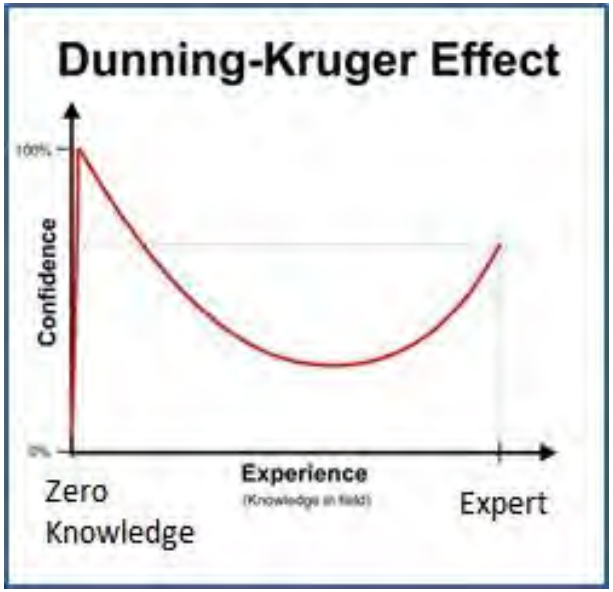
Specifying and Assessing Safety Competence



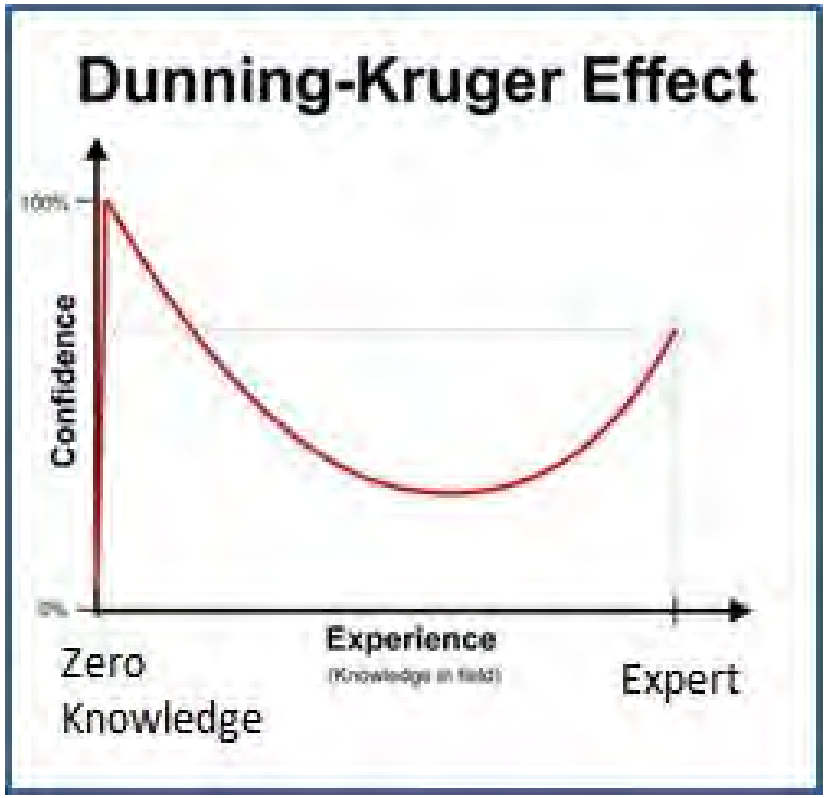
Dr. Carl Sandom, iSys Integrity Ltd.

ASSC 2017

1 June 2017, Sydney, Australia

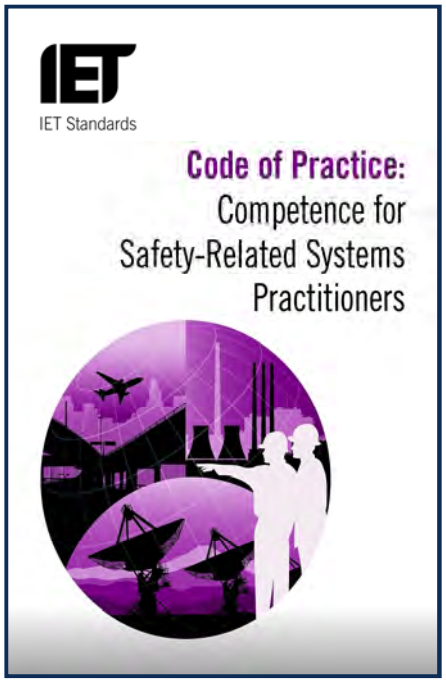
Dunning-Kruger Effect

- A **cognitive bias** in which low-ability individuals suffer from **illusory superiority**, mistakenly assessing their ability as much higher than it really is



Scope

- Competence Requirements (UK)
  - Context for IET CoP
- Competent Safety Assurance
  - Rationale for IET CoP
- IET Code of Practice
  - History
  - Overview



Competence Requirements (UK)

UK Legal Requirement

- UK requirement for competence was made in the common law case of Wilsons and Clyde Coal Co Ltd. v English, 1937
- The case specified that the employer's duty of care involved a three-fold duty to provide:
  - Safe plant and appliances
  - Safe systems of work, and
  - Competent employees
- Now enshrined in UK Health & Safety Law

International Safety Standards

- *IEC 61508 Ed. 2 2010*
  - Requirement for staff competence is upgraded from a recommendation to mandatory
- Requirement to ensure procedures in place ensuring that staff involved with functional safety are competent to carry out their work activities
- Effective Competence Management System (CMS) should be in place to facilitate this

Professional Requirements

- UK Standard for Professional Engineering Competence (UK-Spec)
  - Competence & Commitment Standards set by the EC for:
    - Engineering Technician
    - Incorporated Engineer
    - Chartered Engineer
  - Registrants "*must be competent throughout their working life, by virtue of their education, training and experience*"
    - For specified work activities, with linked abilities, required Standards & examples of evidence
    - Update for 3rd Ed. has extra emphasis on Safety & Risk Management
  - Stresses the importance of commitment to:
    - Engineering values & Code of Conduct (incl. "*Prevent avoidable danger to health or safety*")
    - Managing & applying safe systems of work
    - Maintaining & enhancing competence through Continuing Professional Development

What is Competence?

- "The ability to do something successfully or efficiently" (OED)
- Synonyms include:
  - Capability
  - Ability
  - Proficiency
  - Expertise
  - Skill
  - and many more…..

Common Themes

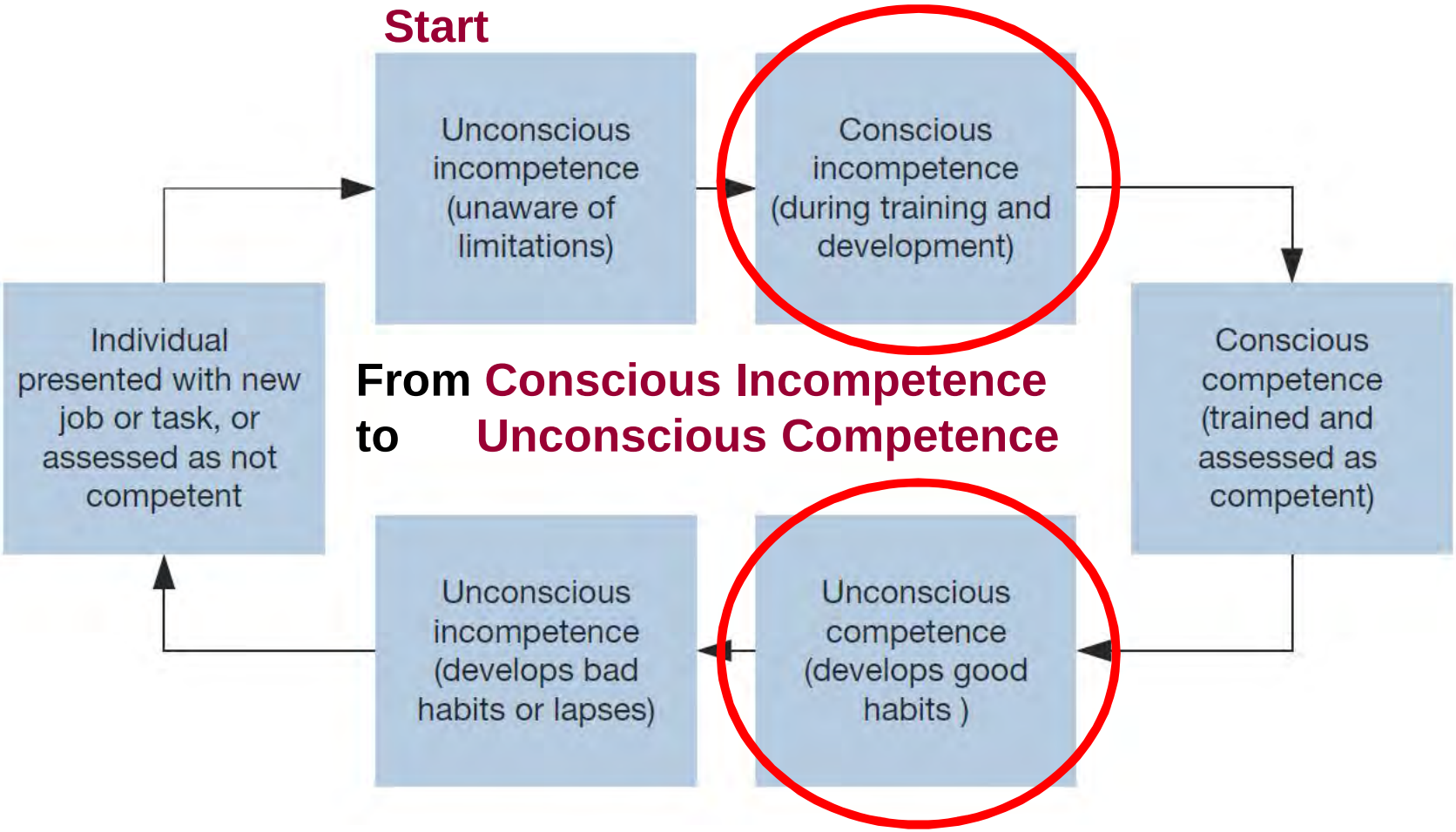
- UK Engineering Council:
  - *The ability to carry out a task to an effective standard. Its achievement requires the right level of knowledge, understanding and skill, as well as a professional attitude.*
- UK Office Rail Regulation:
  - *The ability to undertake responsibilities and to perform activities to a recognised standard on a regular basis. Competence is a combination of practical and thinking skills, experience and knowledge, and may include a willingness to undertake work activities in accordance with agreed standards, rules and procedures.*
- *UK HSE*
  - "*The combination of training, skills, experience and knowledge that a person has and their ability to apply them to perform a task safely.*"

IET Definitions

- Competence (total of competencies)
  - The ability to undertake responsibilities and perform activities to a recognised standard on a regular basis
- Competency/Competencies
  - A combination of knowledge, skills, understanding and personal qualities attained and exhibited by a person to a sufficient enough degree that they become able to perform an activity to a certain level of performance or efficiency

Competent Safety Assurance

Conscious Competence Model



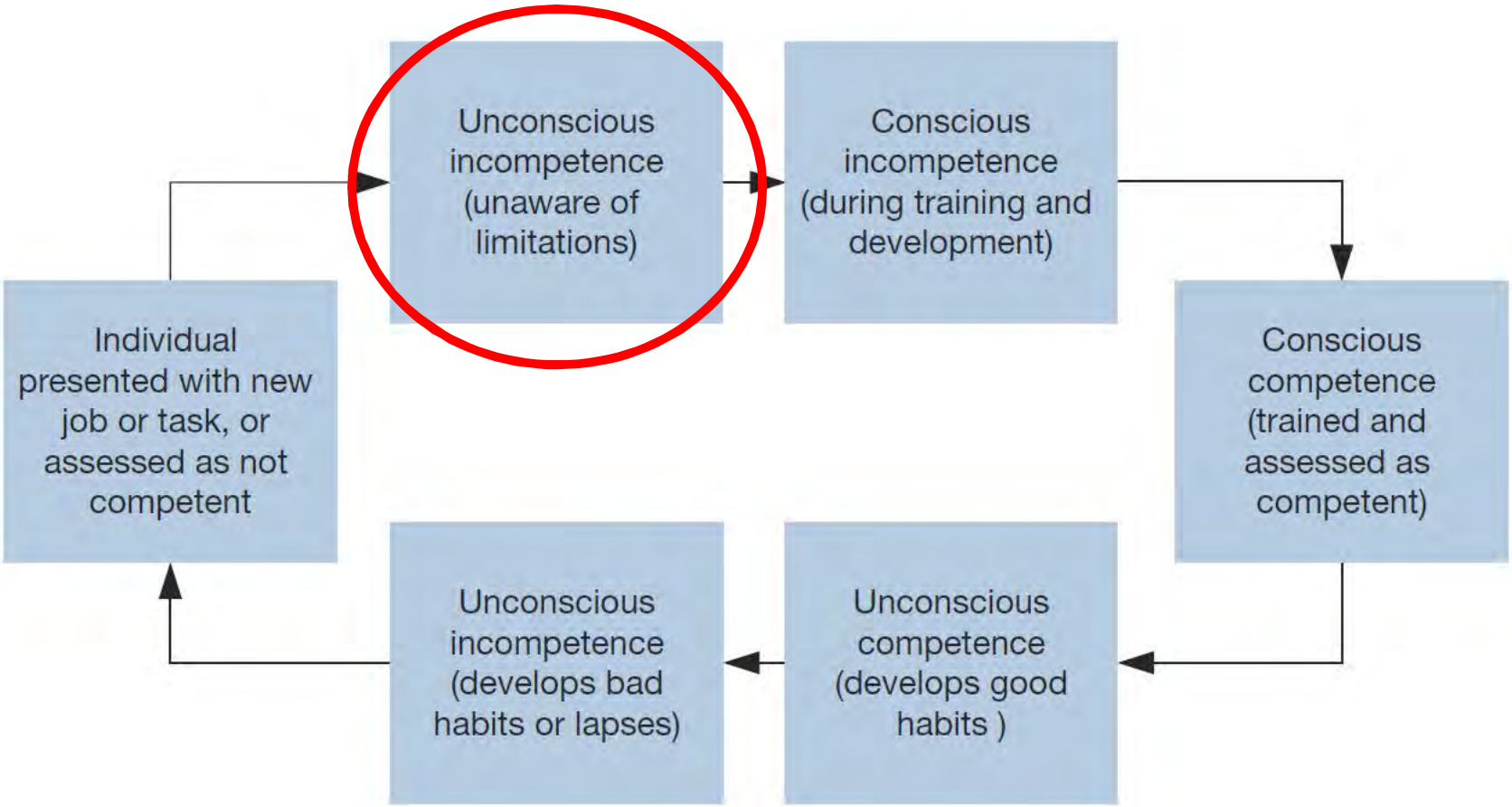
What's the problem?

- Many organizations that develop safety-related systems don't adequately address safety competence
- Often the approach is at best reactive and programme dependent
- Organizational competence may be categorized as:
  - Distributed Competence
  - Limited Competence
  - False Competence

Distributed Competence

- Outsource safety engineering to contractors
  - Contractors provide safety process expertise
  - Staff provide system and domain knowledge
- Competence is ‘distributed’ between internal and external staff
- Does not address competence issue
  - Organizational culture important
  - Inherent risks and limitations
  - Inadequate for safety management
  - Considered cost effective

Distributed Competence

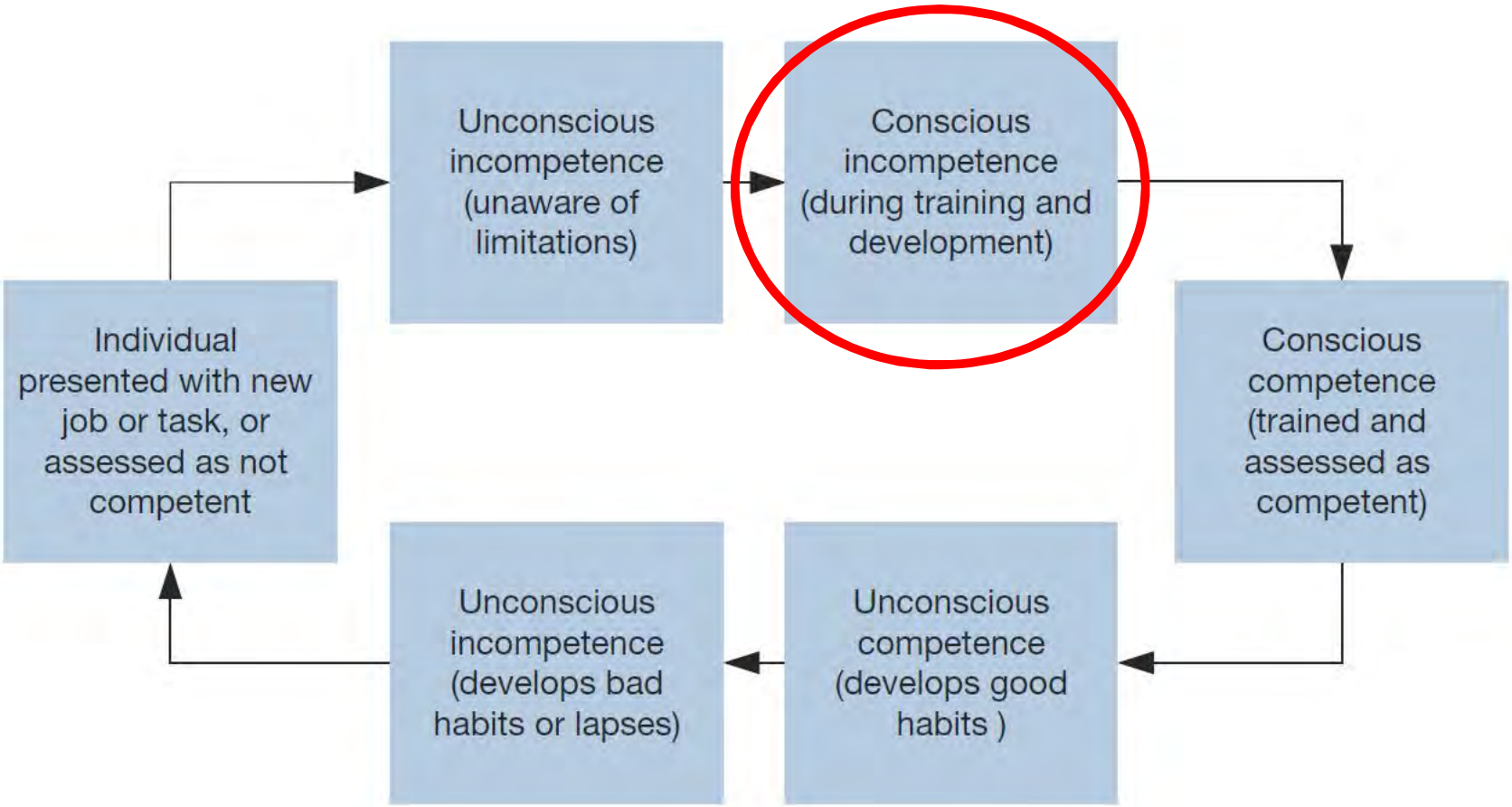


Limited Competence

- ‘Volunteer’ one or more employees with responsibility for safety engineering on a specific programme
  - QA
  - ILS

- Often have little or no safety competence and have to teach themselves and learn safety 'on the job’
- The ‘one eyed man’ approach

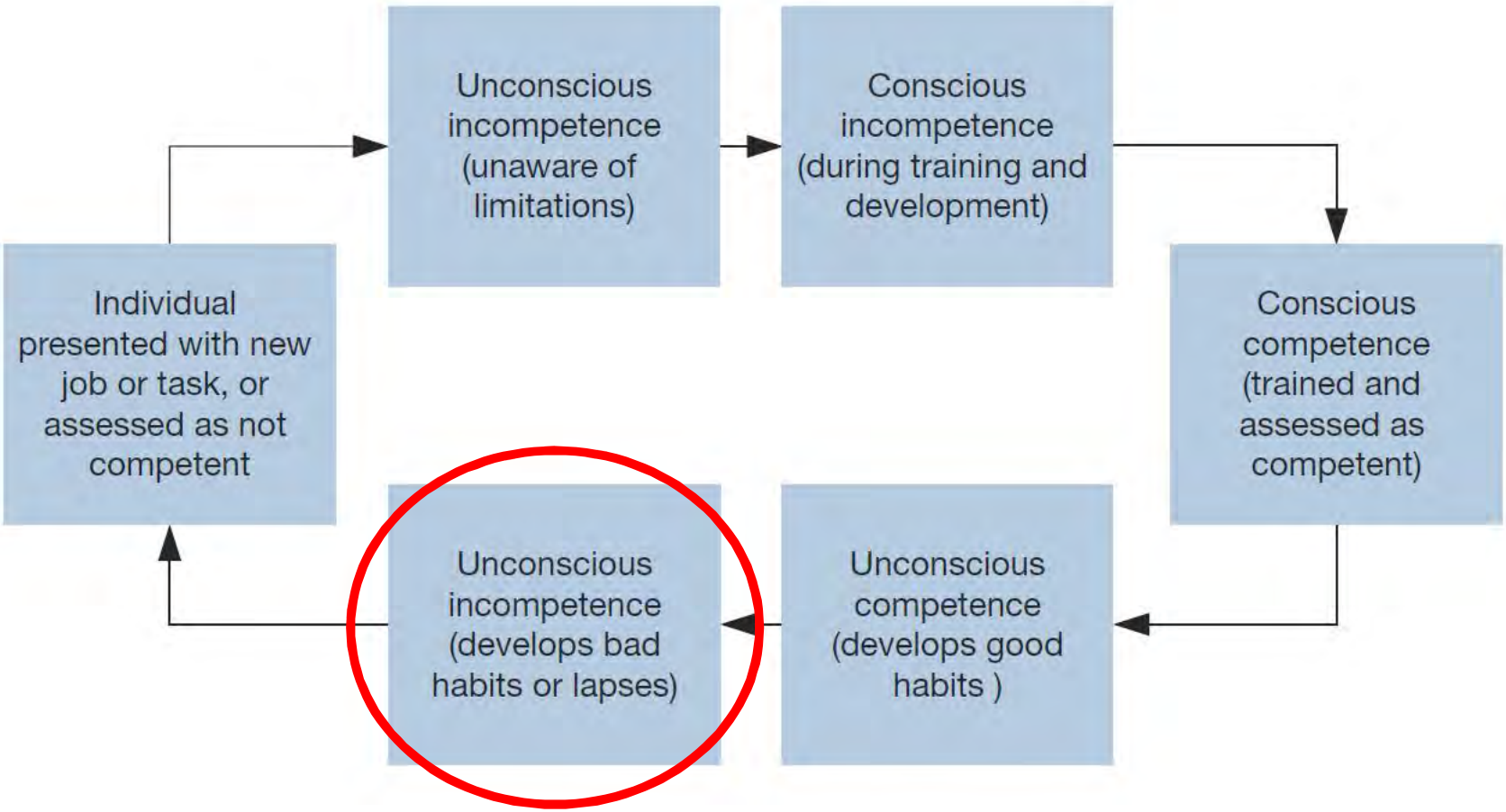
Limited Competence



False Competence

- Organization has some partially competent staff but their knowledge and skills are not up to date
  - Under confident (conscious incompetence)
  - Over confident (unconscious incompetence)
- Lack of Continuing Professional Development
  - New techniques and methods (e.g. STAMP)
  - Updated standards (DO-178)
  - Limited domain knowledge
- Competence gap!

False Competence



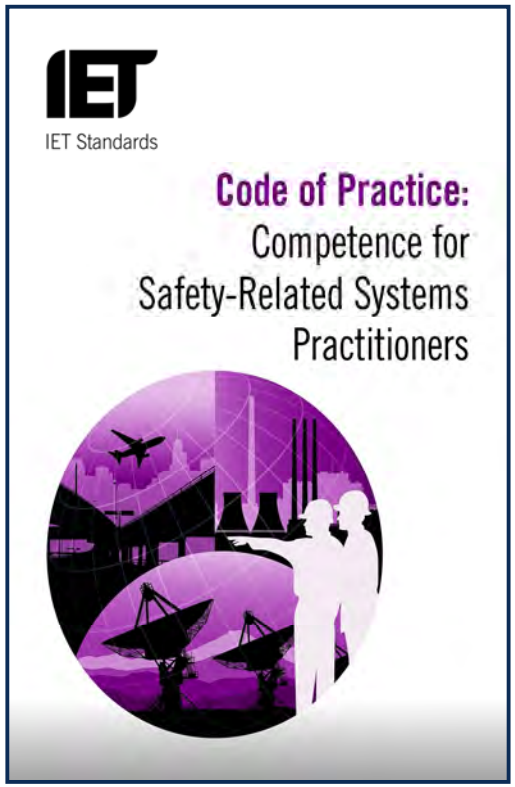
Judgement, Competence and Safety

- Professional judgement is a necessity
  - Many SR systems <5 years old no data
- Safety Assurance ultimately reliant upon professional judgement
- Systems developers should make clear:
  - Where judgement is applied
  - Basis of competence

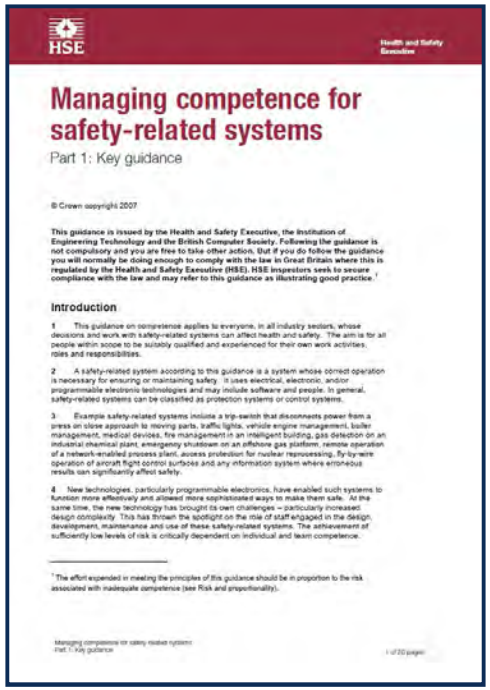
Competence Validity Evidence

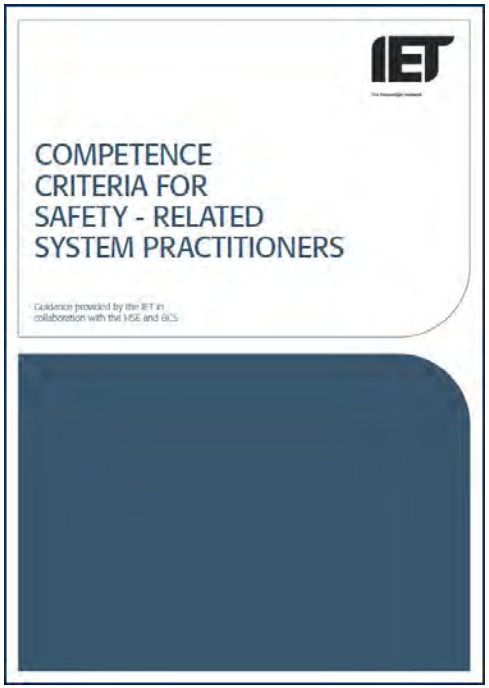
- Claims of Competence
  - Can an organization reasonably claim that they can define, specify and assess the competence of their safety activities and practitioners?
  - Competent to claim competence
- Competence-Based Claims
  - Can an organization demonstrate that any safety-related claims are based upon the judgement of competent people?
  - Competent Claims

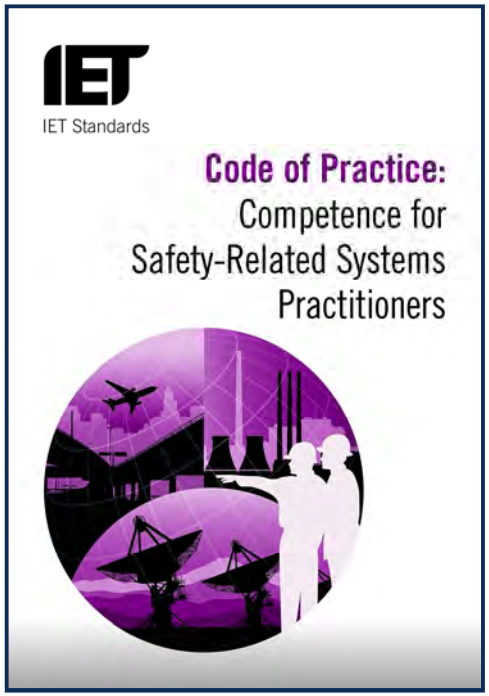
IET Code of Practice (History)



Two Complimentary Publications





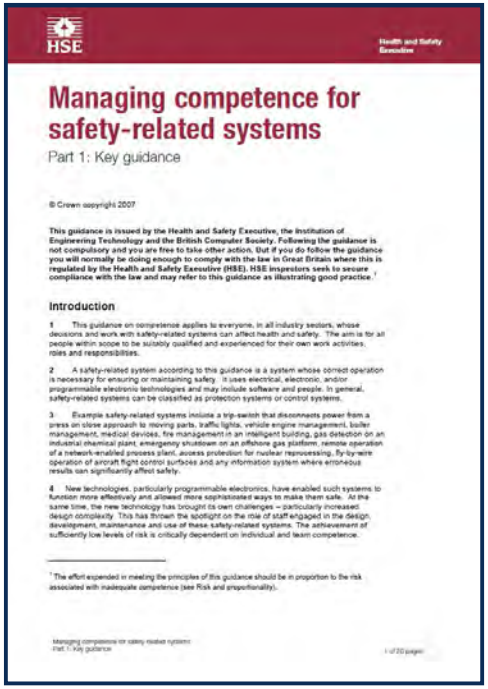


Red Book

Blue Book

Competence Management

- **HSE RED BOOK:** ***Managing Competence for Safety-related Systems***
  - Part 1: Key Guidance
    - Core requirements for Competence Management Systems (CMS): Plan – Design – Operate – Audit & Review
    - Guidance to meet UK legal requirements for competence (not sector-specific)
  - Part 2: Supplementary material
    - How to set up & operate a CMS


HSE

Health and Safety Executive

Managing competence for safety-related systems

Part 1: Key guidance

This guidance is issued by the Health and Safety Executive, the Institution of Engineering Technology and the British Computer Society. Following the guidance is not compulsory and you are free to take other action. But if you do follow the guidance you will normally be doing enough to comply with the law in Great Britain where this is regulated by the Health and Safety Executive (HSE). HSE inspectors seek to secure compliance with the law and may refer to this guidance as illustrating good practice.[1]

Introduction

1 This guidance on competence applies to everyone, in all industry sectors, whose decisions and work with safety-related systems can affect health and safety. The aim is for all people within scope to be suitably qualified and experienced for their own work activities, roles and responsibilities.

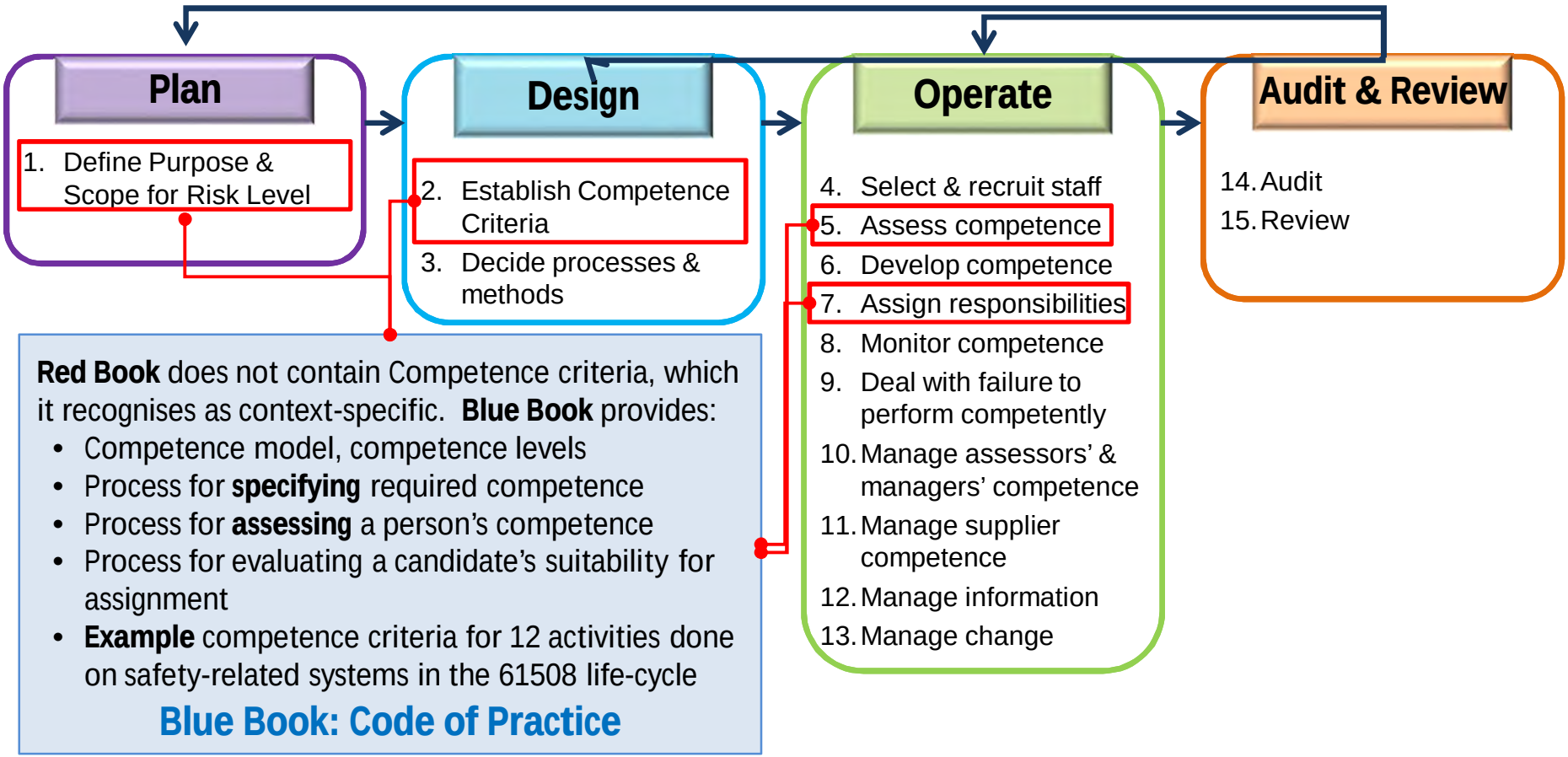
2 A safety-related system according to this guidance is a system whose correct operation is necessary for ensuring or maintaining safety. It uses electrical, electronic, and/or programmable electronic technologies and may include software and people. In general, safety-related systems can be classified as protection systems or control systems.

3 Example safety-related systems include a trip-switch that disconnects power from a press on close approach to moving parts, traffic lights, vehicle engine management, boiler management, medical devices, fire management in an intelligent building, gas detection on an industrial chemical plant, emergency shutdown on an offshore gas platform, remote operation of a network-enabled process plant, access protection for nuclear reprocessing, fly-by-wire operation of aircraft flight control surfaces and any information system where erroneous results can significantly affect safety.

4 New technologies, particularly programmable electronics, have enabled such systems to function more effectively and allowed more sophisticated ways to make them safe. At the same time, the new technology has brought its own challenges – particularly increased design complexity. This has thrown the spotlight on the role of staff engaged in the design, development, maintenance and use of these safety-related systems. The achievement of sufficiently low levels of risk is critically dependent on individual and team competence.

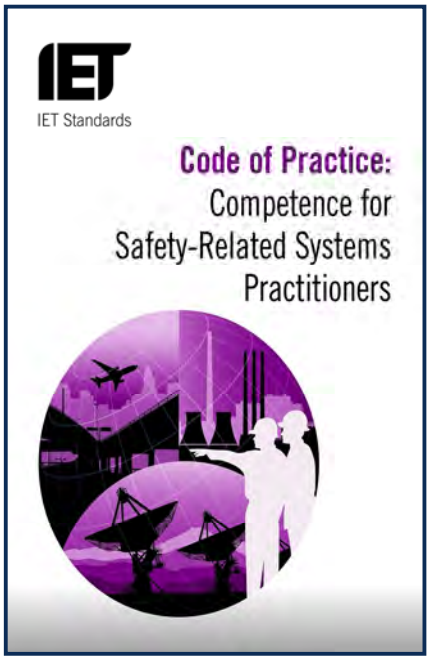
[1] The effort expended in meeting the principles of this guidance should be in proportion to the risk associated with inadequate competence (see Risk and proportionality).

CMS Model/Principles (Red Book)



Competence Criteria

- **IET BLUE BOOK:** ***Competence for Safety-Related Systems Practitioners***
  - Revised 2016 contains:
    - Competence Model
    - Competence Scheme & Competence Assessment Process
    - Example Safety Competence Criteria

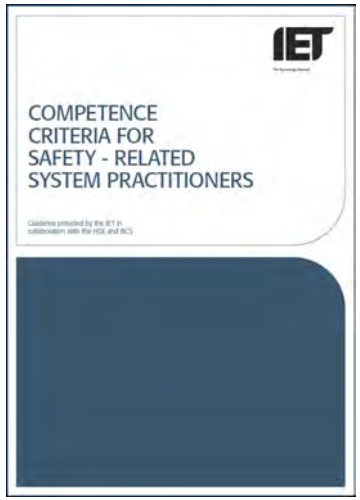


History

- Safety, Competence and Commitment: Competence Guidelines for Safety-Related Systems Practitioners (IEE: 1999)
- Managing Safety for Safety-Related Systems (HSE: 2007)
- Safety, Competence and Commitment: Competence Guidelines for Safety-Related Systems Practitioners (IET: 2007)
- Competence for Safety-Related Systems Practitioners (IET: 2016)

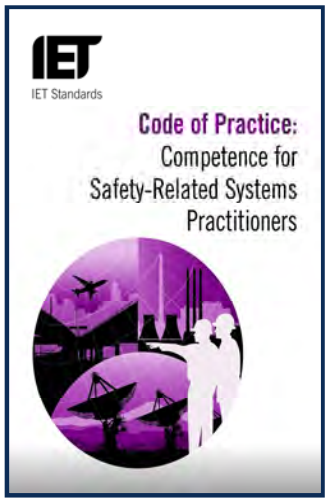
2007 Blue Book Aims

- Competency Framework for System Safety Professionals
  - Focused on individual ‘certification’
  - Professional Recognition Aim
  - One size fits all competence criterion



2016 Blue Book Aims

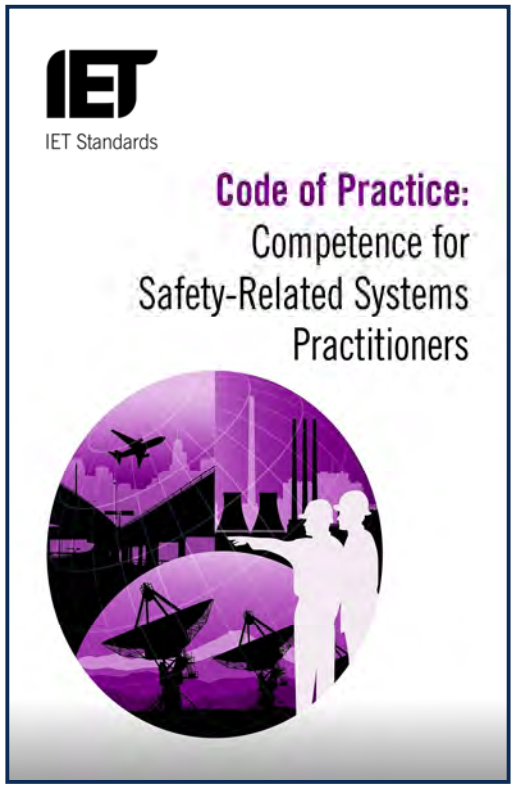
- Remain complimentary to HSE Red Book
- Retain valid competence criteria:
  - Industry adopted
  - Extensive consultation
- Focus on specification and assessment of competence requirements:
  - One size doesn't fit all
  - Organisation not individual



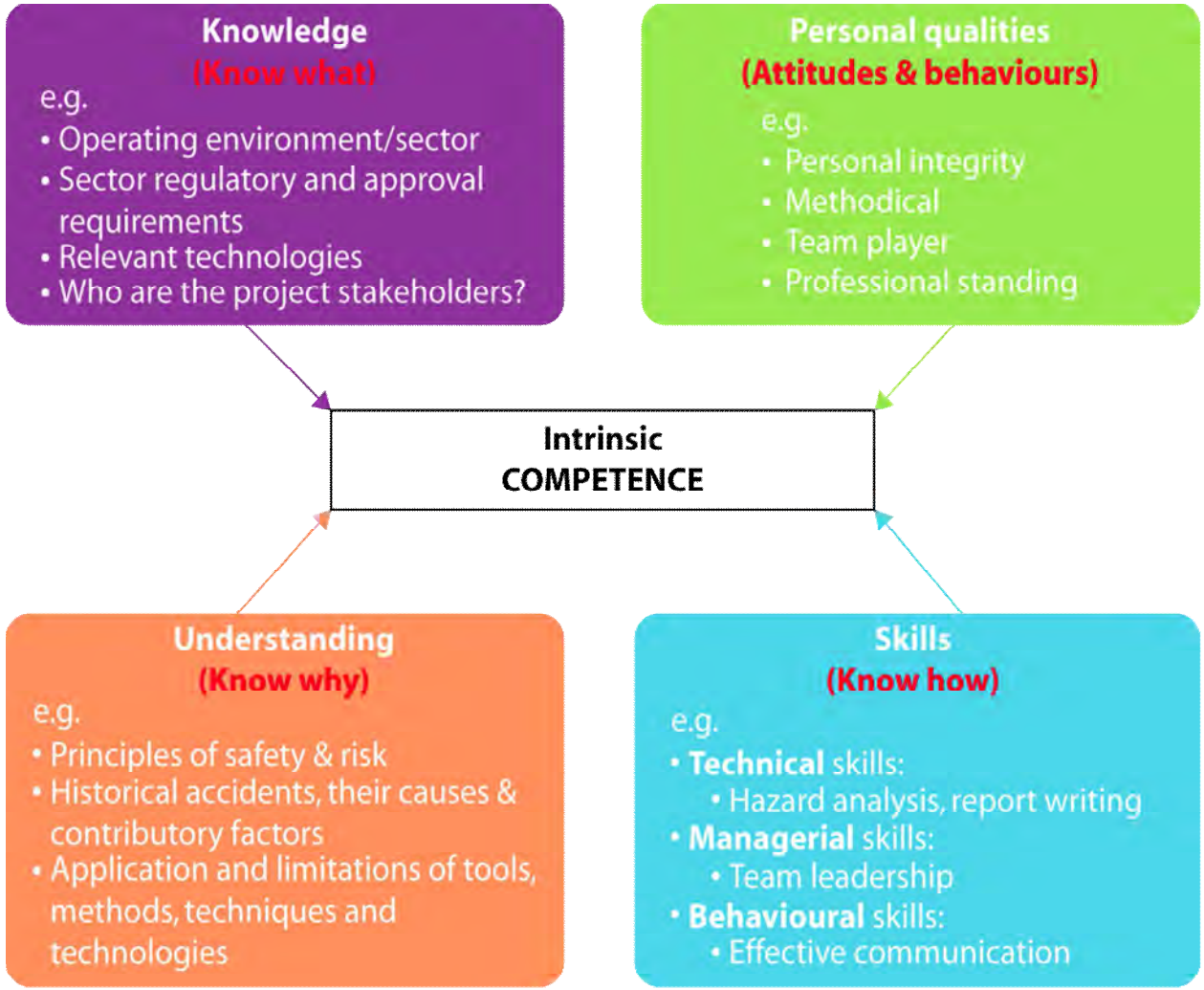
Blue Book Structure

- Part 1: Understanding Competence
  - Purpose, relationship to Red Book
  - Competence Model
- Part 2: Specifying & Assessing Competence
  - **Step 1: Define competence** applicable to an organisation in terms of Activities, Tasks, Attributes & Competence Criteria
  - **Step 2: Specify competence** in terms of the minimum required competence profile required for an Activity
  - **Step 3: Assess competence** in terms of an individual's current competence profile against predefined criteria for all tasks & attributes that may apply to them
  - **Step 4: Compare assessed & required competence** for a candidate to determine their suitability for an assignment with a defined competence requirement
  - Example Competence Criteria

IET Code of Practice (Overview)



Competence Components



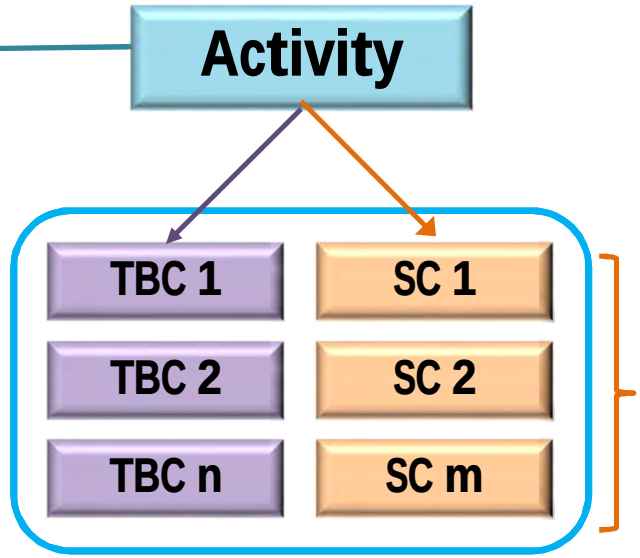
Competence Model & Terminolgy

Activity

Set of related responsibilities that could be discharged by an individual or team.

Blue Book has 12 Activities, e.g.

- Safety hazard & risk analysis (HRA)
- Safety validation



Task-based Competencies

The Activity is broken down into a set of Task-based competencies each of which requires particular skills, knowledge, understanding e.g.

- Defining project scope
- Capturing safety requirements
- Risk Assessment
- Specifying tests

Supporting Competencies

Necessary behaviour or understanding for an individual to discharge responsibilities associated with an Activity, e.g.

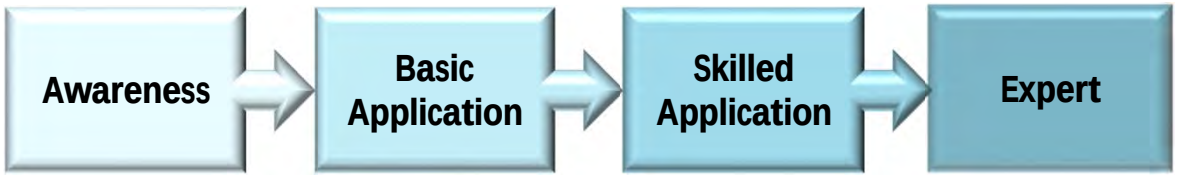
- Team-working
- Application domain knowledge
- Effective communication

Competence Levels apply for each TBC and each SC and NOT for the overall Activity. Competence requirements and Competence assessments of people are stated as a **Competence Profile.**

Competence Levels

- Institute of Ecology & Environmental Management:

- Institution of Chemical Engineers:



- Institution of Engineering and Technology:

  - Focuses on Competencies not people
  - No awareness for practitioners

Competence Process

Specifying and Assessing Competence (Blue Book)		
Blue Book Step	Description	HSE Red Book Principles
1	Define (Safety Activities)	1 2
2	Specify (Activity Competence Profiles)	2
3	Assess (Personal Competence Profile)	5
4	Compare (Personal Competence Profile v Activity Competence Profiles)	7

Activity Competence Profile

	T1	T2	T5	T7	S1	S3	S7
Level 3	R					R	
Level 2	R		R	R	R	R	
Level 1	R	R	R	R	R	R	R
Min. required competence profile for activity X							

A tabulated summary of an activity showing all applicable task-based competencies and supporting competencies and the required level of competence required to be attained for each

Personal Competence Profile

	T1	T2	T3	T4	S1	S2	S3	S4
Level 3		A			A			A
Level 2	A	A		A	A	A	A	A
Level 1	A	A	A	A	A	A	A	A
Assessed competence profile for an individual								

The formal output of a personal competence assessment for a named individual (or team), recording the assessed competence levels for all task-based and supporting competencies covered, together with a formal approval by the competence assessor and a statement of the validity period.

Specify (2) - Assess (3) – Compare (4)

2

	T1	T2	T5	T7	S1	S3	S7
Level 3	R					R	
Level 2	R		R	R	R	R	
Level 1	R	R	R	R	R	R	R
Min. required competence profile for activity X							

	T1	T2	T3	T4	S1	S2	S3	S4
Level 3		A			A			A
Level 2	A	A		A	A	A	A	A
Level 1	A	A	A	A	A	A	A	A
Assessed competence profile for an individual								

3

A **competent** Assessor judges & records the individual's demonstrated experience & abilities based on relevant evidence, using project records, witness testimony, documentary records, competence tests, workplace observation & interviews.

4

Suitability Evaluation

Compares a candidate's (valid) assessed competence profile against minimum required for the assignment, to decide:

- Candidate is suitably competent without reservations
- Candidate is not suitably competent
- Candidate may be suitably competent with stated conditions:
  - Increased supervision for minor shortfalls
  - Adjust scope of the assignment / team composition

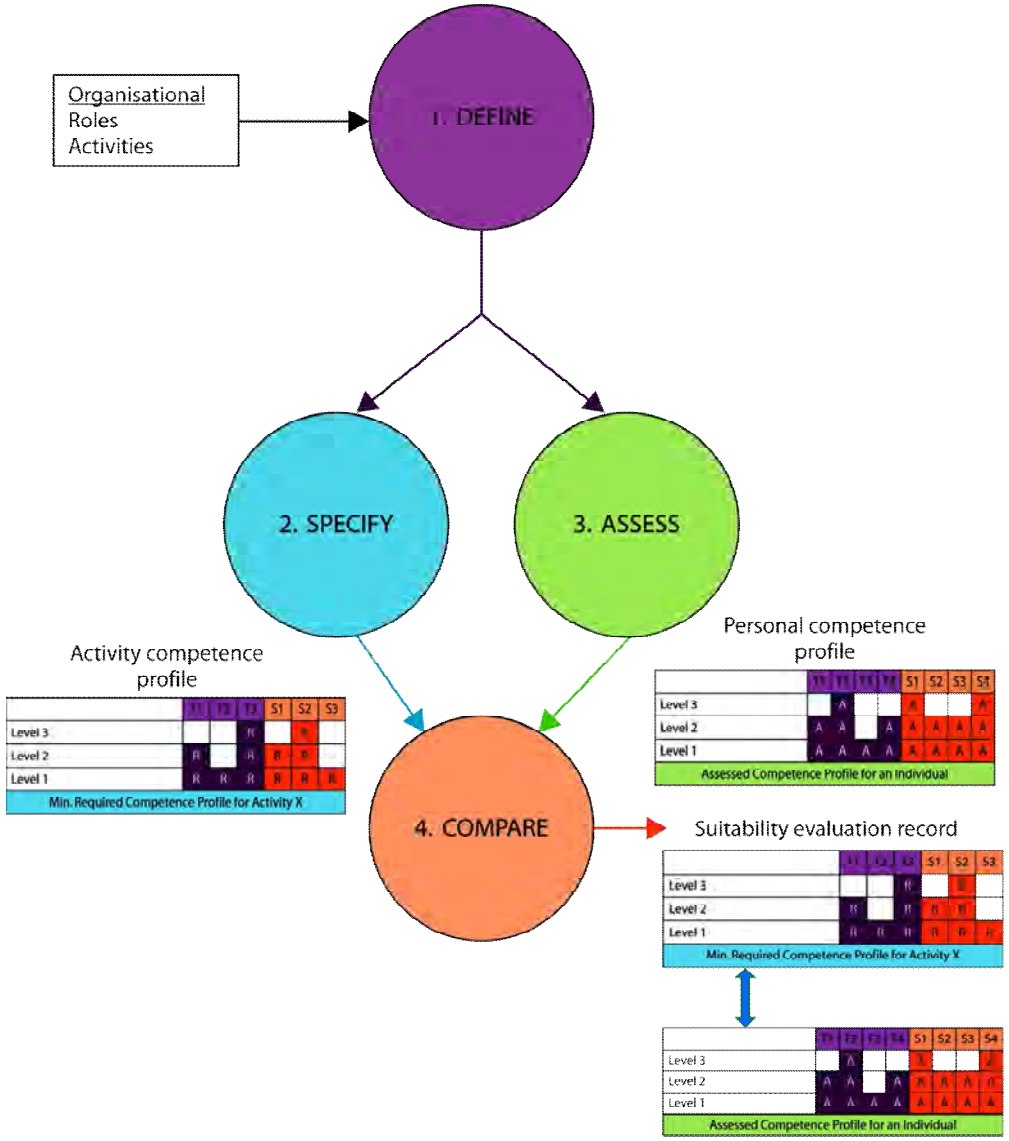
Define Safety Activities (1)

- Safety activities:
  - Corporate functional safety management
  - Project safety assurance management
  - Safety-related system maintenance and modification
  - Safety-related system or services procurement
  - Independent safety assessment
  - Safety hazard and risk analysis
  - Safety requirements specification
  - Safety validation
  - Safety-related system architectural design
  - Safety-related system hardware realisation
  - Safety-related system software realisation
  - Human factors safety engineering

Applying the Guidelines

- Company X
  - Good engineering processes (ISO9001)
  - First safety-related programme
  - Familiar with IEC 61508
- Initiate competence scheme
  - Organizational not programme
  - Perceived business benefits
- Use IET COP and four step process

Specifying and Assessing Overview



Step 1: Define

- Define competence activities and criteria
- Produce Safety Plan
  - Identifies activities, tasks and processes
  - Competence criteria developed for each activity e.g.:
- Safety Hazard Analysis & Risk Analysis (HRA)
  - Annex D6 example criteria good start point
  - Some tailoring required

Step 1: Define

- HRA activity contains a set of tasks and supporting competencies requiring specific
  - skills, knowledge, understanding and personal qualities
- Company X reviews these using a combination of:
  - brainstorming by suitably experienced people
  - reviewing relevant publications
- Considering the specific programme requirements they come up with……

Step 1: Define

- Skilled at:
  - performance of failure and fault analysis
  - performance of risk assessment
  - management and maintenance of hazard logs
  - design, development, maintenance and support and end of life processes for the technology to be used

- Knowledge of:
  - the domain and the application.
  - hazard analysis techniques.
  - the legal and regulatory and standards environment within which the project will operate.
  - the technology to be used and the architecture to achieve the safety requirements.
  - risk assessment techniques
  - etc……

Step 1: Define

- Understanding of:
  - limitations of the hazard analysis and risk assessment techniques
  - principles of functional safety assurance
  - definition of scope and the implications for safety
  - application limitations
  - equipment, technology and architecture limitations
  - legal and regulatory liabilities
- Personal qualities:
  - to lead a workshop
  - to present findings logically and convincingly
  - systematic thinking and methodical approach
  - to articulate with good/strong communication skills
  - to write accurate, clear reports that are fully traceable to source documents

Competence Criteria

Level 1	Level 2	Level 3
(Skill) Can describe the use of hazard analysis techniques employed within the organization. Has been trained in the techniques to be used. Has been trained in use of hazard logs. Can present the results both verbally and through written reports with little re-work needed. (Knowledge) Given a typical project scenario, is able to select the most appropriate set of hazard analysis techniques.	(Skill) Can illustrate, through hazard analysis reports, how the hazard analysis techniques have been correctly employed. (Understanding) Can justify the use of selected hazard analysis techniques by correctly referencing relevant standards and the capabilities of the organisation.	(Knowledge and Understanding) Can illustrate project situations in which the selected hazard analysis techniques were not appropriate to the specific requirements of that project and explain why. Can illustrate, through hazard analysis review procedures, what actions have been taken to ensure that the appropriateness of selected hazard analysis techniques is adequately considered. **Has specific knowledge to be able to elicit and understand the application hazardous event sequences**.
(Knowledge) Can describe the role of operators and maintainers in the application domain.	(Knowledge/Understanding) Has analysed hazardous event sequences using conceptual thinking and can illustrate this by reference to hazard analysis reports and related system documentation. **Can illustrate from previous reports/work how human factors and security have been addressed**	
(Personal quality) Can support a workshop and contribute to reports for delivery by a more experienced team member. (HRA12 - team working) Can work methodically.	(Personal Quality) Reports are well written and results can be trusted. Can be relied upon to deliver accurate verbal presentations, both formal and informal. Can organise and confidently run workshop-type events to perform hazard analysis.	(Personal Qualities) Can mentor, coach and lead teams and provide technical assurance of throughput (from planning through delivery) to ensure that results are delivered through timely, clear, accurate and traceable reports.

COP Key Points

- Not a CMS framework
  - Compliment HSE Red Book
- Focus on organisation/programme/project
  - Competence requirement specification
  - Assess individuals against requirements
- No universal Competence Criterion:
  - Focus on specification of CC
  - Example criterion only

Summary

- Claims of Competence
  - Can an organization reasonably claim that they can define, specify and assess the competence of their safety activities and practitioners?
  - Competent to claim competence
- Competence-Based Claims
  - Can an organization demonstrate that any safety-related claims are based upon the judgement of competent people?
  - Competent Claims

Any Questions?

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