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Standards for Engineering Programmes – WP6

UA, ULB, UoB, IUL, UL, LU, UAl, NDU, MUT, ALI

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National Roundtable 2

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Ministry of Education and Higher Education

Scope of WP6

- Adapt the core standards in WP5
  to the engineering education
- Customise and **Align**
  the adopted Lebanese Qualifications Framework (LQF) in WP1
  to the engineering sector
- Use the adapted standards and sectorial QF to evaluate engineering programmes

Outline

- Introduction and Scope of WP6
- Framework standards for Engineering Education
  - Global classification
  - Comparative study Engineering competencies/outcomes
  - Proposed Lebanese Engineers competencies/outcomes
  - Framing Engineering descriptors for LQF
- Standards for engineering programmes
  - Comparative study
  - Positioning related to core standards in WP5.
- Conclusion

Introduction

- Prior to the **alignment** of the LQF to the engineering programmes
- A study of the Framework standards for Engineering Education is conducted with a highlight to the Engineering competencies/outcomes
- Our aim is to map the engineering competencies to the descriptors of Qualifications in the LQF

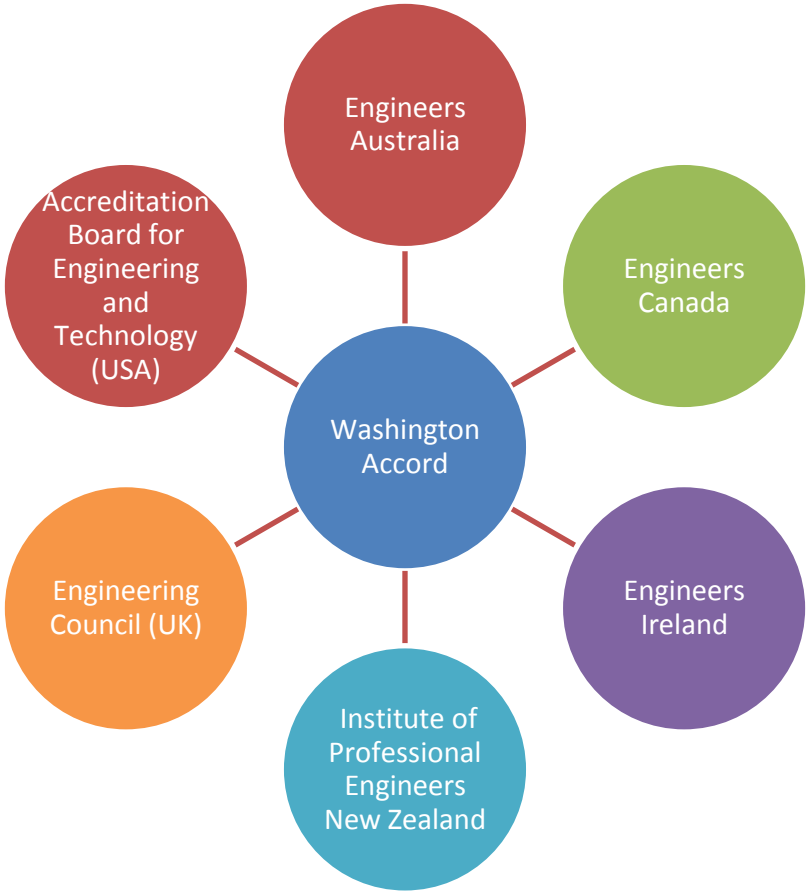
Framework standards for Engineering Education

(Global classification)

Framework standards for Engineering Education (Global classification)

Washington accord

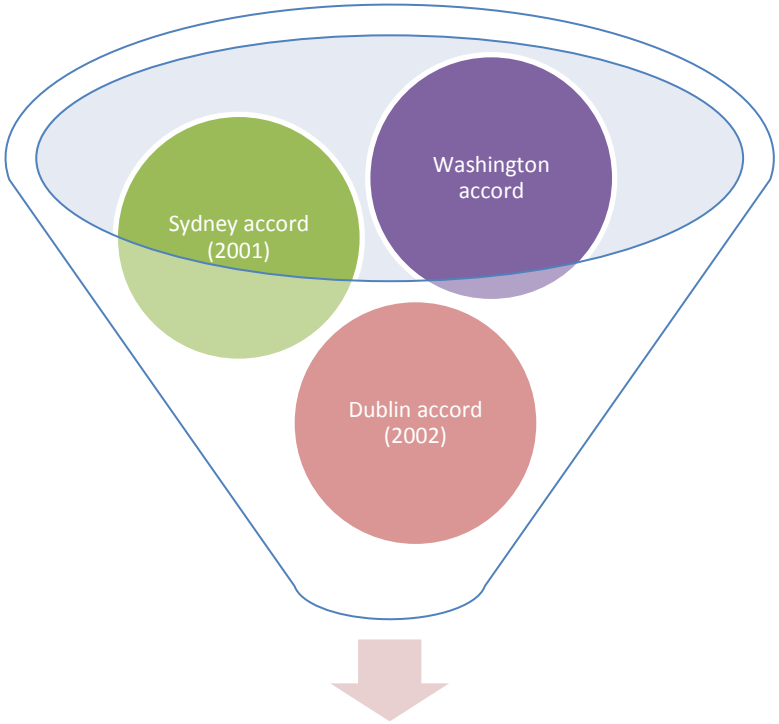
- 6 signatories in 1989
- Same rights and privileges to graduates of programmes accredited
- Makes use of Quality Assurance mechanisms to guarantee an informed recognition of competencies in engineering.



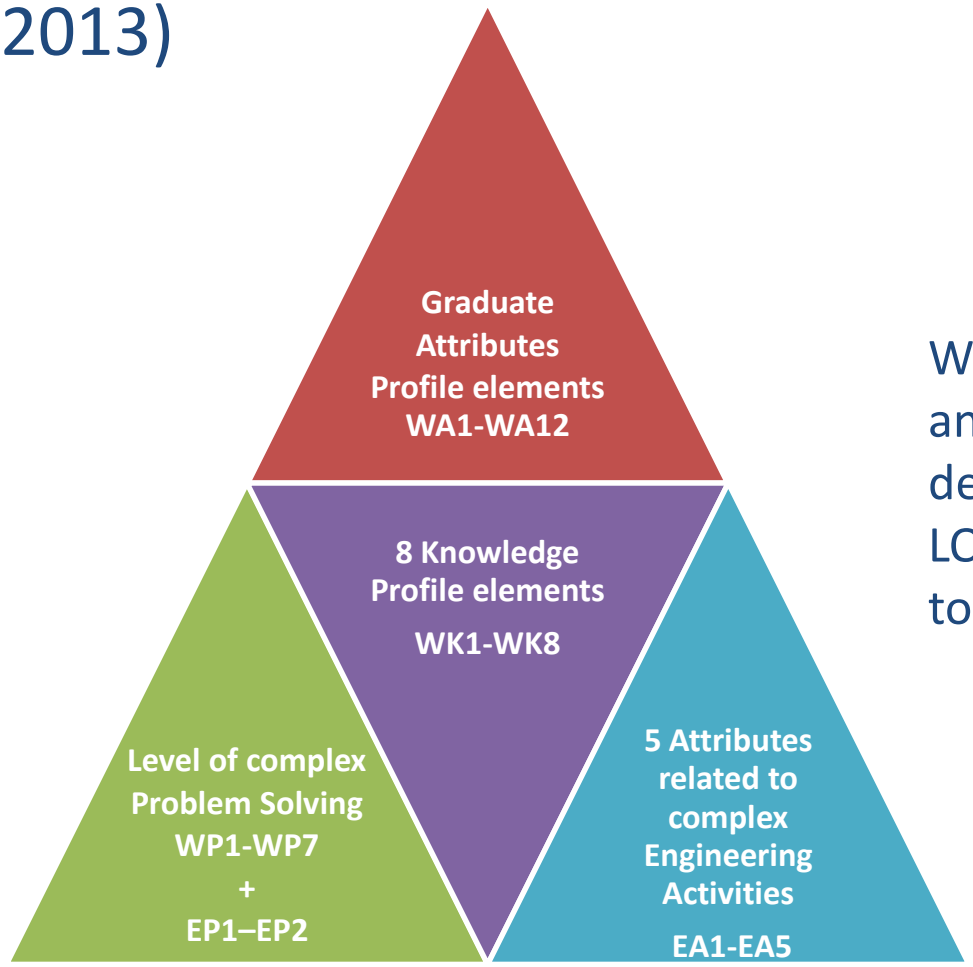
Framework standards for Engineering Education (Global classification)

IEA

- 2 similar accords (engineering technologists and engineering technicians)
- Establishment of the International Engineering Alliance
- Actually, 20 signatories + 5 provisional signatories



Graduates Attributes and Professional Competencies (IEA 2013)



WA descriptors appear to be an adaptation of the general descriptors of **level 7** in the LQF (Erasmus+ TLQAA+ WP1) to the engineering sector.

Framework standards for Engineering Education (Global classification)

EUR-ACE accord

- European Network for Accreditation of Engineering Education (ENAEE)
- 13 signatories in Europe
- To award EUR-ACE Label in addition to national accreditation.
- Accept each other's accreditation decisions about Bachelor and Master degree programmes

Framework standards for Engineering Education (Global classification)

EUR-ACE accord

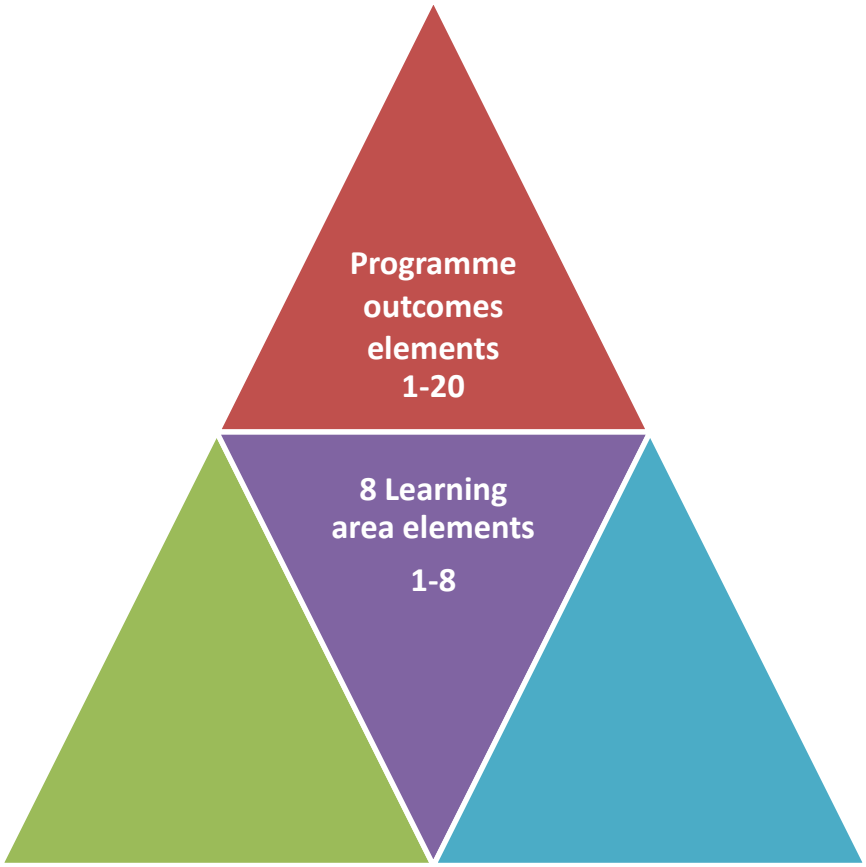
- Actually, 15 signatories
- 4 organizations are members in both Washington Accord and EUR-ACE Accord.
- Mutual understanding between IEA and ENAEE

Framework standards for Engineering Education (Global classification)
EUR-ACE Framework Standards (EAFS) by ENAEE

- The framework requires the **Programme Outcomes**:
  - To be expressed under knowledge, understanding, skills and abilities
  - To be used in both the design of an engineering programme by the higher education institution and its evaluation by an agency

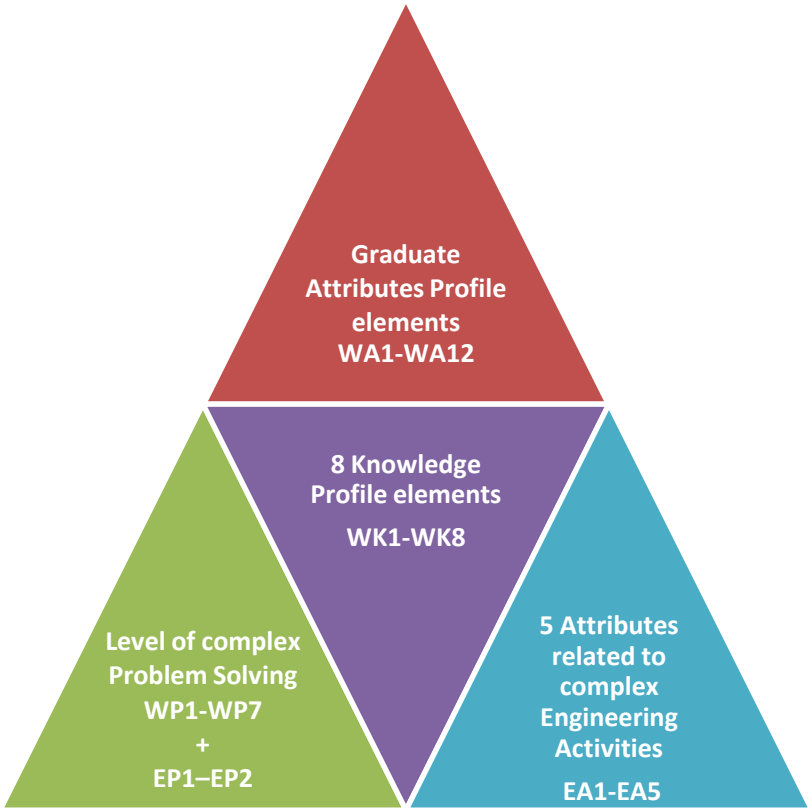
Framework standards for Engineering Education (Global classification)

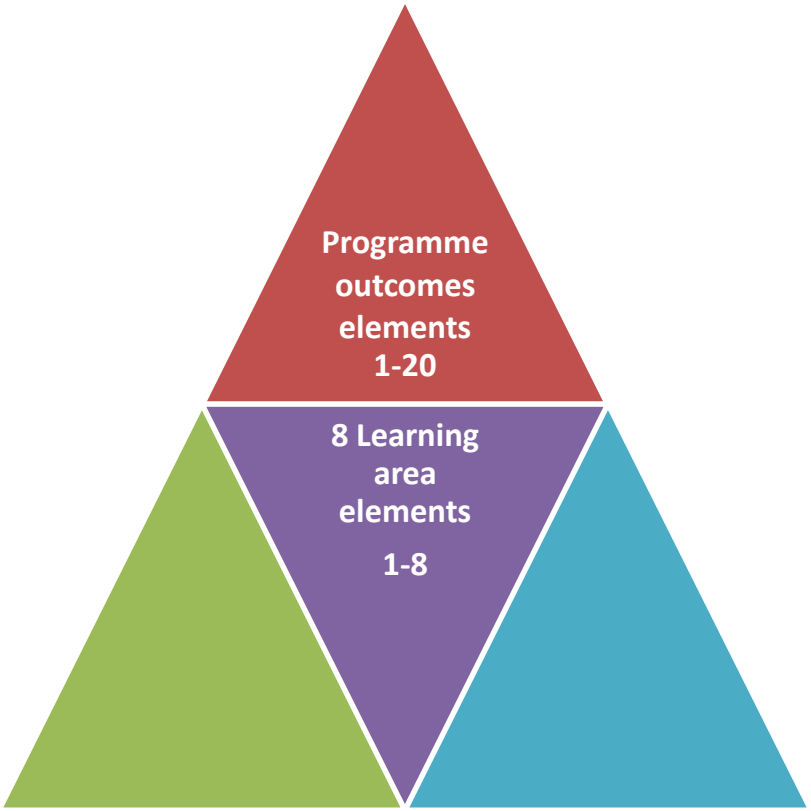
EUR-ACE Framework Standards (EAFS) by ENAEE



- The level of complex problem solving is highlighted between the Descriptors of Engineering Programme Outcomes for both Bachelor and Master levels.

WA vs EAFS


Graduate Attributes Profile elements WA1-WA12
8 Knowledge Profile elements WK1-WK8
Level of complex Problem Solving WP1-WP7 + EP1–EP2
5 Attributes related to complex Engineering Activities EA1-EA5


Programme outcomes elements 1-20
8 Learning area elements 1-8

ABET student outcomes

- Similarly to the **graduate attribute Profile of the WA** and the **Outcomes of an engineering programme of EUR-ACE**
  - ABET defines the attribute profile of a graduate from an engineering programme as **Student Outcomes**

ABET student outcomes

(a) an ability to apply knowledge of mathematics, science, and engineering (e) an ability to identify, formulate, and solve engineering problems	1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
(b) an ability to design and conduct experiments, as well as to analyse and interpret data	6. an ability to develop and conduct appropriate experimentation, analyse and interpret data, and use engineering judgment to draw conclusions
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
(d) an ability to function on multidisciplinary teams	5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
(f) an understanding of professional and ethical responsibility (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context (j) a knowledge of contemporary issues	4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
(g) an ability to communicate effectively	3. an ability to communicate effectively with a range of audiences
(i) a recognition of the need for, and an ability to engage in life-long learning	7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	Implied in 1, 2, and 6

CTI engineering outcomes

- French national agency, Since 1931
- Evaluation of engineering programmes
- A major specificity of CTI:
  - significantly consider the expectations of the professional fields for engineering graduates

- The CTI makes use of programme learning outcomes to designate the profile attribute of a graduate

CTI engineering outcomes

- The actual outcomes have been extended from previously 9 to 14 learning outcomes that are regrouped in 3 main categories as follow (CTI, 2016):
  - The Acquisition of Scientific and Technical Knowledge and the Ability of their implementation
  - The Adaptation to the Specific Requirements of an Enterprise or the Society
  - Taking into Account the Organizational, Personal and Cultural Dimension

CTI engineering outcomes evolution

- Considering the CTI learning outcomes and their evolution the following comments can be formulated:
  - *Going from 9 to 14 LO shows that CTI wants to focus on very specific aspects. An example is the ability to work in an international context.*
  - *The entrepreneurial ability is more highlighted in the recent version of the learning outcomes.*
  - *The Reflective practice is a distinctive learning outcome and is clearly identified in the learning outcome 14.*

Mapping ABET and the CTI Learning Outcomes

- The ABET Programme Outcomes and the CTI Learning Outcomes are comparable
- CTI Learning Outcomes are slightly more specific, while ABET groups together several programme outcomes
- CTI learning outcomes stress more on entrepreneurship, research activities and internationalisation

ABET	CTI	
1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics		Knowledge and understanding of a broad range of basic sciences and the related capacity to summarize and perform analysis,
		Aptitude to use the scientific and technical resources related to a specialty,
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	4.	The ability to design, implement, test and validate innovative solutions, methods, products, systems and services,
	7.	Aptitude to take on board business issues: economic dimension, respect for quality procedures, competitiveness and productivity, commercial requirements, business intelligence,
	8.	Aptitude to take on board the issues of work relations, endorsing ethics, responsibility, safety and health at work,
	9.	Aptitude to take on board environmental issues, particularly through the application of the principles of sustainable development,
	10.	Aptitude to take on board the issues and needs of the society.
3. an ability to communicate effectively with a range of audiences	7.	The ability to integrate into professional life, to integrate into an organization, to animate and drive it forward: self-awareness, team spirit, commitment and leadership, project management, communication capacity with specialists as well as with non-specialists,
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	8.	Aptitude to take on board the issues of work relations, endorsing ethics, responsibility, safety and health at work,
	9.	Aptitude to take on board environmental issues, particularly through the application of the principles of sustainable development,
	10.	Aptitude to take on board the issues and needs of the society.
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	11.	The ability to integrate into professional life, to integrate into an organization, to animate and drive it forward: self-awareness, team spirit, commitment and leadership, project management, communication capacity with specialists as well as with non-specialists,
6. an ability to develop and conduct appropriate experimentation, analyse and interpret data, and use engineering judgment to draw conclusions	3.	The ability or proficiency (la maitrise) to use engineering methods and tools: identification, modelling and problem solving, even those that are not familiar and not fully defined, the use of computing tools, the analysis and design of systems,
	5.	the ability to carry out research activities, fundamental or applied, and to set up experimentations, and to open up to the practice of collaborative work,
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies	14.	The ability to self-identify, self-assess, and self-manage skills (especially in a lifelong learning perspective), to make professional choices (Reflexive approach).
	6.	The ability to find, evaluate and use relevant information.
	12.	The ability to undertake and innovate, as part of personal projects or through initiative and involvement within the company in entrepreneurial projects,
	13.	Aptitude to work in an international context: command of one or more foreign languages and associated cultural openness, ability to adapt to international contexts,

Lebanese Engineers (Engineering Descriptors for LQF)

ABET	CTI	Lebanese Engineers
1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	1. Knowledge and understanding of a broad range of basic sciences and the related capacity to summarize and perform analysis, 2. Aptitude to use the scientific and technical resources related to a specialty,	1. Assimilate and use scientific and technical engineering resources 2. Solve engineering problems by applying principles of engineering, science and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	4. The ability to design, implement, test and validate innovative solutions, methods, products, systems and services, Aptitude to take on board business issues: economic dimension, respect for quality procedures, competitiveness and productivity, commercial requirements, business intelligence, Aptitude to take on board the issues of work relations, endorsing ethics, responsibility, safety and health at work, Aptitude to take on board environmental issues, particularly through the application of the principles of sustainable development, Aptitude to take on board the issues and needs of the society.	1. Design, implement and test engineering solutions, systems and services 2. Respect economic/commercial dimension, quality, competitiveness, productivity, safety, and sustainability in the design and implementation of an engineering solution
3. an ability to communicate effectively with a range of audiences	The ability to integrate into professional life, to integrate into an organization, to animate and drive it forward: self-awareness, team spirit, commitment and leadership, project management, communication capacity with specialists as well as with non-specialists,	Communicate clearly and effectively
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	Aptitude to take on board the issues of work relations, endorsing ethics, responsibility, safety and health at work, Aptitude to take on board environmental issues, particularly through the application of the principles of sustainable development, Aptitude to take on board the issues and needs of the society.	Apply professional codes and respect ethical and professional values while exercising engineering
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	11. The ability to integrate into professional life, to integrate into an organization, to animate and drive it forward: self-awareness, team spirit, commitment and leadership, project management, communication capacity with specialists as well as with non-specialists,	7. Work in a team and lead the development of engineering practices and processes 8. Advance engineering knowledge, practices, processes and systems
6. an ability to develop and conduct appropriate experimentation, analyse and interpret data, and use engineering judgment to draw conclusions	The ability or proficiency (la maitrise) to use engineering methods and tools: identification, modelling and problem solving, even those that are not familiar and not fully defined, the use of computing tools, the analysis and design of systems, the ability to carry out research activities, fundamental or applied, and to set up experimentations, and to open up to the practice of collaborative work,	
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies	14. The ability to self-identify, self-assess, and self-manage skills (especially in a lifelong learning perspective), to make professional choices (Reflexive approach).	9. Apply enquiry competences and search for new engineering solutions and systems 10. Adapt to new working contexts
	12. The ability to undertake and innovate, as part of personal projects or through initiative and involvement within the company in entrepreneurial projects,	
	13. Aptitude to work in an international context: command of one or more foreign languages and associated cultural openness, ability to adapt to international contexts,	11. Work in an international context showing good linguistic skills and cultural knowledge
	The ability to find, evaluate and use relevant information.	

A set of 11 competencies for the Lebanese engineers is suggested and compared to the ABET and CTI list of required competencies.

These competencies need to be discussed and validated with different stakeholders.

Framing Engineering descriptors for LQF

- Considering the recommendations in WP1 that were stated for using of the LQF
- While having an observation on the Engineering competencies/outcomes presented so far
- We can identify that **80% of the engineering competencies can be mapped to the descriptors of Qualifications of Level 6 and Level 7**

Positioning related to core standards in WP5

Comparative study: Standards for engineering programmes

ABET		CTI	TLQAA+ Core Standards
Bachelor's	Master's		
Students	Students and Curriculum	Enrolment of students	Assessment and Student Success
		Employment of graduates	
Student's Outcomes		Engineering programme	
Program Educational Objectives			Curriculum
Curriculum			
Continuous Improvement	Program quality	Quality process and continuous improvement	Continuous Improvement
Faculty	Faculty	Engineering programme	Faculty
Facilities	Facilities		Student Services
			Budget, Resources and Facilities
Institutional Support	Institutional Support	Mission and organisation of the programme	Mission, Goals and Governance
		Partnership and openness	

Positioning related to core standards in WP5

Comparative study: Standards for engineering programmes

- There is a clear overlap between these standards
- CTI standards stress more on the enrolment and employability of the graduates as well as on the openness and international dimension of the programme.
- The Erasmus+ TLQAA+ core standards put forward the services offered to the students and the budget allocated to the programme.

Conclusion

- Based on the outcomes of WP1 and WP5 and on the study conducted:
  - Core standards have been adapted to the engineering education
  - QF descriptors have been defined relatively to the engineering sector

- Future consultation need to be done for fine tuning engineering descriptors for LQF.

Université Antonine

TLQAA+

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Thank you