Engineering Master Graduates Attributes: Qualifications Frameworks EUR-ACE Standards

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Topics:

1. **Graduate attributes**
2. **QF`s and descriptors for master level**
3. **ENAEE and the EUR-ACE system**
4. **Engineering: The EUR-ACE framework standards**
5. **National examples: Germany, NL, USA**

Graduate Attributes

- **Used to describe what a graduate should have acquired at the end of a degree programme**
- **Usually defined as "learning outcomes" related to different dimensions like knowledge, skills, attitudes, competences and to different levels**
- **Can take different forms and degrees of specification:**
  - generic, like in Qualifications Frameworks
  - discipline or branch specific, e.g. engineering
  - programme specific, e.g. addressing different profiles
- **A graduate from an accredited engineering degree programme should have the attributes necessary to work and continuously qualify as an engineer**

Graduate Attributes

- **Graduates from accredited engineering degree programmes should have achieved the attributes specified in accreditation standards**

- **The requirements for an accredited degree programme should be consistent with generic as well as sectoral Qualification Frameworks:**
  - **FQ-EHEA: Framework for Qualifications of the European Higher Education Area / Dublin Descriptors;**
  - **EQF-LLL: European Qualifications Framework for Life-long Learning**
  - **EAFS: EUR-ACE Framework Standards**

- **Degree programmes must satisfy national requirements, QF`s or accreditation standards but can go beyond these minimum standards**

Dublin Descriptors (DD)

- **Developed in 2004 within Bologna Process, became part of the Framework for Qualifications of the European Higher Education Area, (FQ-EHEA) adopted in 2005**

- **Requirements of programmes in EHEA specified for Short, First, Second and Third Cycles with regard to 5 dimensions:**
  - knowledge and understanding
  - applying knowledge and understanding
  - making judgements
  - communications skills
  - learning skills

- **EUR-ACE standards have been developed also in 2004/2005, First and Second Cycle requirements for learning outcomes consistent with DD.**

FQ-EHEA for master level

"Qualifications that signify completion of the second cycle are awarded to students who:

- **- have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with Bachelor's level, and that provides a basis or opportunity for originality in developing and/or applying ideas, often within a research context;**

- **- can apply their knowledge and understanding and problem solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study;**

FQ-EHEA for master level

- have the ability to integrate knowledge and handle complexity, and formulate judgements with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgements;

- - can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously;

- - have the learning skills to allow them to continue to study in a manner that maybe largely self-directed or autonomous."

Source: Bologna Working Group on Qualifications Frameworks,2005, A Framework for Qualifications for the European Higher Education Area

European Qualifications Framework (EQF-LLL)

- **Published in 2008 by European Commission as a framework for life-long learning**
- **Enables comparison of qualifications in different countries**
- **Defines 8 levels of knowledge, skills and competences**

- **Levels for Higher education are:**
  - **Level 6 equivalent to First Cycle (Bachelors);**
  - **Level 7 equivalent to Second Cycle (Masters);**
  - **Level 8 equivalent to Third Cycle (Doctorate).**

European Qualifications Framework (EQF-LLL): Master level descriptors

Knowledge:

- **highly specialised knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research**

- **critical awareness of knowledge issues in a field and at the interface between different fields**

Skills:

- **specialised problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields**

European Qualifications Framework (EQF-LLL): Master Level Descriptors

Competences:

- **manage and transform work or study contexts that are complex, unpredictable and require new strategic approaches**

- **take responsibility for contributing to professional knowledge and practice and/or for reviewing the strategic performance of teams.**

ENAEE and the EUR-ACE System

- **EUR-ACE operated by European Network for Accreditation of Engineering Education (ENAEE)**
- **European Accreditation Framework Standards (EAFS) for Engineering Education developed in 2005, revised (slightly) 2008**
- **Specifies Programme Outcomes for authorising accreditation agencies to award EUR-ACE Label**
- **Programme Outcomes for 1st and 2nd cycle programmes that provide education for qualifying as an engineer**
- **Outcomes are generic and apply to all programmes of engineering, branch specific outcomes have to be defined by programme provider taking EAFS into account**

Members of ENAEE

Engineering (Education) Societies	Engineering Accreditation Agencies	Others
FEANI	ASIIN	CoPI
SEFI	CTI	Unifi
Eurocadres	Engineering Council	BBT
Danish Society of Engineers	Engineers Ireland	ARACIS
Instituto de la Ingenieria de Espana	MÜDEK	
CLAIU	Ordem dos Engenheiros	
IGIP	RAEE	
Finish Association of Graduate Engineers		

ENAEE authorized agencies

Authorized in November 2007

- Ordem dos Engenheiros
- RAEE
- ASIIN
- CTI
- Engineering Council
- Engineers Ireland

Authorized in January 2009

- MÜDEK

The EUR-ACE® Certificate

EUR-ACE®
Accreditation of European Engineering Programmes

This is to certify that the Bachelor programme

Energie- und Prozesstechnik
(Power and Process Engineering)

provided by

Technische Universität Berlin
Fakultät Prozesswissenschaften

accredited by

ASIIN e.V.

on **07 December 2007** until **20 December 2008**

satisfies the outcomes of **First Cycle programmes** specified in the **EUR-ACE Framework Standards for the Accreditation of Engineering Programmes,** and therefore for the above period of accreditation is designated as a **First Cycle EUROPEAN ACCREDITED ENGINEERING PROGRAMME.**

For the European Network for Accreditation of Engineering Education (ENAEE)
The President
Prof. Ing. Giuliano Augusti, Sc.D.

Brussels, 17 December 2007

For ASIIN

The Managing Director
Dr. Iring Wasser

Düsseldorf, 17 December 2007

EUR-ACE Framework Standards (EASF)

Six Categories of learning outcomes

- **Knowledge and understanding**
- **Engineering analysis**
- **Engineering design**
- **Investigations**
- **Engineering practice**
- **Transferable skills**

For each category, outcome criteria for First and Second Cycle programmes (Bachelor and Master level graduates) have been established.

Example of learning outcomes: category Engineering Analysis

Second Cycle graduates should have

- **the ability to solve problems that are unfamiliar, incompletely defined, and have competing specifications;**
- **the ability to formulate and solve problems in new and emerging areas of their specialisation;**
- **the ability to use their knowledge and understanding to conceptualise engineering models, systems and processes;**
- **the ability to apply innovative methods in problem solving.**

Example of consistency with FQ-EHEA in category: knowledge and understanding

- **FQ-EHEA specifies the level in 1st Cycle as:**
  - **'some … knowledge of the forefront'.**
- **In EAFS, 1st Cycle Level is specified by:**
  - **'coherent knowledge … some at the forefront'.**

- **In FQ-EHEA 2nd Cycle Level 'extends' 1st Cycle level.**
- **In EAFS, 2nd Cycle Level comprises in addition**
  - **'critical awareness of forefront…'.**

Statements of level are consistent in Bologna Framework FQ-EHEA and EAFS, but 'forefront' has to be interpreted.

National examples:Germany

- **Germany by national regulations offers the opportunity to differentiate on the master level between research oriented and practice oriented programmes.**
- **Other common formats are continuing education master programmes and transnational joint master programmes.**

- **The Accreditation Agency ASIIN has specified with regard to general as well as branch/subject related outcomes what this would mean for respective programmes.**

- **Research Universities based on their autonomy try to specify their particular profile and respective outcomes.**

National examples: Netherlands

- **The three Technical Universities of the Netherlands (3TU) have developed there own set of master level outcomes in engineering education**

- **They are referring to 7 dimensions of academic education and study:**

- **Competent in one or more scientific disciplines: an example for an outcome would be: the graduate "has a thorough mastery of parts of the discipline extending to the forefront of knowledge",**
- **Competent in doing research: e.g.: the graduate "is able to assess research within the discipline on its scientific value",**
- **Competent in designing, e.g.: the graduate, "given the process stage of the design problem, chooses the appropriate level of abstraction",**

National examples: Netherlands

- **A scientific approach, e.g.: the graduate "has knowledge of current debates about the scientific practice",**

- **Basic intellectual skills, e.g.: the graduate "is able to recognize fallacies",**

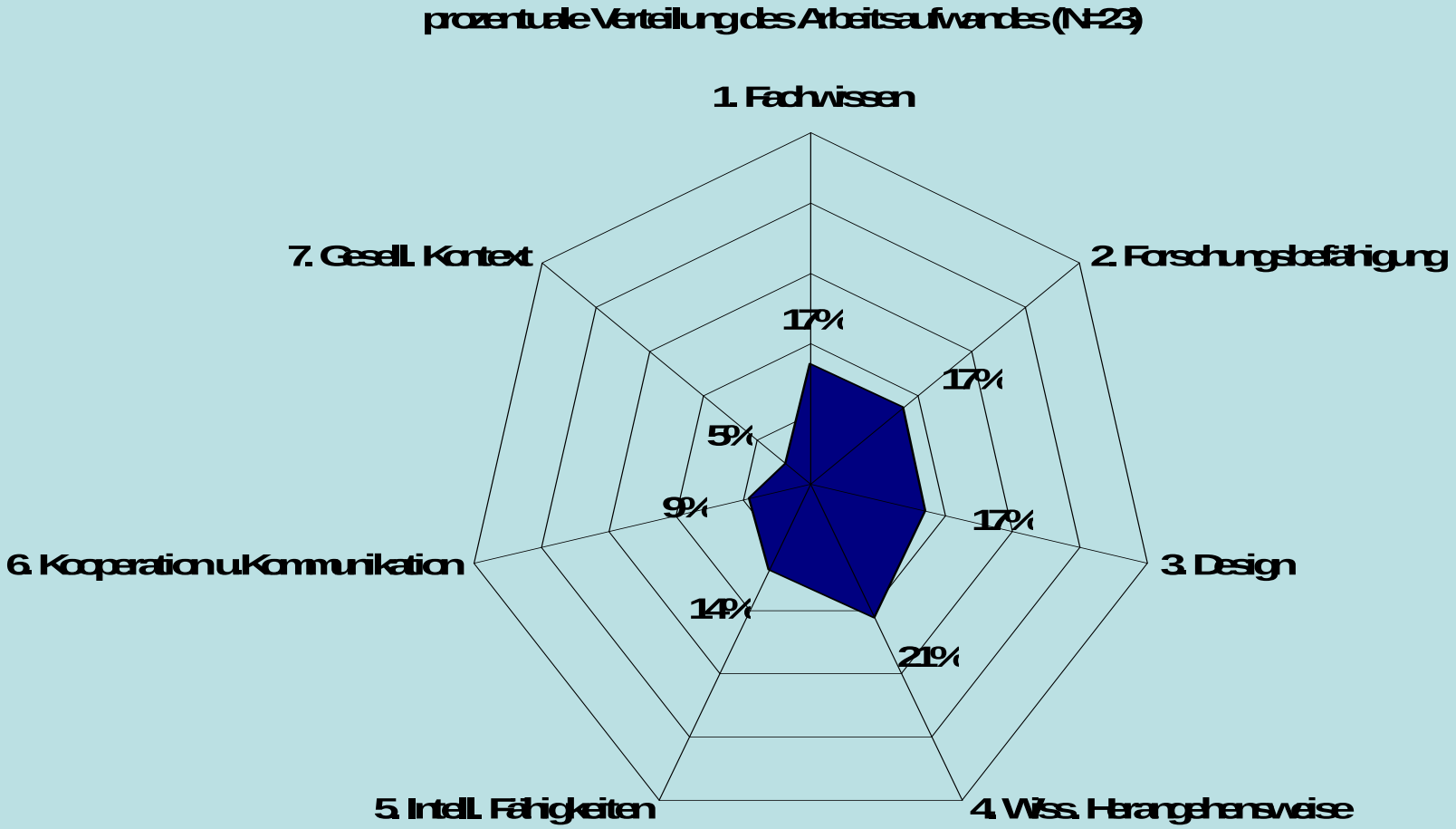
- **Competent in cooperating and communicating, e.g.: the graduate "is able to communicate about research and solutions to problems with colleagues and non-colleagues in a second language,**

- **Takes account of the temporal and social context, e.g. the graduate after analyzing ethical consequences of scientific thinking and acting "integrates these consequences in scientific work".**

National examples: Netherlands

- **Practice is not specifically mentioned in this 3TU concept.**
- **Besides addressing 7 areas of competence it was tried to differentiate between different levels of competences and kind of activities using the terms:**
  - **analyzing**
  - **synthesizing**
  - **abstracting**
  - **concretizing**
- **Other approaches to differentiate between levels of competence or levels of learning outcomes achievement can be found, e.g. TU Berlin, in the CDIO concept, the ASCE/USA Book of Knowledge**

Competence profile of a master programme at TU Berlin



National examples: USA

- **USA through ABET was first in applying accreditation based on learning outcomes to engineering programmes, since about 1997 piloting ABET-Criteria 2000**
- **Focus with regard to 11 categories of outcomes is the bachelor level**
- **Also the Washington Accord with its list of graduate attributes specifies the first degree level, normally the bachelor level**
- **Only the American Society of Civil Engineers (ASCE) is trying to "raise the bar" to a master level as entry into the profession, defining 22 outcomes with 6 different levels of achievement based on Bloom`s Learning Taxonomy**

Thank you for your attention.

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