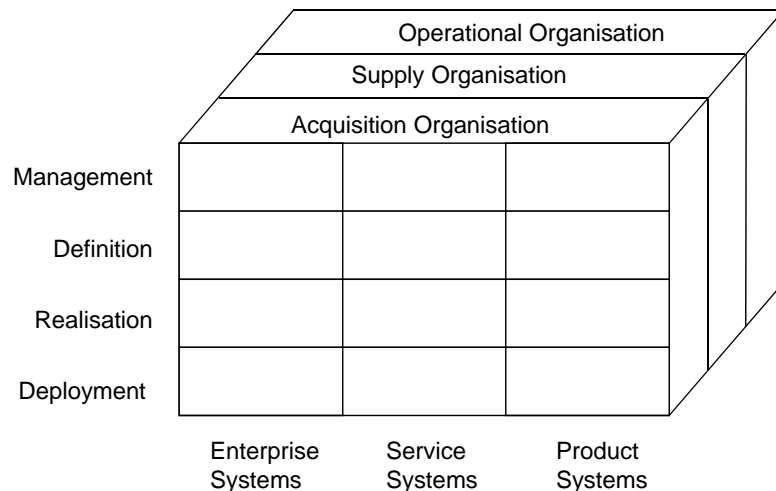
- Taking a systems approach to engineering expands the scope of scientific knowledge to include systems science or systems thinking.
- This approach will seek to
  - define problems, constraints and measures of success outside the boundary of a system of interest and
  - select and combine system elements and relationships inside the boundary in the context of wider system view.
  - It is fundamental to this view of engineering that it is both iterative and recursive in nature.
    - It includes iterative cycling between problem understanding in a wider system context, solution creation within a bounded context and solution insertion and use back in the wider context.
    - We can recursively use this system of interest, wider context approach to tackle problems at several levels of abstraction to deliver solutions to real world problems.
  - To do this we will need ways of assess and dealing with the different properties which arise from combinations of system elements at a number of levels of abstraction.

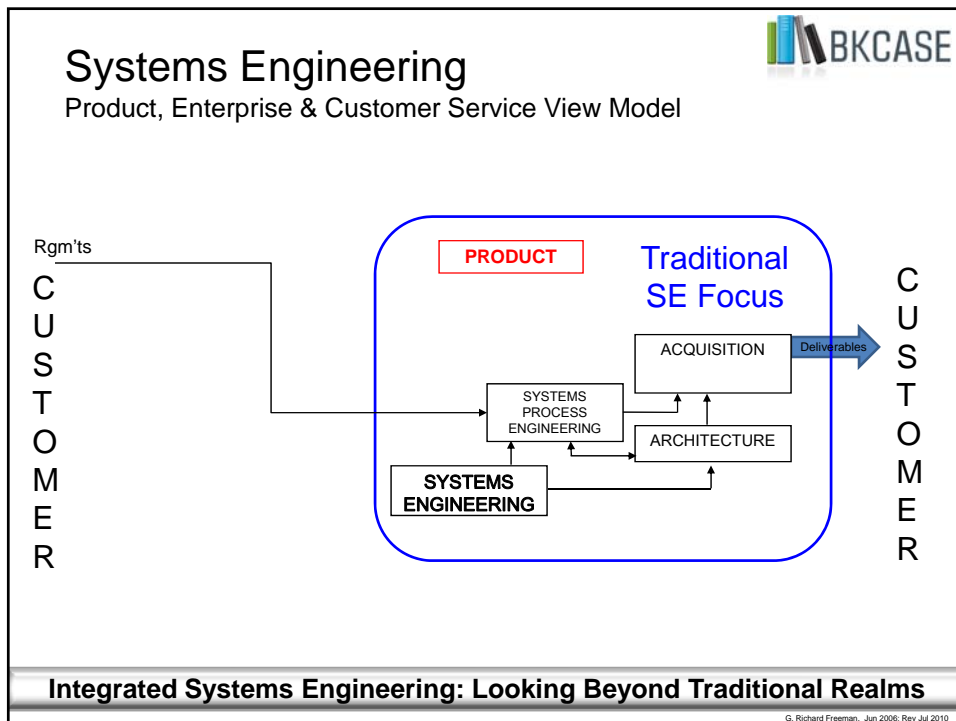
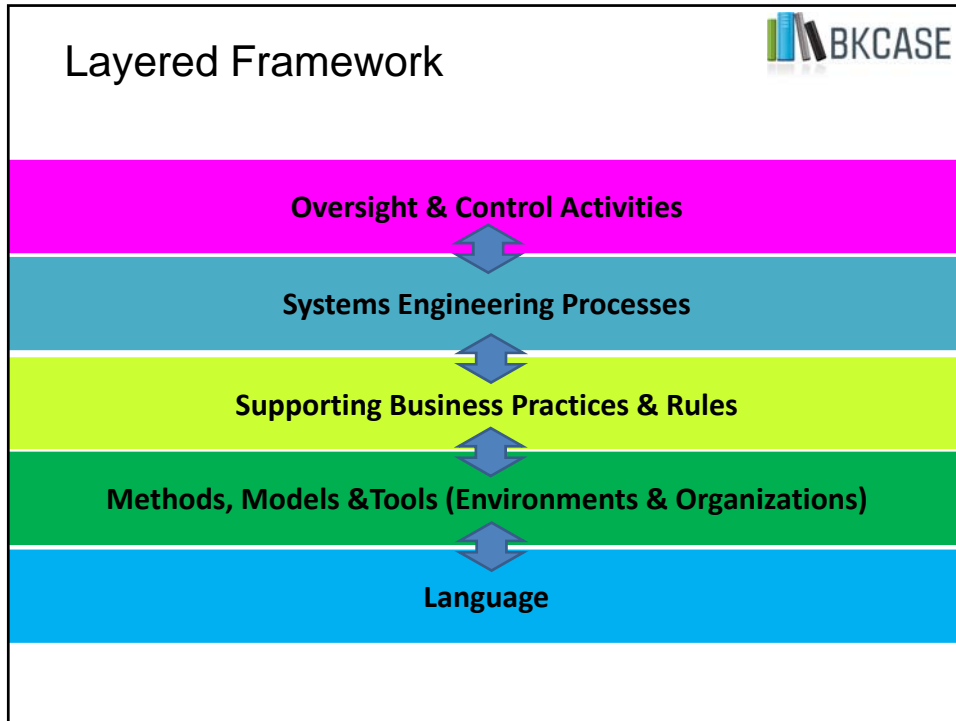
## Systems Engineering

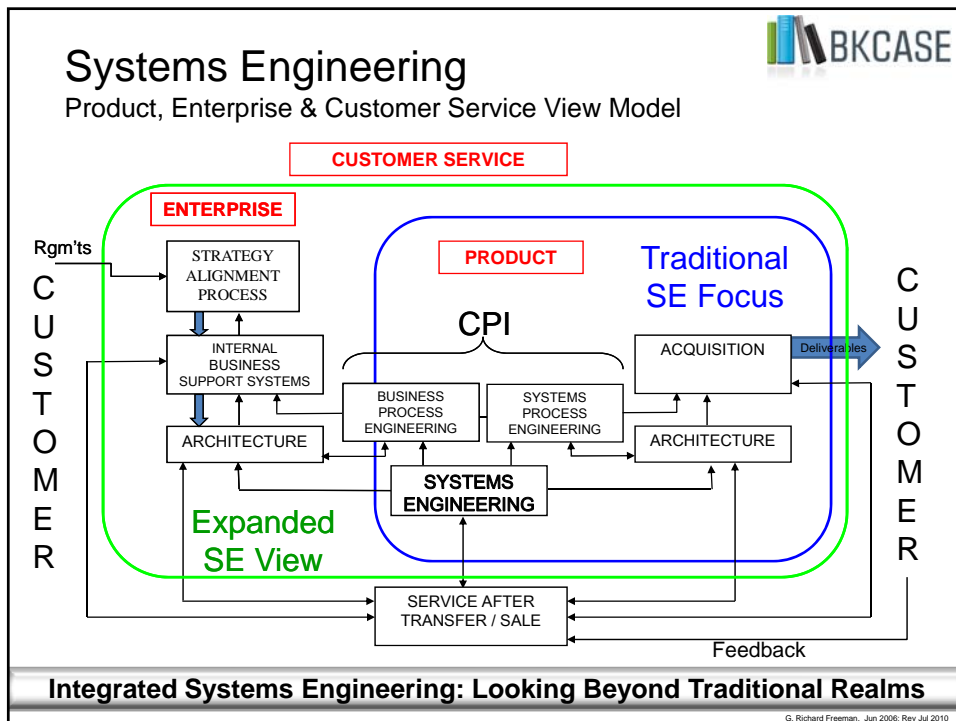
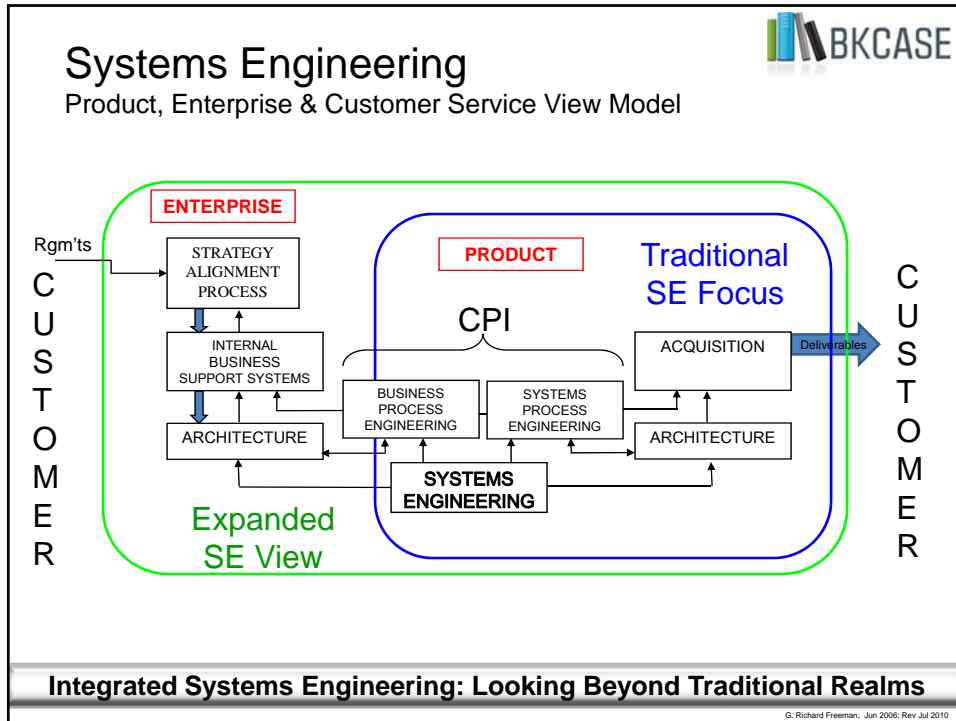


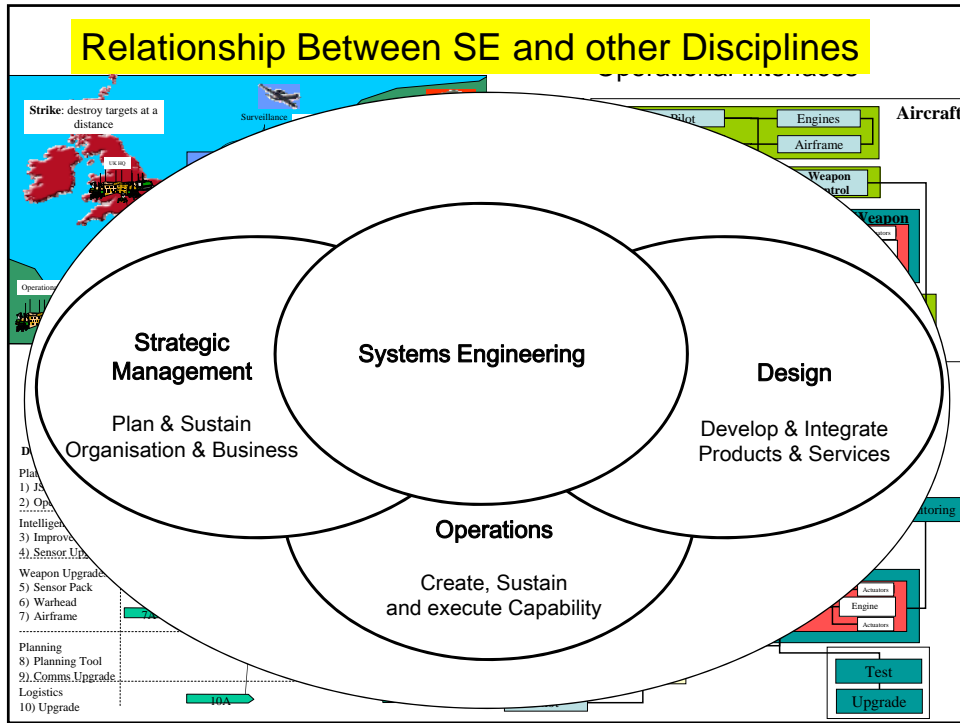
- Two definitions of Engineering:
  - The application of scientific knowledge to practical problems, or the creation of useful things.
  - To (cleverly) arrange for something to happen.
- Systems Engineering is traditionally associated with the first of these, as applied to Product Development
- We may also need to consider the second when we look at the wider application of Systems Engineering to Enterprise Success.

## Systems Engineering Knowledge Areas (SEBoK 0.25)









## Systems People

- Behaviours (The Head)
  - Understanding system concepts and viewpoints
  - Working with people, information broker, etc.
- Core technical skills (The Heart)
  - Overview of SE processes and techniques
  - Understanding of the changing role of SE across lifecycle
- Specific technical skills (The Arms)
  - Areas of specific SE expertise, e.g Requirements, Architecture, V&V
  - Areas of specific domain or application expertise, e.g. Safety, Reliability, Simulation
- Supporting Knowledge (The Legs)
  - Awareness of wider lifecycle issues
  - Awareness of wider business or operational issues

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