Developing Engineering Qualifications Within the South African NQF: a View from ECSA

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* This presentation is made in the author's personal capacity

Outline

- Historical Perspective on Engineering
  - How did modern engineering evolve?
  - Professional roles and development model
- Theme 1: Developing professional qualifications (PQ) and professional designations (PD)
  - The existing Framework of PQ & PD
  - Drivers of change to PQ & PD
  - The evolving structure of PQ & PD
- Theme 2: Developing Engineering Qualifications *within* the NQF?
  - Professional qualifications- are “within”
  - Professional designations – why they can’t be “within”

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A long evolution of engineering …

- The ***Ingeniators***: antiquity – 1750
  - early masters builders, military engineers
- ***Industrial Revolution*** 1750-1850
  - Practical engineers became professionals: civil, mechanical, electrical disciplines
- ***Second Industrial Revolution*** 1850-1950?
  - Science-based engineering, new disciplines
- ***Information Revolution*** 1950s ---
  - Aided by microelectronics, computing and telecoms
- ***Age of Globalisation*** (2000 --
  - Engineering is enabler of and player in globalisation
- ***Struggle for Sustainability*** (2010 --
  - Engineering has enabled society to do so much and consume so many resources that it must now focus mainly on sustainability

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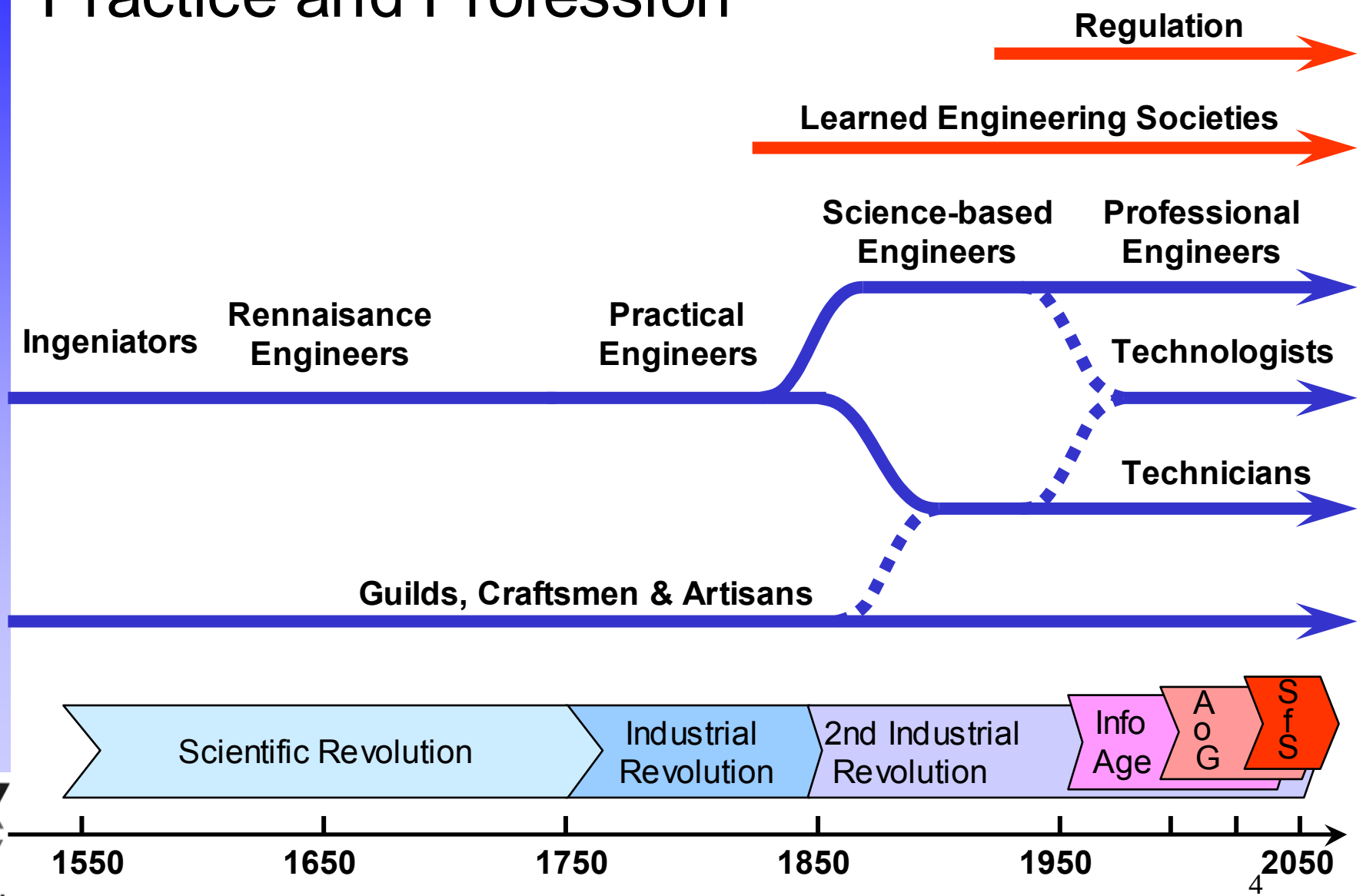
Historical Perspective on Engineering Practice and Profession



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… to modern engineering

Evolution in 19th, 20th and into 21st centuries gives models, ***naturally selected*** for best practice in:

- Formalisation of education: requirements & delivery
  - Standards of education and practice
  - Quality assurance
- Formalisation of practice:
  - Structuring of the profession
  - Development of engineering professionals and
  - Standards of practice
  - Regulation of engineering practice

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A 5-part definition: Engineering: …

1. … encompasses initiatives, services and solving problems that are *important to society and the economy*: infrastructure, manufacture, services, …
2. … brings benefits through exploiting: natural resources, energy, special materials, machinery, manufacture and construction, information, control
3. … functions include: design, planning, investigation, implementing, operating, maintaining, ..
4. … a body of knowledge and distinctive competencies

these activities and processes have risks to health, safety and the environment that must be handled …

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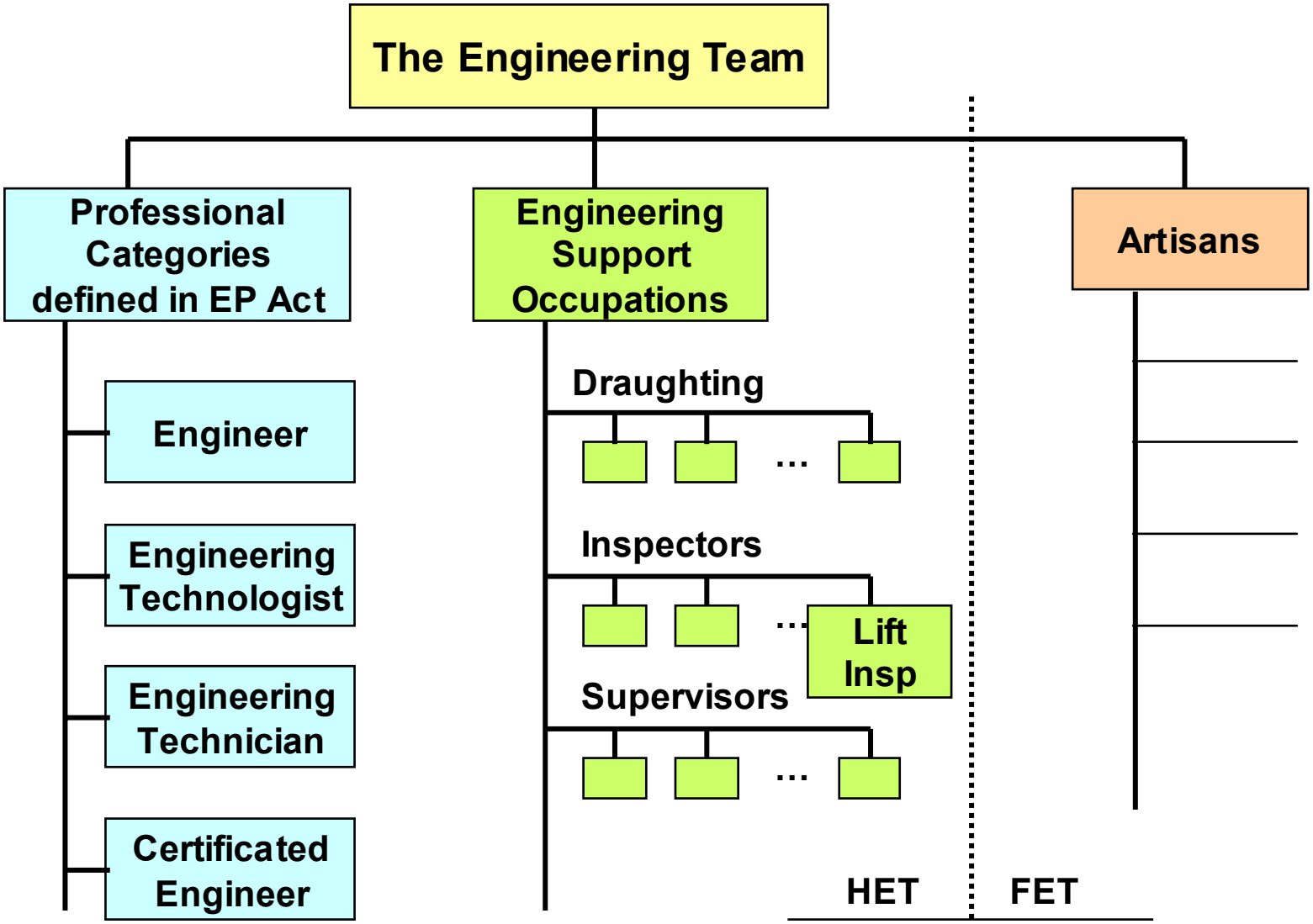
5: Engineering activity requires distinctive roles



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Professional Team Roles - functions

Professional Engineers: **are able to**	solve complex problems, develop components, systems, services and processes through creativity, innovation and application of fundamental & engineering principles.
Professional Engineering Technologists **are able to**	apply established and newly developed engineering technology to solve problems, develop components, systems, services and processes.
Professional Certificated Engineers **are able to**	apply current engineering technology & knowledge of *health and safety legislation & practice*, creatively & innovatively to *effective, safe manufacturing* or *mining.*
Professional Engineering Technicians **are able to:**	apply proven, commonly understood techniques procedures, practices and codes in support of engineering activities.

Also: Leadership/management, autonomy and knowledge base

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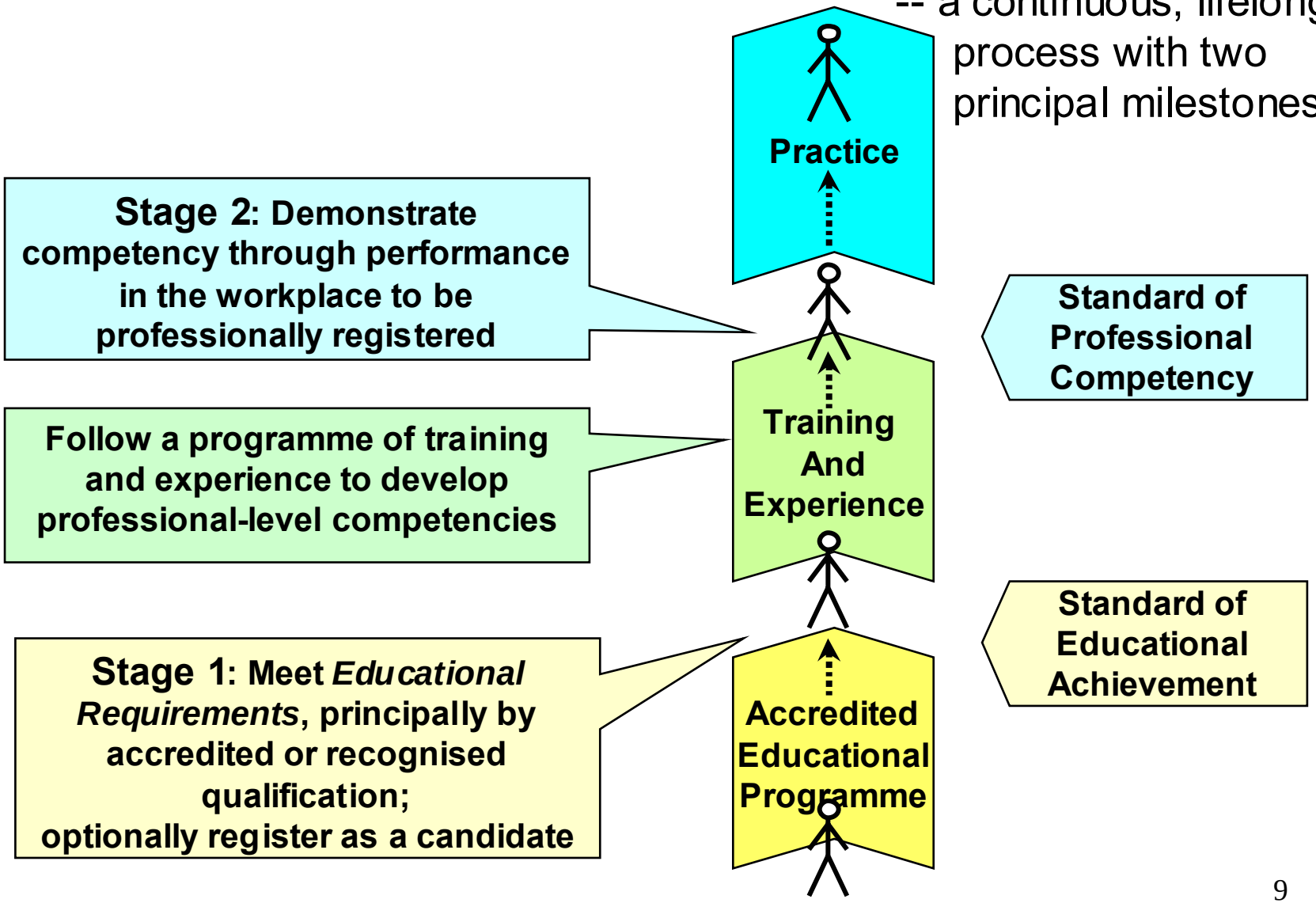
How are Engineering Professionals Developed?

-- a continuous, lifelong process with two principal milestones:



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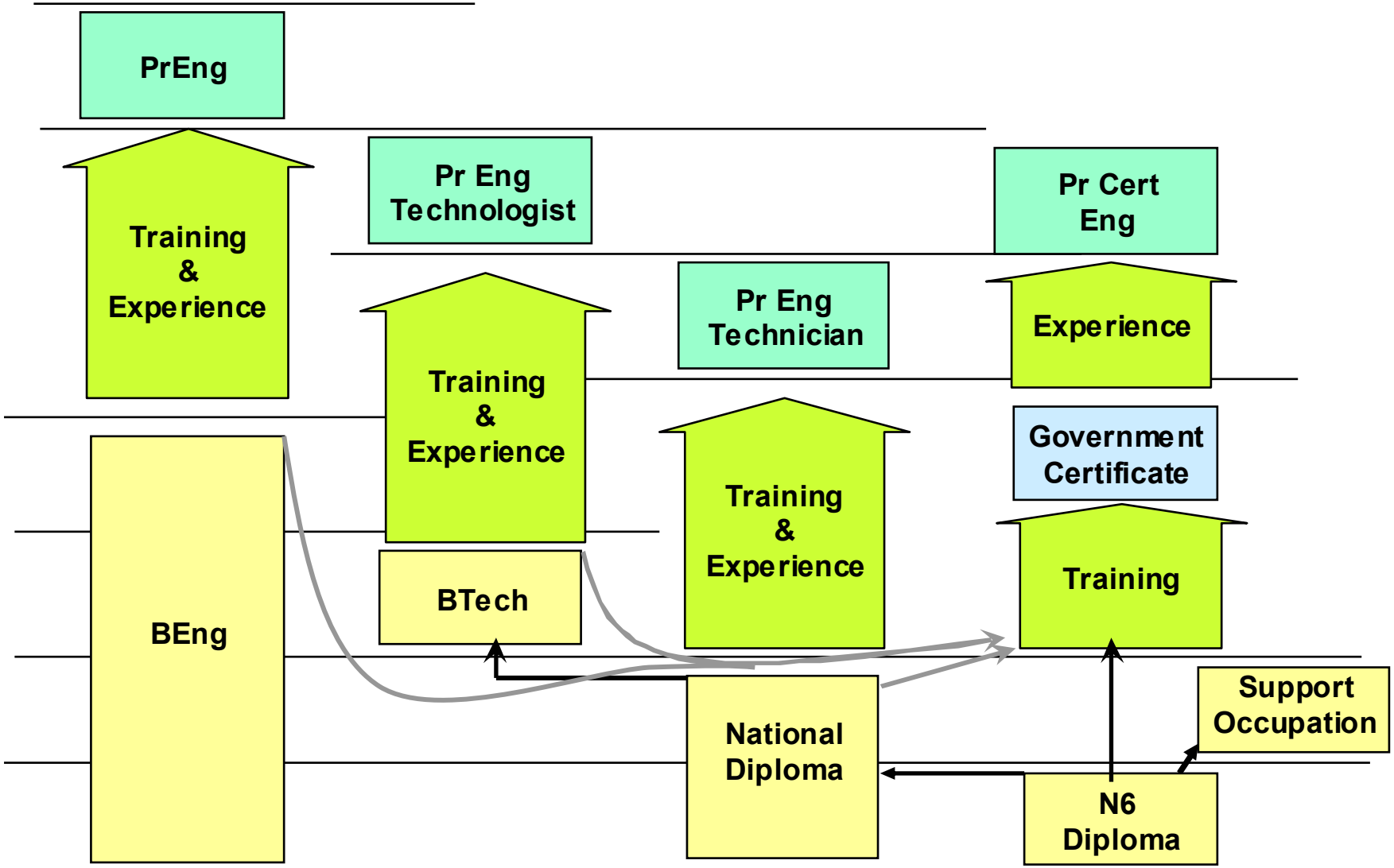
Engineering Qualifications and Professional Designations System



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Professional Qualifications and Designations

Professional Qualification (at Stage 1): e.g. BEng, BTech, ND	**Professional Designation (at Stage 2): e.g. Pr Eng, …**
Serves a specified purpose as part of development toward a designation	Confers title and right to practice
Recognises formal learning, usually obtained in a programme	Recognises assessed competence for practice, however obtained
Requires a planned set of outcomes and knowledge base	Requires performance against competency statements in work context
Combination of formative and summative assessment in a academic/simulated environment	Summative assessment based on substantial evidence from work already performed
Does not impose subsequent obligations and may not be revoked	Imposes obligations on holder and may be revoked if obligations not met
Is a regular higher education qualification	Is in the sole control of the profession

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Defining Competence 1

Stage 2 Competencies	Stage 2 Level Descriptors
Group A: Knowledge-based engineering *problem solving*	**Level of Problem Solving** • **Complex problems** • **Broadly-defined problems** • **Well-defined problems**
Group B: *Manage engineering activities* .	**Level of Engineering Activity** • **Complex EA** • **Broadly-defined EA** • **Well-defined EA**
Group C: Recognising and addressing the *effects of engineering activities*	
Group D: Professional responsibility and judgement	
Group E: undertake *professional development*	

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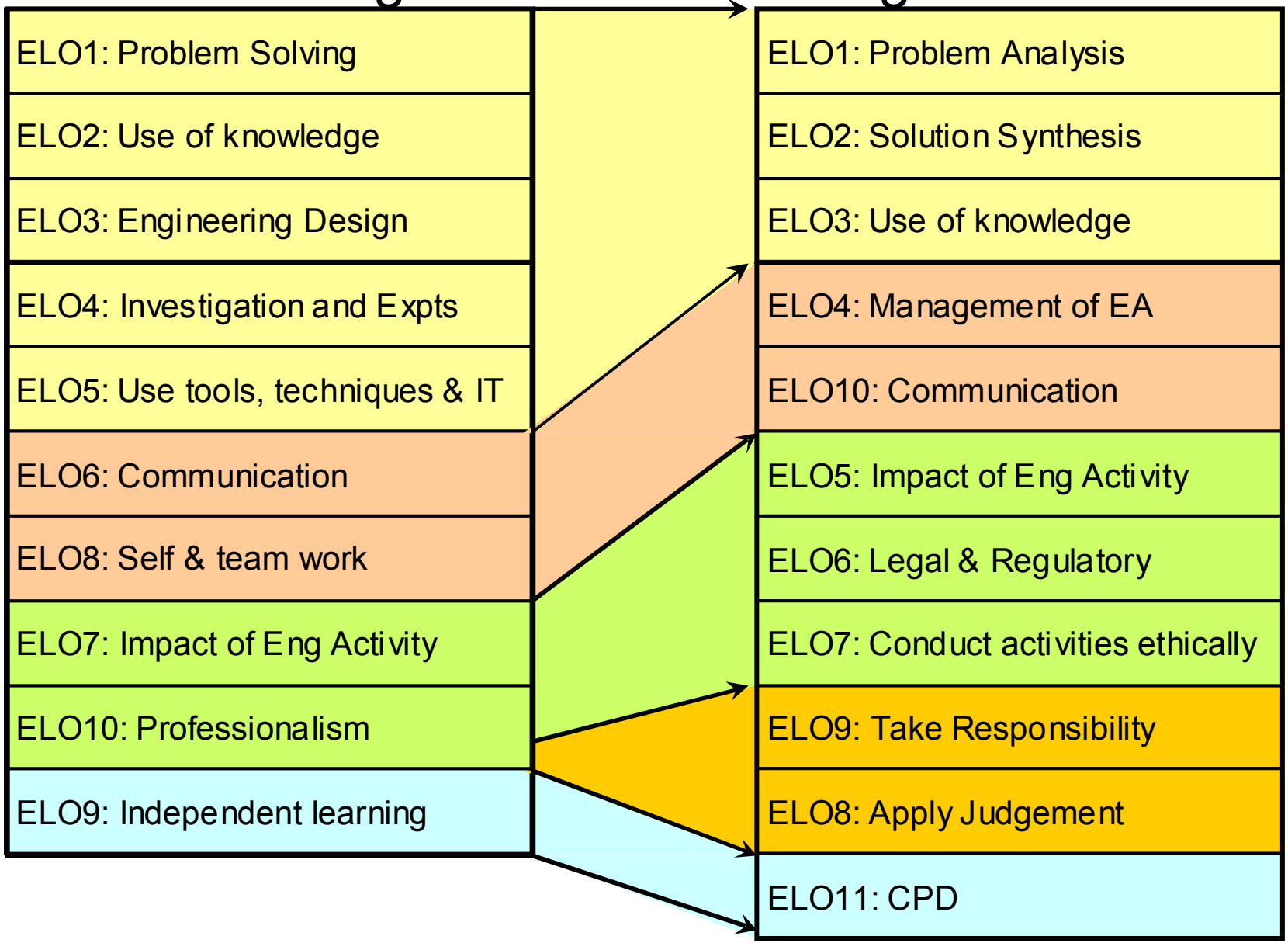
Progression



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Defining Competence 2

Category	Common Stem …	Level Differentiator	… Stem
Engineer	Design or develop solutions to	complex	engineering problems
Engineering Technologist		broadly-defined	
Engineering Technician		well-defined	

Complex Engineering Problems	Broadly-defined Engineering Problems	Well-defined Engineering Problems
Problems require *identification and analysis*, and may be concrete or *abstract*, may be *divergent* and may involve significant *uncertainty*.	Problems require *identification and analysis*, may be ill-posed and have a degree of uncertainty	Problem statement is *concrete*, requirements are largely complete and certain but may require refinement. .
Problems may be *infrequently encountered* types and occur in *unfamiliar contexts*	Problems may be *infrequently encountered* types and occur in *unfamiliar contexts*.	Problems may be *unfamiliar* but occur in *familiar contexts* and are amenable to solution by established methods

Plus Nature of Information, Range of solutions, Interactions and Constraints

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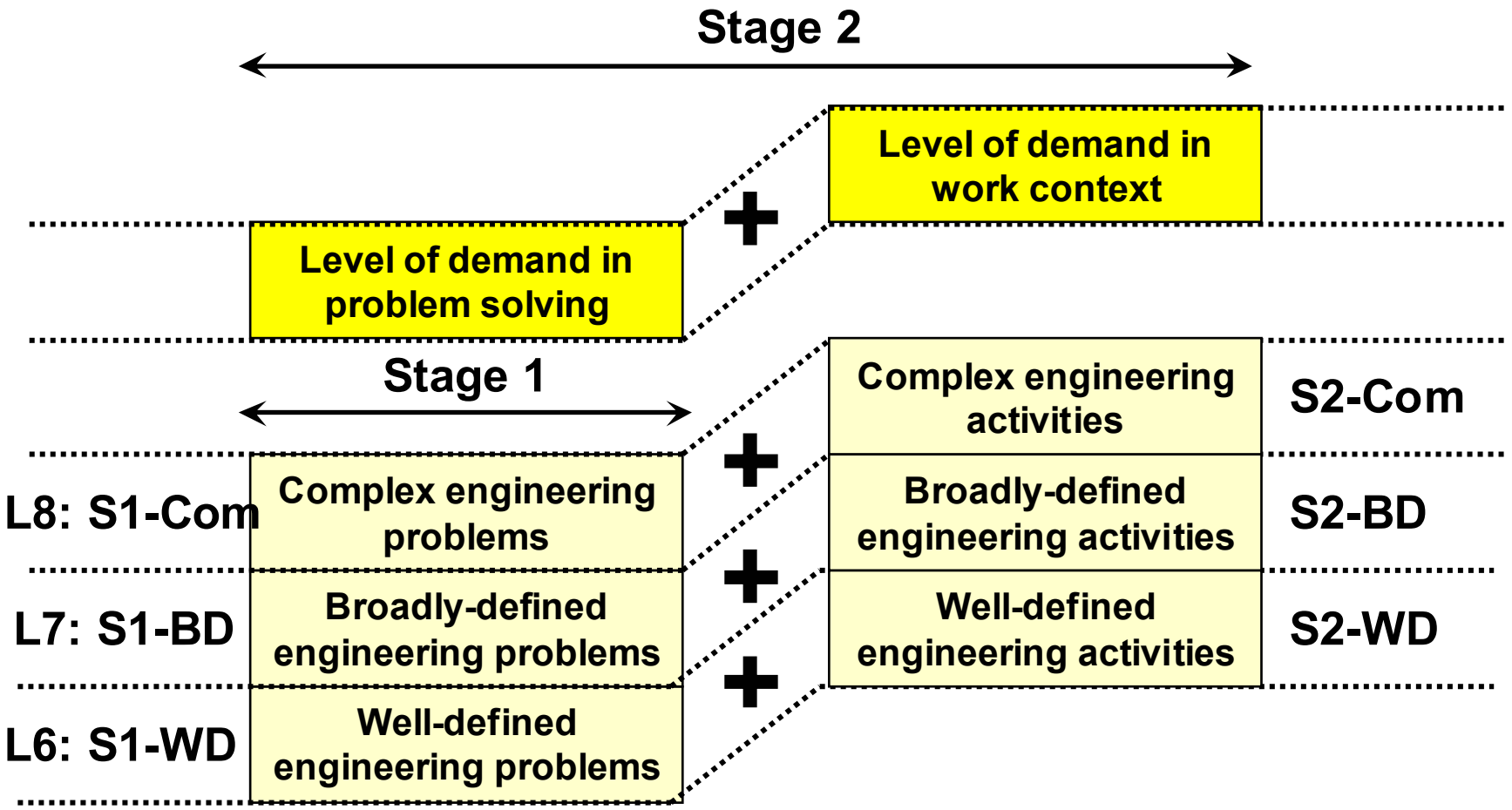
Level Descriptors for Stages 1 and 2



Com = Complex
BD = Broadly-defined
WD = Well-defined

Stage 1 Baseline Knowledge Profile

Knowledge Area	BEng	BTech	ND
Mathematical Sciences	56	10	30
Basic Sciences	56	10	20
Engineering Sciences	168	30	120
Engineering Design (Practice)	67	20	40
Computing & IT	17	10	30
Complementary Studies	56	10	30
Discretionary **(Float <= 25%)**	120	30	90
Total	560	120	360

Second level: judged in QA process by Peers in the category and discipline

First level: credits defined in Standards

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Drivers of The EQ & PD Framework

- Move to competency-based assessment at Stage 2
  - No suitable Level Descriptors for PQs
- Impact of the Higher Education Qualifications Framework
  - Mismatch between BTech and HEQF types
  - Mismatch between old and new diploma
  - Other issues
- Phasing out of the N6 diploma: what replacement?
- Proposed new model for the Certificated Engineer

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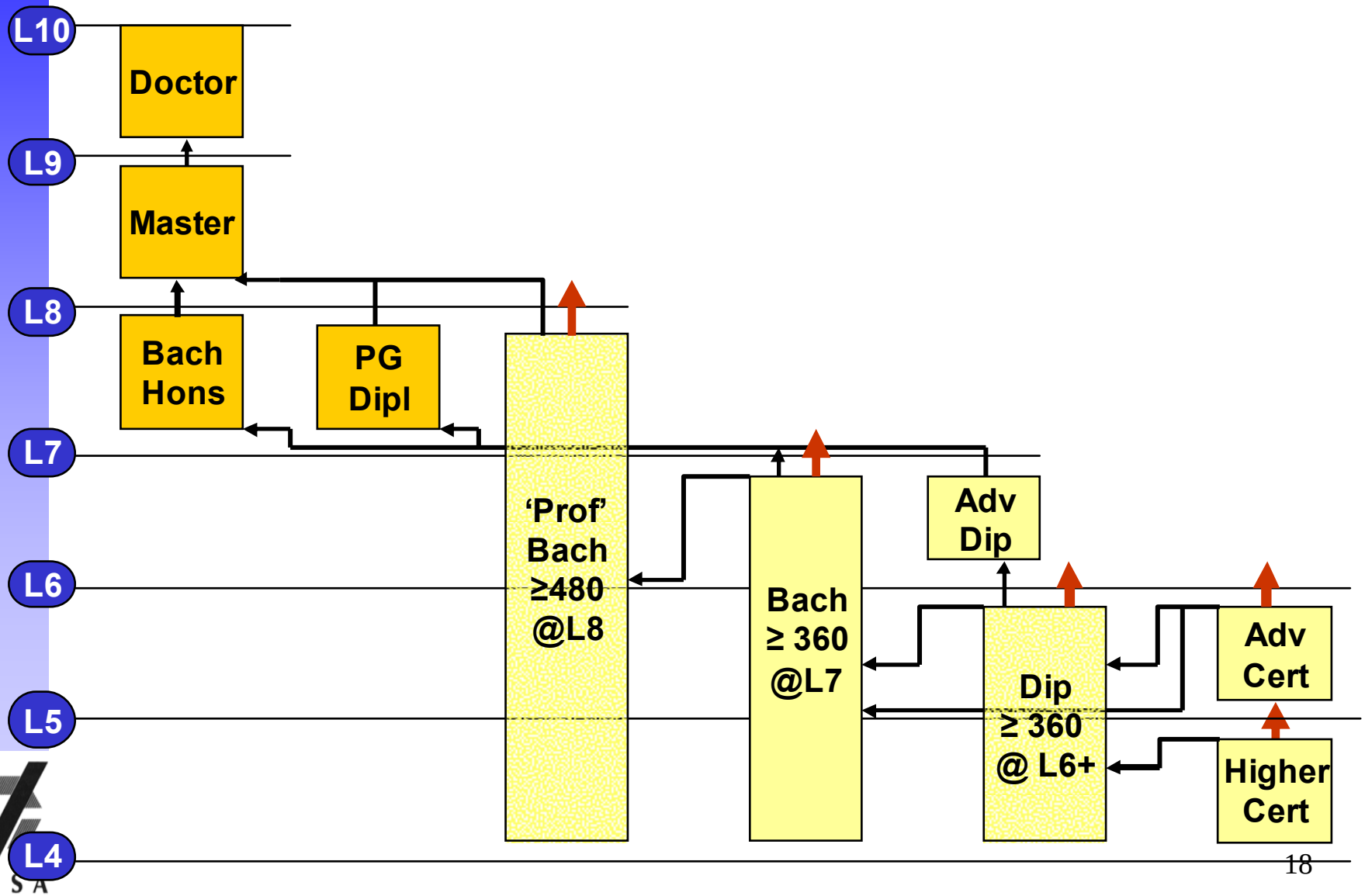
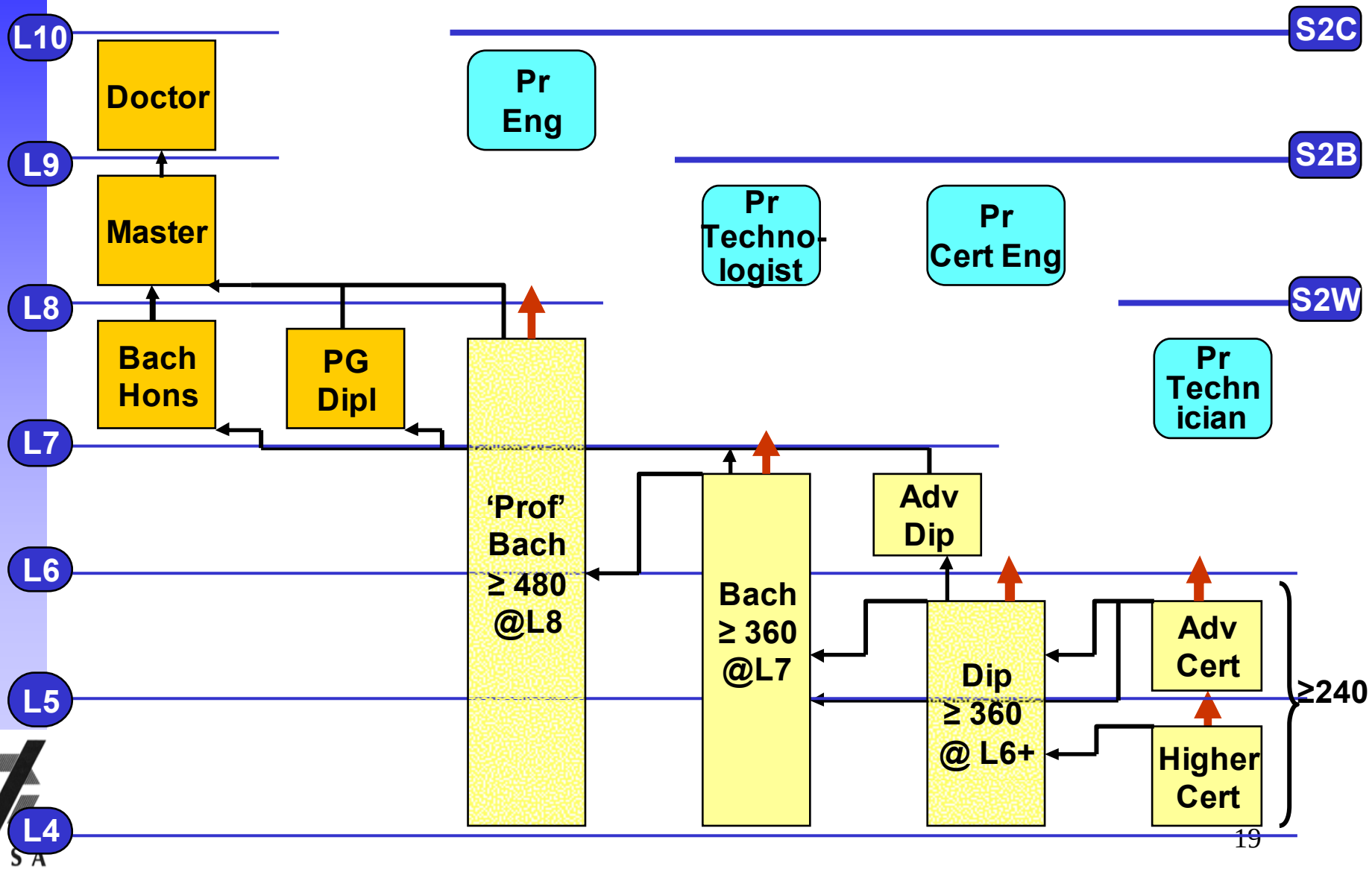
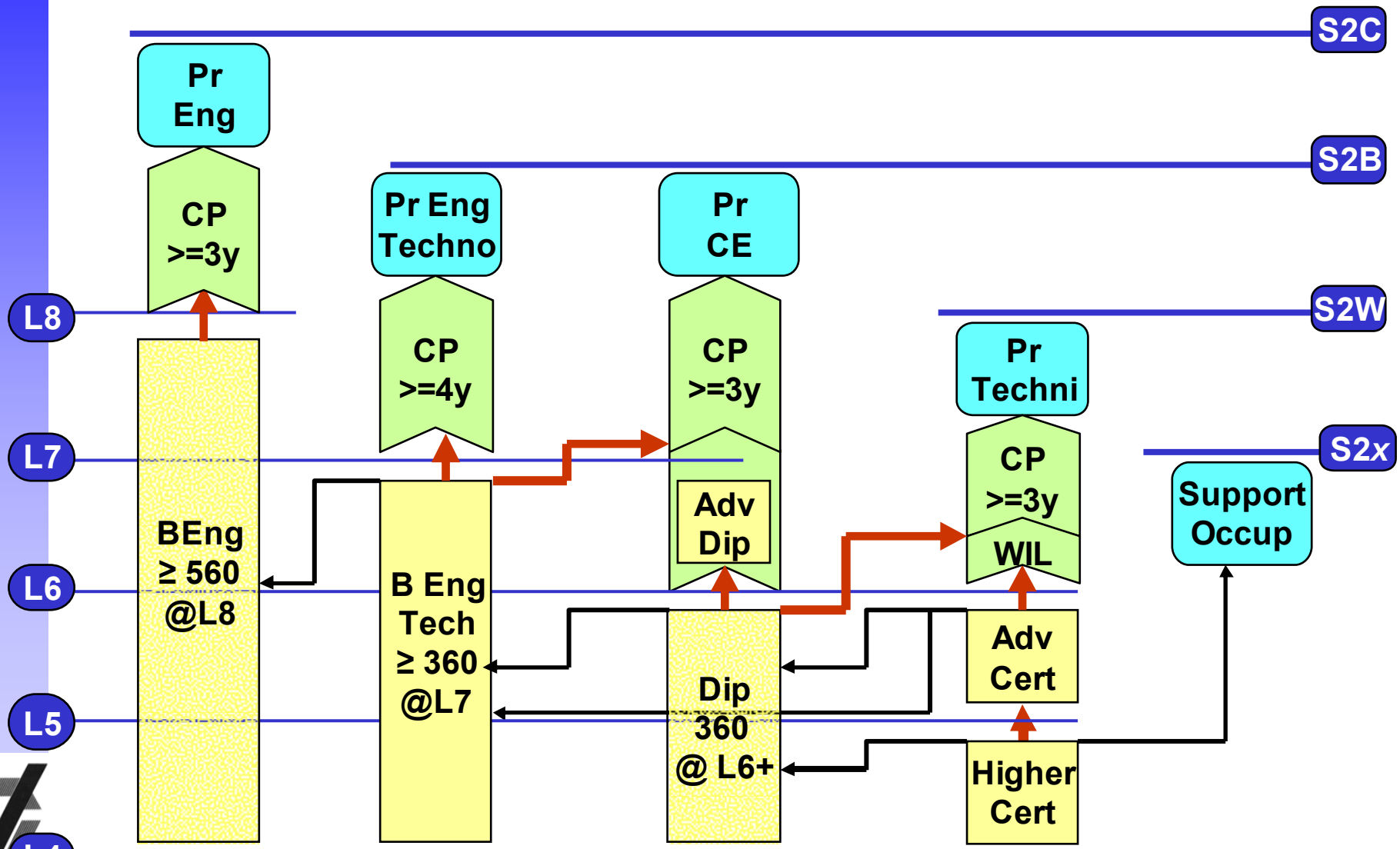
HEQF Delivery Model Menu



Extending Model to Professional Designations



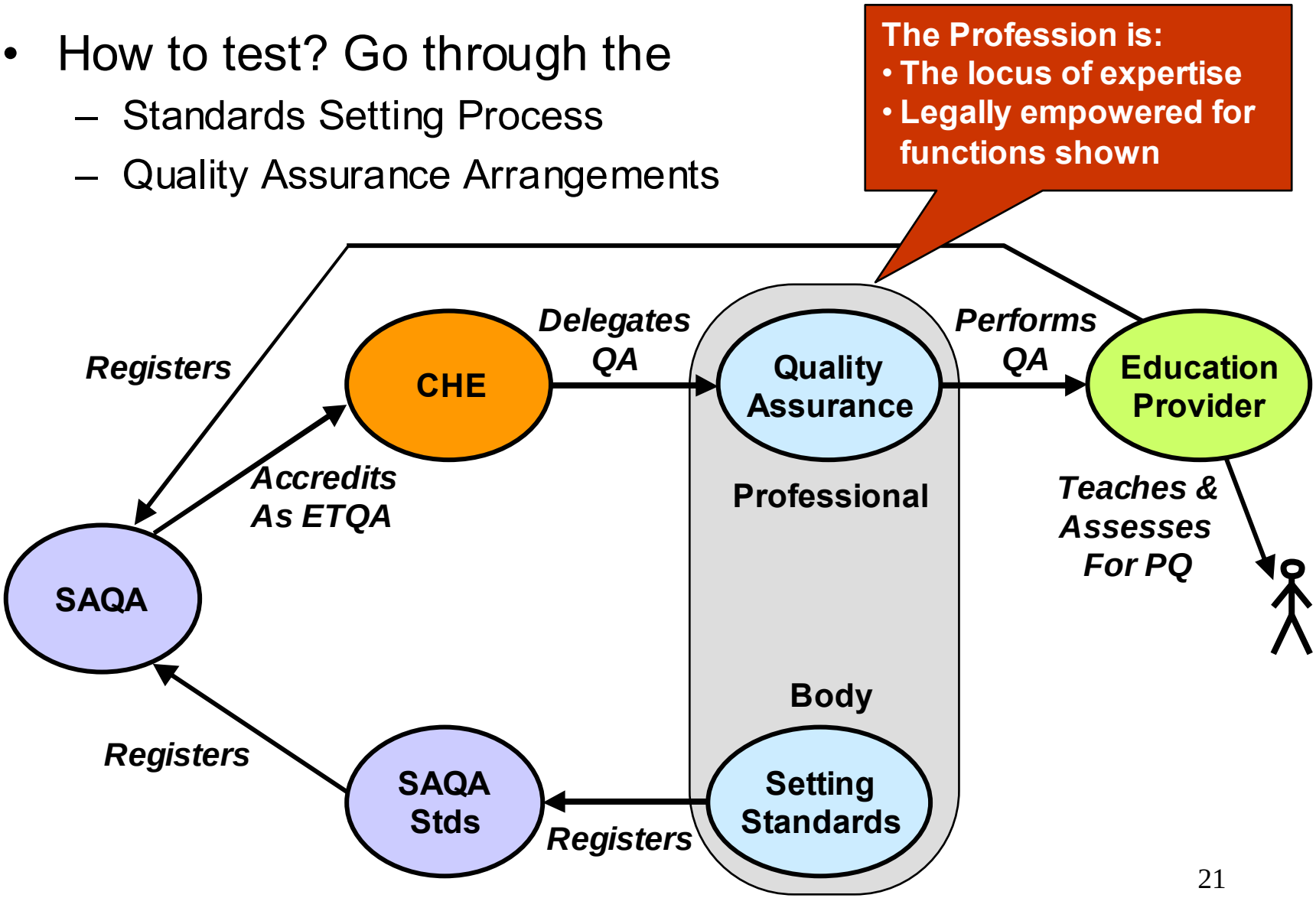
Putting Stage 1 and Stage 2 together*



*Tentative: ECSA/ESGB Workshop on Technology Qualifications 6 Nov 2007

Theme 2: Are Engineering PQs *within* the NQF?

- How to test? Go through the
  - Standards Setting Process
  - Quality Assurance Arrangements



NQF Test: Professional Qualifications

	Standards Setting
	Core Elements
√	• Title, Band, Field
√	• Credits
√	• Level
√	• Purpose
√	• Exit Level Outcomes
	Helpful Elements
√	• Rationale
√	• Learning Assumed
√	• Articulation Possibilities
√	• Integrated Assessment
	ETQA-related Elements
√	• Registration of Assessors
√	• Moderation Arrangements
√	• Certification of Learners
	Assignment of an ETQA = CHE

	ETQA Functions
	Core Elements
√	• Accredited ETQA – the CHE must do programme accreditation (HE Act)
	• Provider must be registered and provide learning prog
	• Program must meet accreditation criteria
	• CHE uses MoUs and delegation model
	• Profession does program evaluation
	ETQA-related Elements
√	• Special Arrangement for all Higher Education Programmes

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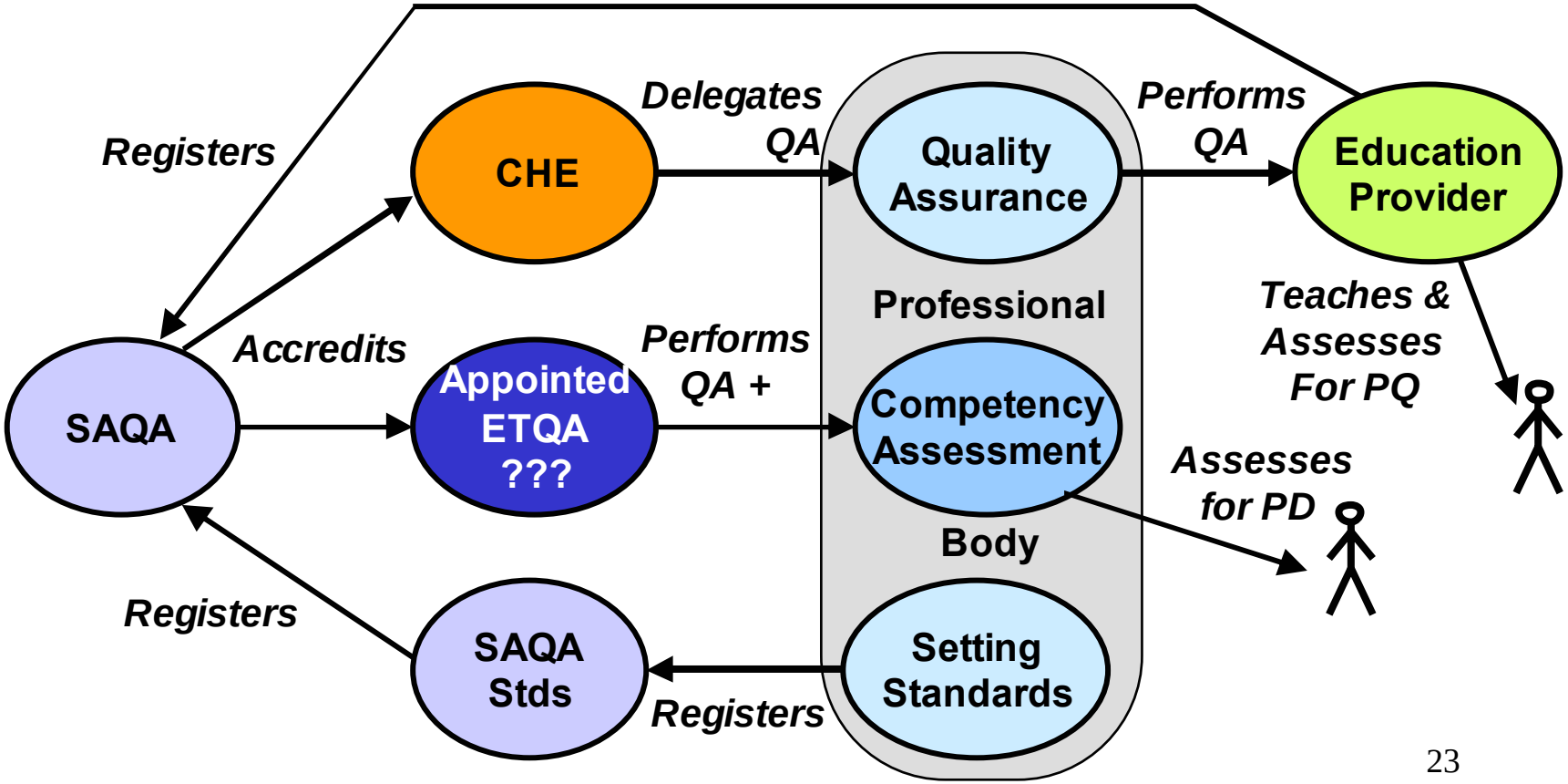
Are Engineering PDs ***within*** the NQF?

- Repeat test for Engineering PDs



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NQF Test: Professional Designations

	Standards Setting
	Core Elements
√	• Title, Band, Field
√	• Credits
√	• Level
√	• Purpose
√	• Exit Level Outcomes
	Helpful Elements
√	• Rationale
√	• Learning Assumed
√	• Articulation Possibilities
x	• Integrated Assessment
	ETQA-related Elements
x	• Registration of Assessors
x	• Moderation Arrangements
x	• Certification of Learners
	Assignment of an ETQA = ???

	ETQA Functions
	To QA on Core Elements
x	• Need experts – don't have
	Basic Issues
x	• Which ETQA, what stakeholders? • Is Profession the kind of provider envisaged in regs? • Is authority of profession diminished? • Is SAQA taking on creeping responsibility it should not?
	ETQA-related Elements
x	• These arrangements are designed for the SETA world • Conflict with profession's legal empowerment

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Conclusion

- There is an evolving, integrated system of Engineering Qualifications and Professional Designations
- Professional qualifications are “within” the NQF
  - Standards
  - Quality Assurance arrangements via CHE
- Professional designations must reside under the provisions of the statutory professions
  - ECSA ensures that PD standards are coherent with NQF qualifications
  - Profession is responsible for assessment for Stage 2
- Fundamentally, statutory professions have authority, capacity to control professional designations

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