Harmonizing Civil Engineering Education

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Outline

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- Introduction – Recommendations of the Bologna Declaration
- ASCE Body of Knowledge
- Tuning & E4
- EUCEET Core Curricula
- Conclusions

Introduction – Prerequisites

Do we need any harmonizing?

- **In 1988 in Bologna Magna Charta Universitatum was signed ⇨ strongly emphasises Autonomy & Freedom of the University;**
- **The Declaration convened in Bologna in June 1999 recommends some harmonization as the precondition of the European Area of Higher Education;**

Is there any contradiction between these documents?

- **Not at all, yet the world changes very quickly and the contemporary conditions must be taken into account.**

- **Globalization, which results among others in:**
  - **studying abroad ⇒ much easier if the curricula are similar**
  - **global employment ⇒ requires readable & comparable degrees**

Wide survey of current European education state preceding the later Bologna Declaration revealed extreme complexity and diversity of curricular and degree structures in European countries.

Introduction – Recommendations of the Bologna Declaration

The Bologna Declaration determines just the prerequisites for the European Area of Higher Education:

- **adoption of a system of easily readable and comparable degrees,**
- **adoption of a system based on two cycles, undergraduate and graduate,**
- **establishment of a comparable system of credits,**
- **developing comparable criteria and methodologies of quality assurance.**

Summarizing:

- **Some harmonization is necessary, as it facilitates students' exchange and global employment;**
- **The harmonization cannot deny the idea of university autonomy and freedom emphasised by Magna Charta Universitatum.**

ASCE Body of Knowledge

Basic questions of each educational activity:

What should we teach ? How should we teach ? Who should teach & learn ?

Answer in terms of subjects

Answer in terms of outcomes

What should the university give to his students?

What should we teach ?

- **KNOWLEDGE, which assures the scientific and technical competence;**

What should we train ?

- **SKILLS, which make possible the effective use of this knowledge for solving engineering problems;**

What should we form ?

- **ATTITUDES, which assure the appropriate approach to co-workers and professional duties;**

ASCE Body of Knowledge - Outcomes

1. an ability to apply knowledge of mathematics, science and engineering.
2. an ability to design and conduct experiments, as well as analyze and interpret data.
3. an ability to design a system, component or process to meet desired needs.
4. an ability to function on multidisciplinary teams.
5. an ability to identify, formulate and solve engineering problems.
6. an understanding of professional and ethical responsibility.
7. an ability to communicate effectively.
8. the broad education necessary to understand the impact of engineering solutions in a global and societal context.
9. a recognition of the need for, and an ability to engage in life-long learning.
10. a knowledge of contemporary issues.
11. an ability to understand the techniques, skills, and modern engineering tools necessary for engineering practice.
12. an ability to apply knowledge in a specialized area related to civil engineering.
13. an understanding of the elements of project management, construction, and asset management.
14. an understanding of business and public policy and administration fundamentals.
15. an understanding of the role of the leader and leadership principles and attitudes.

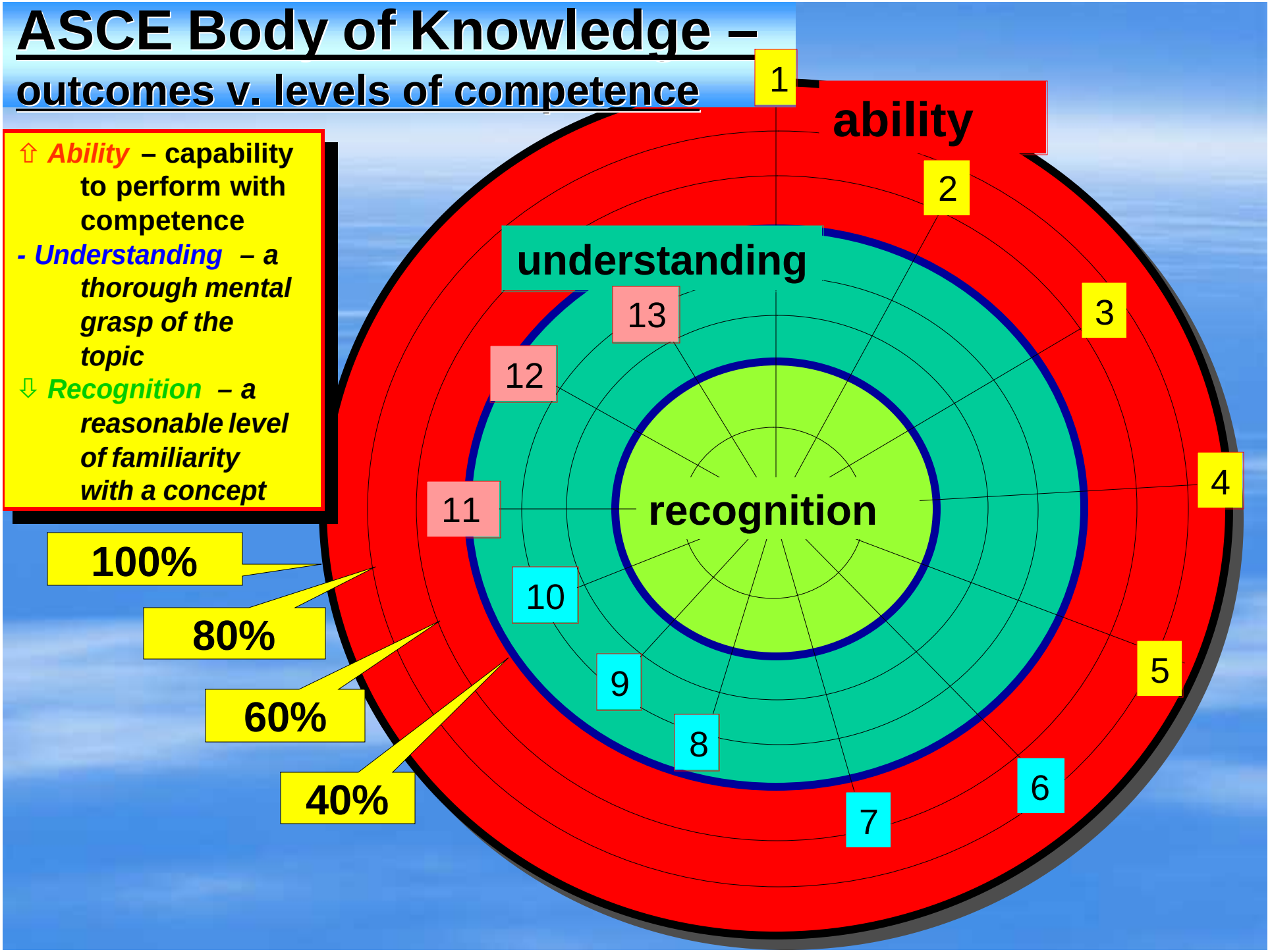
ASCE Body of Knowledge –

outcomes v. levels of competence

⇧ ***Ability*** **– capability to perform with competence**

- Understanding ***– a thorough mental grasp of the topic***

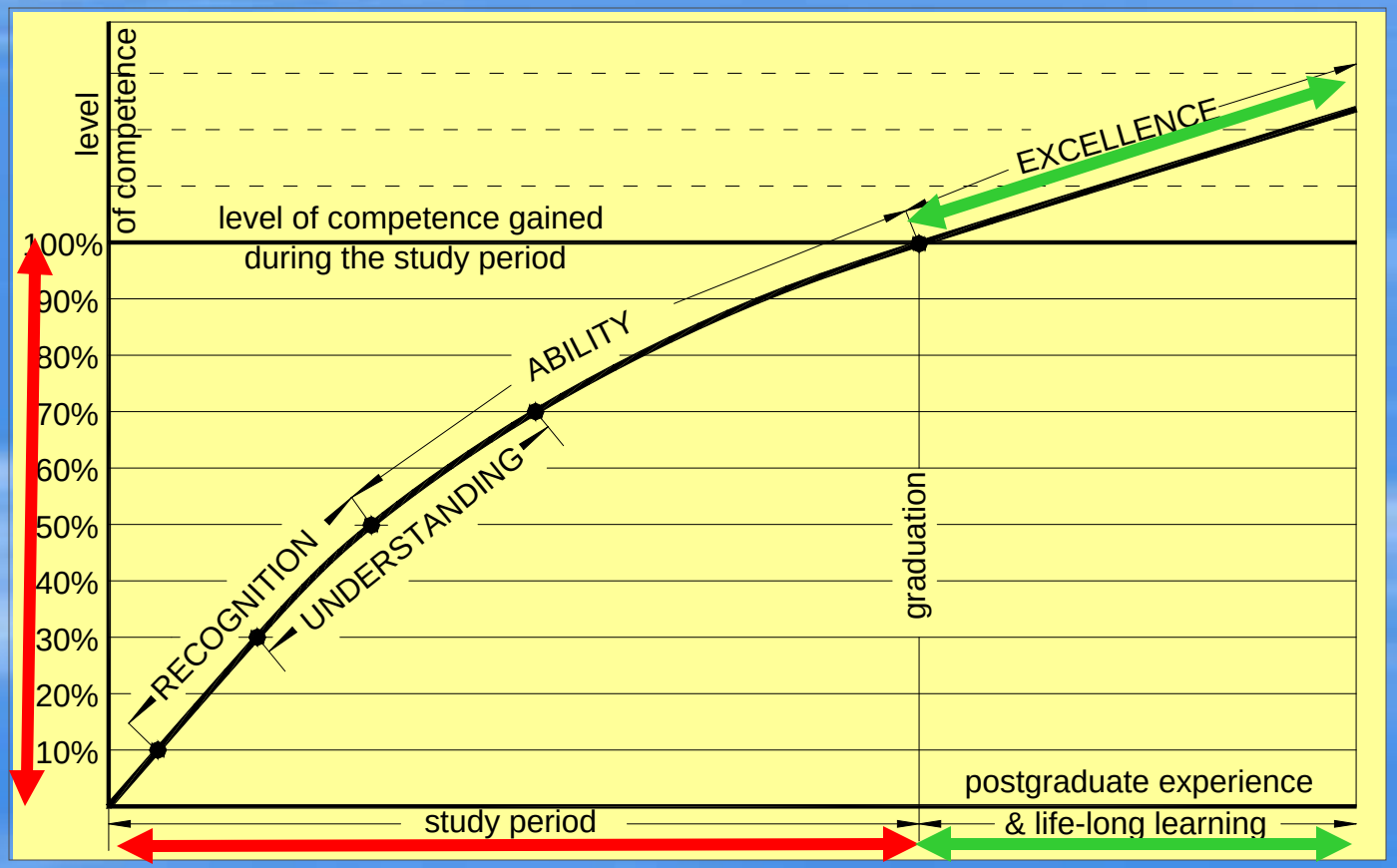
⇩ ***Recognition*** ***– a reasonable level of familiarity with a concept***



ASCE Body of Knowledge – Levels of Competence

Required levels of competence should be FULLY reached during the study period;

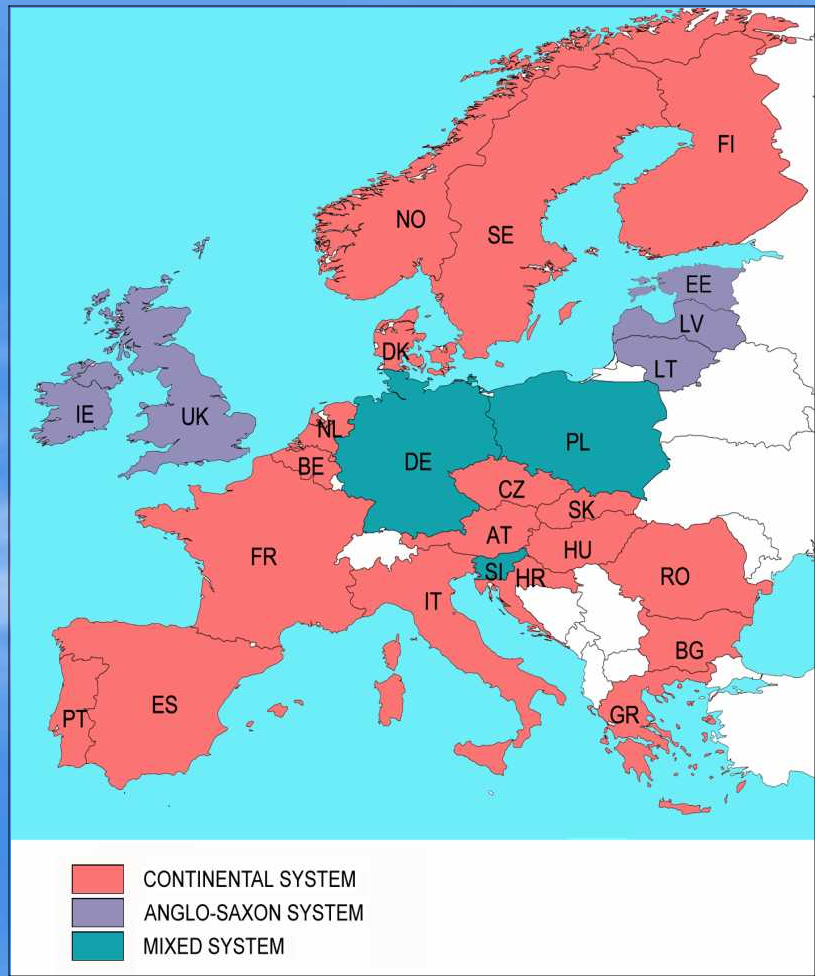
Due to postgraduate experience and life-long learning the EXCELENCE should be achieved.



European projects

- TUNING Educational Structures in Europe,
- E4 – Enhancing European Engineering Education,
- EUCEET – European Civil Engineering Education and Training,

SP1
Studies and Recommendations on Core Curricula for Civil Engineering



EUCEET – Core Subjects and Credit points

Basing on the wide survey the list of 25 Core Subjects have been determined

To each of these subjects credits have been assigned

Profesional subjects comprise 50% of credits

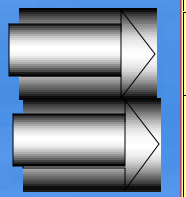
No	CORE SUBJECTS IN CURRICULA FOR CIVIL ENGINEERING	4-years course Credits	5-years course Credits
1	Mathematics and Applied Mathematics	16,0	23,0
2	Applied Chemistry	3,0	3,5
3	Applied Physics	5,5	6,5
4	Computer Science and Computational Methods in C.E.	6,5	8,0
5	Drawing and Descriptive Geometry	4,0	5,0
10	Engineering Surveying	5,0	5,5
11	Building Materials	5,5	6,5
12	Buildings' Construction	4,0	4,5
13	Basis of Structural Design	4,5	4,5
14	Engineering Geology	3,5	4,0
15	Soil Mechanics and Geotechnical Engineering	6,5	9,0
16	Structural Concrete	7,5	9,5
17	Steel Structures	6,0	8,0
18	Timber, Masonry and Composite Structures	3,5	4,5
19	Transport Engineering	4,0	4,5
20	Urban Planning	2,5	3,0
21	Water Structures and Water Management	3,5	4,5
22	Construction Technology & Organization	6,0	7,0
23	Economics and Management	6,0	7,5
24	Environmental Engineering	4,0	4,5
25	Non-technical subjects	6,0	9,0
Core subjects total		140,0	175,0
Specialization and Elective Subjects Including Practical Placement and Final Project		100,0	125,0
Total		240,0	300,0

Frame Syllabuses

A brief list (1 A4 page) with main topics, which should be known to every graduate of CE faculty, irrespectively to her/his specialization.

In each syllabus there will be determined:

- **parts of teaching material,**
- **levels of competence for particular parts of contents,**
- **skills achieved within the subject.**



SUBJECT: **STRUCTURAL CONCRETE**	7-8 credit points

Course contents

RC1. *The course regards to the design of RC beams, one way slabs and columns, comprising the dimensioning rules under bending, shear and torsion (beams) as well as simultaneous action of bending, and axial force (columns) with regard to ultim ate load and serviceability limit states.*

Concept and idea of concrete reinforcement. Historical background. Material properties - concrete and steel. General characteristic of RC design principles (limit state approach), EC2 and national version. Design of beams (rectangular and T section) with regard to ultimate load limit state under bending, shear and torsion. Single- and multi-span one-way slabs and beams. Design of columns subjected to axial force and bending. Compression: general rules, slenderness and stability. Design with regard to ultimate load limit state for rectangular section. M-N interaction diagrams. Confined columns. Tension: design with regard to ultimate load limit state for rectangular section. Limit states of serviceability - deflection of RC beams, cracking in reinforced concrete.

RC2. *The course regards to principals of RC elements design. These principals will be presented at simple and popular in constructional practice elements such as floor structures (beam -and-slab, flat slab), st airs, frames, and retaining walls.*

Beam-and-slab floors. Two-way slabs: calculation in elastic stadium and by critical load method; reinforcement distribution. Reinforced concrete stairs. Reinforced concrete frame structures. Approximate methods of frame analysis under vertical and horizontal load. Computational methods of frame analysis. Reinforcing rules for frame structures. Reinforced concrete spot footings and strip foundations. Spot footings for pre-cast columns. Retaining walls: calculation and rules of reinforcing.

RC3. *The course regards to principals of pre -stressed concrete.* Concept of pre-stressing of structural concrete members. Materials and techniques for pre-stressed concrete. High strength concrete and steel for pre-stressing. Pre-tensioning and post-tensioning techniques. Losses of pre-stressing force – short time and long term effects. Basic assumptions for sectional design of flexural pre-stressed members according to ultimate limit state method. Serviceability limit states of pre-stressed members.

RC4. Brief presentation of advanced reinforced concrete and pre-stressed structures proving the possibilities and advantages of structural concrete.

Level of competence	Ability in RC1 and RC2, Understanding in RC3, Recognition in RC4.
Skills achieved	Proficiency in calculation of reinforcement and loading capacity of beams, slabs and columns subjected to bending moment, shear and axial force as well as familiarity with reinforcing rules for elements discussed within RC2.

EUCEET version of ASCE BOK Outcomes

The ASCE Body of Knowledge outcomes were adopted and slightly modified in EUCEET SP1.

Scientific & technical outcomes

1. An *ability* to apply knowledge of mathematics, science and civil engineering;
2. An *ability* to design and conduct experiments, as well as analyze and interpret data;
3. An *ability* to design a system, component or process to meet desired needs;
4. An *ability* to identify, formulate and solve engineering problems;
5. An *ability* to understand the techniques, skills, and modern engineering tools necessary for engineering practice;
6. An *ability* to apply knowledge in a specialized area related to civil engineering;

Professional outcomes

1. An *ability* to function on multi-disciplinary teams;
2. An *ability* to communicate effectively;
3. An *understanding* of the elements of project management, construction, and asset management;
4. An *understanding* of business and public policy and administration fundamentals;
5. An *understanding* of the role of the leader and leadership principles.

Attitude outcomes

1. An *understanding* of professional and ethical responsibility;
2. The broad education necessary to *understanding* the impact of engineering solutions in a global and societal context
3. A *recognition* of the need for, and an *ability* to engage in life-long learning;

3 Levels of competence:

⇧ *Ability* – capability to perform with competence
- Understanding – a thorough mental grasp of the topic
⇩ *Recognition – a reasonable level of familiarity with a concept*

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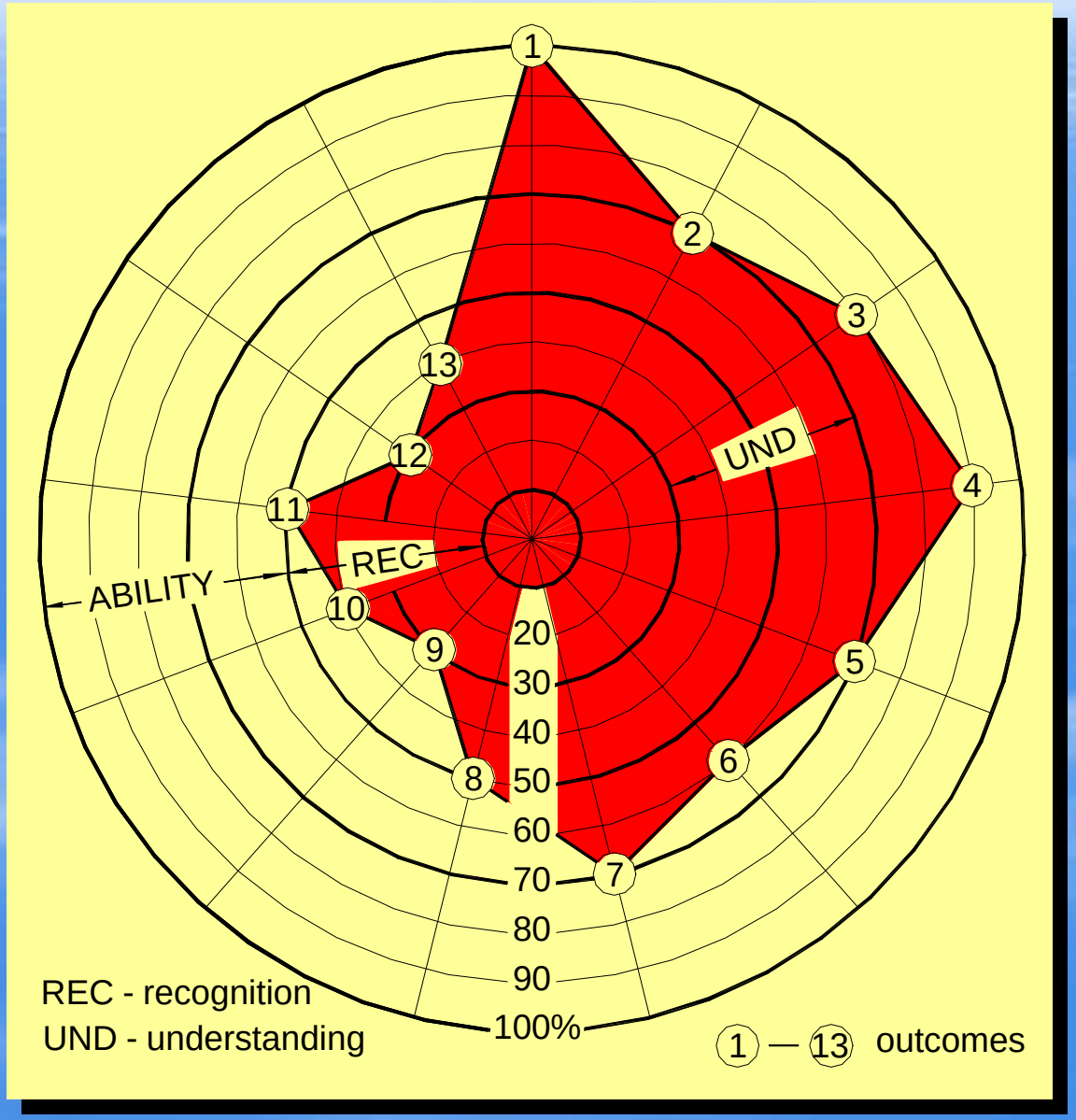

CONCLUSIONS

1. No doubt that the uniformity never will be the objective of the education, yet some level of compatibility can be useful or even indispensable, if we mind the globalization of employment.
2. Knowledge, skills and attitudes of a professional should be comparable irrespective to the place of his graduation.
3. Thus the compilation of the Bologna Declaration and post-Bologna process, ASCE Body of Knowledge Committee recommendations and the results of EUCEET Core-Curricula Studies can be interesting at least to establish the common module and to recognize individual distance from this module.
4. Current accomplishments of above-mentioned bodies create a good basis to start the discussion about the harmonization in the global scale.

Thank you for your attention

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