



Asia - South East

**Reference Points
for the Design and
Delivery of Degree
Programmes in Civil
Engineering**



Reference Points
for the Design and Delivery
of Degree Programmes
in Civil Engineering

Tuning Asia-South East

Reference Points for the Design and Delivery of Degree Programmes in Civil Engineering

Authors:

Ahmad Farhan bin Mohd Sadullah, Universiti Sains Malaysia, Norhazilan Md
Noor, Universiti Teknologi Malaysia, Taksiah A Majid, Universiti Sains Malaysia,
Mastura Azmi, Universiti Sains Malaysia

Other contributors

Withit PANSUK, Chulalongkorn University
Thu NGUYEN, Ho Chi Minh University of Technology
Umboro LASMINTO, Institut Teknologi Sepuluh Nopember
Virak HAN, Institute of Technology of Cambodia
Aphinat ASHAKUL, King Mongkut's University of Technology, Thonburi
Dondrej TUNGtakanPOUNG, Naresuan University
Tian Dung NGUYEN, National University of Civil Engineering
Neil Edwin ESCALONA, University of San Augustin
Karl VERGEL, University of the Philippines System

2019
University of Deusto
Bilbao

Reference Points for the Design and Delivery of Degree Programmes in Civil Engineering

Reference Points are non-prescriptive indicators and general recommendations that aim to support the design, delivery and articulation of degree programmes in Civil Engineering. Subject area group including experts from South East Asia and Europe has developed this document in consultation with different stakeholders (academics, employers, students and graduates). This publication has been prepared within Tuning Asia – South East (TA-SE) project 573760-EPP-1-2016-1-ES-EPPKA2-CBHE-JP.

This project has been funded with support from the European Commission. The European Commission's support for the production of this publication does not constitute an endorsement of the contents, which reflect the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Authors: Ahmad Farhan bin Mohd Sadullah, Universiti Sains Malaysia, Norhazilan Md Noor, Universiti Teknologi Malaysia, Taksiah A Majid, Universiti Sains Malaysia, Mastura Azmi, Universiti Sains Malaysia

© Tuning

Although all material that has been developed as part of the Tuning project and is owned by its formal participants, other Higher Education Institutions are free to test and use the material after publication, provided that the source is acknowledged.

No part of this publication, including the cover design, may be reproduced, stored or transmitted in any form or by any means, whether electronic, chemical, mechanical, optical, by recording or photocopying, without prior permission of the publisher.

Cover design: Estugraf Impresores, SL (Madrid)
© Deusto University Press
Apartado 1 - 48080 Bilbao
e-mail: publicaciones@deusto.es

ISBN: 978-84-1325-046-5
Printed in Spain

EXECUTIVE SUMMARY

The quest to nurture the most appropriate students and graduates for the future has been high on the agenda of institutions of higher learning for many years. The TUNING methodology was introduced to facilitate this effort with the primary intention of developing graduates with the desired attributes and competencies. TUNING also aspires to enhance the student's learning experience throughout their academic years.

This report shares the experience of 11 selected universities offering civil engineering-related academic programmes, which were selected to be part of the TUNING Academy's endeavour known as TUNING Asia South East (TA-SE), dedicated to universities in the Southeast Asia region. The group is referred to as the Civil Engineering Subject Area Group (SAG) of the TA-SE. The TA-SE has two other SAGs, namely the Medical Education SAG and the Teachers' Education SAG.

The report begins by explaining the TUNING philosophy, comparing and contrasting it to the other methodologies adopted for Outcome-Based Education (OBE), especially when many civil engineering programme owners are already subject to some form of professional accreditation. The report then goes on to describe the steps of the TUNING methodology, by first highlighting the SAG's efforts in determining generic and specific competencies and then outlining the approach taken, and the highlights of creating the ME-TA-PROFILE used.

The respective design of each member university is then described, followed by a more in-depth description of their experience by Universiti Sains Malaysia (USM), the implementing university (see Chapter 5). Other than USM, of the TEN-STEP process of the TUNING Methodology, the remaining ten programme owners only performed up to the DESIGN stage. APPENDIX A provides a self-account and narration by all universities on their TUNING Experience.

The report concludes by setting forth challenges and recommendations, not only regarding the experience of the SAG, but also for TUNING ACADEMY to ensure the sustainability of TUNING going forward.

Table of contents

EXECUTIVE SUMMARY	5
PREFACE	9
1. INTRODUCTION	13
1.1. Competencies of graduates in civil engineering	13
1.2. The TUNING methodology	14
1.3. Aligning the TUNING methodology with Outcome-Based Education (OBE)	15
1.4. The participating universities in TUNING CIVIL ENGINEERING SAG	18
1.5. Report Objectives	19
2. STUDENT COMPETENCIES FOR CIVIL ENGINEERING	21
2.1. Design and Methodology	21
2.2. Generic Competencies	22
2.3. Specific Competencies	24
2.4. Consultation Process of Generic and Subject-Specific Competencies	24
2.4.1. Online Survey	25
2.4.2. Selection of Stakeholders	25
2.4.3. Analysis of Survey Results	26
2.5. Improvement on List of Specific Competencies	30
3. DEVELOPMENT OF META-PROFILE FOR CIVIL ENGINEERING	33
3.1. Initial Framework of Meta-Profile for Civil Engineering	33
3.1.1. <i>Attributes of 21st Century Learners</i>	34
3.1.2. The 4 th Industrial Revolution	35
3.1.3. Sustainable Development Goals	36

3.2.	Meta-Profile Concept	37
3.3.	Consultation on Meta-Profile	40
3.4.	Critical Analysis of Meta-Profile with existing Academic Programmes	42
4.	PROGRAMME DESIGN	43
4.1.	From Meta-Profile to Programme Design	43
4.2.	Academic Programme Design of Member-Universities	44
4.3.	Study Load Survey	44
5.	IMPLEMENTATION OF TUNING AT UNIVERSITI SAINS MALAYSIA	51
5.1.	The Existing programme at the School of Civil Engineering, Universiti Sains Malaysia	51
5.2.	Alignment of the TUNING approach and the OBE Practiced	55
5.3.	Identification of Gaps	58
5.4.	The Adopted Change	61
5.5.	Implementation of Experience and Results	67
5.6.	Recommendations	68
6.	CONCLUSIONS	69
6.1.	Reflection by Individual Universities	69
6.2.	Challenges of Adoption	69
6.3.	End Notes	70
	REFERENCES	72
	APPENDIX A: A short brief by Civil Engineering SAG members on TUNING Methodology Application	73

PREFACE

Internationalisation of higher education in Southeast Asia is a multidimensional process that promotes the development of an integrated higher education space in the region. In this context the ASEAN University Network (AUN) plays a crucial role, providing a platform for discussions on policy development for higher education, and strengthening existing cooperation networks among universities in Southeast Asia.

In 2016, AUN and the Tuning Academy started an Erasmus+ project with the goal of achieving cross-border collaboration, sub-regionally and regionally, in curriculum development, educational standards and quality assurance; joint structural convergence, consistency of systems, as well as compatibility, recognition and transfer of degrees in order to facilitate mobility. As a result, the Tuning TA-SE project was adopted as a possible instrument for advancing the Southeast Asian cooperation process with curriculum at the heart of the initiative.

The Tuning Asia-South East (TA-SE) project uses the “*Tuning methodology*”, which has been successfully implemented in 130 countries since 2000. It is a university-driven project which aims to offer higher education institutions and subject areas a concrete approach to implementing competency-based and student-oriented approaches. Most importantly, Tuning has served as a forum for developing reference points at subject area level. These are relevant for making programmes of studies comparable, compatible and transparent.

According to Tuning, the change from a staff-centred approach to a student-oriented approach emphasises the fact that it is the students who have to be prepared to the greatest extent possible for their future roles in society. At this moment in the global process of reforms in higher education, it is experientially clear that it is not enough just to desire change, or even to programme it at the general level, but rather it is necessary to consider processes and tools at the institutional level.

The TA-SE project has brought together a group of experts, highly qualified in their fields, from 23 reputed higher education institutions in 7 countries in Southeast Asia (Cambodia, Indonesia, Malaysia, Myanmar, the Philippines, Thailand and Vietnam). It has provided a structured way for them to work together, both on issues regarding 3 subject areas (Civil Engineering, Medicine and Teacher Education) and on aspects relevant to the entire area of higher education. Much of Tuning's work focuses on the role of subject areas. This aspect of Tuning reflects the conviction that only those who have actual knowledge and experience in teaching and research at an advanced level can create the framework for developing new programmes and guarantee their quality, in design and delivery, in the new global context.

The TA-SE project has provided a platform for developing understanding and insight into how this can be best accomplished. In a carefully organised process of dialogue and debate, all the universities involved have reached deeper levels of understanding regarding the elements which constitute the essence of degree programmes in a national and international setting. Both common and diverse elements have been identified and formulated in wording which is commonly understood. For the last nineteen years, Tuning has proved to be an effective way of reaching international consensus while respecting –and indeed positively implementing– the rich diversity of educational traditions and the specific experience and insight of different subject areas.

In the course of its operation, the TA-SE project has developed a common language and conceptual framework. Thus, it favours dialogue between different academic traditions and facilitates mutual understanding and transparency between universities and the broader community of stakeholders –i.e. ultimately society at large. It has stimulated a process of reflection, development and innovation in higher education programmes. All of this has constituted an intense and demanding, but ultimately useful and rewarding, learning process for all involved. The TA-SE project empowered those who are responsible directly for the design and implementation of curricula. The hands-on experience gave them the know-how and confidence to roll it out for their colleagues in other degree programmes.

The three subject area groups in TA-SE (Civil Engineering, Medicine and Teacher Education), developed final documents following a similar procedure to obtain their results. Through discussion, creation of reciprocal knowledge and mapping the ways the discipline is learned and taught in the various countries, insight was gained and consensus built on what constitutes the vital core of each subject area.

This book reflects the outcomes of the work done by the Civil Engineering Subject Area Group in the TA-SE project and shows in synthesis the consensus reached after intense, prolonged and lively discussions. The outcomes are presented in the standard format, introducing the methodology developed to design and to deliver degree programmes on the basis of well identified profiles and how this can be expressed in competencies and translated into learning outcomes. In general terms, we may consider that TA-SE project developed reference points for the design and implementation of degree programmes in Southeast Asia.

In the carrying out of the TA-SE project, the collaboration of numerous academics and administrative staff from Southeast Asian countries has been essential. A remarkable degree of talent, expertise, generosity, loyalty and commitment has distinguished the TA-SE project. We owe great gratitude to all the academics involved directly and indirectly in the elaboration process. They have shown tremendous commitment and imagination, finding new solutions and ways forward in an open and constructive dialogue. They have shown that Southeast Asian academics have the calibre and the vision necessary to tackle vital issues at an international level. Today's global society requires this kind of vision and commitment.

This project would never have been possible without the dedication and wisdom of the Subject Area Coordinators (Muhamad Saiful Bahri Bin Yusoff, Ahmad Farhan Bin Mohd Sadullah and Richard Jugar). They have been the pillars of the project, not only carrying great responsibility but also channelling discussions and debate in a constructive and stimulating manner. They have shown their ability to build consensus and reach outcomes which will prove useful for Southeast Asian Higher Education institutions in general.

We also want to thank the four implementing universities (West Visayas State University, Sanata Dharma University, Universiti Sains Malaysia and University of Malaya), who through their academic and administrative staff have offered us their time, energy and support to help meet our goals, piloting a concrete Tuning experience.

We would like to thank the European Commission, which through its Erasmus+ Programme has offered us the support that has made this project possible.

We express our sincere gratitude to Julia González and Robert Wagenaar, who created and initiated Tuning in 2000 and whose commitment and recommendations were invaluable during the implementation of the TA-SE project in the region. We also thank the eight

European experts (Emilien Azema, Diego Lo Presti, Emma Melgarejo, Riccardo Ruffoli, Jean-François Schved, Alfredo Soeiro, Anna Maria van Trigt and Maria Yarosh), who have greatly enriched the project, both with their wealth of knowledge and insight, and new questions and ideas.

This project means dreaming –imagining ways in which current practices can be transformed and improved. But it means not only dreaming of this future, but of getting down to the work of making it a reality. In doing this, we have appreciated the help of AUN Secretariat staff (Achavadee Wiroonpetch and Korn Ratanagosoom), who contributed to the organisation and success of the General Meetings and Policy Forums.

We would also like to highlight the important contribution made at each Policy Forum and plenary session by the people who spoke about their experiences and contributed and enriched the discussions. Our special thanks go to Maida Marty, Edurne Bartolomé and Jon Paul Laka, the experts in statistics from the University of Deusto who prepared consultations, analysed the data, and presented the results.

Finally, and indispensably to running the project at the University of Deusto, we would like to acknowledge the work of Ivan Dyukarev, TA-SE project manager, and Sara Goitia, project assistant, whose energy kept things moving and got the project completed on time and within budget, whose enthusiasm kept teams motivated and on track, and whose dedication ensured that the project obtained the best result possible. All members of TA-SE project highly appreciate their indispensable work. They have shown great devotion and commitment to the Tuning Asia-South East project.

We hope and believe that the material contained in this publication will be very useful for all higher education institutions wanting to implement a competency-based and student-oriented approach, and that it will help them find and use the most suitable tools for adapting or creating higher education programmes to respond to the needs of today's society.

PABLO BENEITONE,
Director of Deusto International Tuning Academy and

CHOLTIS DHIRATHITI,
Executive Director of ASEAN University Network

Bilbao and Bangkok, July 2019

1. INTRODUCTION

1.1. COMPETENCIES OF GRADUATES IN CIVIL ENGINEERING

Civil engineering is arguably the oldest profession in engineering and has successfully overcome many different challenges posed by centuries of evolution and development, including all the industrial revolutions. Perhaps one of the major reasons for this has been the resilience, creativity and the competencies of engineers. Civil engineers continue to marvel us through the design, construction and operationalisation of basic human needs, necessary infrastructure and many inspiring mega-structures and facilities.

In order to sustain such qualities, civil engineering education must continue to nurture graduates that possess attributes desirable by the profession and the industry. Higher education has been rather conventional for many centuries, until recently, when it has been widely acknowledged that recent and future generations of learners are remarkably different from their many century-long predecessors. These are 21st century learners, whose innate attributes have dramatically changed over the last few decades. They are commonly recognised as gen-y, gen-z, and now gen-Alpha learners.

The need to design and deliver civil engineering academic programmes capable of nurturing 21st century graduates with the desired attributes and competencies is becoming increasingly imperative and critical. This is important, as the current feeder students are generally less desirous of science, technology and mathematics; however, the need to produce future engineers with 21st century skill requirements is on the rise, and this brings us the biggest challenge. This is especially true, as the future civil engineers will perform their profession in a very challenging world, with expected future mega trends that will be much more technology-dependent, in a world with a higher aging population, and yet with older existing infrastructures.

Outcome-based education (OBE) aims to ensure that any academic programme is designed in a constructive alignment that will facilitate nurturing and producing graduates with the desired attributes. In Europe, the TUNING methodology has been widely recognised as the OBE equivalent, aspiring to play similarly important roles.

This document reports the efforts made by the civil engineering Subject Area Group (SAG) of TUNING Asia South East (TA-SE) which commenced in Bilbao, Spain on 3 May 2017.

1.2. THE TUNING METHODOLOGY

The TUNING methodology stemmed from the European Bologna Process in the year 2000, the original intentions of which were to ensure comparable and compatible systems of higher education in order to facilitate mobility, increase employability, allow equitable student access and progression, and to strengthen Europe's attractiveness and competitiveness worldwide.

In order to meet these aspirations, the TUNING methodology was developed based on two important pillars, namely:

- a. The design of compatible and comparable degree programmes that are relevant to society and have in-built mechanisms for maintaining and improving quality
- b. A contribution to a full implementation process supporting capacity building – continuous staff development and research into curriculum development, teaching, learning and assessment (scholarship of teaching and learning)

The TUNING Academy has best described the TUNING methodology through an infographic shown as Figure 1.1.

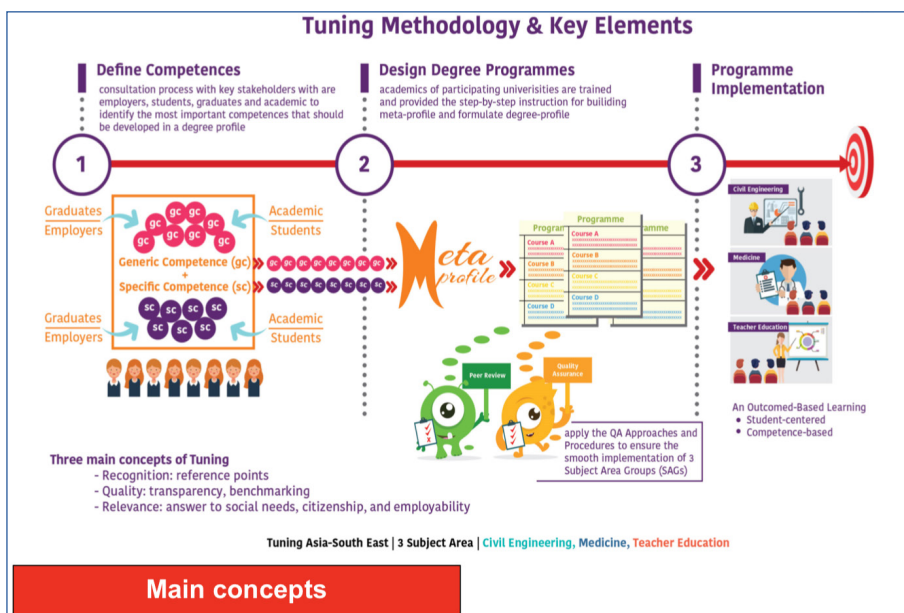


Figure 1.1: Infographic for TUNING approach
(source: Forum SAE TUNING, Bangkok, 2018)

1.3. ALIGNING THE TUNING METHODOLOGY WITH OUTCOME-BASED EDUCATION (OBE)

At first exposure to the TUNING methodology, many of us who were familiar with OBE sensed immediately that both TUNING and OBE have similarities. The ultimate aim is the same, i.e., to nurture graduates to have the desired competencies as an individual, generally, and as a civil engineer, specifically. Both methodologies prepare graduating engineers to be able to be employed and be global professional engineers.

The TUNING methodology can be categorised into the following steps:

- i. Consulting
- ii. Profiling
- iii. Designing
- iv. Learning
- v. Evaluating
- vi. Enhancing

Whilst there are many similarities between TUNING and OBE, there are also differences, which may be the strategic differentiation for the TUNING methodology over the practices of OBE in the other civil engineering education settings. The following are some of the comparisons made:

1. Consulting

This is the first apparent difference noticed. In the TUNING methodology, much effort is taken to define the desired generic and specific competencies of the graduates. This approach differs from the approach taken by many qualification agencies, such as the ASEAN Universities Network Qualification Agency (AUN-QA), the Malaysian Qualification Assurance (MQA), and the Malaysian Engineering Accreditation Council (EAC), where the competencies or outcomes are typically pre-defined by the accreditation bodies. The TUNING approach empowers academic programme owners to define the list of generic and specific competencies that best suit the needs of the most relevant stakeholders. Through this, the TUNING approach allows academic programme owners to pre-define the differentiating attributes of their graduates as part of the design of the academic programme.

2. Profiling

The TUNING methodology emphasises the philosophy behind the design of any curriculum. The term “META-PROFILING” is being used to put all the competencies into a framework that incorporates intangible attributes, such as values, and also other generic, but critical, outcomes. The owners of academic programmes are able to design a profile that is deemed fit for the desired attributes, with the inclusion of other attributes that are innate to the intended eco-system.

One may include important future global agenda such as the Sustainable Development Goals (SDG), 21st Century Skills, future industrial revolutions (i.e. the 4th Industrial Revolution), or others that may represent a local culture or context. The Meta-Profile may also incorporate some form of gap analysis, or if necessary and desired, it may also represent different weightages to reflect varying degrees of importance on the lists of competencies.

The META-PROFILE will provide the framework upon which the design of the academic programme will be based. This is rather

unique to the TUNING methodology and is definitely a strategic differentiator compared to others.

3. Designing

The design of the academic programme will be based on the Meta-Profile. Designing in the TUNING approach involves TEN steps, which are explained in Table 1.1. These ten steps are very similar to other qualification framework for OBE, which is commonly known as the “Constructive Alignment” for OBE academic programmes.

Table 1.1: The TEN Design Steps in the TUNING Methodology

1	Name of the new or revised programme	6	Linking the degree with the agreed META-Profile
2	Length and level of the programme	7	Define the structure of the programme
3	Explain the social need of the new or revised programme	8	Programme overall consistency
4	Future fields, sectors of employment of graduates	9	Internal Quality Control/Enhancement
5	Description of the degree profile (outcomes and competencies)	10	Other relevant aspects

4. Learning

The teaching and learning activities in any academic programme shall be delivered and ensured, such that the attainment of the outcomes and competencies will be met. Not much is being discussed in this category, except for an effort to make a critical analysis of the student workload (both formal and self-learning). This is also known as the Student’s Learning Time (SLT) in other frameworks. Other OBE frameworks have addressed the learning aspects in greater detail.

5. Evaluating

The TA-SE effort did not focus much on evaluating, as the coaching was primarily up to the design stage. However, the implementation university, namely Universiti Sains Malaysia, was given exposure to the CALOHEE project (Measuring and Comparing Achievements of Learning Outcomes in Higher Education in Europe).

Assessing learning outcome attainment is highly critical to ensuring the academic programme is properly designed and the subsequent delivery and learning experience have helped students towards attaining their learning outcomes, and thus the desired competencies.

The Washington Accord practice places greater importance on assessment and the evaluation process, which is regarded as the confirmation to a properly executed constructive alignment during the design stage of the academic programme.

6. Enhancing

In any quality effort, the Plan-Do-Check-Action (PDCA) principle must be a critical element. The TA-SE endeavour has not focussed on this matter, but the SAG team acknowledges the need for “Closing the Loop” as part of continual quality improvement (CQI), as prescribed by many OBE quality frameworks.

1.4. PARTICIPATING UNIVERSITIES IN THE TUNING (TA-SE) CIVIL ENGINEERING SUBJECT AREA GROUP (SAG)

Eleven universities from six countries make up the TA-SE Civil Engineering SAG. The privileged universities are as follows:

	University	Country
1	Chulalongkorn University	Thailand
2	King Mongkut’s University of Technology, Thonburi	Thailand
3	Naresuan University	Thailand
4	University of the Philippines (Diliman)	Philippines
5	University of San Augustin	Philippines
6	Universiti Teknologi Malaysia	Malaysia
7	Universiti Sains Malaysia	Malaysia
8	National University of Civil Engineering	Vietnam
9	Ho Chi Minh University of Technology	Vietnam
10	Institute of Technology of Cambodia	Cambodia
11	Institut Teknologi Sepuluh Nopember	Indonesia

One of the universities, namely Universiti Sains Malaysia has agreed to be the implementing university and has gone through the ten steps of the TUNING methodology. The remaining ten universi-

ties were also exposed and have participated up to the “designing” stage. Some background on the universities is given in Appendices A of their respective sections.

1.5. REPORT OBJECTIVES

The objectives of this report are to document and share the experience of the TA-SE Civil Engineering SAG in the implementation of the TUNING methodology for outcome-based education.

2. STUDENT COMPETENCIES FOR CIVIL ENGINEERING

2.1. DESIGN AND METHODOLOGY

The first general meeting introduced a general concept of student competencies based on previous TUNING projects in 120 countries aimed at implementing Bologna tools in selected universities by building a framework of comparable, compatible and transparent programmes of studies. This was meant to develop an understanding among participants of how the bottom-up approach under the TUNING methodology can be used to design a new engineering curriculum with outcome-based education (OBE) elements. The proposed new curriculum will be student-centred, competency-based, relevant to the current job market, respond to social needs, be globally recognised and quality assured through global benchmarking. A new list of competencies is required to develop a Meta-Profile for curriculum design of the civil engineering programme. Prior to the competencies selection process, every participant presented the existing curriculum structure of their respective institution.

Competency-based curricula can guide institutions to determine whether their education programme has the ability to prepare their students with a specific set of skills, knowledge and values for them to perform a specific task related to their job scope. Skill alone will only reflect the ability to perform a task, but is not sufficient to tell us how successfully the task can be executed by the student. This is where competencies play a vital role in shaping the student for the future requirements of the industry and society. A round-table session was conducted to shortlist relevant student competencies. Competency-based learning refers to systems of instruction, assessment, grading, and academic reporting that are based on students demonstrating that they have learned the knowledge, skills, attitude and values they are expected to learn as they progress through their education (Gervais, 2016).

The shortlisted competencies were discussed in detail in order for them to meet the requirement and expectation of every institution involved in this project as well as being very concise and clear. This is to ensure that the proposed competencies can fulfil the aspirations of stakeholders across the ASEAN region. The final list of competencies should be mutually agreed by all members. According to the TUNING methodology, the proposed Meta-Profile of the civil engineering curriculum should be developed based on generic and specific competencies. The separation of competencies into generic and specific groups is seen as a good strategy to harmonise competencies among different Specific Area Groups (SAGs) whilst maintaining the signature competencies of the civil engineering programme. Moreover, the curriculum design process would be more methodical, whereby student achievement could be evaluated according to generic and specific competencies.

It is worth noting that the majority of engineering programme owners represented in the SAG have been exposed to outcome-based education. Many subscribe to the requirements of their own engineering board's accreditation system or directly to the OBE system prescribed by the Accreditation Board for Engineering and Technology (ABET). As such, many have already defined their own programme outcomes, which are very similar to the generic competencies and specific competencies as defined by the TUNING methodology. However, having the SAG for civil engineering did not confine our suggestions to the existing list. We deliberated on the depth of the specific competencies, especially when we had a choice to be as generic as possible across the many civil engineering disciplines. We agreed not to be discipline specific, except where we felt it was a fundamental requirement for any civil engineer.

2.2. GENERIC COMPETENCIES (FOR ALL SPECIFIC AREA GROUPS)

Generic competencies under the TUNING approach reflect common knowledge and skills required by students across all SAGs including the Civil, Teacher Education and Medical subject areas. The proposed list of competencies must be mutually agreed not just at specific SAG level but also among SAGs. The proposed list was also benchmarked with 16 global competencies from previous TUNING projects. The benchmarking showed that the proposed generic list is in line with the global competencies. Tables 2.1 and 2.2 list the global competencies and the finalised generic competencies for all subject areas, respectively.

Table 2.1: List of global competencies (Beneitone, 2017)

No.	Generic competencies
1	Problem solving and Decision making
2	Oral and written communication
3	Interpersonal skills
4	Critical and self-critical abilities
5	Teamwork
6	Ethical commitment
7	Creativity and Concern for quality
8	Ability to work autonomously
9	Capacity to learn actively and Computing skills
10	Information management skills and Ability to apply knowledge in practice
11	Commitment to the conservation of the environment
12	Problem solving and Decision making
13	Oral and written communication
14	Interpersonal skills
15	Critical and self-critical abilities
16	Capacity for abstract thinking, analysis and synthesis

Table 2.2: List of student generic competencies

No.	Generic competencies
1	Ability to work collaboratively and effectively in diverse contexts
2	Ability to use information and communication technology purposefully and responsibly
3	Ability to uphold professional, moral and ethical values
4	Ability to demonstrate responsibility and accountability towards society and the environment
5	Ability to communicate clearly and effectively
6	Ability to think critically, reflectively and innovatively
7	Ability to understand, value, and respect diversity and multiculturalism
8	Ability to carry out lifelong learning and continuous professional development
9	Demonstration of problem-solving abilities
10	Ability to initiate, plan, organise, implement and evaluate courses of action
11	Ability to conduct research
12	Ability to demonstrate leadership attributes
13	Ability to apply knowledge into practice

2.3. SPECIFIC COMPETENCIES FOR CIVIL ENGINEERING GROUP

A shortlist of 14 specific competencies was agreed upon by the members of the Civil Engineering SAG, as listed in Table 2.3. The proposed list was deeply consulted among members by considering current social needs and job market patterns in the ASEAN region.

Table 2.3: List of student specific competencies

No.	Specific competencies for civil engineering
1	Ability to demonstrate entrepreneurial attributes (creativity, risk-taking, resilience and innovation) – transferred from the original generic competency
2	Ability to show strong knowledge in science and mathematics (including statistics)
3	Ability to interpret engineering drawings
4	Ability to create algorithms to solve engineering problems
5	Ability to understand principles of material science
6	Ability to carry out civil engineering analyses
7	Ability to interpret engineering data from testing
8	Ability to utilise relevant design codes and regulations
9	Ability to design civil engineering elements (e.g. structural, geotechnical, water, transportation and highway, environmental engineering, and others)
10	Ability to monitor the progress and quality of civil engineering works
11	Ability to identify the appropriate construction technology and methods
12	Ability to uphold safety measures
13	Ability to evaluate the impact of engineering decisions
14	Ability to integrate all civil engineering knowledge into a workable system

2.4. CONSULTATION PROCESS OF GENERIC AND SUBJECT-SPECIFIC COMPETENCIES

The elaboration and identification of generic and subject-specific competencies from the first general meeting was then followed by a consultation process by online survey/consultation. Based on the TUNING methodology, the consultation process of the different stakeholders is meant to identify three important variables, which are the “*importance, achievement and ranking*” of generic and subject-specific competencies. These three variables play an important role as a foundation for the development of the Meta-Profile. “Importance” will indicate the level of urgency for any particular competency to be considered in the curriculum design process. Any competency that is labelled as “important” should be given a much higher priority and more coverage by courses during the curriculum design stage. Meanwhile, the “*achieve-*

ment” variable will disclose how far the existing curriculum has managed to cover the generic and subject-specific competencies, as proposed during the first general meeting. The hierarchy of the competencies can then be developed based on the “*ranking*” variable.

2.4.1. Online Survey

Each member of the SAG was assigned a task to consult stakeholders from their institution and country for their response on the “*importance, achievement and ranking*” of generic and subject-specific competencies. The consultation process was conducted through an online TA-SE survey system from 16 June 2017 to 17 July 2017. The survey exercise aimed to provide a practical platform for universities in ASEAN to enhance mutual understanding of degrees across Southeast Asia and the European Union through mutual work and discussion (Dyukarev, 2017). This included consideration of what the focus of the studies might be, the teaching, learning and assessment approaches, quality assurance and the credit weight of courses. The survey was divided into two parts of generic and specific competencies. Part-1 asked the respondent to assess the importance of generic competencies in the educational programme in order to identify the “*important*” variable. The “*achievement*” variable was identified through responses on the extent to which these generic competencies are developed in the university. At the end of the survey section, the respondent was required to rank the top-5 most important competencies for the “*ranking*” variable. The respondent had to answer the question about the institution from which they graduated (for graduates), were about to graduate (for students), in which they work (for academics), or cooperate (for employers). In Part-2, the respondent answered a similar set of questions but this time on subject-specific competencies (see Figure 2.1).

2.4.2. Stakeholder Selection

Four stakeholders were involved in the online consultation process to attain the views from a range of different and equally important groups of people: actual students, graduates, academics who teach in universities, and employers. The responses from these different groups of stakeholders gave a comprehensive view of the future needs of competencies that are relevant across stakeholders. The required minimum number of the respondents was set at 30 persons per institution, per stakeholder (30 academics, 30 students, 30 graduates, 30 employers).

2.4.3. Analysis and Results of Survey

The survey carried out by the TA-SE group yielded the following number of responses. The number of responses was regarded by the Tuning Academy study team as extremely satisfactory (see Table 2.4). The following are some of the general points made by the Civil Engineering SAG with regard to generic and specific competencies.



TUNING Asia-South East (TA-SE): Questionnaire on Civil Engineering Specific Competences
(for Graduates, Employers, Academics and Students)

This questionnaire presents a series of questions related to the *Civil Engineering Specific Competences* that may be important for success in a career. Please answer all the questions. The answers may be very valuable in improving course planning for future students. Please select the best option in each case.

For each of the competences listed below, please estimate:

- the **importance** of the competence, in your opinion, for work in your profession;
- the **level** to which each competence is developed by degree programmes at your university.

The blank spaces may be used to indicate any other competences that you consider important but which do not appear on the list.

Please use the following scale:
1 = not important; 2 = important; 3 = very important; 4 = strong

Civil Engineering Specific Competences	Importance	Level to which developed by University Degree (Achievement)
1. Ability to demonstrate entrepreneurial attributes (creative, risk taking, resilient and innovative) – transferred from the original generic competency	<input type="checkbox"/>	<input type="checkbox"/>
2. Ability to show strong knowledge in science and mathematics (including statistics)	<input type="checkbox"/>	<input type="checkbox"/>
3. Ability to interpret engineering drawings	<input type="checkbox"/>	<input type="checkbox"/>
4. Ability to create algorithm to solve engineering problems	<input type="checkbox"/>	<input type="checkbox"/>
5. Ability to understand principles of material science	<input type="checkbox"/>	<input type="checkbox"/>
6. Ability to carry out civil engineering analysis	<input type="checkbox"/>	<input type="checkbox"/>
7. Ability to interpret engineering data from testing	<input type="checkbox"/>	<input type="checkbox"/>
8. Ability to utilise relevant design codes and regulations	<input type="checkbox"/>	<input type="checkbox"/>
9. Ability to design civil engineering elements (e.g.: structural, geotechnical, water, transportation and highway, environmental engineering, and others)	<input type="checkbox"/>	<input type="checkbox"/>
10. Ability to monitor the progress and quality of civil engineering works	<input type="checkbox"/>	<input type="checkbox"/>
11. Ability to identify the appropriate construction technology and methods	<input type="checkbox"/>	<input type="checkbox"/>
12. Ability to uphold safety	<input type="checkbox"/>	<input type="checkbox"/>
13. Ability to evaluate the impact of engineering decisions	<input type="checkbox"/>	<input type="checkbox"/>
14. Ability to integrate all civil engineering knowledge into a workable system	<input type="checkbox"/>	<input type="checkbox"/>
15. <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please rank below the five most important competences according to your opinion. Please write the number of the competence within the box. Mark on the first box the most important, on the second box the second most important and so on.

1. Number of the competence
2. Number of the competence
3. Number of the competence
4. Number of the competence
5. Number of the competence

Many thanks for your cooperation.

SUBMIT

Figure 2.1: Screenshot of online survey

The Civil Engineering SAG analysed the results of the survey to appreciate and understand the messages that can be derived as an indication of importance and the gap (between expectation and perception) from the 1,571 and 1,395 respondents for generic competencies and specific competencies, respectively. The results are summarised as below. The survey gave rise to two types of analysis, namely ranking and rating. Even though there is more information from the rating analysis, the SAG members felt that the results of the ranking process may have more credence since respondents were asked to rank their top five competencies. The extra thinking process associated with the ranking process may represent a more accurate perception (see Figures 2.2-2.4).

Data



NUMBER OF RESPONDENTS: GENERIC COMPETENCES

	Academics	Employers	Students	Graduates	TOTAL
ENGINEERING	297	222	688	364	1571
MEDICINE	330	224	754	305	1613
TEACHING EDUCATION	334	391	393	436	1554
TOTAL	961	837	1835	1105	4738

NUMBER OF RESPONDENTS: SUBJECT SPECIFIC COMPETENCES

	Academics	Employers	Students	Graduates	TOTAL
ENGINEERING	260	206	619	310	1395
MEDICINE	312	214	717	286	1529
TEACHING EDUCATION	327	373	387	423	1510

Table 2.4: Total number of respondents

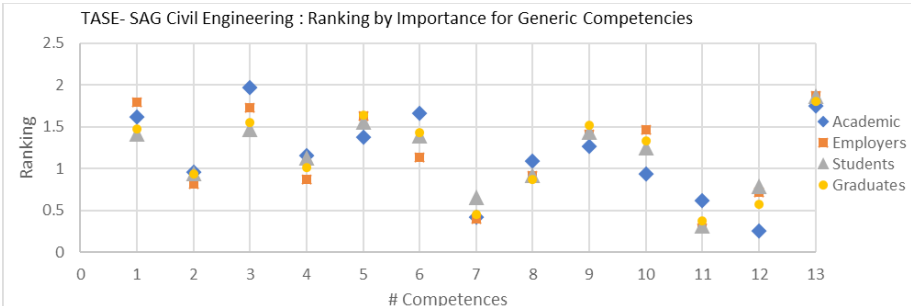


Figure 2.2: Ranking by importance for generic competencies



Figure 2.3: Rating vs Ranking for generic competencies



Figure 2.4: Rating vs Ranking for specific competencies

A marginal gap between achievement and importance is highly correlated with the bottom five generic and specific competencies. This indicates that the least important competency can be considered more successful in terms of achievement among all stakehold-

ers. The importance, achievement and gap marks are highly scattered for generic competency among all stakeholders. Graduates and students show low marks in gap across all generic and specific competencies. The importance and gap marks are highly scattered for specific competencies. However, achievement yields the most consistent pattern among all stakeholders. Ranking and rating are relatively uncorrelated for specific competencies as opposed to generic competencies.

The survey results were taken with caution. Asia participants are more courteous in answering; therefore the high marks may reflect this courteousness. There may be some discrepancies in the survey answers especially on “*achievement*” –due to the question “Level to which developed by university degree (achievement)”. As a result, the group was more cautious about using the gap analysis between “*importance*” and “*achievement*”. The group, however, agreed that all competencies (generic and specific) are important. Moreover, the numbers in the ranking should not be given too much emphasis as they are all important, notwithstanding, when the low items are consistent across all respondent categories, they must be scrutinised, especially if they can impact the ultimate outcome of a civil engineer. It is noticeable that ranking gives a better indication than rating because respondents have to think harder before they rank the best five in terms of importance.

2.5. IMPROVEMENT ON LIST OF SPECIFIC COMPETENCIES

Clarity in the expression of all competencies is important because these will be the outcomes based upon which civil engineering curricula will be designed. Some ambiguity may have occurred due to poor expression of the competencies during the survey stage. A revision of selected specific competencies was carried out before it can be finalised. Competencies, whether generic or specific, with low ratings/rankings should be revised for their level of importance by benchmarking with 21st century civil engineering attribute, 4th industrial revolution and Sustainable development goal (SDG). The purpose of the revision is to make the proposed meta-profile of competencies relevant to current and future needs. Table 2.5 shows the revised version of subject-specific competencies after considering the results of the survey and consultation held among SAG members.

Table 2.5: List of revised student specific competencies for civil engineering

No.	Specific competencies
1	Ability to show resilience
2	Ability to use knowledge in science and mathematics (including statistics)
3	Ability to interpret engineering drawings
4	Ability to create processes to solve engineering problems
5	Ability to apply the knowledge of material science
6	Ability to carry out civil engineering analyses
7	Ability to interpret engineering data
8	Ability to use relevant design codes and regulations
9	Ability to design civil engineering elements (e.g. structural, geotechnical, water, transportation and highway, environmental engineering, and others)
10	Ability to monitor the progress and quality of civil engineering works
11	Ability to identify the appropriate construction technology and methods
12	Ability to uphold safety measures
13	Ability to evaluate the impact of engineering decisions
14	Ability to integrate all civil engineering knowledge into a workable system

3. DEVELOPMENT OF META-PROFILE FOR CIVIL ENGINEERING

The results of the online consultation gave a clear indication on the level of importance and how to prioritise the list of competencies based on stakeholders' views. The list itself is not sufficient to become a point of reference for curriculum design. It is vital at this stage that the list of competencies be shaped into a framework with a clear indication of not just hierarchy and level of importance, but also the interdependency between competencies. The framework should represent a clear concept and philosophy for the basis of curriculum design via hierarchy, interdependency, and correlation with future demands. This is where the Meta-Profile comes into relevance before curriculum design can be executed.

Meta-Profile of student competencies will give an identity or a unique signature to the curriculum design of the subject area by combining competencies according to the chosen concept. On the basis of the list of competencies, the Meta-Profile will methodically show how all competencies are positioned within the profile framework with well-defined inter-relation between generic and specific competencies. It can showcase how all competencies inter-link with each other. Meta-Profile can be considered as mental constructions that categorise, structure and organise components into recognisable components and illustrate their inter-relations (Beneitone *et al.*, 2014).

3.1. INITIAL FRAMEWORK OF META-PROFILE FOR CIVIL ENGINEERING

A Meta-Profile will explain the all-round capacities of a civil engineering graduate, combining both generic and specific competencies. However, before the analysis was carried out, we took cognizance to the fact that all this effort was geared at ensuring our academic programmes and our graduates are of quality, relevant and recognised. The Meta-Profile would also incorporate some form of gap analysis and perhaps some weightage would be applied to reflect the varying

perceptions between “importance” and “achievement”. A framework was then formulated to incorporate the possible contributors, especially with regards to the uncertainties of the future.

For Civil SAG, the development of the Meta-Profile was based on inter and intra-relation between competencies, inner strengths, qualities, values and future challenges. Inner strengths and qualities represent different skills in terms of knowledge (engineering literacies), thinking (personal skills) and inter-personal (social) skills. Inner strengths and qualities are supported by values so that ethical elements are well embedded within the stated skills. The formation of this framework is supported by external factors related to the attributes of 21st century learners, the 4th Industrial revolution and the Sustainable Development Goals. The initial conceptual framework for the Civil SAG Meta-Profile is illustrated in Figure 3.1.

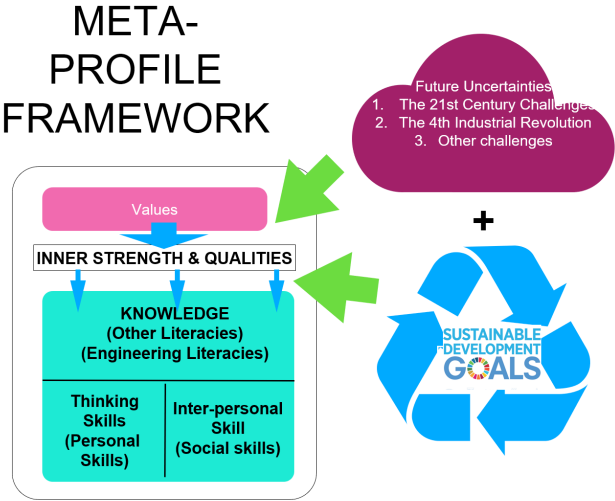


Figure 3.1: Initial framework of the Civil Meta-Profile

3.1.1. Attributes of 21st Century Learners

The term “21st Century Skills” is generally used to refer to certain core competencies grouped into foundational literacies, competencies related to complex challenges and character qualities. This group of competencies needs to be addressed by the current education system to help students thrive in today’s world (see Figure 3.2). According to

the World Economic Forum Report, there is a need to bridge the gap between the skills people learn and the skills people need since the gap is becoming more obvious. This is due to the shortfalls of traditional learning in equipping students with the knowledge they need to thrive in the future digital world (World Engineering Forum, 2016). Students’ ability to approach complex challenges must be accompanied by social and emotional proficiency through social and emotional learning (SEL) (World Engineering Forum, 2016). Combined with traditional skills such as ability to collaborate, critical thinking, creativity and communication, this social and emotional proficiency will equip students to succeed in the evolving digital economy (World Engineering Forum, 2016). The global education association is actively promoting the “21st Century Skills” agenda to become a shared goal and competency of education systems everywhere.

Exhibit 1: Students require 16 skills for the 21st century

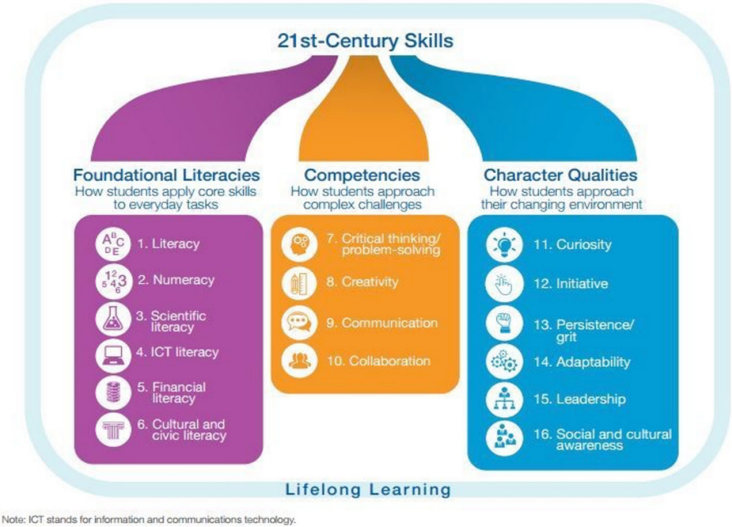


Figure 3.2: 21st Century Skills needed by students
(source: World Economic Forum (2015), New Vision for Education

3.1.2. The 4th Industrial Revolution

The Fourth Industrial Revolution (4IR) is the fourth major industrial era since the initial Industrial Revolution of the 18th century. The main criteria to define the 4IR concept is the fusion of technologies that is blurring the lines between the physical, digital, and biological spheres,

collectively referred to as cyber-physical systems [Schwab, 2016]. The spark of new emerging technology with extraordinary innovations such as artificial intelligence, space exploration, nanotechnology, quantum computing, 3D printing, fully autonomous vehicles, cloud computing, to name but a few, are disrupting almost every industry in every country. Students need to be equipped with a set of competencies so that they can prepare themselves to face the mega scale of digitisation and system integration via artificial intelligence. Programming skills and big data awareness are among elements that can accelerate the acclimatisation process and make students more relevant in a fast-moving and challenging industry climate in the future.

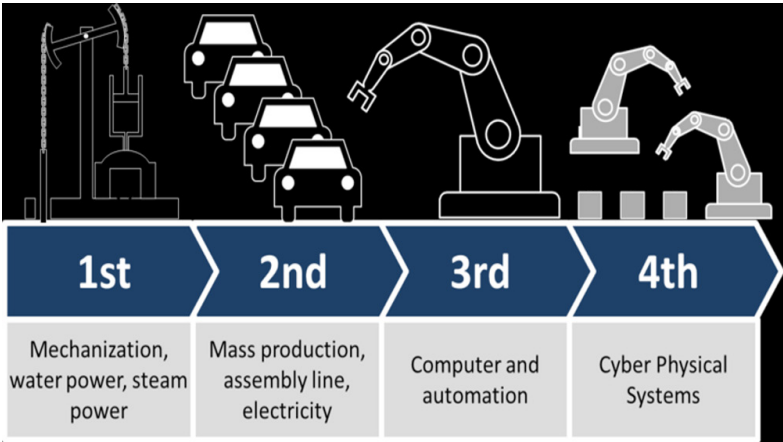


Figure 3.3: The progress of industrial revolution
(Source: Cristoph Roser at AllAboutLearn.com)

3.1.3. Sustainable Development Goals

The Sustainable Development Goals (SDGs) (or Global Goals for Sustainable Development), as depicted in Figure 3.4, are a collection of 17 global goals set by the United Nations Development Programme. The formal introduction to the SDG concept was done through the title: “Transforming our World: the 2030 Agenda for Sustainable Development.” This has been shortened to the “2030 Agenda” (United Nations, 2015). The Sustainable Development Goals are intended to be achieved by the year 2030. Hence, it is important for the global educational system to be aligned with the 2030 Agenda by overlaying the student accordingly.

Students with appropriate competencies and great awareness of future global challenges, including those related to poverty, inequality, climate, environmental degradation, prosperity, and peace and justice can spearhead the improvement of life quality through science and engineering in order to achieve a better and more sustainable future for all.



Figure 3.4: Sustainable development goals

3.2. META-PROFILE CONCEPT

Early clustering of the Civil SAG Meta-Profile was based on Attributes of 21st Century Learners by the World Economic Forum, whereby the generic and subject-specific competencies were classified and grouped into four different domains of technical skills, personal skills, social skills and values, as depicted in Figure 3.5. Each domain comprises three criteria, i.e. character qualities, foundation literacies, and competencies. Throughout the clustering process, competencies that fell into more than one domain (primary and secondary) were considered as having higher priority than single-clustered competencies. The next process was to establish a meta-profile diagram based on the overlapping circle principle. There are four circles representing the domains of technical skills, personal skills, social skills and values.

Each competency was mapped to its corresponding circle according to the clustering process, as listed in Table 3.1.

Then a colour code was assigned to each competency to indicate its level of priority. The colour coding is yellow, blue and red representing the top, medium and bottom levels of priority, respectively. The level of priority was decided based on an initial ranking of importance by the stakeholder through online consultation, competency across two domains (overlapped circle area), and consensus among SAG members. The final version of the Meta-Profile diagram for Civil SAQ is depicted in Figure 3.6. It was found that of the 11 top competencies, 8 are positioned in the overlapped area. This indicates that competencies which fall into two domains may have the potential to be top priorities and should be given more attention during curriculum design. The proposed Meta-Profile has two advantages. Competencies that fall into two domains allow our future graduates to better possess 21st Century Skills. Then, the designation of importance in the meta-profile will demand more emphasis in curriculum design and also in teaching and learning activities. Figure 3.7 illustrates the relationship between the Civil SAG Meta-Profile and the external domain of future challenges.

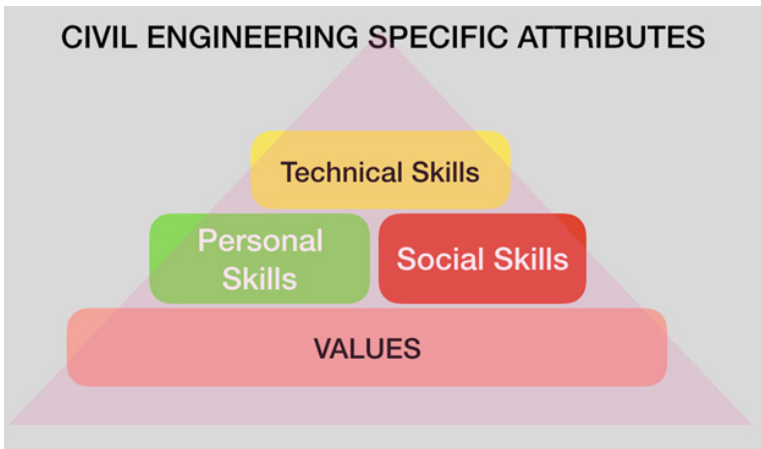


Figure 3.5: Skills and values clusters

Table 3.1: Clustered competencies according to primary and secondary domains

No	Competency	Primary	Secondary
G1	Ability to work collaboratively and effectively in diverse contexts	Social skills	Values
G2	Ability to use information and communication technology purposefully and responsibly	Technical skills	
G3	Ability to uphold professional, moral and ethical values	Values	
G4	Ability to demonstrate responsibility and accountability towards the society and environment	Values	Personal skills
G5	Ability to communicate clearly and effectively	Social skills	Personal skills
G6	Ability to think critically, reflectively and innovatively	Personal skills	
G7	Ability to understand, value, and respect diversity and multi-culturalism	Social skills	Values
G8	Ability to carry out lifelong learning and continuous professional development	Personal skills	
G9	Demonstration of problem-solving abilities	Personal skills	Values
G10	Ability to initiate, plan, organise, implement and evaluate courses of action	Technical skills	Values
G11	Ability to conduct research	Technical skills	Personal skills
G12	Ability to demonstrate leadership attributes	Personal skills	Values
G13	Ability to apply knowledge into practice	Technical skills	Values
S1	Ability to demonstrate entrepreneurial attributes (creativity, risk taking, resilience and innovation)	Personal skills	Values
S2	Ability to show strong knowledge in science and mathematics (including statistics)	Technical skills	
S3	Ability to interpret engineering drawings	Technical skills	Personal skills
S4	Ability to create algorithms to solve engineering problems	Technical skills	Personal skills
S5	Ability to understand principles of material science	Technical skills	
S6	Ability to carry out civil engineering analyses	Technical skills	Personal skills
S7	Ability to interpret engineering data from testing	Technical skills	Personal skills
S8	Ability to use relevant design codes and regulations	Technical skills	
S9	Ability to design civil engineering elements (e.g. structural, geoTech, water, transport & highway, environmental engineering, etc.)	Technical skills	
S10	Ability to monitor the progress and quality of civil engineering works	Personal skills	Values
S11	Ability to identify the appropriate construction technology and methods	Technical skills	
S12	Ability to uphold safety measures	Values	
S13	Ability to evaluate the impact of engineering decisions	Technical skills	Values
S14	Ability to integrate all civil engineering knowledge into a workable system	Technical skills	Personal skills

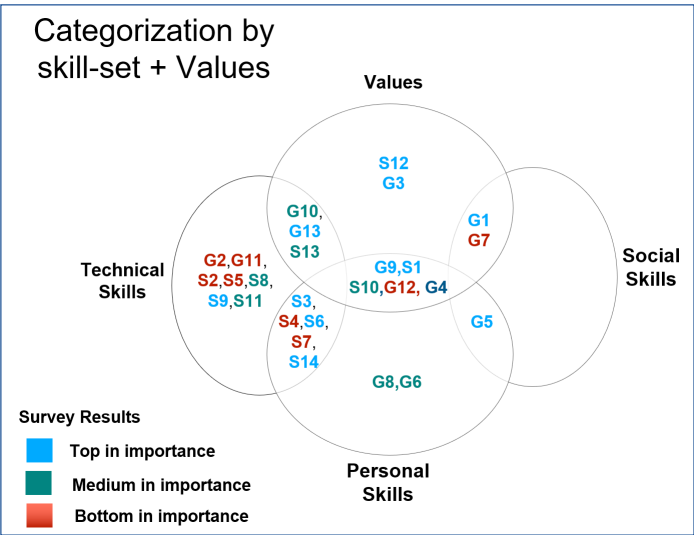


Figure 3.6: Meta-Profile of Civil SAG

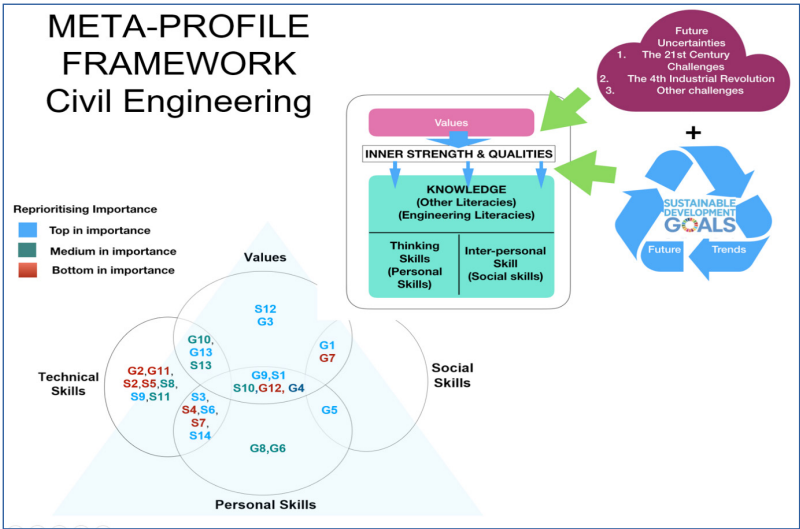


Figure 3.7: Relationship between Civil SAG Meta-Profile and external domain of future challenges

3.3. CONSULTATION ON META-PROFILE

A briefing and discussion session on the proposed Meta-Profile of student attributes was conducted by each member of the SAG after

the end of the 2nd general meeting in Kuala Lumpur. The session was generally attended by selected academic staff to share their views on the Meta-Profile. Participants were given details on the list of the generic and specific attributes as well as the Meta-Profile design process using a concept of overlapping and interconnected circles. The Meta-Profile circle is well connected to the attributes of the 4th Industrial revolution, the sustainable development goal concept, and the World Economic Forum's 21st Century Skills. The list of generic and specific student attributes has been ranked according to its importance, based on the survey results and its dual coverage on two different skills from among technical skills, personal skills, social skills and values.

Referring to a compilation of reports by all SAG members, the list of generic and specific student attributes is almost identical to the attributes covered by the current curriculum design. Nevertheless, the fruitful discussion was more geared towards the design of the Meta-Profile. The participants believe that the bottom-up approach implemented by the TUNING methodology is more realistic and meaningful, enabling the academician to fully understand the overall process of designing engineering curricula. The current state of curriculum design is more geared towards a Top-down approach, wherein the existing curriculum was being adapted to fit the list of student attributes set by accreditation councils. Moreover, the existing competencies are not divided into generic and specific. The competencies are also not ranked according to their importance.

Meanwhile, the list of student attributes by TA-SE underwent a detailed and systematic analytical process, considering opinions from different stakeholders, before the list could be published for Meta-Profile development. Even the development of the Meta-Profile went through a rigorous process so that each of the student attributes could be ranked wisely, according to its importance. For instance, if S2 'Ability to use knowledge in science and mathematics (including statistics)' has the highest priority, then the curriculum design can take this into consideration by having more mathematics-based courses to equip their students with strong foundations on the first principal concept. This priority level can give greater vision to academicians when designing future engineering curricula since the list of student attributes can reflect actual expectations from the different stakeholders. In fact, each university can place their unique signature on the engineering programme whilst still complying with the accreditation requirements of each country.

3.4. CRITICAL ANALYSIS OF META-PROFILE WITH EXISTING ACADEMIC PROGRAMMES

All academic programmes in the Civil Engineering SAG of TA-SE have compared their own current list of competencies against the meta-profile, and the mapping has shown good matching.

The inclusion of technical skills, personal skills, social skills and values has particularly enhanced the design of the respective academic programmes. This is especially important in the present and for the future settings, where higher education institutions don't just want to produce civil engineers, but need them to be humanised and able to serve their roles and functions better. As a civil engineer, it is also important for them to be sensitive to the needs of society and the environment. In addition, with the META-PROFILE emphasising these four sub-categories, programme owners must ensure, through their programme design and subsequent delivery, that all of their graduates will possess the necessary skills for the challenging future of the 21st century.

The META-PROFILE also allows programmes to design student learning outcomes that address combined competencies, and this will also help in a more effective teaching and learning environment, which many feel is more suitable for current 21st century learners.

Each programme has explained them in greater detail in their respective write-ups (referred to as the PEER REVIEW REPORT).

4. PROGRAMME DESIGN

4.1. FROM META-PROFILE TO PROGRAMME DESIGN

The META-PROFILE represents the philosophy behind the academic programme and should guide the subsequent design steps. Each participating university was expected to carry out the programme design based on the TUNING ten-step system shown earlier in Table 1. Each programme must initially decide whether to create a new programme or revise an existing one. All except two (Institute of Technology of Cambodia and National University of Civil Engineering, Hanoi) are revising their programmes. The new programme by the Institute of Technology of Cambodia is the only masters level programme. The rest are full civil engineering programmes or more focussed civil engineering programmes at undergraduate level.

Extra attention was given to steps 7 through 11, as this is the essence of the design. Step 6 is also critical for the META-PROFILE to be relevant and referred to, as described earlier. The principle of “Constructive alignment” was used to help members to design their curricula. This will also ensure that the learning outcomes of each course (Course Learning Outcome (CLO)) are aligned with the competencies. The competencies are also referred to as the Programme Outcomes (PO), where they are actually describing the desired attributes of the civil engineering graduates upon graduation. This is essential to ensure that they possess both the desired generic and specific competencies.

Each member was expected to consult their colleagues in the design. The intention is for the member institution of higher learning to adopt the TUNING methodology in future curriculum design. The entire designed curriculum is typically represented in a table form, for clarity of use and spread.

The “constructive alignment” principle has been served by STEP 8, in order to ensure overall programme consistency. Here, all courses

(with their respective CLO defined) will be mapped against the programme outcomes (PO). Once the consistency is affirmed effectively, the design of the academic programme is ready for execution.

Emphasis is also given to the quality management system, where an internal quality system needs to be in place. Several sharing of experience sessions were held, and each programme owner has been reminded to establish their own internal quality management system.

4.2. ACADEMIC PROGRAMME DESIGN OF MEMBER-UNIVERSITIES

Each member of the civil engineering SAG of TA-SE has submitted their full report based on the TEN steps. These are available in the “PEER REVIEW reports”, while a briefer description of the design is also available in APPENDIX A.

Below are the names of the designed programmes for each university.

	University	Name of Program	Type of Design
1	Chulalongkorn University	Bachelor of Engineering (Civil Engineering)	Enhancement for OBE
2	King Mongkut’s University of Technology, Thonburi	Bachelor of Engineering (Civil Engineering, International Program)	Enhancement for OBE
3	Naresuan University	Bachelor of Engineering (Civil Engineering)	Enhancement for OBE
4	University of the Philippines (Diliman)	Bachelor of Science in Civil Engineering	From 5 to 4 years and OBE
5	University of San Augustin	Bachelor of Science in Civil Engineering (BSCE)	From 5 to 4 years and OBE
6	Universiti Teknologi Malaysia	Bachelor of Engineering (Honours) (Civil Engineering)	Incorporation of TUNING competencies
7	Universiti Sains Malaysia	Bachelor of Engineering (Honours) (Civil Engineering).	Improving constructive alignment to TUNING competencies
8	National University of Civil Engineering	Construction Engineering Technology	New programme
9	Ho Chi Minh University of Technology	Bachelor of Engineer in Civil Engineering	Enhancement for OBE
10	Institute of Technology of Cambodia	Master of Materials and Structures	New programme
11	Institut Teknologi Sepuluh Nopember	Bachelor of Engineering (Civil Engineering)	Improving with TUNING competencies

4.3. STUDY LOAD SURVEY

Student Learning Time (SLT) can be defined as the amount of time required by students for an effective learning process involving face-to-

face and non-face-to-face activities. It is an important element in the design process of engineering curricula whereby SLT can be used to determine the value of credit hours for each subject. Moreover, SLT can guide students to understand the teaching materials according to the recommended hours they need to spend inside and outside the classroom. One of the issues in identifying the correct amount of SLT is the comparability of SLT from lecturers' and students' point of view. As the new era of teaching and learning is geared towards student-centred learning, the lecturers' point-of-view on the SLT for their specific subject is no longer sufficient to identify the appropriate SLT for each subject and for the whole programme. Since New Academia Learning Innovation (NALI) has become a main agenda to improve the learning experience for the millennial generation based on blended learning philosophy, students as active learners should be given a chance to learn the teaching material through multiple learning mode initiative (outcome-based education, problem-based learning, case study teaching) and material mode initiative (e-learning, open courseware). Since a blended learning philosophy will encourage a variety of learning modes and materials, apart from the traditional classroom and physical textbook, SLT calculation should be based on a more rigorous approach, incorporating stakeholders' points of view so that the learning time can be spread over activities inside and outside classroom accordingly.

As the instructor of the subject, the lecturer has a great responsibility to ensure that the proposed SLT can duly reflect the competencies of that particular subject. Moreover, the lecturer should also take a proactive initiative to identify the SLT by having a good notion of the time required to complete each single learning activity and assessment task. A good notion of the time required for the learning process must also consider student perception, since the student plays a crucial role in monitoring their learning activity, especially outside the classroom. To do so, combining lecturer experience with student expectation may give a better perspective and clarity on the appropriate SLT. Hence, improving the quality of the curriculum design framework means not overburdening the student with unnecessary learning activities and assessments. For this particular reason, a consultation process in the form of a survey exercise was carried out among the Civil Engineering SAG with the aim of identifying the SLT for one academic calendar semester from the lecturers' and students' points of view. Each member was required to calculate the SLT based on subjects registered in the fifth semester (4-year programme) of their corresponding institution. Each subject offered to students in

the fifth semester must be evaluated for their SLT via a consultation with a sample of at least ten students and one lecturer. The survey data from each member was then combined and analysed statistically using the TUNING tool to calculate the average of SLT according to lecturers’ and students’ points of view.

The student workload survey is divided into two sections tailored for lecturer and student separately. Tables 4.1 and 4.2 show the sample online form of the survey for lecturer and student respectively. Both parties need to identify contact hours and independent work according to different types of questions. The contact hours include the amount of time spent to complete face-to-face learning activities such as lectures, seminars and tutorials. For independent work, both lecturer and student need to identify time spent to complete non-face-to-face and non-supervised activities, such as working with internet sources and preparation for lectures, exams and group projects. Lecturer were also asked if they have taken into consideration the hours for independent work as well as students’ feedback during subject planning. Students were asked if lecturers have informed them about the number of hours required for independent work. They were also asked if they have been given an opportunity to give feedback about the workload of the particular subject.

Table 4.1: Sample of online Student workload survey for lecturer.

8.	How many CONTACT HOURS in total are there in your unit/course/module during the SEMESTER?	..... hours	
9.	From the list below, specify the types of INDEPENDENT WORK you require in the unit/course/module during the SEMESTER . Enter the estimated number of hours which, in your opinion, the student should spend in order to complete the independent study in the unit/course/module.		
a.	Reading texts or literature	Yes, ... hours	No
b.	Fieldwork (site visits, etc.)	Yes, ... hours	No
c.	Laboratory work (not supervised by you)	Yes, ... hours	No
d.	Preparation and presentation of written work (essays, reports, design work, modelling)	Yes, ... hours	No
e.	Working with Internet sources	Yes, ... hours	No
f.	Preparing for interim assessment, final examinations, tests, etc.	Yes, ... hours	No
g.	Other (specify):	..... hours	No
10.	How many hours does an <u>AVERAGE</u> student need to complete all the requirements of your unit/course/module in this SEMESTER (taking into account CONTACT HOURS and INDEPENDENT WORK)?	..... hours	

11.	How many hours does an AVERAGE student need to complete all the requirements of your unit/course/module per WEEK (taking into account CONTACT HOURS and INDEPENDENT WORK)?	..... hours	
12.	When planning your unit/course/module, did you estimate the hours students will have to spend on independent work?	Yes	No
13.	Did you take students' expectations and feedback into consideration when planning the workload for your course?	Yes	No

Table 4.2: Sample of online Student workload survey for student.

8.	How many CONTACT HOURS in total were you given to study this unit/course/module during the SEMESTER?	..... hours	
9.	Using the list below, specify the types of INDEPENDENT WORK you used in the unit/course/module during the SEMESTER . Under g. add any other ways of learning that you use that are not included here. Enter the estimated number of hours that you needed to complete the independent work on unit/course/module.	..... hours	
a.	Reading texts or literature	Yes, ... hours	No
b.	Fieldwork (site visits, etc.)	Yes, ... hours	No
c.	Laboratory work (not supervised by the teacher)	Yes, ... hours	No
d.	Preparation and presentation of written work (essays, reports, design work, modelling)	Yes, ... hours	No
e.	Working with Internet sources	Yes, ... hours	No
f.	Preparing for interim assessment, final examinations, tests, etc.	Yes, ... hours	No
g.	Other (specify):	..... hours	No
10.	How many hours did you spend in the SEMESTER to complete all the requirements of this unit/course/module (taking into account CONTACT HOURS and INDEPENDENT WORK)?	..... hours	
11.	How many hours per WEEK did you spend (both CONTACT HOURS AND INDEPENDENT WORK) to complete all the requirements of this unit/course/module?		
12..	At the beginning of the unit/course/module, were you informed about the number of hours planned for independent work?	Yes	No
13.	Were you given the opportunity to provide feedback about the workload in this unit/course/module?	Yes	No

According to the survey results as listed in Table 4.3, the mean values of contact hours for one subject in a semester are 318 and 348 hours from the lecturer's and student's point of view, respectively. The result is quite comparable since the face-to-face activities are relatively easy to calculate quantitatively. Meanwhile, there is contradic-

tion in the hours required for independent work from the lecturer and student standpoint. Lecturers’ perspective yields a result of 575 hours, a margin difference of 15% as compared to 493 hours from the students’ perspective. This shows that student expectation is much higher on contact hours of face-to-face activities rather than independent learning. From the overall perspective, the total hours for student workload considering both contact hours and independent works are 893 and 841 hours from lecturers’ and students’ points of view, respectively. Even though the difference of hours is marginal between lecturer and student, it is obvious that from lecturers’ and students’ points of view, students need to work independently more than the time they spend in the classroom. The proportion of hours for independent work is higher from the lecturer’s point of view, as depicted in Figure 4.1.

Table 4.3: Mean value of student workload (itemised)

Category	Lecturer	Student
Contact Hours	318 hours	348 hours
Independent Work	575 hours	493 hours
Total	893 hours	841 hours



Figure 4.1: Percentage of hours for contact hours and independent work

Previous results on student workloads were based on the sum of contact hours and independent work. The next section of the questionnaire asked both lecturer and student to identify the total student workload from an overall perspective for one whole semester, without having to calculate the hours for face-to-face and non-face-to-face activities individually. According to the result, the total student work-

load determined by lecturer and student are almost comparable, 709 and 707 hours, respectively (see Table 4.4). Again, we can see a much better consistency from both parties' points of view. Since the total recorded hours is lower than the previous section (sum of the contact hours and independent work individually), this implies that lecturers need to itemise the calculation of SLT according to contact hours and independent work in order to produce a more representative SLT value. Student workload was also averaged by week, yielding results of between 44 hours (lecturer) and 66 hours (student). In fact, by averaging the weekly hours into one working day, the average is between 8-13 hours per subject per day. This is considered very high relative to the European SLT. The final section of the survey has identified that 92% of lecturers had planned the SLT for their subject by considering the independent work and students' feedback. Meanwhile, only 59% of students have testified that they are aware of the number of hours intended for independent work even though 80% of them has admitted that lecturers have explained in detail the necessary workload for independent work items.

Table 4.4: Mean value of student workload from an overall perspective (non-itemised)

Category	Lecturer	Student
Average per week	709 hours	707 hours
Average per working day	44 hours	66 hours

Each member of the Civil Engineering SAG has been required to calculate the total SLT and its corresponding distribution among guided-learning and self-learning (including continuous assessment) categories. According to Table 4.5 (please refer to Table for acronym of university's name), the majority of the institutions have SLT for guided learning percentages that are higher than self-learning category, except for USM and USA. UTM and KMUTT have a similar pattern of SLT distribution percentage to the survey result based on the student perspective, with a guided learning to self-learning ratio of 41:59 (see Figure 4.1). Meanwhile, ITS and HCMUT calculations are more similar to a 36:64 ratio based on the lecturer perspective. In contrast, SLT distribution by USM and USA shows much heavier weightage for guided learning as compared to self-learning and continuous assessment. On average, the SLT distribution of guided learning to self-learning is estimated at a 46:54 ratio, in line with survey results from the student perspective. The mixed results of SLT distribution show a

diversity of pattern in the design of civil engineering curricula incorporating an SLT element. It is important to find the right balance of SLT distribution among learning activity categories and the total credit so that the assigned SLT can reflect the actual workload for every subject. This will assure that the designed curriculum will not overburden the student due to improper alignment between actual SLT and total credit.

Table 4.5: SLT distribution according to institution of Civil Engineering SAG

No	Institution	Total SLT (hour)	Total Credit (SLT/40)	SLT Distribution (%)	
				Guided Learning	Self- Learning
1	Universiti Teknologi Malaysia (UTM)	5520	138	42%	58%
2	University of Saint Augustine (USA)	8120	203	63%	37%
3	King Mongkut's University of Technology Thonburi (KMUTT)	4997	125	44%	56%
4	Institut Teknologi Sepuluh Nopember (ITS)	8911	223	36%	64%
6	Ho Chi Minh City University of Technology (HCMUT) *1 credit = 60 SLT	8880	148	28%	72%
7	Universiti Sains Malaysia (USM)	5465	137	62%	38%
Average				46%	54%

5. IMPLEMENTATION OF TUNING AT UNIVERSITI SAINS MALAYSIA

5.1. THE EXISTING PROGRAMME AT THE SCHOOL OF CIVIL ENGINEERING (SOCE), UNIVERSITI SAINS MALAYSIA

The Civil Engineering programme offered by SoCE, USM requires a minimum full-time residence period of four years to accumulate 135 credits, which fulfils the EAC minimum requirement of 135 total SLT credits. Each academic year consists of two semesters, and in order to graduate, students must accumulate the required number of credit units. Courses for the undergraduate programme are conducted through lectures, tutorials, practical/laboratory work, fieldwork, seminars and workshops. The courses are classified into core, electives and university requirements. Bahasa Malaysia (Malay Language) and English Language courses form part of the graduation requirements. Final examinations are held at the end of each semester and students are required to reach a satisfactory level of performance before they are permitted to continue their studies without any restrictions in the following semester, failing which, they are placed on probation. Students must pass all courses with minimum grade C and achieve a cumulative grade point average (CGPA) of at least 2.0 to graduate. Students may also attend courses for self-enrichment purposes, but it will not contribute towards the credit units required for graduation.

Out of the 135 credits, 108 credits are contributed by core courses, 12 credits of elective courses and 15 credits of University requirement courses. The 108 credits of core courses are constituted by 98 credits of engineering courses, 8 credits of engineering mathematics and 2 credits of computer programming. Hence, the total 98 credits of core courses fulfils the Engineering Accreditation Council (EAC) requirement of 90 credits of engineering courses in engineering sciences and engineering design/projects related to Civil Engineering.

As an institution which aspires to produce competent engineers, emphasis is always given towards integration between theory and

practical work in its education. From the first year, students are exposed to basic engineering knowledge and new technologies. This includes computer programming, engineering mathematics, geology, civil engineering materials, statics and dynamics and engineering drawing. Students are required to undergo industrial training at either government agencies or in the industries in the third year of study.

In the third and final year, students are required to choose 6 elective courses in Civil Engineering disciplines. Students are also required to prepare a final year project report in the form of a dissertation or project report in any of the Civil Engineering sub-disciplines. This is to prepare students for research, project-based activities and technical report writing.

The elective courses offered by the SoCE, USM are grouped into the following sub-disciplines:

Structural Engineering <ul style="list-style-type: none"> • Sustainable Concrete Materials and Practices • Timber and Masonry Engineering • Advanced Structural Engineering 	Environmental Engineering <ul style="list-style-type: none"> • Air Pollution in Civil Engineering • Noise Pollution Control • Solid Waste Management • Industrial Waste Management
Highway and Traffic Engineering <ul style="list-style-type: none"> • Sustainable Transport • Highway Design • Transport Planning Process and TIA 	Water Resources Engineering <ul style="list-style-type: none"> • Hydraulic Structures • Urban Water Management • River Conservation and Rehabilitation
Geotechnical Engineering <ul style="list-style-type: none"> • Soil Stabilisation and Ground Improvement • Rock Engineering and Tunnelling Technology 	Geomatic Engineering and Management <ul style="list-style-type: none"> • Geographical Information System • Disaster Management • Project Management

The curriculum also contains courses prescribed by the University to enhance the students’ ability to communicate (language subjects), appreciation of various cultures (Islamic and Asian Civilisation, Ethics Studies), endeavour in entrepreneurship skills (Core Entrepreneurship) and Co-Curriculum/Uniform Units. These courses constitute 15 credit hours and students need to pass with minimum of Grade C. In addition to the normal courses, the students also acquire various skills through Laboratory subjects (second and third year), Geomatic Camp (first year), ten weeks of Industrial Training (third year), Integrated Design Project/Capstone Design Project (final year) and the Final Year Project (final year). In addition, the students are

also exposed to professional practices by the industries in the form of visits, talks and seminars.

The existing programme curriculum structure of the Bachelor of Engineering (Hons.) (Civil Engineering) at Universiti Sains Malaysia is shown in Figure 5.1. This current curriculum has gone through a very long process of improvement based on comments primarily from the successive visits by the external examiners, EAC and Industrial Advisory Panels (IAP). External examiners were drawn amongst professors from renowned universities abroad as well as from renowned local universities who are familiar with Outcome-Based Education (OBE).

SoCE graduates are also marketable; several with doctoral degrees, serving back the department and elsewhere. Our graduates also include professionals currently employed as captains of the industry, working with multi-nationals and some are entrepreneurs.

Type	Credit Value	LEVEL 100			LEVEL 200			LEVEL 300			LEVEL 400		
CORE	Engineering Core	SEMESTER 1	SEMESTER 2		SEMESTER 1	SEMESTER 2		SEMESTER 1	SEMESTER 2		SEMESTER 1	SEMESTER 2	
		EAA1102 Civil Engineering Drawing	EUM1143 Advanced Engineering Calculus		EAA2102 Engineering Mathematics for Civil Engineers	EAP2103 Water Supply and Wastewater Engineering		EAP3103 Wastewater Engineering	EAP2203 Engineers in Society		EAA3115 Industrial Training	EAS4502 Pre-Stressed Concrete Design	
		EAA1102 Programming for Civil Engineering	EAA1634 Geomatic Engineering		EAA2210 Fluid Mechanics for Civil Engineers	EAP2163 Introduction to Environmental Engineering		EAL3370 Pavement Engineering	EAA3253 Engineering Hydrology		EAA4572 Structural Steel Design	EAA 4842 Building and Construction Technology	
		EUM1133 Engineering Calculus	EAS1520 Strength of Materials		EAG2450 Soil Mechanics	EAA2250 Hydraulics		EAG2450 Geotechnical Analysis	EAL3363 Transportation and Road Safety		EAA4302 Construction Management	EAA4826 (3) Final Year Project	
		EAG4412 Geology for Civil Engineers			EAS2503 Theory of Structures	EAL3352 Highway and Traffic Engineering		EAS3530 Reinforced Concrete Structure Design I	EAG3462 Geotechnical Design		EAA4302 (1-3) Final Year Project		
		EAS1510 Statics and Dynamics			EAA2730 Civil Engineering Practice	EAS2540 Structural Analysis			EAS3562 Reinforced Concrete Structural Design II		EAA4564 Integrated Design Project		
		EAA1133 Civil Engineering Materials			EAA3042 Strength of Materials and Strength of Materials Laboratory	EAL3042 Highway and Traffic Engineering and Fluid Mechanics Laboratory		EAA3552 Geotechnical and Environmental Engineering Laboratory	EAL3042 Highway and Traffic Engineering Laboratory				
University Requirement (LOCAL)		15	18		15	16	14	15		18	7	15	
	University Requirement (INTERNATIONAL)											15	
ELECTIVE COURSES (SPECIALISATION)												12	
Total Units for Graduation												135	

Figure 5.1: Curriculum Structure of Bachelor of Engineering (Hons.) (Civil Engineering)

Therefore, there is generally no basic flaw in the philosophy, fundamentals and coverage of the current curriculum. The current curriculum review results also indicate that the current curriculum is on par with other renowned universities. It has also been benchmarked by several universities in Malaysia (Table 5.1). The current curriculum is credible and has been offered to students since the 2014/2015 academic session. In the 2017/2018 session, the first batch graduated with the complete PO attainment of the current curriculum.

Table 5.1: Benchmarking Visits to SoCE

Benchmarking visit by	Date
Faculty of Civil and Environmental Engineering, Universiti Tun Hussein Onn Malaysia	12 April 2018
School of Industrial Technology (PPTI), USM and Graduate School of Business, USM	21 November 2017
Faculty of Civil Engineering, UiTM Shah Alam	24 August 2016
Faculty of Civil Engineering, UiTM Pulau Pinang	18 August 2016
University College of Technology Sarawak (UCTS)	11 August 2016
Department of Civil Engineering UNIMAS	16 July 2016
Faculty of Civil Engineering & Earth Resources, Universiti Malaysia Pahang	17-18 May 2016
Faculty of Civil and Environmental Engineering, Universiti Tun Hussein Onn Malaysia	26 August 2015
Faculty of Civil Engineering, UiTM Pulau Pinang	18 February 2014

5.2. ALIGNMENT OF THE TUNING APPROACH AND THE OBE PRACTICED

As an implementing university, SoCE of Universiti Sains Malaysia must implement the TUNING 10-Step Programme Design. As OBE is already embraced and practiced, for SoCE, the process starts at Step 5 and 6 where the description of Generic/Specific Competencies and Learning Outcomes at programme level are mapped and linked to the degree with the agreed meta-profile. Table 5.2 shows the mapping of Programme Learning Outcomes to Tuning Competencies and Figure 5.2 shows the meta-profile mapped for the programme.

Table 5.2: Mapping of Programme Learning Outcome to Tuning Competencies

Competencies (Tuning)	USM – School of Civil Engineering
<p>G13 – Ability to apply knowledge into practice</p> <p>S2 – Ability to use knowledge in science and mathematics (including statistics)</p> <p>S5 – Ability to apply the knowledge of material science</p>	<p>PO1 – Engineering Knowledge: Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialisation to the solution of complex engineering problems</p>
<p>G6 – Ability to think critically, reflectively and innovatively</p> <p>G9 – Demonstration of problem-solving abilities</p> <p>S3 – Ability to interpret engineering drawings</p> <p>S6 – Ability to carry out civil engineering analyses</p> <p>S7 – Ability to interpret engineering data</p>	<p>PO2 – Problem Analysis: Identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences</p>
<p>G10 – Ability to initiate, plan, organise, implement and evaluate courses of action</p> <p>S4 – Ability to create processes to solve engineering problems</p> <p>S8 – Ability to use relevant design codes and regulations</p> <p>S9 – Ability to design civil engineering elements</p> <p>S14 – Ability to integrate all civil engineering knowledge into a workable system</p>	<p>PO3 – Design/Development of Solutions: Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations</p>
<p>G11 – Ability to conduct research</p>	<p>PO4 – Investigation: Conduct investigation into complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions</p>
<p>G2 – Ability to use information and communication technology purposefully and responsibly</p>	<p>PO5 – Modern Tool usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities, with an understanding of the limitations</p>

Competencies (Tuning)	USM – School of Civil Engineering
G7 – Ability to understand, value, and respect diversity and multiculturalism S12 – Ability to uphold safety measures	PO6 – The Engineer and Society: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex civil engineering problems
G4 – Ability to demonstrate responsibility and accountability towards society and the environment S13 – Ability to evaluate the impact of engineering decisions	PO7 – Environment and Sustainability: Ability to demonstrate understanding of and to evaluate the sustainability and impact of professional engineering work in the solution of complex civil engineering problems in societal and environmental contexts.
G3 – Ability to uphold professional, moral and ethical values S1 – Ability to integrate all civil engineering knowledge into a workable system	PO8 – Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice
G5 – Ability to communicate clearly and effectively	PO9 – Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
G1 – Ability to work collaboratively and effectively in diverse contexts G12 – Ability to demonstrate leadership attributes	PO10 – Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings
G8 – Ability to carry out lifelong learning and continuous professional development	PO 11– Lifelong Learning: Recognise the need for, and have the preparation and ability to engage in, independent and lifelong learning in the broadest context of technological change
S10 – Ability to monitor the progress and quality of civil engineering works S11 – Ability to identify the appropriate construction technology and methods	PO12 – Project Management and Finance: Ability to demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

From Table 5.2, it can be seen that the Programme Outcomes are well aligned with the TUNING Meta-Profile.

5.3. IDENTIFICATION OF GAPS

From the mapping of TUNING competencies and SoCE Programme Outcomes, several gaps were identified. SoCE has classified the gaps into two (2) stages. The first stage was identified after the 4th GM Meeting (Bangkok, 19-22 September 2018) and the second stage was identified after the TUNING Asia – Southeast Asia (TA-SE) USM Implementing Visit (Penang, 1-2 November 2018). Both stages are described as follows:

- 1) Stage 1 – competencies and outcomes requiring further attention and intervention in the existing programme.
During stage 1, it was found that four Programme Outcomes which correspond to 3 generic competencies and 3 specific competencies are getting the least coverage in the existing programme. The four Programme Outcomes are listed in Table 5.3. Eleven courses from the existing programme have been identified for scrutiny and were chosen as part of the Tuning Implementation Programme.

Table 5.3: Four Programme Outcomes selected for Tuning implementation

SoCE Programme Outcomes			TUNING Competencies
PO8	Ethics	Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.	(G3) Ability to uphold professional, moral and ethical values (S1) Ability to show resilience
PO11	Lifelong learning	Ability to recognise the need for, and have the preparation and ability to engage in, independent and lifelong learning in the broadest context of technological change.	(G8) Ability to carry out lifelong learning and continuous professional development
PO12	Project Management/ Financing	Ability to demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	(S10) Ability to monitor the progress and quality of civil engineering works (S11) Ability to identify the appropriate construction technology and methods

SoCE Programme Outcomes			TUNING Competencies
PO4	Investigation	Ability to conduct investigations of complex problems using research-based knowledge and research methods, including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.	(G11) Ability to conduct research

- 2) Stage 2 – ensuring appropriateness of assessment method for programme and examining the whole programme based on new mapping.

After stage 1, SoCE realised that another one (1) programme outcome was not emphasised. This was commented by the External Examiner (EE) for the programme. The EE commented that PO7 (Environment and Sustainability) was not accentuated in the programme and this is important to reflect the Vision and Mission of Universiti Sains Malaysia. Based on the TUNING Asia – Southeast Asia (TA-SE) USM Implementing Visit, SoCE realised the need to increase the number of courses mapped to identify Programme Outcomes and competencies through an appropriate assessment method. This also helped to ensure that the constructive alignment is achieved and, ultimately, the Programme Outcomes attained.

From all the changes made, SoCE believes that it is important to look at the overall programme mapping for Programme Outcome distribution based on the changes made above.

Figures 5.3 and 5.4 show the different stages of implementation in SoCE. In each figure, the left box shows stage 1 of the implementation plan, and the right box shows the final implementation at SoCE, including dates implemented.

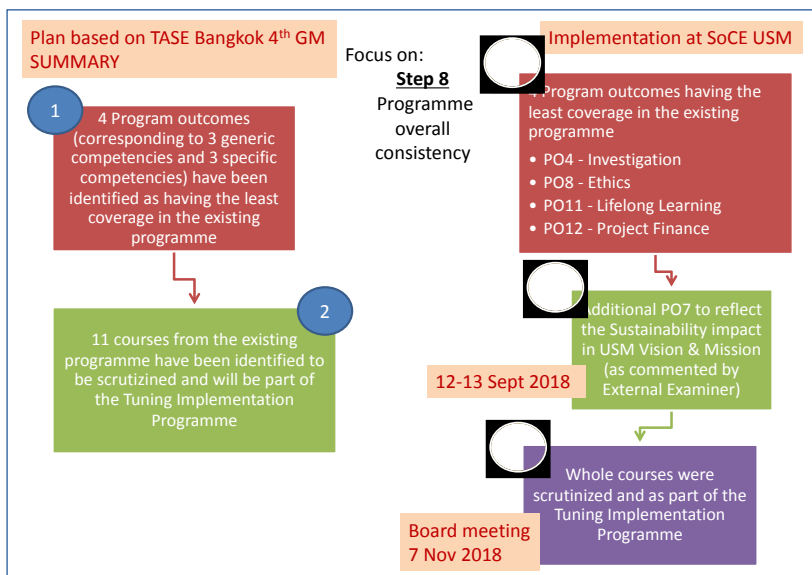


Figure 5.3. Programme overall consistencies based on stage 1 and stage 2

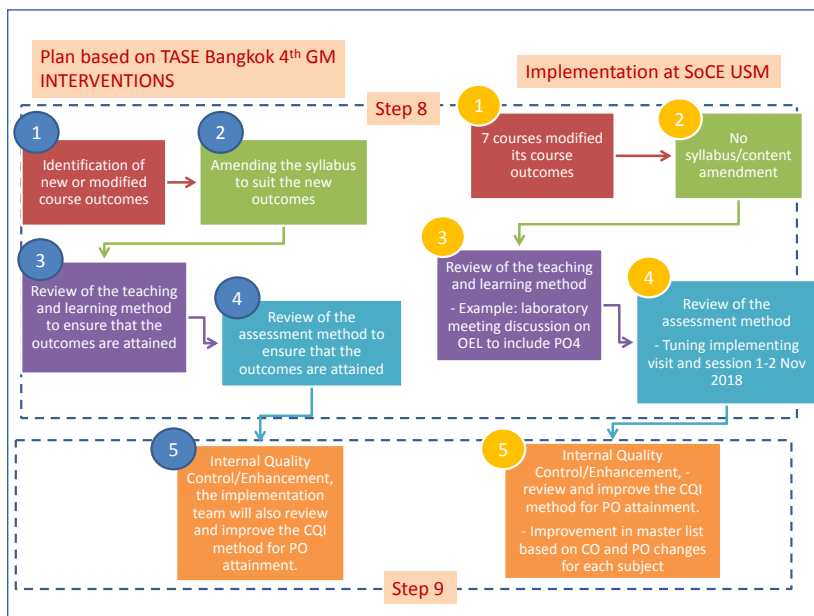


Figure 5.4. Steps to improve the programme

5.4. THE ADOPTED CHANGE

SoCE decided that the most important steps to achieve for TUNING implementation are redesigning step 8 (programme overall consistency) and step 9 (internal quality control/enhancement). The first step taken by SoCE was identification of new or modified Course Outcomes. 7 courses were identified, and their Course Outcomes were modified. 3 of the 7 courses identified were culminating courses (courses which are deemed to consolidate as many programme outcomes as possible), such as Industrial Training, Integrated Design Project and Final Year Project. Through these courses, the learning outcomes were modified, examined and deliberated to ensure that the assessments are done correctly, interpreted and measured to reflect the Programme Outcomes mapped to the course.

Although the initial plan in stage 1 (Figure 5.4) included amending the syllabus to suit new outcomes, it was found that there is no requirement to amend neither syllabus nor content of the courses in the programme. The next part in step 8 was reviewing the teaching and learning method to ensure that the outcomes measured were attained. This was done in several stages, for example, to increase the number of courses to map to PO4 (Investigation), all lecturers involved in laboratory courses met to discuss and reassess the open-ended level (OEL) of all tests in all courses (open-ended level is required by the Engineering Accreditation Board, EAC). Through this process, it was found that the OEL level is directly related to the assessment criteria and learning activities carried out. By increasing the OEL level, PO4 can be achieved through proper rubric usage in assessment.

However, at this particular stage, there were doubts by the instructors on whether the decision made was correct and thus reflecting the Programme Outcomes attainment. This was allayed when the assessment methods were reviewed to ensure that the outcomes are attained. Based on the TUNING Asia – Southeast Asia (TA-SE) USM Implementing Visit, discussions were held and all relevant lecturers on the courses (in this case laboratory courses) agreed that the assessment done is sufficient to reflect the attainment of PO4.

For step 9, internal quality control/enhancement, SoCE planned to review and improve the CQI method for Programme Outcome attainment. This was done by mapping the whole courses in the programme to the new Programme Outcomes. Table 5.4 shows the mapping of all courses prior to Tuning implementation, after stage 1 (14 August 2018) and the final stage on 9 November 2018. It can be seen

that there was a total increase of 159 Course Outcomes from an initial of 111 Course Outcomes. Programme Outcome changes can be seen – not only the initial selected four (4) Programme Outcomes related to Tuning competencies, but also other Programme Outcomes, such as PO2 (Problem Solver – reduce 1), PO3 (Solutions Designer – reduce 1), PO4 (Investigation – add 2), PO6 (Engineer and Society – add 1), PO7 (Environmental and Sustainability – add 11 from initial 2014), PO8 (Ethics – add 2), PO9 (Communication – reduce 2), PO10 (Individual and Teamwork – reduce 1), PO11 (Lifelong Learning – add 1) and PO12 (Project Management and Finance – add 1).

Table 5.4: Mapping after stage 1 and stage 2 Tuning implementation to SoCE programme

No	Date revised	Course		Engineering Knowledge	Problem Solver	Solutions Designer	Investigation	Modern Tool Usage	Engineer and Society	Environment and Sustainability	Ethics	Communication	Individual and Team Work	Lifelong learning	Project Management and Finance
			CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
1	Initial 2014	Total	111	23	26	12	3	10	6	4	4	6	11	2	4
2	14 th August 2018	Total	152	36	34	25	3	14	5	9	5	4	10	3	4
3	9 th November 2018	Grand total	159	36	33	24	5	14	7	15	6	4	10	3	5

As far as courses are concerned, the distribution of Programme Outcomes for core and elective courses can be seen in Table 5.5. The yellow and grey highlights show the changes after 9 November 2018.

Table 5.5: List of Courses Mapped to Programme Outcomes

No	Course Code	Course Title	Course Outcomes												
			CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
1	EAA110/2	Civil Engineering Drawing	2					✓							
2	EAA111/2	Programming for Civil Engineering	2	✓	✓			✓							
3	EAG141/2	Geology for Civil Engineers	3	✓	✓										
4	EAK163/4	Geomatic Engineering	5	✓	✓				✓				✓		
5	EAS151/3	Statics and Dynamics	4	✓	✓										
6	EAS152/3	Strength of Materials	3	✓	✓				✓						
7	EAS153/3	Civil Engineering Materials	3	✓	✓										
8	EAA204/2	Structures and Strength of Materials Engineering Laboratory	3		✓				✓				✓		
9	EAA206/2	Structures, Concrete and Fluid Mechanics Laboratory	3		✓				✓				✓		
10	EAA211/2	Engineering Mathematics for Civil Engineers	2	✓	✓										
11	EAA273/2	Civil Engineering Practice	3	✓					✓				✓		
12	EAG245/3	Soil Mechanics	2	✓	✓										
13	EAH221/3	Fluid Mechanics for Civil Engineers	2	✓	✓										
14	EAH225/3	Hydraulics	2		✓										
15	EAL235/2	Highway and Traffic Engineering	2		✓										
16	EAP215/3	Water Supply and Water Treatment Engineering	3	✓	✓		✓								✓

No	Course Code	Course Title	CO	PO 1	PO 2	Solutions Designer	Investigation	Modern Tool Usage	Engineer and Society	Environment and Sustainability	Ethics	Communication	Individual and Teamwork	Lifelong Learning	Project Management and Finance
17	EAP216/3	Introduction to Environmental Engineering	3	✓					✓		✓				
18	EAS253/3	Theory of Structures	2		✓										
19	EAS254/3	Structural Analysis	3		✓										
20	EUP222/3	Engineers in Society	3						✓	✓	✓				✓
21	EAA304/2	Geotechnical, Highway and Traffic Engineering Laboratory	3		✓		✓	✓					✓		
22	EAA305/2	Hydraulics, Geotechnical and Environmental Engineering Laboratory	3		✓		✓	✓					✓		
23	EAA371/5	Industrial Training	3	✓							✓	✓		✓	✓
24	EAG345/3	Geotechnical Analysis	2	✓	✓										
25	EAG346/2	Geotechnical Design	3		✓	✓							✓		
26	EAH325/3	Engineering Hydrology	3		✓										
27	EAL337/3	Pavement Engineering	2			✓									
28	EAL338/3	Transportation and Road Safety	2		✓										
29	EAP315/3	Wastewater Engineering	3	✓	✓	✓				✓					
30	EAS353/3	Reinforced Concrete Structural Design I	4		✓	✓						✓	✓		
31	EAS356/2	Reinforced Concrete Structural Design II	3	✓		✓						✓			
32	EAA483/2	Construction Management	3	✓		✓			✓						✓
33	EAA484/2	Building Construction and Technology	3	✓	✓										

No	Course Code	Course Title	CO	PO 1	PO 2	PO 3	PO 4	PO 5	Engineer and Society	Environment and Sustainability	Ethics	Communication	Individual and Teamwork	Lifelong Learning	Project Management and Finance
34	EAA492/6	Final Year Project	4			✓	✓	✓	✓	✓	✓	✓		✓	
35	EAA495/4	Integrated Design Project	6	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
36	EAS457/2	Structural Steel Design	3	✓		✓	✓						✓		
37	EAS458/2	Pre-stressed Concrete Design	3	✓		✓									
		TOTAL (Core courses)	108	21	25	11	4	10	5	5	6	4	10	3	4
1	EAA485/2	Disaster Management	2	✓		✓									
2	EAA486/2	Project Management	3	✓		✓									✓
3	EAG443/2	Rock Engineering and Tunnelling Technology	3	✓	✓	✓									
4	EAG444/2	Soil Stabilisation and Ground Improvement	3	✓	✓	✓				✓					
5	EAH316/2	Hydraulic Structure	3	✓	✓	✓									
6	EAH416/2	River Conservation and Rehabilitation	2		✓	✓				✓					
7	EAH417/2	Urban Water Management	3	✓	✓	✓				✓					
8	EAK382/2	Geographic Information System	3		✓			✓		✓					
9	EAL339/2	Sustainable Transport	3	✓		✓			✓	✓					
10	EAL431/2	Highway Design	3	✓		✓									
11	EAL434/2	Transport Planning Process and TIA	3	✓		✓		✓							
12	EAP316/2	Air Pollution in Civil Engineering	3	✓				✓		✓					

No	Course Code	Course Title	CO	PO 1	PO 2	Solutions Designer	Investigation	Modern Tool Usage	Engineer and Society	Environment and Sustainability	Ethics	Communication	Individual and Teamwork	Lifelong Learning	Project Management and Finance
13	EAP318/2	Noise Pollution Control	3	✓				✓	✓	✓					
14	EAP414/2	Industrial Waste Management	3	✓			✓			✓					
15	EAP415/2	Solid Waste Management	3	✓		✓				✓					
16	EAS357/2	Sustainable Concrete Materials and Practices	3	✓	✓					✓					
17	EAS451/2	Timber and Masonry Engineering	3	✓		✓									
18	EAS456/2	Advanced Structural Engineering	2		✓	✓									
		TOTAL (Elective courses)	51	15	8	13	1	4	2	10	0	0	0	0	1
		Grand total	159	36	33	24	5	14	7	15	6	4	10	3	5

5.5. IMPLEMENTATION EXPERIENCE AND RESULTS

The Tuning methodology and key elements of implementation include three phases, namely:

a) Defining competencies

Process where identification of generic and specific competencies for the graduate was done through involvement of stakeholders, such as employers, students, graduates and alumni. These competencies must be relevant to uncertainties in the future of the industry and the graduate's employability by considering 21st century challenges, the 4th industrial revolution and other relevant challenges.

Based on the challenges, values are looked into which include inner strengths and qualities of the graduates. Qualities and strengths comprise knowledge, thinking skills and inter-personal skills. The SoCE implemented the Outcome-Based Education (OBE) system as stated by the Engineering Accreditation Council (EAC), Board of Engineers Malaysia (BEM). Therefore, the competencies are pre-determined as required by EAC. Using the Tuning methodology, the competencies set are mapped together with the outcomes set by the EAC and classified based on their importance to the civil engineering programme. The triangulation between setting the skillset (competencies) to the importance of the skillset to the civil engineering programme is done through surveys to relevant stakeholders and also through meetings with department members.

b) Designing degree programmes

Using the agreed meta-profile (in SoCE, there were 12 outcomes that reflected the profile of civil engineering graduates), the structure of the programme with relevant learning outcomes and teaching assessments are designed (constructive alignment). Continuous Quality Improvement (CQI) is carried out regularly to ensure the overall consistency and quality control of the programme. The curriculum is reviewed every 4 to 5 years based on inputs from stakeholders (especially from the Industrial Advisory Panel) and through benchmarking processes to ensure the programme stays relevant to the industry.

c) Programme implementation

SoCE implementation of Outcome-Based Learning has been carried out since 2008 and, through reviews including reflections on curriculum, the programme has continuously improved and

matured over the years. Through the Tuning program, better CQI can be conducted, especially on course content and delivery. Courses are reviewed based on the learning outcomes to ensure the teaching and learning process, as well as the assessment method, are relevant and measurable. Tuning through CALO-HEE has managed to help SoCE to improve designing assessment methods, especially assessment of soft skills. This is important as we need graduates' competencies not only in the knowledge skillsets but also in soft skills.

5.6. RECOMMENDATIONS

For OBE practitioner as SoCE, implementing TUNING in the current programme requires that the 10-step design processes are abided by, particularly in construction alignment (Step 8 and Step 9). For OBE practitioners to really appreciate the TUNING methodology and implementation, one of the important aspects that needs to be taken into account is ensuring that the assessment dimension is adaptable and fully understood by the programme and its implementer. Assessment requires literacy and it helps educators to perceive, analyse and use data on student performance to improve teaching. Assessment is important for the students to determine matters that are important: what counts?; how will they spend their time?; and how will they see themselves as learners? In order to improve student learning, the assessment methods/tasks need to be improved first. It is also important to ensure that assessment tasks are aligned with the ILOs so that tasks give students the opportunity to demonstrate how they can use knowledge pragmatically. Hence, for every assessment task, it is important to critically analyse whether they actually promote learning of the ILOs, or simply content that has been learnt.

6. CONCLUSIONS

6.1. REFLECTION

There were mixed reactions amongst member-universities of TA-SE, upon being exposed to the TUNING methodology. To those who are familiar with the Outcome-Based Education (OBE), immediately, they could see that TUNING is addressing similar goals. They appreciated that there are different terminologies used, but the overall concept is similar.

However, to those who have never been exposed to OBE, trepidation was their early reaction. It required some time before they began to feel comfortable and started to see the advantage of TUNING. Primarily, the fact that programme owners must design the academic programmes for the students and not for the instructors.

The coaching by the TUNING Academy and existing OBE-practising members has helped in the appreciation, adoption and design of their respective programmes, both for new and existing programmes. Each university has provided its own reflection on their experience in APPENDIX A.

6.2. CHALLENGES OF ADOPTION

There were several challenges faced by TA-SE civil engineering SAG members in adopting the TUNING methodology. In addition to the initial confusion on the purpose of TUNING, the subsequent challenge was to be able to abide by the consensual agreement of the group on the generic and specific competencies, as well as the META-PROFILE. The Civil Engineering SAG was fortunate as, generally, there was not much disagreement on both elements.

As team members were going through the TEN steps in the programme design, the next challenge faced by many members was STEP 8, where the overall consistency needed to be maintained. The appre-

ciation of “constructive alignment” was used to represent consistency, and when mapping between Course Learning Outcomes and the Programme Outcomes/Competencies was suggested, many understood the process better. However, doing it alone in itself posed an extra challenge as, typically, it should be done at faculty level. Some members were able to bring the concept back to their respective faculties, where the appropriate buy-in process had happened.

The buy-in process is another challenge that members had to face. In any academic setting, the ability for faculty members to accept new things have been quite challenging. TUNING and for that matter, any form of OBE methodology, will require a change in the faculty members’ mindset, primarily from being teacher-centric to being student-focussed. Usually, a top-down commitment from university management would facilitate the effectiveness of adoption.

The TA-SE project has only gone up to the “Design” stage, which has not given the closure to the required quality academic system in OBE. The inability to “Close the Loop” will hamper the appreciation of the full benefit of TUNING, as implementers may not see how continual quality improvement (CQI) is in action to make sure not only the design of the academic program, but also the delivery, would ensure that the attributes, and thus competencies, of graduates would be achieved satisfactorily. In order to achieve this, the attainment of outcome assessment needs to be carried out, and this will also add to the challenges thus far experienced for the implementation of TUNING.

6.3. ENDNOTES

The members of the TA-SE Civil Engineering SAG greatly appreciate the opportunity to participate in this project. It has definitely led to a better understanding and embracing of outcome-based education. The philosophy of making our higher education system more student-focussed as opposed to instructor-centric has been widely accepted. This has led to the realisation of the importance of designing our academic programmes towards nurturing graduates aspired to have certain necessary qualities, attributes, and thus competencies. Along the way, the TUNING methodology has not only guided us towards a very systematic process for the design of academic curricula and programmes, but has also provided additional values, like the introduction of META-Profiling, which has allowed design philosophies to be incorporated as well.

However, the TUNING methodology for this group has been limited to the DESIGN stage only. It remains incomplete since we are unable to assess the attainment of outcomes and, consequently, be able to carry out remedial measures and interventions towards ensuring that graduates will ultimately embody the desired attributes. Nevertheless, the implementing university (Universiti Sains Malaysia) has had the opportunity to do so.

Table 6.1: summarises the strengths and challenges that would help and be faced when any institution of higher learning wishes to implement TUNING. This will be especially important given that TUNING in Southeast Asia is to go beyond the current eleven members of the Civil Engineering SAG.

During the experience with TUNING, there were many misconceptions about the actual intention of TUNING. Many amongst the existing OBE practitioners saw TUNING as an alternative and not as a complement to current OBE practices. It would therefore be advantageous for TUNING to be positioned differently for different types of audiences. This is illustrated in Table 6.2.

In conclusion, the experience of the Civil Engineering SAG of TA-SE has been a memorable one, and it is hoped that the practice of Outcome-Based Education will flourish and that the TUNING methodology will meet its original objectives and continue to add value to the global higher education eco-system, especially in the coming challenging times.

Table 6.1: Strength and Challenges when implementing TUNING

STRENGTH AND CHALLENGES	
STRENGTH	CHALLENGES
Commitment : Some countries have their own Qualification Requirement which will make implementation easier	Curriculum Review and Design
Positive Attitude: Positive view towards outcome based education	The practice of Continual Quality Improvement (CQI) is not encultured, thus introducing TUNING will be very challenging
Culture: Mind-sets, attitudes and SOPs are already aligned to TUNING/OBE	Commitment of Top Management
Enabling Systems : There are already existing system used to facilitate OBE (eg: COBES at USM)	When there is no push and support, implementing TUNING will be challenging
	Mind-set and attitude of academic staff
	1. Resistant vs Just Follow vs Embracer vs Believer vs Champion
	2. Silo and lack of team-work
	Priority
	Teaching and Learning (Student's matters) are not priority to academic staff
	No autonomy
	Still very regimented with little or no autonomy from central agencies. Very difficult to adopt complete TUNING methodology
	TUNING vs TRANSFORMATIONAL
	TUNING: incremental improvement TRANSFORMATIONAL: completely new approach (the potential of META-PROFILE)

Table 6.2: Recommendations on positioning TUNING

Sustaining the Impact of TUNING	
<ul style="list-style-type: none">TUNING must be positioned as the major enabler for the effort towards more wide-spread and effective Outcome-based Education (OBE)	Audience
	Non-OBE embracer
	New OBE embracer
	OBE embracer going for accreditation
	OBE practitioner
	Blue-Ocean for TUNING
Suggested Approach	
The introduction and appreciation of the TUNING methodology must emphasize the competency and outcome-based approach and why they are important for the future of higher education	
Using the 10 Steps of TUNING is most helpful	
Ensuring that the 10 steps are abided, especially on the CONSTRUCTIVE ALIGNMENT (step 8 - program overall consistency) and the Quality System (step 9)	
Bringing the ASSESSMENT dimension into TUNING (eg. CALOHEE - Measuring and Comparing Achievements of Learning Outcomes on Higher Education)	
Research must be done to identify new VALUES, as TUNING already have case studies from the WORLD	

REFERENCES

Beneitone P. (2017) Introduction to Methodology, Presentation of the Tuning project and its context, 1st General Meeting of TA-SE, Bilbao, 3 May 2017.

Beneitone P., González J. & Wagenaar R. (2014) Meta-profiles and profiles: A new approach to qualifications in Latin America, University of Deusto.

Dyukarev I. (2017) General introduction to the Tuning Asia-South East project: Objectives, Main Outcomes and Activities, 1st General Meeting of TA-SE, Bilbao, 3 May 2017.

Gervais, J. (2016) The operational definition of competency-based education, Competency-based Education, 2016, 1: 98-106.

Schwab K. (2017) The Fourth Industrial Revolution. New York: Crown Publishing Group.

United Nations (2015) Transforming our world: the 2030 Agenda for Sustainable Development”. United Nations – Sustainable Development knowledge platform, General Assembly, A/RES/70/1.

World Engineering Forum (2016) New Vision for Education: Fostering Social and Emotional Learning through Technology.

APPENDIX A

A SHORT BRIEF BY CIVIL ENGINEERING SAG MEMBERS ON TUNING METHODOLOGY APPLICATION

1. CHULALONGKORN UNIVERSITY, THAILAND

1. Brief University Profile

Chulalongkorn University is a public and autonomous research university in Bangkok, Thailand. Chulalongkorn University was founded in March 1917 as Thailand's first institution of higher learning. Chulalongkorn University consists of 19 faculties, three colleges, one school, and many institutes which function as teaching and research units.

2. Brief Programme Profile

Bachelor of Engineering (Civil Engineering) is a 4-year programme with eight 16-week semesters. It is a single major programme. Total credits for the whole programme: 146 Credits

3. Mapping of the Programme's Learning Outcomes (PLOs) to the TUNING Competencies

T	P	S	V	Tuning Competencies	Programme Learning Outcome (PLO)
X	X	X	X	G13: Ability to apply knowledge into practice	C1: Application of mathematics, science and engineering knowledge
		X	X	G1: Ability to work collaboratively and effectively in diverse contexts	C6: Individual and Teamwork
		X	X	G7: Ability to understand, value, and respect diversity and multiculturalism	C6: Individual and Teamwork
	X	X		G5: Ability to communicate clearly and effectively	C7: Communication
	X		X	G4: Ability to demonstrate responsibility and accountability towards society and the environment	C8: The Engineer, Society, Environment and Sustainability

T	P	S	V	Tuning Competencies	Programme Learning Outcome (PLO)
	X		X	G9: Demonstration of problem-solving abilities	C2: Problem Analysis
	X		X	G12: Ability to demonstrate leadership attributes	C6: Individual and Teamwork
	X		X	S1: Ability to show resilience	C10: Risk Management and Investment
X	X			S3: Ability to interpret engineering drawings	C1: Application of mathematics, science and engineering knowledge
X	X			S4: Ability to create processes to solve engineering problems	C3: Design/development of solutions
X	X			S6: Ability to carry out civil engineering analyses	C2: Problem Analysis
X	X			S7: Ability to interpret engineering data	C1: Application of mathematics, science and engineering knowledge C4: Investigation
X	X			S14: Ability to integrate all civil engineering knowledge into a workable system	C1: Application of mathematics, science and engineering knowledge
			X	G3: Ability to uphold professional, moral and ethical values	C9: Ethics
			X	S12: Ability to uphold safety measures	C8: The Engineer, Society, Environment and Sustainability
X				S9: Ability to design civil engineering elements	C1: Application of mathematics, science and engineering knowledge
X	X	X	X	G10: Ability to initiate, plan, organise, implement and evaluate courses of action	C3: Design/development of solutions
X	X	X	X	S13: Ability to evaluate the impact of engineering decisions	C8: The Engineer, Society, Environment and Sustainability
	X		X	S10: Ability to monitor the progress and quality of civil engineering works	C1: Application of mathematics, science and engineering knowledge
	X			G6: Ability to think critically, reflectively and innovatively	C2: Problem Analysis
	X			G8: Ability to carry out lifelong learning and continuous professional development	C11: Lifelong learning
X				S8: Ability to use relevant design codes and regulations	C1: Application of mathematics, science and engineering knowledge
X				S11: Ability to identify the appropriate construction technology and methods	C5: Modern Tool Usage
X				G2: Ability to use information and communication technology purposefully and responsibly	C5: Modern Tool Usage
X				G11: Ability to conduct research	C4: Investigation
X				S2: Ability to use knowledge in science and mathematics (including statistics)	C1: Application of mathematics, science and engineering knowledge
X				S5: Ability to apply the knowledge of material science	C1: Application of mathematics, science and engineering knowledge

T = Technical Skills, P = Personal Skills, S = Social Skills, V = Values

4. SUMMARY OF MAPPING OF CLO TO PLO

PLO	Number of Courses	Number of CLO
C1	15	50
C2	12	33
C3	3	5
C4	4	8
C5	4	4
C6	7	12
C7	2	2
C8	1	2
C9	1	1
C10	2	5
C11	2	2

5. CURRICULUM STRUCTURE

S1	S2	S3	S4	S5	S6	S7	S8
Engineering Drawing	Exploring Engineering World	Statistics for Civil Engineering	Mechanics of Materials I	Structural Analysis I	Reinforced Concrete Design	Steel and Timber Design	Construction Management
Calculus I	Engineering Materials	Civil Engineering Profession	Applied Mathematics for Civil Engineers	Civil Engineering Materials	Structural Analysis II	Construction Engineering and Cost Estimating	Civil Engineering Project
General Chemistry	Computer Programming	Engineering Mechanics I	Geology for Civil Engineers	Soil Mechanics	Construction Supervision	Pre-Project	General Education
General Chemistry LAB	Calculus II	Calculus III	Materials Testing Laboratory	Soil Mechanics LAB	Highway Engineering	Foreign Language	Approved Electives
General Physics I	General Physics II	Communication and Presentation Skills	Surveying	Transportation Engineering	Geotechnical Engineering Design and Construction	General Education	Free Electives

S1	S2	S3	S4	S5	S6	S7	S8
General Physics LAB I	General Physics LAB II	General Education	Hydraulics I	Principle of Hydrology	Hydraulic Engineering	Approved Electives	
Experiential English I	Experiential English II		General Education	Hydraulic LAB I	Field Practice on Topographic Surveying	Free Electives	
					Engineering Practice		
17 credits	19 credits	18 credits	18 credits	18 credits	21 credits	20 credits	15 credits

6. SELF-REFLECTION ON THE TUNING METHODOLOGY

1. The bottom-up process of the Tuning methodology could modify the current degree profile with more specific detail following the Tuning Competencies. 2. The Tuning Competencies contain 4 categories: Technical Skills, Personal Skills, Social Skills and Values. These help design the courses in the curriculum, prioritising the importance of items for society. 3. The Competencies agreed by ASEAN universities could help understand the common needs in the civil engineering field in ASEAN countries.

2. KING MONGKUT'S UNIVERSITY OF TECHNOLOGY THONBURI, THAILAND

1. Brief University Profile

King Mongkut's University of Technology Thonburi was founded on 4 February 1960 as Thonburi Technical College, obtaining university status on 7 March 1998. It has become the first ever university to transform from the government sector into an independent university.

2. Brief Programme Profile

The programme is a four-year bachelor's level programme (8 semesters) with 142 credit hours in total. Co-opt and Exchange are optional.

3. MAPPING OF THE PROGRAMME'S LEARNING OUTCOMES (PLOS) TO THE TUNING COMPETENCIES

PLO 1	Ability to work and live well under the law and moral frames of Thai and other societies and be aware of the need to study orders and beliefs in the workplace or organisation, or the necessity to live differently from one's own familiar path.	<p>S1 Ability to show resilience</p> <p>G3 Ability to uphold professional, moral and ethical values</p> <p>G4 Ability to demonstrate responsibility and accountability towards society and the environment</p> <p>G7 Ability to understand, value, and respect diversity and multiculturalism</p>
PLO 2	Ability to demonstrate scientific and mathematical knowledge	<p>S2 Ability to use knowledge in science and mathematics (including statistics)</p>
PLO 3 – sub PLO 3.1	Understanding of engineering drawings, ability to select relevant codes and standards both in Thailand and foreign country contexts, and ability to design civil engineering components.	<p>S3 Ability to interpret engineering drawings</p> <p>S8 Ability to use relevant design codes and regulations</p> <p>S9 Ability to design civil engineering elements (e.g. structural, geo-technical, water, transportation and highway, environmental engineering, and others)</p>
PLO 3 – sub PLO 3.2	Ability to analyse civil engineering problems, ability to integrate civil engineering and other knowledge to create workable procedure and systems, and ability to identify proper technologies and construction techniques.	<p>S4 Ability to create processes to solve engineering problems</p> <p>S6 Ability to carry out civil engineering analyses</p> <p>S11 Ability to identify the appropriate construction technology and methods</p> <p>S14 Ability to integrate all civil engineering knowledge into a workable system</p>
PLO 3 – sub PLO 3.3	Ability to understand material science and engineering data from tests.	<p>S5 Ability to apply the knowledge of material science</p> <p>S7 Ability to interpret engineering data</p>
PLO 3 – sub PLO 3.4	Ability to assess impacts from engineering decisions, ability to monitor progress and quality control, and ability to uphold safety measures	<p>S10 Ability to monitor the progress and quality of civil engineering works</p> <p>S12 Ability to uphold safety measures</p> <p>S13 Ability to evaluate the impact of engineering decisions</p>
PLO 4	Ability to learn, improve, and develop both oneself and work, including creating innovation.	<p>G6 Ability to think critically, reflectively and innovatively</p> <p>G8 Ability to carry out lifelong learning and continuous professional development</p> <p>G9 Demonstration of problem-solving abilities</p> <p>G10 Ability to initiate, plan, organise, implement and evaluate courses of action</p>

		<p>G11 Ability to conduct research (investigative mind)</p> <p>G12 Ability to demonstrate leadership attributes</p> <p>G13 Ability to apply knowledge into practice</p>
PLO 5	Ability to work in multiple roles in the team, including promoting harmony and improving group performance.	G1 Ability to work collaboratively and effectively in diverse contexts
PLO 6	Ability to create understanding amongst stakeholders both in Thai and English by various means of communication.	<p>G2 Ability to use information and communication technology purposefully and responsibly</p> <p>G5 Ability to communicate clearly and effectively</p>
PLO 7	Understanding of basis of good business and the ability to present the relevant business model to one's own work.	S1 Ability to show resilience
PLO 8	Awareness of current world issues and problems and assessing impact of one's work thereon.	G8 Ability to carry out lifelong learning and continuous professional development

4. SUMMARY OF MAPPING OF CLO'S TO PLO'S

PLO's	Number of courses with measurement	Number of CLO's
PLO 1	8	11
PLO 2	17	23
PLO 3.1	18	20
PLO 3.2	24	46
PLO 3.3	7	12
PLO 3.4	7	7
PLO 4	10	11
PLO 5	8	8
PLO 6	11	11
PLO 7	4	4
PLO 8	4	4

Type	Category	Freshman				Sophomore			Junior		Senior	
OHEC	Lab	CHM 160				CVE 223	CVE 225	CVE 363				
		Chemistry Laboratory				Surveying Practices	Surveying Field Camp	Soil Mechanics Lab				
		PHY 191	PHY 192					CVE 394				
		General Physics Lab I	General Physics Lab II					Hydraulics Laboratory				
			GEN 111			GEN 121	GEN 231	GEN 241			GEN 351	
University	GEN		Man & Ethics of Living			Problem Solving	Miracle of Thinking	Beauty of Life			Modern Management	
		LNG 105	LNG 106			LNG 107						
		Academic English	Listening & Speaking			Reading & Writing						
		GEN 101										
		Physical Education										
Electives									CVE xxx		CVE xxx	XXX xxx
											XXX xxx	

6. SELF-REFLECTION ON THE TUNING METHODOLOGY

Thanks to a stroke of luck, the EU-Tuning began almost simultaneously with a major overhaul of the curriculum for the Bachelor of Engineering in Civil Engineering, International Programme, at King Mongkut's University of Technology, Thonburi. The direction of the programme itself was about to adopt the Outcome-Based Education or OBE approach; therefore, the experiences from EU-Tuning sessions have helped fine-tune the restructuring of the programme from its core in a great deal.

During the first session, competencies or outcomes, both generic ones applicable to any profession and specific ones for civil engineering, were widely discussed among colleagues. Some outcomes were newly introduced and were warmly accepted. The outcomes proposed during the Tuning activity matched up well with those in the curriculum. The next step was to hold a survey on these proposed outcomes among the stakeholders, i.e. fellow instructors, current students, alumni, and professionals. Even though the survey had been conducted in different countries in Southeast Asian region, the results were generally conforming. The major revelations were that some outcomes were viewed as very important by stakeholders and that some were not so. These results were very useful because they provided clear directions for the curriculum to take in terms of putting emphasis on outcomes.

Based on the level of importance of each outcome, the concept dubbed as the "Meta-Profile" could be drawn up. This was another major step as it allowed characteristics such as ingredients creating immunity to the 4th industrial revolution, or building sustainability to be inserted into the curriculum. This has helped put the reflection on the curriculum's current goals. The original philosophies of the curriculum were thus reviewed and investigated with the mindset of having a framework, i.e. a student profile.

The review of students' working hours was clearly very helpful as it underlined how they can realistically undertake the burden of the curriculum. However, the recently presented data may not prove to be of much use in terms of incorporation into the curriculum.

Elaboration on the most recent design of the curriculum along with peer review has underlined what should be emphasised in the structure of the curriculum. Many useful suggestions were made, including the provision of an exact assessment method on each Course Learning Outcome to ensure its attainment, the measurement of

weight of classes assigned on each outcome, and the creation of procedures to ascertain and clarify how each outcome is assessed in exams. These shall be used to further enhance the practice and quality assurance of the curriculum.

Joining EU Tuning has yielded many invaluable experiences that can only help strengthen the curriculum. As previously mentioned, the timing of the EU Tuning activity has coincided with the reform of the curriculum; thus, the reforming process has been in line with the EU approach. In addition, many worthwhile lessons have been learnt from colleagues in Southeast Asia. The sharing of curricula has brought harmony, empathy, and increased opportunities to establish significant and fruitful collaborations among universities in the future.

3. Naresuan University, Thailand

1) Brief University Profile

Naresuan University emphasises the improvement of educational opportunity and equity for all as one of the top government universities in Thailand. A strong focus is placed upon research, innovation, partnership, and internationalisation. Naresuan University aspires to be the University of Innovation. It is strategically located at the heart of the Thai Kingdom, Phitsanulok province, the major city of the lower northern region and more importantly, the birthplace of King Naresuan the Great, after whom our University is named. In line with the auspicious date of the 400th anniversary of King Naresuan the Great's accession to the throne, the University was officially founded on 29 July 1990. The institution's history can, however, be traced back to its inception as the College of Education in 1967. At present, the comprehensive university lives up to the public's expectations in providing diverse, cutting-edge programmes through 22 faculties, colleges, and a demonstration school.

2) Brief Programme Profile

The Civil Engineering Department of Naresuan University (NU) was established in 1995. It consists of 2 main programmes which are Civil and Environmental Engineering. 3 Associate Professors, 11 Assistant Professors and 11 lecturers are currently working in the department. The civil engineering students have to complete a total of 149 credits in order to graduate with a B. Eng. degree. A total of 60 students grad-

uated in 2017. The civil engineering programme was officially adjusted 8 times since the beginning and approved by the university council and Council of Engineers (COE) of Thailand.

3) Mapping of the Programme's Learning Outcomes (PLOs) to the TUNING Competencies (Step 6)

T	P	S	V	Meta-Profile agreed in Kula Lumpur	Revised Competencies
X	X	X	X	G13: Ability to apply knowledge into practice	C1: Knowledge of Mathematics, Sciences and Engineering C2: Engineering Problems Analysis
		X	X	G1: Ability to work collaboratively and effectively in diverse contexts	C6: Individual and Teamwork
		X	X	G7: Ability to understand, value, and respect diversity and multiculturalism	C6: Individual and Teamwork C7: Communication
	X	X		G5: Ability to communicate clearly and effectively	C7: Communication
	X		X	G4: Ability to demonstrate responsibility and accountability towards society and the environment	C8: Society, Environment, Sustainability, and Engineering Profession
	X		X	G9: Demonstration of problem-solving abilities	C2: Engineering Problems Analysis C3: Design and Develop Solutions for Complex Engineering
	X		X	G12: Ability to demonstrate leadership attributes	C6: Individual and Teamwork
	X		X	S1: Ability to show resilience	C10: Project Management and Finance
X	X			S3: Ability to interpret engineering drawings	C1: Knowledge of Mathematics, Sciences and Engineering
X	X			S4: Ability to create processes to solve engineering problems	C2: Engineering Problems Analysis
X	X			S6: Ability to carry out civil engineering analyses	C3: Design and Develop Solutions for Complex Engineering
X	X			S7: Ability to interpret engineering data	C4: Investigation
X	X			S14: Ability to integrate all civil engineering knowledge into a workable system	C3: Design and Develop Solutions for Complex Engineering C4: Investigation
			X	G3: Ability to uphold professional, moral and ethical values	C9: Ethics
			X	S12: Ability to uphold safety measures	C3: Design and Develop Solutions for Complex Engineering C5: Modern Tool Usage
X				S9: Ability to design civil engineering elements	C3: Design and Develop Solutions for Complex Engineering
X	X	X	X	G10: Ability to initiate, plan, organise, implement and evaluate courses of action	C3: Design and Develop Solutions for Complex Engineering
X	X	X	X	S13: Ability to evaluate the impact of engineering decisions	C4: Investigation C5: Modern Tool Usage
	X		X	S10: Ability to monitor the progress and quality of civil engineering works	C3: Design and Develop Solutions for Complex Engineering
	X			G6: Ability to think critically, reflectively and innovatively	C3: Design and Develop Solutions for Complex Engineering C5: Modern Tool Usage

T	P	S	V	Meta-Profile agreed in Kula Lumpur	Revised Competencies
	X			G8: Ability to carry out lifelong learning and continuous professional development	C11: Lifelong Learning
X				S8: Ability to use relevant design codes and regulations	C3: Design and Develop Solutions for Complex Engineering
X				S11: Ability to identify the appropriate construction technology and methods	C5: Modern Tool Usage
X				G2: Ability to use information and communication technology purposefully and responsibly	C5: Modern Tool Usage C7: Communication
X				G11: Ability to conduct research	C4: Investigation
X				S2: Ability to use knowledge in science and mathematics (including statistics)	C1: Knowledge of Mathematics, Sciences and Engineering C2: Engineering Problems Analysis
X				S5: Ability to apply the knowledge of material science	C2: Engineering Problems Analysis

T = Technical Skills, P = Personal Skills, S = Social Skills, V = Values

4) Summary of Mapping of CLO to PLO

PLO	Number of Courses	Number of CLO
C1	2	6
C2	7	19
C3	9	13
C4	6	13
C5	4	6
C6	6	9
C7	7	19
C8	6	8
C9	6	12
C10	4	6
C11	7	10

5) A one-page curriculum structure

S1	S2	S3	S4	S5	S6	S7	S8
Engineering Drawing	Developmental English	Mechanics of Materials I	Mechanics of Materials II	Structural Analysis I	Reinforced Concrete Design	Design of Timber and Steel Structures	Construction Engineering and Management
Calculus I	Basic Tool and Machine Workshops	Geology for Engineers	Structural Analysis I	Applied Mathematics for Civil Engineering	Hydraulic Engineering	Transportation Engineering	Civil Engineering Project
Principles of Chemistry	Engineering Mechanics I	Computer Programming	Engineering Statistics	Soil Mechanics	Foundation Engineering	Civil Engineering Pre-Project	General Education
Sports and Exercises	Calculus II	Calculus III	Civil Engineering Materials and Testing Laboratory	Soil Mechanics LAB	Highway Engineering	Engineering Elective Course	Engineering Elective Course
Physics I	Physics II	Engineering Materials	Surveying	Concrete Technology	Highway Materials Laboratory	Free Electives	Communicative English for Professional Purposes
Essential Mathematics for Civil Engineering	Introduction to Civil Engineering Profession	General Education	Fluid Mechanics	Principle of Hydrology	Hydraulic Engineering		Ethics for Engineers
Experiential English I	Elective in Humanity subject		English for Academic Purposes	Technopreneur	General Education		
Thai Language Skills	Elective in Science subject		Fluid Mechanics Laboratory	Practical Training in Surveying			
21 credits	20 credits	19 credits	21 credits	19 credits	17 credits	17 credits	15 credits

Training in Civil Engineering (Non-credit) during S6 and S7

6) Self-reflection on the TUNING methodology

The challenges of globalisation and the 4th industrial revolution are inevitable. The university will be faced with many unforeseen challenges. Therefore, the Tuning methodology, particularly the Meta-Profile design process (which allowed the new trends and opportunities for setting up and prioritising the appropriate competencies), is the key for the next generation of the university programme. For the NU's civil engineering program, we clearly accepted the process of Tuning Asia-South East, especially the gap between the Meta-Profile and the NU's course-learning outcome. Also, it is generally agreed that G7 (Ability to understand, value, and respect diversity and multiculturalism) is the considerable competency that should be added into the NU's outcome. Therefore, we adjust the content in C6 of the Learning Outcomes as follows: Ability to function effectively as an individual and as a member or leader in multidisciplinary and multicultural teams. Hopefully, this modification will facilitate improving the NU's civil engineering programme and also the civil engineering profession in Thailand in the near future.

4. University of the Philippines (Diliman)

Bachelor of Science in Civil Engineering University of the Philippines (Diliman)

1. Brief University Profile

The University of the Philippines (UP) System is the only national university in the Philippines. The University was established on 18 June 1908 and currently has 8 constituent units: UP Diliman, UP Manila, UP Los Baños, UP Visayas, UP Mindanao, UP Open University, UP Baguio, and UP Cebu, located on 14 campuses throughout the country. UP's constituent universities nurture the intellectual and cultural growth of the Filipino through 258 undergraduate and 438 graduate programmes. Almost 26.6% of its faculty members hold doctoral degrees and 36.2% hold master's degrees. In 2011-2012, it had a population of 41,991 undergraduate students. Internationally recognised as the leading educational institution in the country, UP is the only Philippine university in the Association of Pacific Rim Universities (APRU). UP is also the only Philippine university in the ASEAN-European University Network (ASEA UNINET), and is one of two Philippine universities in the ASEAN University Network (AUN).

The U.P. College of Engineering was established 100 years ago on 13 June 1910. Two Institutes (Institute of Civil Engineering and Electrical and Electronics Engineering Institute) and six Departments (Chemical Engineering, Computer Science, Geodetic Engineering, Industrial Engineering & Operations Research, Mechanical Engineering and Mining, Metallurgical & Materials Engineering) offer 12 undergraduate programmes and 22 graduate programmes and has 230 full-time faculty members, more than half of whom hold advanced degrees. As of June 2017, the College has a population of 3,902 undergraduate students.

In October 2008, the University approved the Department's transformation into an Institute with the creation of the Institute of Civil Engineering to address the growing need for a centre of excellence in civil engineering and its specialised fields, with combined capabilities in instruction, research and extension service. Currently it is the first and only institute of civil engineering in the country. As of August 2018, the Institute has 45 full-time faculty members, comprising 12 professors, 7 associate professors, 18 as-

sistant professors and 13 instructors, including 19 doctoral degree holders in the various fields of study in civil engineering. As of August 2018, the Institute has 565 undergraduate students and 282 graduate students.

2. Brief Programme Profile

The revised programme effective August 2018 is for eight regular semesters (four months each) and a two-month internship in the mid-year term of the third year.

Length of programme:	136 weeks over 8 semesters (4 years)
Level:	Bachelor's degree
Number of courses:	52 academic courses, 4 physical education (PE) and 2 national service training programme (NSTP) courses

Graduates of the programme can progress to the Master of Science in Civil Engineering and Doctor of Philosophy in Civil Engineering programmes.

The degree profile of the B.S. Civil Engineering is shown in terms of the student outcomes of the revised 4-year programme and also considering the objectives of the General Education (GE) Programme of the University of the Philippines (UP). Figure 1 shows the 11 student outcomes of the civil engineering programme, consisting of core competencies, drivers, enablers and values.

The 11 University of the Philippines (Diliman Campus) B.S. in Civil Engineering Student Outcomes (SOs) or Programme Learning Objectives according to the four clusters tagged VDCE are:

C – Core Competencies

- SO1. An ability to apply principles of engineering, science and mathematics.
- SO2. An ability to identify, formulate and solve complex engineering problems.
- SO3. An ability to develop and conduct appropriate experimentation, analyse and interpret data, and use engineering judgment to draw conclusions.
- SO4. An ability to apply the engineering design process to produce solutions that meet specified needs with consideration for public health and safety and global, cultural, social, environ-

mental, economic, and other factors, as appropriate to the discipline.

E – Enabling Competencies

- SO5. An ability to communicate effectively with a range of audiences by a variety of means.
- SO6. An ability to function effectively as a member or leader of a team that establishes goals, plans tasks, meets deadlines, and creates a collaborative and inclusive environment.

D – Drivers (for action and excellence)

- SO7. A knowledge of contemporary issues in the profession and society.
- SO8. A liberal education with emphasis on nation-building.
- SO9. An ability to recognise the ongoing need to acquire new knowledge, to choose appropriate learning strategies, and to apply this knowledge.

V – Values (paradigms, context)

- SO10. An ability to consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
- SO11. An ability to recognise ethical and professional responsibilities in engineering situations and make informed judgments.

3. Mapping of the Programme's Learning Outcomes to the TUNING Competencies

In general, most of the generic and subject-specific competencies of the CE Meta-Profile are covered by the University of the Philippines (Diliman) Student Outcomes/Programme Learning Objectives of the revised 4-Year B.S. Civil Engineering Programme. The University of the Philippines Civil Engineering Student Outcomes are wider in coverage and can cover two or more competencies of the CE Meta-Profile which are more specific in formulation. Graphically, Figure 1 shows the Civil Engineering Meta-Profile where the correspondence of the generic competencies (G1, .. G13) and subject-specific competencies (S1, .. S14) with the University of the Philippines (Diliman) civil engineering student outcomes/programme learning objectives (SO1, ... SO11).

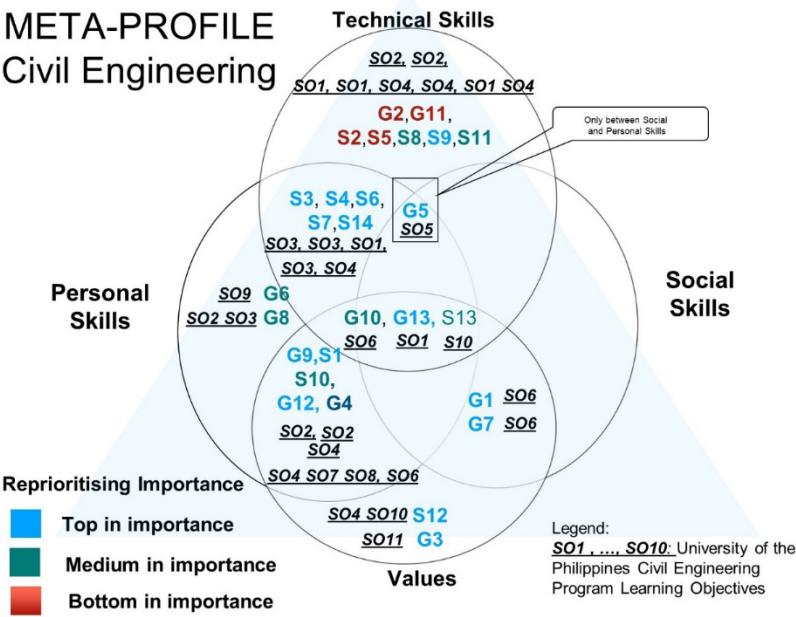


Figure 1. Civil Engineering Meta-Profile and the Student Outcomes/Programme Learning Objectives of the University of the Philippines (Diliman)

4. Summary of Mapping of CLO to PLO

Table 1 shows the number of courses that satisfy the programme learning outcomes or student outcomes (SO) of the University of the Philippines (Diliman) and the corresponding number of course outcomes (CO) corresponding to each student outcome.

Table 1. Mapping of Course Learning Outcomes to Programme Learning Outcomes

PLO: Student Outcome (SO)	Number of Courses	Number of Course Outcomes (CO)
SO1	38	155
SO2	21	83
SO3	14	38
SO4	15	69
SO5	20	70
SO6	17	53

PLO: Student Outcome (SO)	Number of Courses	Number of Course Outcomes (CO)
SO7	15	59
SO8	14	42
SO9	17	70
SO10	11	48
SO11	14	48

5. Curriculum Structure

Figure 2 shows the revised 4-year Bachelor of Science in Civil Engineering Programme in terms of engineering core courses (26 civil engineering, 3 engineering mechanics, 2 geodetic engineering), 9 mathematics and sciences (physics and chemistry) and 10 general education courses (English, communication, arts, social science and philosophy, maths, science and technology).

Type	FIRST YEAR			SECOND YEAR			Type	THIRD YEAR			FOURTH YEAR		
	Semester 1	Semester 2		Semester 1	Semester 2			Semester 1	Semester 2		Semester 1	Semester 2	
ENGINEERING CORE		ES 1 / 2 Engineering Drawing		ES 101 / 4 Mechanics of Particles and Rigid Bodies	ES 102 / 3 Mechanics of Deformable Bodies		ENGINEERING CORE	CE 18 / 4 Solid Mechanics	CE 116 / 3 Water Resources & Environmental Engineering I		CE 199 / 3 Undergraduate Research Project	CE 196 / 3 Civil Engineering Design Project	
		GE 10 / 3 General Surveying I		CE 22 / 4 Geomatics Engineering II	CE 17 / 3 Hydroinformatics			CE 115 / 4 Water Resources & Coastal Engineering I	CE 124 / 3 Construction Engineering I				
		CE 1 / 3 Introduction to Civil Engineering		CE 11 / 3 Engineering Geology and Engineering Meteorology	CE 22 / 3 Engineering Economics			CE 123 / 3 Construction Engineering & Management I	CE 132 / 3 Sanitary Engineering I				
		CE 29 / 3 Probability and Statistics for Engineering		CE 24 / 3 Mathematical Methods in Civil Engineering I	CE 25 / 3 Mathematical Methods in Engineering II			CE 141 / 3 Transportation Engineering I	CE 142 / 3 Transportation Engineering II				
				CE 41 / 2 Construction Plans	CE 31 / 3 Materials Elements of Environmental and Energy Engineering			CE 151 / 4 Structural Engineering I	CE 152 / 4 Structural Engineering II				
MATH & SCIENCE							MATH & SCIENCE	CE 162 / 3 Geotechnical Engineering I	CE 163 / 3 Geotechnical Engineering II				
									CE 190 / 1 Research Methods in Civil Engineering				
								21	20		3	3	
GEN. EDUC.							GENERAL EDUCATION						
ELECTIVE							ELECTIVE						

Figure 2. Revised 4-Year Bachelor of Science in Civil Engineering Programme, University of the Philippines (Diliman), 155 units 6.

Self-Reflection

The Tuning approach is very much applicable in revising as well as formulation of academic degree programmes as it employs a logical step-by-step process that includes programme specifications, social need for the programme, future jobs of graduates, degree profile in terms of generic and specific competencies, linking the degree profile with the Meta-Profile, overall programme consistency and internal quality control and continuous improvement. It is very much related to the outcome-based education approach, except that it is not prescriptive and allows the university to maintain its identity through its mission and vision, and local and national needs, building on its own strengths.

5. University of San Augustin, the Philippines

1. University profile

The University of San Agustin (commonly referred to as San Agustin, San Ag, or USA) is a private Catholic university in Iloilo City, Philippines. With 40 founding students, it was established in 1904 as a preparatory school for boys by the Spanish Catholic missionaries under the oldest religious Roman Catholic order in the Philippines during the American colonial period, the Order of Saint Augustine (San Agustin). In 1917, it was incorporated and became Colegio de San Agustin de Iloilo. In March 1953, San Agustin attained university status making it as the First University in Western Visayas. San Agustin is the first and only Augustinian university in the Asia-Pacific region.

Present day Augustinians trace their apostolate in the Philippines to the five pioneering Augustinians: Friars Martín de Rada, Diego de Herrera, Agustín de Aguirre, Pedro de Gamboa, and Andrés de Urdaneta “the pivot upon which everything in the early history of the Philippines turned”. One of the purposes of their expedition was to bring the Catholic faith to the Philippine archipelago. The purpose of their Augustinian apostolate had an educational and cultural dimension. As early as the 1880’s, the Augustinians planned the establishment of a school in the province of Iloilo, on Panay island. The University of San Agustin ranks as a veritable leader among the hundreds of Augustinian institutions found in over forty countries across the globe.

On 15 July 2004, the University of San Agustin celebrated its centenary with the theme “USA@100: Living the Legacy, Leading the

Way". The centennial celebration heralded the University's role as an enlightened leader in the area of instruction, research, community extension, and evangelisation.

The University of San Agustin now provides programmes from Basic Education up to post-graduate studies in the areas of Business, Education, Computer Studies, Arts, Sciences, Performing Arts, Music, Engineering, Medical Technology, Nursing, and Pharmacy.

II. Programme profile

Bachelor of Science in Civil Engineering (BSCE)

The Bachelor of Science in Civil Engineering (BSCE) of the University of San Agustin is a revised programme since the outcome-based approach will now be used and the length of the programme will now be reduced from 5 years to 4 years due to the implementation of the K-12 programme by the government. From General Civil Engineering program, the revised programme will now have 5 areas of specialisation: (1) Construction Engineering & Management; (2) Geotechnical Engineering; (3) Structural Engineering; (4) Transportation Engineering; & (5) Water Resources Engineering. Students will now have to choose their area of specialisation. The University offers 2 tracks: **Track 1: Structural Engineering; Track 2: Construction Engineering & Management.**

III. Comparison of the formulated meta-profile with the actual BSCE programme of the university

The following table illustrates the mapping between the programme outcomes of the said academic programme and the generic and specific competencies used in the Meta-Profile.

PLO	University of San Agustin	Formulated META-PROFILE
A	Apply knowledge of mathematics and science to solve complex civil engineering problems	(G9) Demonstration of problem-solving abilities
		(G13) Ability to apply knowledge into practice.
		(S2) Ability to use knowledge in science and mathematics (incl. statistics)
		(S5) Ability to apply the knowledge of material science
B	Design and conduct experiments, as well as analyse and interpret data	(G11) Ability to conduct research
		(S7) Ability to interpret engineering data

PLO	University of San Agustin	Formulated META-PROFILE
C	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, in accordance with standards	(G4) Ability to demonstrate responsibility and accountability towards society and the environment
		(S1) Ability to show resilience
		(S4) Ability to create processes to solve engineering problems
		(S12) Ability to uphold safety measures
		(S13) Ability to integrate all civil engineering knowledge into a workable system
D	Function in multidisciplinary and multi-cultural teams	(G1) Ability to work collaboratively and effectively in diverse contexts
E	Identify, formulate, and solve complex civil engineering problems	(G6) Ability to think critically, reflectively and innovatively
		(S6) Ability to carry out civil engineering analyses
F	Understand professional and ethical responsibility	(G3) Ability to uphold professional, moral and ethical values.
G	Communicate effectively civil engineering activities with the engineering community and with society at large	(G5) Ability to communicate clearly and effectively
H	Understand the impact of civil engineering solutions in a global, economic, environmental, and societal context	(S13) Ability to evaluate the impact of engineering decisions.
I	Recognise the need for, and engage in, lifelong learning	(G8) Ability to carry out lifelong learning and continuous professional development
J	Know contemporary issues	(G7) Ability to understand, value, and respect diversity and multiculturalism
K	Use techniques, skills, and modern engineering tools necessary for civil engineering practice	(G2) Ability to use information and communication technology purposefully and responsibly
		(S3) Ability to interpret engineering drawings
		(S11) Ability to identify the appropriate construction technology and methods
L	Know and understand engineering and management principles as a member and leader of a team, and manage projects in multidisciplinary environments	(G10) Ability to initiate, plan, organise, implement and evaluate courses of action
		(G12) Ability to demonstrate leadership attributes
		(S8) Ability to use relevant design codes and regulations
		(S10) Ability to monitor the progress and quality of civil engineering works
M	Understand at least one specialised field of civil engineering practice	(S9) Ability to design civil engineering elements. (e.g. structural, geotechnical, water, transportation and highway, environmental engineering and others)
N	Know and understand the fundamental Augustinian values in relation to their profession (such as concern for the common good of society, sense of community, spirit of generous service, love for peace and order, constant pursuit of excellence, etc.)	(G3) Ability to uphold professional, moral and ethical values.
		(G4) Ability to demonstrate responsibility and accountability towards society and the environment

PLO	Number of Courses	Number of CLO
A	43	156
B	18	77
C	14	58
D	32	128
E	23	96
F	20	83
G	38	136
H	11	50
I	19	49
J	24	87
K	40	151
L	14	46
M	12	34
N	6	18

IV. Curriculum Structure (See Attached)



University of San Agustin
General Luna Street, 5,000
Iloilo City, Philippines
www.usa.edu.ph



COLLEGE OF TECHNOLOGY
Civil Engineering Program

TYPE	YEAR 1		YEAR 2		YEAR 3		YEAR 4	
	1ST SEMESTER	2ND SEMESTER	1ST SEMESTER	2ND SEMESTER	1ST SEMESTER	2ND SEMESTER	1ST SEMESTER	2ND SEMESTER
CORE	GE 1 Science, Technology and Society	GE3 Mathematics in Modern World	Math 110 Differential Equations	Math 111E Engineering Data Analysis	CE 351 Structural Theory	TP 1 Technopreneurship	CE 451 Principle of Transportation Eggs	CE 451 Principle of Transportation Eggs
	GE 2 Reading in Philippine History	GE4 Contemporary World	Math 310 Statistics of Rigid Bodies	CE 261 Geology for Civil Engineers	CE 352 Highway and Railroad Engineering	CE 361 Building Design for CE	CE 452 Geotechnical Engineering 1	CE 452 Geotechnical Engineering 1
	Math 91E Calculus 1	Math 91E Calculus 1	CE 261 Statistics of Rigid Bodies	Math 320 Statistics of Rigid Bodies	CE 353 Engineering Surveying	CE 362 Design of Steel Design	CE 453 CE Project 1	CE 453 CE Project 1
	Math 91E Calculus 1	Math 91E Calculus 1	CE 261 Statistics of Rigid Bodies	Math 322 Statistics of Rigid Bodies	CE 354 Engineering Surveying	CE 363 Principle of Reinforced Concrete	CE 454 CE Project 2	CE 454 CE Project 2
ENGINEERING CORE	CE 151 Civil Engineering Orientation	Phys 1E Physics for Engineers (calculus based)	CE 7 Engineering Economy	CE 262 Mechanics of Deformable Bodies	CE 355 Engineering Utilities 1	CE 365 Principle of Reinforced Concrete	CE 455 CE Project 3	CE 455 CE Project 3
	CE 152 Civil Engineering Orientation	Phys 1E Physics for Engineers (calculus based)	CE 7 Engineering Economy	CE 262 Mechanics of Deformable Bodies	CE 355 Engineering Utilities 2	CE 365 Principle of Reinforced Concrete	CE 455 CE Project 3	CE 455 CE Project 3
	CE 153 Civil Engineering Orientation	Phys 1E Physics for Engineers (calculus based)	CE 7 Engineering Economy	CE 262 Mechanics of Deformable Bodies	CE 355 Engineering Utilities 2	CE 365 Principle of Reinforced Concrete	CE 455 CE Project 3	CE 455 CE Project 3
	CE 154 Civil Engineering Orientation	Phys 1E Physics for Engineers (calculus based)	CE 7 Engineering Economy	CE 262 Mechanics of Deformable Bodies	CE 355 Engineering Utilities 2	CE 365 Principle of Reinforced Concrete	CE 455 CE Project 3	CE 455 CE Project 3
LABORATORY	CE 155 Civil Engineering Orientation	Phys 1E Physics for Engineers (calculus based)	CE 7 Engineering Economy	CE 262 Mechanics of Deformable Bodies	CE 355 Engineering Utilities 2	CE 365 Principle of Reinforced Concrete	CE 455 CE Project 3	CE 455 CE Project 3
	CE 156 Civil Engineering Orientation	Phys 1E Physics for Engineers (calculus based)	CE 7 Engineering Economy	CE 262 Mechanics of Deformable Bodies	CE 355 Engineering Utilities 2	CE 365 Principle of Reinforced Concrete	CE 455 CE Project 3	CE 455 CE Project 3
	CE 157 Civil Engineering Orientation	Phys 1E Physics for Engineers (calculus based)	CE 7 Engineering Economy	CE 262 Mechanics of Deformable Bodies	CE 355 Engineering Utilities 2	CE 365 Principle of Reinforced Concrete	CE 455 CE Project 3	CE 455 CE Project 3
	CE 158 Civil Engineering Orientation	Phys 1E Physics for Engineers (calculus based)	CE 7 Engineering Economy	CE 262 Mechanics of Deformable Bodies	CE 355 Engineering Utilities 2	CE 365 Principle of Reinforced Concrete	CE 455 CE Project 3	CE 455 CE Project 3
SPECIALIZATION	CE 159 Civil Engineering Orientation	Phys 1E Physics for Engineers (calculus based)	CE 7 Engineering Economy	CE 262 Mechanics of Deformable Bodies	CE 355 Engineering Utilities 2	CE 365 Principle of Reinforced Concrete	CE 455 CE Project 3	CE 455 CE Project 3
	CE 160 Civil Engineering Orientation	Phys 1E Physics for Engineers (calculus based)	CE 7 Engineering Economy	CE 262 Mechanics of Deformable Bodies	CE 355 Engineering Utilities 2	CE 365 Principle of Reinforced Concrete	CE 455 CE Project 3	CE 455 CE Project 3
	CE 161 Civil Engineering Orientation	Phys 1E Physics for Engineers (calculus based)	CE 7 Engineering Economy	CE 262 Mechanics of Deformable Bodies	CE 355 Engineering Utilities 2	CE 365 Principle of Reinforced Concrete	CE 455 CE Project 3	CE 455 CE Project 3
	CE 162 Civil Engineering Orientation	Phys 1E Physics for Engineers (calculus based)	CE 7 Engineering Economy	CE 262 Mechanics of Deformable Bodies	CE 355 Engineering Utilities 2	CE 365 Principle of Reinforced Concrete	CE 455 CE Project 3	CE 455 CE Project 3
Total Units for Graduation: 128								

V. Reflection

The first time I heard of Tuning was during the summer of 2017. We received a call at the Human Resources Office (HR) and were asked if we were willing to travel to Spain for a meeting/conference. We had to decide on the spot because it was the last day for signing up to the meeting. The three of us (w/ Ms. Remi Salvilla of the College of Pharmacy & Ms. Sylvia Sajo of the Teachers' College) did not want to pass up this opportunity to travel, so we decided to go. Still, we had no idea of what we were getting into and what we are about to do at the meeting. We had to prepare our travel documents immediately because of the limited time before the scheduled meeting.

When we arrived in Bilbao, Spain, we still had no idea of what we were about to do. There, we met other participants from different countries in Southeast Asia. It was during the first plenary session that we were introduced to the Tuning Academy and what we are about to do. That this programme is a 3-year programme with scheduled meetings every 6 months and tasks in between. Still, we had little idea of how and what we were supposed to do with our tasks. As we met and discussed with our different Subject Area Groups (SAG), we slowly understood what our tasks for the duration of the programme would be. Some of us were hearing the terms Meta-Profile, Competencies, etc. for the first time. But as the meetings progressed and we performed the interim tasks, we gradually understood the purpose of this programme and that its purpose is to develop a uniform curriculum (of competencies) for the students of the future in the entire Southeast Asian region.

I can say that the timing of this programme has been perfect for us in the Philippines because with the implementation of the K-12 programme by the government, we are in midst of revising our curricula. With the knowledge gained in the programme, we have enhanced our curricula and aligned our programmes with the Tuning Programme. As the programme's end is fast approaching, may we have strengthened each of our schools' programmes with our alignment to the Tuning Programme. I pray that this Tuning Programme will continue to help the development of our future students. To my colleagues who I've met in this program, I am thankful to have met each one of you. May we see each other again in the future. God bless us all!

6. UNIVERSITI TEKNOLOGI MALAYSIA

School of Civil Engineering (FKA)

The Bachelor of Engineering (Honours) (Civil Engineering) programme is designed as a four-year engineering programme covering 57 courses with 137 total credits for graduation. The Technical to Generic skills ratio is set at 75:25 according to generic guidance on curricula models. Graduates are able to progress to Master's and PhD level (fast track program) right after the completion of B.Eng (Civil) provided that the minimum entry requirement has been met. The programme is fully accredited by the Malaysian Engineering Accreditation Council (EAC) in accordance with the Washington Accord and certified with the ISO 9001:2008 certificate.

The main purpose of the revision exercise for this programme according to the TUNING methodology was to incorporate the weightage of TA-SE competencies (according to survey results and consensus among SAG members) into the existing programme so that curriculum design is based on the multiple perspectives of the different stakeholders. This will instigate initiative to design Civil engineering curricula according to the TUNING philosophy with specific exclusivity, whilst still complying with the Malaysian Engineering Accreditation Manual / WASHINGTON ACCORD. Revised curricula may also look into deep learning elements in response to the 4th Industrial Revolution which has been infused into the Civil Engineering Meta-Profile during the second general meeting.

The curriculum takes into consideration the element of sustainability, complexity in solving problems and entrepreneurship in the courses. The curriculum is made up of a total of 137 credits spread over 8 semesters, as summarised in Table 1. Of the total credits, 70.1% are allocated to engineering courses. In the first 2 years of the programme, the course contents strongly emphasise the principles of Civil Engineering that will equip students with an adequate foundation in structural engineering, materials, environmental engineering, hydrology and hydraulic engineering, highway and transportation engineering, as well as geotechnical engineering. Starting year 3, three comprehensive integrated design project courses that focus on site planning, feasibility studies and preliminary design, implementation and integration of infrastructure/building design are offered. In the final year, three electives courses, an entrepreneurship course and two English competencies courses are offered. The curriculum also adheres to the requirements of EAC, as per Ap-

pendix B of the EAC Manual 2012 and EAC Manual 2017. The curricula are balanced and are reflected through the distribution of courses in the various classifications and the percentage contribution (see Table 1). The revision will consider the infusion of deep learning elements into the existing courses or the creation of a specific course to cater to the deep learning foundation (Artificial Intelligence) in line with the proposed TA-SE Meta-Profile and 4th Industrial Revolution concept. The constructive alignment, a principle used for devising teaching and learning activities, and assessment tasks, that directly addresses the intended PLOs is demonstrated in the example of programme course outlines of SKAB 4153 (Offshore structure) in Appendix A.

No.	Classification	Credit Hours	Percentage
i.	University Courses		
	a. General	14	19.7%
	b. Language	8	
	c. Entrepreneurship	2	
	d. Co-Curriculum	3	
ii.	Faculty/Programme Core	101	73.7%
iii.	Programme Electives	9	6.6%
	Total	137	100%
A	Engineering Courses		
	(a) Lecture/Project/Laboratory	81	70.1%
	(b) Workshop/Field/Design Studio	4	
	(c) Industrial Training	5	
	(d) Final Year Project	6	
	Total Credit Hours for Part A	96	
B	Related Courses		
	(a) Applied Science/Mathematic/Computer	20	29.9%
	(b) Management/Law/Humanities/Ethics/Economy	10	
	(c) Language	8	
	(d) Co-Curriculum	3	
	Total Credit Hours for Part B	41	
	Total Credit Hours for Part A and B	137	100%
	Total Credit Hours to Graduate	137 credit hours	

Table 1: Classification of the Curriculum

The competencies; later referred to as Programme Learning Outcomes (PLOs); are attributes that are expected to be attained by students upon completion of their Bachelor of Civil Engineering Programme. These have been established in line with the requirements set by EAC. The PLOs are outlined and defined in Tables 2 and 3. The current curriculum is made up of twelve PLOs that can be directly mapped with the twelve PLOs set by EAC. From the 12 PLOs, the first five PLOs, namely PLO1, PLO2, PLO3, PLO4 and PLO5, focus on the technical skills of the students, whereas the remaining PLOs, PLO6 to PLO12 focus on the generic skills of the students. The PLOs are also mapped to the attributes set by EAC, Ministry of Higher Education (MoHE) and ABET. It is therefore evident that the formulated PLOs comply with the outcome requirements listed in Section 6.2 of the EAC Manual.

The achievement of PLOs is partly manifested by the attainment of the CLO through appropriate teaching and learning deliveries, as described in the course outlines of each course. All these processes involved are summarised in Table 2. In addition to the assessment tools mentioned above, other indirect measurements such as the feedback from the industrial advisory panels and external examiners are also adopted. The attainment of PLO of students at course level is reported by the respective course coordinator to the head of department by filling in the Course Assessment Report (CAR) form. The contents of the CAR report are: Achievement level of each Course Learning Outcome (CLO) and whether the KPI is achieved or not, Achievement level of each PLO, Students' feedback based, Reflections, CQI or Remedial action taken, and Comments from the department head.

The achievement of PLOs is measured using the direct and indirect methods. The direct measurements, which are carried out by the academic staff, are divided into two parts, i.e. based on examination and exit test. The indirect methods are implemented through an exit survey collected immediately upon completion of the academic programme, while an employer survey is used to measure the perception of employers towards the attainment of PLOs by the graduates employed by them after 3-5 years of completing the academic programme. Similar surveys are also conducted on employers who have provided industrial training to students.

Table 2: Assessment Plan for the Attainment of PLOs

<i>Programme Outcomes</i>	<i>Assessment tools or methods used</i>	<i>When will the data collection/analysis be performed and presented?</i>	<i>What will be the indicator that the outcome is achieved?</i>
PLO1: Engineering Knowledge PLO2: Problem Analysis PLO3: Design or Development of Solutions PLO4: Investigation PLO5: Modern Tool Usage PLO8: Ethics	Students' examination performance in mathematics and basic civil engineering courses	End of semester	70% getting B and above in each course
	Employers perception survey (Industrial training)	Every year	>80% giving a positive feedback by the employer
	Exit Test	Every semester	100% getting D and above. (Exit Tests are graded as A=80-100, B=65-79, C=50-64, D=40-49)
PLO6: The Engineer and Society PLO7: Environment and Sustainability PLO9: Communication PLO10: Individual and Teamwork PLO11: Lifelong Learning PLO12: Project Management and Finance	Student Perception based on Exit survey	Every year	>80% indicating a satisfactory remark
	Students' generic skill performance in selected courses	Every semester	>75% attained higher than level 3
	Employers' perception survey (Industrial training)	Every year	>80% giving a positive feedback by the employer
	Student Perception based on Exit survey	Every year	>80% indicating a satisfactory remark

The Meta-Profile proposed by the TA-SE Civil Engineering Area is well connected to the attributes of the 4th Industrial revolution, the sustainable development goal concept, and the World Economic Forum's 21st Century Skills. The list of generic and specific student attributes has been ranked according to its importance based on the survey results and its dual coverage on two different skills among technical skill, personal skill, social skill and values. According to Table 3, the list of generic and specific student attributes are identical and well mapped to the current attributes (PLOs) covered by the 12 PLOs of B.Eng (Civil) programme. Since the current PLOs have been designed according to the Washington Accord, the current list of student attributes addressed by each subject in the Civil Engineering programme can be considered comprehensive and identical to the proposed student attributes as listed by TA-SE project.

The bottom-up approach as implemented by the TA-SE project is more realistic and meaningful, enabling academicians to fully understand the overall process of designing engineering curricula. The current state of curriculum design is more towards a top-down approach, whereby the existing curriculum was being adapted to fit the list of student attributes set by the EAC. The list of EAC student attributes is not divided into generic and specific. Moreover, the attributes are not ranked according to their importance. Hence, the process of designing engineering curricula is more like fitting the existing programme prior to OBE into the new framework without any major change. The process is all about assigning the student attributes to each course so that the student attributes as a whole can be covered by the programme. In the end, the compliance of OBE is merely based on how deep the programme can cover the student attributes on paper without any specific weightage that can give a unique trademark and direction to the programme. For example, according to distribution of PLOs based on the existing programme as depicted in Figure 1, PLO 6 (AD) ‘Ability to understand the impact of professional engineering solutions’, has recorded the lowest percentage of coverage by all courses despite its high weightage of competencies under the TA-SE Meta-Profile (see Table 3).

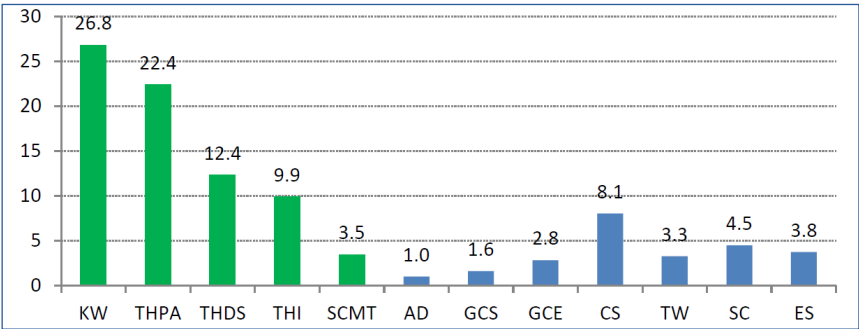


Figure 1: Distribution of PLO coverage by all courses

Meanwhile, the list of student attributes by TA-SE has undergone a detailed and systematic analytical process by considering opinions from different stakeholders before the list can be published for Meta-Profile development. Even the development of the Meta-Profile has gone through a rigorous process so that each of the student attribute can be ranked wisely according to its importance (Top, Medium, Low). For instance, if S2 ‘Ability to use knowledge in science

and mathematics (including statistics)’ has the highest priority, then the curriculum design can take this into consideration by having more mathematic-based courses to equip their students with a strong foundation on the first principal concept. This priority level can give greater vision to academicians when designing future engineering curricula since the list of student attributes can reflect the actual expectations of the different stakeholders. In fact, each university in Malaysia can have their unique signature on the engineering programme whilst still complying with the Washington Accord’s OBE.

Table 3: Mapping of PLOs to TA-SE competencies

PO	Keywords	PROGRAMME LEARNING OUTCOMES (PLOs)	TA-SE
(PLO 1) KW	Engineering Knowledge	Ability to apply knowledge of mathematics, science, civil engineering fundamentals and other relevant fields of study to solve complex engineering problems.	G13 (Top) S2 (Low) S5 (Low)
(PLO 2) THPA	Problem Analysis	Ability to identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.	G6 (Medium) G9 (Top) G2 (Low) S3 (Top) S6 (Top) S7 (Top)
(PLO 3) THDS	Design or Development of Solutions	Ability to design or develop solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.	G10 (Medium) S4 (Top) S8 (Medium) S9 (Top) S14 (Top)
(PLO 4) THI	Investigation	Ability to conduct investigation into complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.	G11 (Low)
(PLO 5) SCMT	Modern Tool Usage	Ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities, with an understanding of the limitations.	G8 (Medium) S11 (Medium)
(PLO 6) AD	The Engineer and Society	Ability to provide contextual reasoning to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.	G7 (Top) S12(Top)
(PLO 7) GCS	Environment and Sustainability	Ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.	G3 (Top) G4 (Top) S1 (Top) S13 (Medium)

PO	Keywords	PROGRAMME LEARNING OUTCOMES (PLOs)	TA-SE
(PLO 8) GCE	Ethics	Ability to uphold the ethics of engineering practice.	G3 (Top)
(PLO 9) CS	Communication	Ability to communicate effectively with confidence, including ability to write and make convincing presentations on complex engineering problems.	G5 (Top)
(PLO 10) TW	Individual and Team-work	Ability to function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.	G1 (Top) G12 (Top) S10 (Medium)
(PLO 11) SC	Lifelong Learning	Ability to continuously seek and acquire contemporary technology changes.	G8 (Medium) S11 (Medium)
(PLO 12) ES	Project Management and Finance	Ability to demonstrate understanding of project and financial management and possess entrepreneurial skills to create business opportunity.	G1 (Top) G12 (Top)

The key element in the revision process will be focusing on improving the distribution of PLOs across all 57 courses so that the distribution pattern complies with the pre-defined level of importance of competencies as per the Meta-Profile. The next stage is to monitor the achievement of PLOs, the coverage of which has been increased by assigning more courses to this particular PO. The effectiveness of the revision process will be based on student achievement on specific PLOs which are relevant to the Meta-Profile. New courses related to deep learning (Artificial neural network, Deep neural network, Deep decision trees), system integration and current technology (Building Information Modelling) will be introduced as a part of the revision process to meet the current demand of the industries and in line with the attributes of 21st century learners, the 4th Industrial revolution movement, and the Sustainable development goal policy. Furthermore, a few selected courses will be introduced with case studies to improve students' soft skills in solving real-life problems.

To be specific, the proposed revision will not tamper with the pre-defined ratio of technical to generic skills of 75%:25%. Instead, the existing distribution percentage of PLOs across all courses needs to be adjusted so that it can be aligned with the Meta-Profile of the Civil engineering course. For instance, according to the existing distribution of PLOs, as depicted in Figure 2, PLO4 THI (Investigation) is more prominent than PLO5 SCMT (Modern tool usage). However, according to the mapping of PLOs on the Meta-Profile components, competencies of G8 and S11, which mapped to PLO5 SCMT (Modern

tool usage), are classified as medium priority as compared to the low priority of G11 in PLO4 THI (Investigation), as shown in Table 3. Another good example of the potential revision is on PLO6 AD (Engineer & Society) and PLO11 SC (Lifelong learning). PLO6 AD (Engineer & Society) has the lowest coverage by all courses as compared to PLO11 SC (Lifelong learning). According to Table 3, PLO6 AD (Engineer & Society) consists of G7 and S12 competencies and is ranked as top priority compared to the medium priority of G8 and S11 competencies in PLO11 SC (Lifelong learning). These contradictory results should be revised so that PLO5 SCMT (Modern tool usage) and PLO6 AD (Engineer & Society) will have more coverage by courses as compared to PLO4 THI (Investigation) and PLO11 SC (Lifelong learning), hence matching the Meta-Profile concept.

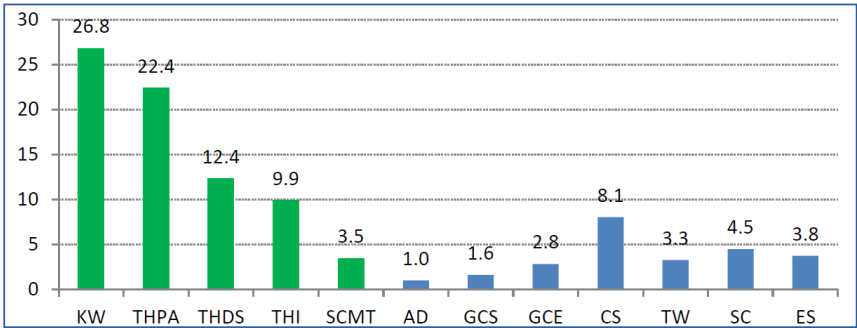


Figure 2: Revision on PLO coverage by all courses

The Meta-Profile of the Civil engineering course has undergone extensive consultation by various stakeholders. There is a crystal-clear indication of stakeholders' desire to see future generations of civil engineers be more competitive by mastering modern tool usage, not just simply limited to engineering software but also having the capability to develop an autonomous system with deep-learning functions (artificial intelligence). Future trends in infrastructure construction are geared towards sustainable systems wherein the overall life cost of the infrastructure can be minimised with longer lifetimes. This can be achieved by implementing green design and robust repair and maintenance schemes including real-time monitoring systems to detect system failure autonomously. Real-time monitoring systems will produce huge amounts of data continuously and any anomalies can be detected by the system for an accurate decision-making process with less human intervention. All of this can only be achieved if the

engineers have great competencies in modern tool usage including deep knowledge of artificial intelligence. The reinforcement of PLO5 SCMT (Modern tool usage) can increase student competencies so that they can embrace the dynamic change of modern construction technology as per Industrial Revolution 4.0. The same goes for PLO6 AD (Engineer & Society) which has received greater attention by stakeholders. Sustainable infrastructure development can only be materialised to a much higher standard by engineering a society with high moral values and great awareness of safety technology. Table 4 summarises the proposed revision of the PLO distribution.

Table 4: Summary of revision of PLO coverage by all courses

No.	PLO	Competencies	Existing coverage	Revised coverage	Action	Meta-Profile priority
1	PLO4 THI (Investigation)	G8 & S11	9.9%	3-4%	Reduce	Low
2	PLO5 SCMT (Modern tool usage)	G11	3.5%	9-10%	Increase	Medium
3	PLO6 AD (Engineer & Society)	G7 & S12	1.0%	3-5%	Increase	Top
4	PLO11 SC (Lifelong learning)	G8 & S11	4.5%	1-2%	Reduce	Medium

BIBLIOGRAPHY

Beneitone P., González J. & Wagenaar R. (2014), “Meta-profiles and profiles: A new approach to qualifications in Latin America”, Tuning Latin America, International Tuning Academy.

FKA (2016), “Civil Engineering Handbook – 2016”, Faculty of Civil Engineering, Universiti Teknologi Malaysia.

Noor M.N (2018), “Report on Meta-Profile of Student Attributes for Civil Engineering Program”, Tuning Asia– South East, International Tuning Academy.

SAR (2013), “Self-Assessment Report for EAC Accreditation – 2013”, Faculty of Civil Engineering, Universiti Teknologi Malaysia.

SAR (2018), “Self-Assessment Report for EAC Accreditation – 2018”, Faculty of Civil Engineering, Universiti Teknologi Malaysia.

7. UNIVERSITI SAINS MALAYSIA

1. Brief University Profile

Universiti Sains Malaysia (USM) was founded after an agreement made based on a resolution approved by the Penang State Legislative Council in 1962, which suggested that a university college be established in the state. An area in Sungai Ara was identified and later the foundation stone was placed by the then Prime Minister, Y.T.M Tunku Abdul Rahman Putra Al-Haj on 7 August 1967. In 1969, the University of Penang was established in response to the need for a larger campus with a more conducive environment, appropriate to the future needs of the country.

In April 1969, Professor Hamzah Sendut was elected as the Vice-Chancellor. Two months later, a group of 57 students were enrolled for study. The group was placed at the Malayan Teachers' Training College at Bukit Gelugor on loan from the Education Ministry since the area of Sungai Ara could not be developed as fast as required. In 1971, the campus, which was originally planned to be situated in Sungai Ara, moved to its present site, Minden, a beautiful location covering an area of 500 acres. The green and hilly scenery facing the sea is truly captivating.

A programme of engineering studies was first offered in 1972 by the School of Applied Science at the USM's Main Campus in Penang. The engineering campus was first established in 1986 at a temporary campus in Ipoh Town Council building while waiting for the completion of the construction of the USM Perak Branch Campus (USMKCP) in Bandar Baru Seri Iskandar, Perak. The School of Civil Engineering (SoCE) was established on the first day of 1989. In April 1990, the engineering campus had completed its relocation to the USMKCP campus. In 1997, the government decided to relocate USMKCP back to Penang, hence the Engineering Campus moved again at the end of 2000 in stages. The USM's Engineering Campus in Seri Ampangan, Nibong Tebal began its operations in May 2001.

USM was granted the APEX (Accelerated Programme for Excellence) by the Ministry of Higher Education. The selection was made based on USM's innovative and constantly evolving curricula and its comprehensive transformation plan which aims at "Transforming Higher Education for a Sustainable Tomorrow". The APEX programme was extended for a second time in 2014 with an emphasis on good governance, developing and empowering talent, nurturing responsible citizens, research and innovations, financial sustainability, positioning and services.

2. Brief Programme Profile

The Civil Engineering Programme has been offered by the School of Civil Engineering (SoCE), USM since 1989. The title of the degree offered is Bachelor of Engineering (Honours) (Civil Engineering). Currently, the programme is offered in a full-time format, requiring a total of 135 credits within a 4-year course of study. The total credits comprise of 108 credits of core courses, 12 credits of elective courses and 15 credits of university requirement courses.

The Civil Engineering Programme is designed to prepare students to fulfil the needs of the challenging engineering career in a wide spectrum of the Civil Engineering disciplines. The curriculum of the programme is formulated to include activities in theoretical exposures, laboratory work, fieldwork, analysis, design and projects. The curriculum encompasses the different Civil Engineering sub-disciplines, which include Structures, Geotechnics, Water Resources, Highway and Traffic, Environment, Geomatics, as well as Management. Practical aspects to develop the soft skills of the graduates are achieved through hands-on training in engineering laboratories, civil engineering practices, industrial training and capstone projects. Sustainable development is given emphasis in the curriculum in line with USM's vision and mission. The students are also exposed to non-technical subjects such as management and finance, engineering ethics, entrepreneurship and communication skills that are essential for engineers.

Starting from the 2006/2007 academic session, the Outcome Based Education (OBE) approach or practice has been adopted in teaching and learning as well as assessments of the Civil Engineering Programme. The Bachelor of Engineering (Hons.) (Civil Engineering) offered by the SoCE is designed in accordance with the quality and standard requirements for engineering degrees, and is accredited by the Board of Engineers Malaysia (BEM). The School has produced eleven (11) batches of civil engineering graduates under the OBE system, graduating from 2010 onwards.

3. Mapping of the Programme's Learning Outcomes (PLOs) to the TUNING Competencies

Competencies (Tuning)	USM – School of Civil Engineering
<p>G13 – Ability to apply knowledge into practice</p> <p>S2 – Ability to use knowledge in science and mathematics (including statistics)</p> <p>S5 – Ability to apply the knowledge of material science</p>	<p>PO1 – Engineering Knowledge: Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialisation to the solution of complex engineering problems</p>
<p>G6 – Ability to think critically, reflectively and innovatively</p> <p>G9 – Demonstration of problem-solving abilities</p> <p>S3 – Ability to interpret engineering drawings</p> <p>S6 – Ability to carry out civil engineering analyses</p> <p>S7 – Ability to interpret engineering data</p>	<p>PO2 – Problem Analysis: Identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences</p>
<p>G10 – Ability to initiate, plan, organise, implement and evaluate courses of action</p> <p>S4 – Ability to create processes to solve engineering problems</p> <p>S8 – Ability to use relevant design codes and regulations</p> <p>S9 – Ability to design civil engineering elements</p> <p>S14 – Ability to integrate all civil engineering knowledge into a workable system</p>	<p>PO3 – Design/Development of Solutions: Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations</p>
<p>G11 – Ability to conduct research</p>	<p>PO4 – Investigation: Conduct investigation into complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions</p>
<p>G2 – Ability to use information and communication technology purposefully and responsibly</p>	<p>PO5 – Modern Tool usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities, with an understanding of the limitations</p>

Competencies (Tuning)	USM – School of Civil Engineering
G7 – Ability to understand, value, and respect diversity and multiculturalism S12 – Ability to uphold safety measures	PO6 – The Engineer and Society: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex civil engineering problems
G4 – Ability to demonstrate responsibility and accountability towards society and the environment S13 – Ability to evaluate the impact of engineering decisions	PO7 – Environment and Sustainability: Ability to demonstrate understanding, and evaluate the sustainability and impact, of professional engineering work in the solution of complex civil engineering problems in societal and environmental contexts.
G3 – Ability to uphold professional, moral and ethical values S1 – Ability to integrate all civil engineering knowledge into a workable system	PO8 – Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice
G5 – Ability to communicate clearly and effectively	PO9 – Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
G1 – Ability to work collaboratively and effectively in diverse contexts G12 – Ability to demonstrate leadership attributes	PO10 – Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings
G8 – Ability to carry out lifelong learning and continuous professional development	PO11 – Lifelong Learning: Recognise the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change
S10 – Ability to monitor the progress and quality of civil engineering works S11 – Ability to identify the appropriate construction technology and methods	PO12 – Project Management and Finance: Ability to demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

4. Summary of Mapping of CLO to PLO

No	Course Code	Course Title	CO	Engineering Knowledge	Problem Solver	Solutions Designer	Investigation	Modern Tool Usage	Engineer and Society	Environment and Sustainability	Ethics	Communication	Individual and Teamwork	Lifelong Learning	Project Management and Finance	Bloom taxonomy level		
				PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	C	P	A
1	EAA110/2	Civil Engineering Drawing	2					✓								P4		
2	EAA111/2	Programming for Civil Engineering	2	✓	✓			✓								P4		
3	EAG141/2	Geology for Civil Engineers	3	✓	✓											C5		
4	EAK163/4	Geomatic Engineering	5	✓	✓			✓			✓		✓			C4	P3	A4
5	EAS151/3	Statics and Dynamics	4	✓	✓											C4		
6	EAS152/3	Strength of Materials	3	✓	✓											C4		
7	EAS153/3	Civil Engineering Materials	3	✓	✓											C4		
8	EAA204/2	Structures and Strength of Materials Engineering Laboratory	3		✓			✓					✓			C4	P4	A2
9	EAA206/2	Structures, Concrete and Fluid Mechanics Laboratory	3		✓			✓					✓			C4	P4	A2
10	EAA211/2	Engineering Mathematics for Civil Engineers	2	✓	✓											C4		

No	Course Code	Course Title	CO	Engineering Knowledge	Problem Solver	Solutions Designer	Investigation	Modern Tool Usage	Engineer and Society	Environment and Sustainability	Ethics	Communication	Individual and Teamwork	Lifelong Learning	Project Management and Finance	Bloom taxonomy level		
				PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	C	P	A
11	EAA273/2	Civil Engineering Practice	3	✓				✓					✓			C4	P3	A3
12	EAG245/3	Soil Mechanics	2	✓	✓											C4		
13	EAH221/3	Fluid Mechanics for Civil Engineers	2	✓	✓											C4		
14	EAH225/3	Hydraulics	2		✓											C4		
15	EAL235/2	Highway and Traffic Engineering	2		✓											C4		
16	EAP215/3	Water Supply and Water Treatment Engineering	3	✓	✓	✓				✓						C6		A2
17	EAP216/3	Introduction to Environmental Engineering	3	✓					✓		✓					C5		A2
18	EAS253/3	Theory of Structures	2		✓											C4		
19	EAS254/3	Structural Analysis	3		✓											C4		
20	EUP222/3	Engineers in Society	3						✓	✓	✓				✓	C4		A3
21	EAA304/2	Geotechnical, Highway and Traffic Engineering Laboratory	3		✓		✓						✓			C4	P4	A2

No	Course Code	Course Title	CO	Engineering Knowledge	Problem Solver	Solutions Designer	Investigation	Modern Tool Usage	Engineer and Society	Environment and Sustainability	Ethics	Communication	Individual and Teamwork	Lifelong Learning	Project Management and Finance	Bloom taxonomy level		
			PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	C	P	A	
22	EAA305/2	Hydraulics, Geotechnical and Environmental Engineering Laboratory	3		✓		✓	✓					✓			C4	P4	A2
23	EAA371/5	Industrial Training	3	✓							✓	✓		✓	✓	C4		A4
24	EAG345/3	Geotechnical Analysis	2	✓												C4		
25	EAG346/2	Geotechnical Design	3		✓	✓							✓			C6		A4
26	EAH325/3	Engineering Hydrology	3		✓											C4		
27	EAL337/3	Pavement Engineering	2			✓										C4		
28	EAL338/3	Transportation and Road Safety	2		✓											C4		A2
29	EAP315/3	Wastewater Engineering	3	✓	✓	✓				✓			✓			C6		A1
30	EAS353/3	Reinforced Concrete Structural Design I	4		✓	✓						✓				C6		A4
31	EAS356/2	Reinforced Concrete Structural Design II	3	✓		✓										C6		
32	EAA483/2	Construction Management	3	✓		✓			✓						✓	C4		A3
33	EAA484/2	Building Construction and Technology	3	✓	✓											C5		
34	EAA492/6	Final Year Project	4		✓	✓	✓	✓	✓	✓		✓		✓		C6	P4	A3

No	Course Code	Course Title	CO	Engineering Knowledge			Problem Solver	Solutions Designer	Investigation	Modern Tool Usage	Engineer and Society	Environment and Sustainability	Ethics	Communication	Individual and Teamwork	Lifelong Learning	Project Management and Finance	Bloom taxonomy level		
				PO 1	PO 2	PO 3												C	P	A
35	EAA495/4	Integrated Design Project	6	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	C4	P4	A3
36	EAS457/2	Structural Steel Design	3	✓		✓		✓							✓			C6		A4
37	EAS458/2	Pre-stressed Concrete Design	3	✓		✓		✓										C6		
		TOTAL (Core courses)		21	26	11	4	5	10	5	5	5	5	4	10	3	4			
1	EAA485/2	Disaster Management	2	✓		✓		✓										C5		
2	EAA486/2	Project Management	3	✓		✓		✓									✓	C5		A3
3	EAG443/2	Rock Engineering and Tunnelling Technology	3	✓	✓	✓		✓										C5		
4	EAG444/2	Soil Stabilisation and Ground Improvement	3	✓	✓	✓		✓				✓						C5		
5	EAH316/2	Hydraulic Structure	3	✓	✓	✓		✓										C4		
6	EAH416/2	River Conservation and Rehabilitation	2		✓	✓		✓				✓						C4		
7	EAH417/2	Urban Water Management	3	✓	✓	✓		✓				✓						C6		
8	EAK382/2	Geographic Information System	3		✓					✓								C5	P3	A4
9	EAL339/2	Sustainable Transport	3	✓		✓		✓			✓	✓						C4		

No	Course Code	Course Title	CO	Engineering Knowledge			Problem Solver	Solutions Designer	Investigation	Modern Tool Usage	Engineer and Society	Environment and Sustainability	Ethics	Communication	Individual and Teamwork	Lifelong Learning	Project Management and Finance	Bloom taxonomy level		
				PO 1	PO 2	PO 3												C	P	A
10	EAL431/2	Highway Design	3	✓		✓												C6		
11	EAL434/2	Transport Planning Process and TIA	3	✓		✓				✓								C4	P4	
12	EAP316/2	Air Pollution in Civil Engineering	3	✓						✓		✓						C4		A3
13	EAP318/2	Noise Pollution Control	3	✓						✓	✓	✓						C5	P4	
14	EAP414/2	Industrial Waste Management	3	✓					✓			✓						C4		A3
15	EAP415/2	Solid Waste Management	3	✓		✓						✓						C5		A3
16	EAS357/2	Sustainable Concrete Materials and Practices	3	✓	✓							✓						C5		
17	EAS451/2	Timber and Masonry Engineering	3	✓	✓	✓												C6		
18	EAS456/2	Advanced Structural Engineering	2		✓	✓												C4		
		TOTAL (Elective courses)		15	9	13	✓	1	4	2	10	0	0	0	0	0	1			
		Grand total		36	35	24	✓	5	14	7	15	5	5	4	10	3	5			

5. One page of curriculum structure

Indicate changes in November 2018

Type	Category	LEVEL 100			LEVEL 200			LEVEL 300			LEVEL 400		
CORE	Engineering Core	SEMESTER 1	SEMESTER 2	SEMESTER BREAK			SEMESTER 1	SEMESTER 2	EAA371 INDUSTRIAL TRAINING FOR 10 WEEK (Register in Semester 1 Year 4)			SEMESTER 1	SEMESTER 2
		EAA110/2 Civil Engineering Drawing	EUM114/3 Advanced Engineering Calculus				EAA211/2 Engineering Mathematics for Civil Engineers	EAP215/3 Water Supply and Treatment Engineering				EAA371/5 Industrial Training	EAS458/2 Pre-Stressed Concrete Design
		EAA111/2 Programming for Civil Engineering	EAK163/4 Geomatic Engineering				EAA221/3 Fluid Mechanics for Civil Engineers	EAP216/3 Introduction to Environmental Engineering				EAS457/2 Structural Steel Design	EAA 484/2 Building and Construction Technology
		EUM113/3 Engineering Calculus	EAS152/3 Strength of Materials				EAG245/3 Soil Mechanics	EAA225/3 Hydraulics				EAA483/2 Construction Management	EAA492/6 (3) Final Year Project
		EAG141/2 Geology for Civil Engineers					EAS253/3 Theory of Structures	EAL235/2 Highway and Traffic Engineering				EAA492/6 (3) Final Year Project	
		EAS151/3 Statics and Dynamics					EAA273/2 Civil Engineering Practice	EAS254/3 Structural Analysis				EAA495/4 Integrated Design Project	
		EAS153/3 Civil Engineering Materials											
							EAA204/2 Structures and Strength of Materials Laboratory	EAA206/2 Concrete and Fluid Mechanics Laboratory				EAA304/2 Geotechnical, Highway and Traffic Engineering Laboratory	
		15	10				15	16				14	15
	LABS.												
												7	108

Category	LEVEL 100		LEVEL 200			LEVEL 300			LEVEL 400		
	Type		LSP300/2 English Language	HTU223/2 Asian and Islamic Civilisation	Co-Curriculum (2 unit)	LSP404/2 English Language					
University Requirement (Local)		LKM400/2 Malay Language									15
		WUS101/2 Core Entrepreneurship SHE101/2 Ethnic Study			Co-Curriculum/ Option /Language subject (1-2 unit)						
University Requirement (International)		LKM100/2 Malay Language	LSP300/2 English Language	SEA205E/4- Malaysian Studies	Co-Curriculum (2 unit)	LSP404/2 English Language					15
					Co-Curriculum/ Option /Language subject (3-4 unit)						
ELECTIVE COURSES (SPECIALISATION)						EAP316/2 Air Pollution in Civil Engineering	EAP415/2 Solid Waste Management	EAP414/2 Industrial Waste Management			12
						EAH316/2 Hydraulic Structure	EAH417/2 Urban Water Management	EAH416/2 River Conservation and Rehabilitation			
						EAS357/2 Sustainable Concrete Materials and Practices	EAS451/2 Timber and Masonry Engineering	EAS456/2 Advanced Structural Analysis			
							EAG444/2 Soil Stabilisation and Ground Improvement	EAG443/2 Rock Engineering and Tunnelling Technology			
							EAL431/2 Highway Design	EAL434/2 Transport Planning Process and TIA			
							EAA485/2 Disaster Management	EAA486/2 Project Management			
						EAK382/2 Geographic Information System					
Total Units for Graduation											135

6. Self-reflection on the TUNING methodology

The Tuning methodology and key elements include three phases, namely:

- a) Defining competencies – process where identification of generic and specific competencies for the graduate are done through involvement of stakeholders such as employers, students, graduates and alumni. These competencies must be relevant to uncertainties in the future of the industry and the graduate's employability by considering 21st century challenges, the 4th industrial revolution and other relevant challenges.

Based on the challenges, values are looked into, which include the inner strengths and qualities of the graduates. Qualities and strengths comprise knowledge, thinking skills and inter-personal skills. The School of Civil Engineering (SoCE) implemented the Outcome-Based Education (OBE) system as stated by the Engineering Accreditation Council (EAC), Board of Engineers Malaysia (BEM). Therefore, the competencies are pre-determined as required by the EAC. Using the Tuning methodology, the competencies set are mapped together with the outcomes set by the EAC and classified based on their importance to the civil engineering programme. The triangulation between setting the skillset (competencies) to the importance of the skillset to the civil engineering programme is done through surveys to relevant stakeholders and also through meetings with department members.

- b) Designing degree programmes – using the agreed Meta-Profile (in SoCE, there are 12 outcomes that reflected the profile of civil engineering graduates), the structure of the programme with relevant learning outcomes and teaching assessments are designed (constructive alignment). Continuous Quality Improvement (CQI) is carried out regularly to ensure the overall consistency and quality control of the programme. The curriculum is reviewed every 4 to 5 years based on inputs from stakeholders (especially from the Industrial Advisory Panel) and through benchmarking processes to ensure the programme stays relevant to the industry.

- c) Programme implementation – SoCE implementation of Outcome-Based Learning has been carried out since 2008 and through reviews including reflections on curriculum, the programme has continuously improved and matured over the years. Through the Tuning program, better CQI can be conducted especially on course content and delivery. Courses are reviewed based on the learning outcomes to ensure the teaching and learning process, as well as the assessment method, are relevant and measurable. Tuning through CALOHEE has managed to help SoCE review designing assessment methods, especially assessment of soft skills. This is important to highlight graduate competencies not only in knowledge skillsets, but also in soft skills.

8. NATIONAL UNIVERSITY OF CIVIL ENGINEERING, VIETNAM

NATIONAL UNIVERSITY OF CIVIL ENGINEERING (NUCE), HANOI, VIETNAM

1. Introduction

– *About the University:*

National University of Civil Engineering (NUCE) is the leading university in the field of construction training in Vietnam. Established in 1966, NUCE has over 20 thousand enrolled students. In 2017, NUCE was one of the first four higher education institutions in Vietnam to be accredited by the HCERES (High Council for Evaluation of Research and Higher Education) and achieved the international evaluation standard within a term of 5 years (2017-2022).

– *About new programme: Construction Engineering Technology*

The Construction Engineering Technology programme provides students with fundamental and core knowledge, professional practice skills and the necessary research and creative capacity to solve problems related to the conception, design and implementation of construction activities for civil facilities. The programme also prepares students to work in areas requiring advanced knowledge of construction engineering systems, or to continue to postgraduate studies. Graduates of our programme will:

1. Apply the knowledge of mathematics, basic science, basic principles of engineering to conceive, design and implement the system of construction engineering for civil facilities;
2. Demonstrate personal, occupational and communication skills, teamwork, and ability to work in a dynamic, multi-cultural, multinational environment.
3. Understand economics, politics, society and law; demonstrate the ability and desire to commit to ethics and lifelong learning in order to contribute effectively to the sustainable development of the society and community.
4. Continue professional development in the field of construction engineering: register successfully domestic and international professional licences; or complete a postgraduate programme.

– *Length and level of the programme*

The length of the programme is **four and a half years**. A minimum of **145 credits** must be earned to graduate with **the engineering degree**. Students should consult with their university or department adviser for information on further study or entering another programme simultaneously.

– *Future fields, sectors of employment/occupation of graduates.*

Students will be able to plan, design, inspect and direct residential, commercial, infrastructure and transportation projects. Graduates of this programme are prepared for immediate employment in every phase of construction. Engineers who have mastered the technology of construction are in high demand for recruitment by general contractors, subcontractors in all fields of construction, businesses, consultancy organisations, investors and research institutions.

2. Mapping of the Programme's Learning Outcomes

Competency	Learning outcomes (at programme level)	Compared to the Meta-Profile of TUNING
CPT1 – Advanced knowledge, methods and tools	LO1 – Select and apply the advanced engineering knowledge to broadly-defined construction engineering technology activities LO2 – Evaluate and select the appropriate methods/technologies and modern tools to broadly-defined construction engineering technology activities	G13 – Ability to apply knowledge into practice S11 – Ability to identify the appropriate construction technology and methods
CPT2– Fundamental knowledge	LO3 – Select and apply the knowledge of underlying mathematics (including statistics) and sciences LO4 – Select and apply the core engineering fundamental knowledge to construction engineering technology problems	S2 – Ability to show strong knowledge in science and mathematics (including statistics) S5 – Ability to understand principles of material science G13 – Ability to apply knowledge into practice

Competency	Learning outcomes (at programme level)	Compared to the Meta-Profile of TUNING
CPT3 – Investigation and Experimentation	<p>LO5 – Able to formulate hypotheses and conduct surveys of printed and electronic literature</p> <p>LO6 – Able to conduct standard tests and measurements as well as field and laboratory experiments</p> <p>LO7 – Able to validate experimental data and use them for possible improvements.</p>	<p>G11 – Ability to conduct research</p> <p>S7 – Ability to interpret engineering data from testing</p>
CPT4 – Design, implementation	<p>LO8 – Understand needs; set system/component/process goals; define system/component/process functions and concepts; and develop a project management for broadly-defined construction engineering technology problems.</p> <p>LO9 – Develop a design and implementation process, its phasing, its approach for broadly-defined construction engineering technology problems</p> <p>LO10– Use knowledge in design and implementation for safety, manufacturability, sustainability and other objectives</p> <p>LO11 – Able to test, verify and validate systems/components/processes for broadly-defined construction engineering technology problems</p>	<p>G10 – Ability to initiate, plan, organise, implement and evaluate courses of action</p> <p>S4 – Ability to create algorithms to solve engineering problems</p> <p>S8 – Ability to use relevant design codes and regulations</p> <p>S9 – Ability to design civil engineering elements</p> <p>S14 – Ability to integrate all civil engineering knowledge into a workable system</p>
CPT5 – Teamwork	<p>LO12 – Evaluate how to form effective teams and team operations</p> <p>LO13 – Evaluate team leadership, team growth and evolution</p> <p>LO14 – Understand and practice technical and multidisciplinary teaming</p>	<p>G1 – Ability to work collaboratively and effectively in diverse contexts</p>

Competency	Learning outcomes (at programme level)	Compared to the Meta-Profile of TUNING
CPT6 – Problem solving	LO15 – Able to formulate and identify broadly-defined construction engineering technology problems LO16 – Able to demonstrate problem modelling and analysis to find solutions. LO17 – Select and apply modern engineering and IT tools to complex construction engineering technology problems	G6 – Ability to think critically, reflectively and innovatively G9 – Demonstration of problem-solving abilities S6 – Ability to carry out civil engineering analyses
CPT7 – Communication	LO18 – Able to define communication strategy and structure LO19 – Apply written, oral, electronic/multimedia and graphic communication in both technical and non-technical environments LO20 – Able to demonstrate listening, negotiation and advocacy skills and establish diverse connection and networking.	G5 – Ability to communicate clearly and effectively G2 – Ability to use information and communication technology purposefully and responsibly S3 – Ability to interpret engineering drawings
CPT8 – Attitudes, thought and learning	LO21 – Explain the need for initiative, willingness to make decisions in the face of uncertainty, perseverance and flexibility LO22 – Demonstrate the ability to think critically and creatively LO23 – Explain the importance of lifelong learning and educating for continuing professional development	G8 – Ability to carry out lifelong learning and continuous professional development
CPT9 – Ethical and professional responsibilities	LO24 – Demonstrate roles and responsibility of engineers/Technicians LO25 – Understand about ethics, integrity and social and professional responsibilities LO26 – Understand about equity, diversity, trust and loyalty	G3 – Ability to uphold professional, moral and ethical values G7 – Ability to understand, value, and respect diversity and multiculturalism

Competency	Learning outcomes (at programme level)	Compared to the Meta-Profile of TUNING
CPT10 – Contemporary issues	LO27 – Understand staying current in the world of engineering LO28 – Understand society's regulation of engineering LO29 – Demonstrate the impact of engineering technology solutions on society and environment	G4 – Ability to demonstrate responsibility and accountability towards society and the environment S12 – Ability to uphold safety measures S13 – Ability to evaluate the impact of engineering decisions
CPT11 – Quality	LO30 – Explain the need to assure quality and continuous improvements in construction engineering technology activities, and demonstrate how LO31 – Evaluate the need for time management	S10 – Ability to monitor the progress and quality of civil engineering works
CPT12 – Leadership and entrepreneurship	LO32 – Able to demonstrate attitudes of leadership, create and deliver a purposeful vision LO33 – Understand various enterprise cultures, enterprise stakeholders, strategy, goals and technical entrepreneurship LO34 – Demonstrate basic engineering project finance and economics	S1 – Ability to demonstrate entrepreneurial attributes (creative, risk taking, resilient and innovative) G12 – Ability to demonstrate leadership attributes

3. Summary of Mapping of PLO and CLO

	CPT1		CPT2		CPT3		CPT4			CPT5			CPT6			CPT7			CPT8			CPT9			CPT10				CPT11		CPT12			
	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO 10	LO 11	LO 12	LO 13	LO 14	LO 15	LO 16	LO 17	LO 18	LO 19	LO 20	LO 21	LO 22	LO 23	LO 24	LO 25	LO 26	LO 27	LO 28	LO 29	LO 30	LO 31	LO 32	LO 33	LO 34
Number of courses	26	27	9	9	4	6	7	19	15	13	16	39	39	39	10	12	10	8	8	8	3	3	3	3	3	3	1	1	1	3	3	1	1	1
Number of CLOs	56	60	20	20	7	9	12	39	25	18	31	70	70	70	15	18	15	10	10	10	5	5	5	6	6	6	3	3	3	5	5	3	3	3

4. Curriculum sheet of new programme

FIRST YEAR			
Fall semester/ 1 st semester	Credits	Spring semester/ 2 nd semester	Credits
Introduction to Construction Engineering Technology	2	Introductory Calculus for Engineering	3
Linear Algebra for Engineering	3	Engineering Physics 2	2
Engineering Physics 1	3	Engineering Physics 2: Laboratory	1
Engineering Physics 1: Laboratory	1	Fundamental Mechanics	3
National Defence Education 1	3	Descriptive Geometry and Graphics for Engineering	3
National Defence Education 2	2	Microeconomics	2
National Defence Education 3	3	Computer Programming – General	2
		Physical Education 1	1
Total:	17	Total:	17
SECOND YEAR			
Fall semester/ 3 rd semester	Credits	Spring semester/ 4 th semester	Credits
Applied Calculus for Engineering	3	Engineering Probability and Statistics	2
Structural Geology	3	Soil Mechanics	2
Strength of Materials	3	Structural Mechanics	3
General Chemistry for Engineering	2	Construction Materials	3
General Chemistry for Engineering: Laboratory	1	Professional skills: Writing, Reading and Communicating for Engineering	2
English for Engineers 1	3	English for Engineers 2	3
Physical Education 2	1	Physical Education 3	1
		General Principles of Marxist-Leninist Ideology 1	2
Total:	16	Total:	18
THIRD YEAR			
Fall semester/ 5 th semester	Credits	Spring semester/ 6 th semester	Credits
General Hydraulics	2	Engineering Economics	2
Hydrology	2	General Planning and Architecture	2
Geodesy for Engineering	2	Environmental Engineering and Sustainable Development	3
Geodesy for Engineering: Practices	1	Steel Structures 1	2
Reinforced Concrete Structures 1	3	Foundation Engineering	2
Reinforced Concrete Structures 1: Mini Project	1	Foundation Engineering: Mini Project	1
General Principles of Marxist-Leninist Ideology 2	3	Social Responsibility and Career Ethics	2
Revolutionary Path of Vietnam Communist Party	3	Ho Chi Minh Ideology	2
Total:	17	Total:	16

FOURTH YEAR			
Fall semester/ 7 th semester	Credits	Spring semester/ 8 th semester	Credits
Construction Methods and Equipment	3	Technical Elective (1)	6
Reinforced Concrete Structures 2	3	Technical Elective (2)	2
Steel Structures 2	3	Mechanical, Electrical and Plumbing Systems	3
Transportation Engineering	2	Occupational Health and Safety	2
Transportation Engineering: Mini Project	1	Construction Project Management	3
Construction Planning and Scheduling	3		
Construction Planning and Scheduling: Mini Project	1		
Total:	19	Total:	17
Technical Elective (1a) – Building electives	Credits	Technical Elective (2)	Credits
Design of Composite Structures	3	Construction Estimating	2
Building Construction Technology	3	Construction Standards, Regulations and Specifications	2
Building Construction Technology: Mini Project	1	Sustainable Construction	2
Technical Elective (1b) – Bridge electives	Credits	Computer Applications in Construction	2
Bridge Engineering and Design	3		
Bridge Construction Technology	3		
Bridge Construction Technology: Mini Project	1		
FIFTH YEAR			
Fall semester/ 9 th semester	Credits		
Internship for Graduation	3		
Final Year Project	5		
Total:	8		
MINIMUM CREDITS REQUIRED FOR GRADUATION: 145			

9. HO CHI MINH UNIVERSITY OF TECHNOLOGY, VIETNAM

VIETNAM NATIONAL UNIVERSITY HO CHI MINH CITY HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY (HCMUT) FACULTY OF CIVIL ENGINEERING (FCE) Bachelor of Science in Civil Engineering

I. Brief University Profile

Ho Chi Minh City University of Technology (HCMUT) was established in 1957 and has been recognised as a Centre of excellence among technological universities in Vietnam. Prior to the country's reunification in 1975, the university was the only institution to produce engineers in Southern Vietnam. Up to the present day, HCMUT still remains as the largest, most prestigious and oldest engineering university in the South of Vietnam.

The University has two campuses: one is located within Ho Chi Minh City area (14.5 ha) and the other on the outskirts of the city (26.0 ha). HCMUT has 22,656 students enrolled in 11 academic faculties and 1,242 full-time staff members.

Since 1993, HCMUT has been using a credit system in education. HCMUT is the first university in Vietnam to use a credit system to quantify the cumulative knowledge of students. Training duration was reduced to 4.5 years instead of 5 years. In 2009, HCMUT experimentally and voluntarily employed the principles of CDIO (Conceive – Design – Implement – Operate) Initiatives in developing and implementing the study programme for Manufacturing Engineering, a major in the Faculty of Mechanical Engineering. In 2014, based on social demand for high quality human resources in engineering and science, social demand to shorten degree duration in order to lengthen years of service in the industry, a research result with title of 'A project to develop a 4-year undergraduate education model in engineering', and preliminary results of volunteer deployment of the CDIO education model, HCMUT decided to officially employ CDIO education technology for all study programmes. Course duration was reduced to 4 years instead of 4.5 years.

In terms of quality assurance at programme level, up to December 2016, there are 22 programmes accredited by many prestigious organisations. There are 2 programmes accredited by ABET, 7 programmes accredited by CTI, and 11 programmes certified by AUN-QA. In terms of quality assurance at institutional level, HCMUT re-

ceived accreditation by MoET in 2009. In June 2017, HCMUT was accredited under the HCERES standard (France). Since 2017, HCMUT is officially assessed by AUN-QA.

II. Brief Programme Profile

- Programme title: Civil Engineering (CE)
- Name of the final award: Bachelor of Engineer in Civil Engineering
- Course duration: 4 years (8 semesters)
- Course knowledge: minimum of 142 credits

CE major includes five specialisations: Civil (Structure) Engineering (formerly Civil and Industrial Structures), Port and Coastal Engineering, Transportation Engineering, Infrastructure Engineering, and Water Resources Engineering. All five specialisations have a unique set of expected programme outcomes. The specialisation division process starts in the second semester and the division results are applied from the third semester. Students begin to take various core courses (courses for specialisation) from the sixth semester.

III. Mapping of the Programme's Learning Outcomes (PLOs) to the TUNING Competencies

The list of expected competencies for a civil engineer graduated from HCMUT is as follows:

No	Competencies At the time of graduation, students will be able to:
a	Apply basic math, science and engineering knowledge
b	Design and conduct experiments, as well as the ability to understand and analyse data in construction specialisations such as structure, materials, geology, geodesy, and water resources.
c	Design a system, component, or process that meets the needs of conditions in which there are practical constraints such as economic, environmental, social, political, health and safety, productivity and sustainability.
d	Work in interdisciplinary teams.
e	Identify, establish, and solve problems of construction.
f	Be aware of the responsibility and professional ethics of construction.
g	Communicate effectively. Minimum English level is equivalent TOEIC 450.
h	Explain the impact of technical solutions in a global, economic, environmental and social context.
i	Be aware of the need and ability to participate in lifelong learning.
j	Use knowledge of contemporary issues, policy understanding, economic and legal issues of the country.
k	Use modern methods, skills, and tools needed for building practice.

Competencies		In HCMUT										
Meta-Profile		a	b	c	d	e	f	g	h	i	j	k
Specific competencies (Ability to)												
1	Show resilience											
2	Use knowledge in science and mathematics (including statistics)	x										
3	Interpret engineering drawings			x								
4	Create processes to solve engineering problems					x						
5	Apply knowledge and material science											
6	Carry out civil engineering analyses					x			x			
7	Interpret engineering data		x									
8	Use relevant design codes and regulations			x								
9	Design civil engineering elements			x								
10	Monitor the progress and quality of civil engineering works					x						
11	Identify the appropriate construction technology and methods								x		x	x
12	Uphold safety measures			x								
13	Evaluate the impact of engineering decisions			x					x		x	
14	Integrate all civil engineering knowledge into a workable system			x							x	
Generic competencies (Ability to)												
1	Work collaboratively and effectively in diverse contexts				x							
2	Use information and communication technology purposefully and responsibly											x
3	Uphold professional, moral and ethical values						x					
4	Demonstrate responsibility and accountability towards society and the environment						x					
5	Communicate clearly and effectively							x				
6	Think critically, reflectively and innovatively											
7	Understand, value, and respect diversity and multiculturalism											
8	Carry out lifelong learning and continuous professional development									x		
9	Demonstrate problem-solving abilities					x						
10	Initiate, plan, organise, implement and evaluate courses of action											x
11	Conduct research											
12	Demonstrate leadership attributes											
13	Apply knowledge into practice											x

IV. Summary of Mapping of CLO to PLO

Programme learning outcomes (PLO)	a	b	c	d	e	f	g	h	i	j	k
Number of Courses	32	10	26	22	25	5	7	15	17	6	15

V. Curriculum Structure

No	Course ID	Course (credits)	No	Course ID	Course (credits)
Semester 1			Semester 3		
1	LA1003	English 1 (2)	1	LA1007	English 3 (2)
2	MT1007	Linear Algebra (3)	2	MT1005	Calculus 2 (4)
3	MT1003	Calculus 1 (4)	3	MT2001	Probability and Statistics (3)
4	PH1003	General Physics 1 (4)	4	CI2007	Strength of Materials (4)
5	CI1001	Introduction to Engineering (3)	5	CI1007	Basis of Surveying (3)
6	EN1003	Humans and the Environment (3)	1 elective course group A (3)	CH2011	Inorganic Chemistry (3)
7	PH1007	General Physics Labs (1)		CH2027	Biology (3)
Semester 2			Semester 4		
1	LA1005	English 2 (2)	1	LA1009	English 4 (2)
2	MT1005	Calculus 2 (4)	2	LA1009	English 4 (2)
3	PH1005	General Physics 2 (4)	3	MT1009	Numerical Methods (3)
4	CH1003	General Chemistry (3)	4	CI2029	Mechanics of Structures (4)
5	CI1033	Engineering Drawing (3)	5	CI2037	Construction Materials (3)
6	AS1003	Theoretical Mechanics (3)	6	CI1043	Engineering Geology (2)
			Semester 4 (summer)		
			1	CI2057	Field Trip (1)

Semester 5		
1	SP1005	Ho Chi Minh Ideology (2)
2	CI3001	Soil Mechanics (4)
3	CI2091	Reinforced Concrete Structures 1 (2)
4	CI2093	Project of Reinforced Concrete Structures 1 (1)
5	CI3061	Finite Element Method (3)
6	CI3009	Steel Structures 1 (2)
1 elective course group B (3)	CI1045	Principles of Construction Economics and Management (3)
	CI1047	Construction Economics and Laws (3)
Semester 6		
1	SP1009	Revolutionary Policies of the Vietnam Communist Party (3)
2	CI3095	Water Supply & Sewerage (2)
3	CI3195	Foundation Engineering (2)
4	CI3197	Project of Foundation Engineering (1)
5	CI3043	Construction Equipment and Method (3)
6	CI3175	Reinforced Concrete Structures 2 (2)
8	CI3211	Steel Structures 2 (2)
9	CI3213	Project of Steel Structures (1)
Semester 6 (summer)		
1	CI3343	Internship (3)

Semester 7		
1	CI4037	Soft Soil Engineering (3)
2	CI4011	Structural Testing (1)
3	CI4125	On-Site Construction Management (3)
4	CI4127	Project of On-Site Construction Management (1)
2 elective	CI3115	Reinforced Concrete Structures 3 (3)
courses	CI3121	Tall Buildings (3)
group C (6)	CI3123	Prestressed Concrete Structures (3)
	CI4067	Dynamics of Structures (3)
	CI1049	Architecture (3)
	CI1053	Construction Project Management (3)
Semester 8		
1	CI4343	Thesis (9)
2	SP1007	Introduction to Vietnamese Law (2)
1 elective	CI3131	Ventilation
course	CI3147	Sustainable Urban Planning
group D (3)	CI4081	High-Rise Steel Structures
	CI1051	Maintenance, Repair and Renovation of Structures

VI. Self-Reflection

This study programme has been developed following the principles of CDIO (Conceive – Design – Implement – Operate) initiatives and the TUNING methodology. Students in CE avail of a dynamic environment in which to develop their career path. The study environment supplied by FCE (and HCMUT in general) always provides chances and sets the conditions for students to practice their will and spirit and develop their talent, aiming to realise the expected outcome. FCE will continuously evaluate and improve the system for assessing the achievement of programme learning outcomes of students at graduation.

10. INSTITUTE OF TECHNOLOGY OF CAMBODIA

INSTITUTE OF TECHNOLOGY OF CAMBODIA

Master's Program

Materials and Structures

I. Brief University Profile

The institute of technology of Cambodia was created in 1964, and its mission is to produce qualified engineers for the development of infrastructure in the country. Since its establishment, ITC has not only produced engineers for building and developing infrastructure but also expanded its international cooperation by providing master's courses and Ph. D. education. ITC has increased the number of students enrolled and the number of departments in order to provide human resources of different expertise in serving the country in the new globalisation trend.

II. Brief Programme Profile

Materials and structures is the updated name, revised in 2017, from the former master's in civil engineering which had been in place since 2010. The master's is the double-degree programme under the MOU of ITC-INSA de Rennes. The programme is 1 year in duration for 5-year bachelor's degree holders and 2 years for 4-year bachelor's degree holders.

For the 5-year bachelor's degree programme, the fifth year is considered to be the first year of the master's. In Cambodia, ITC offers a 5-year engineering degree programme so all students of ITC take only one year to do the master's, however, students from other universities who enrol in this Master's in Materials and Structures will take 2 years. Successful students obtain a full master's degree. The importance of the master's is M2 for graduated engineers of ITC.

The real needs of the revised master's programme is to sufficiently train human resources capable of doing research in the fields of materials and structures. The new name will be of interest to engineers in 4 fields of engineering, i.e. civil engineering, mechanical engineering, geo-resource and geotechnical engineering, and rural engineering. Those who are involved in materials and structures can come to join this new master's. The programme improves the knowledge and know-how of engineers working in materials and structures as professionals, researchers and managers.

III. Mapping of the Programme's Learning Outcomes (PLOs) to the TUNING Competencies

Programme outcomes	Title	Descriptions	Competencies (Meta-Profile)
PO1	Scientific and engineering knowledge	Understanding and applying the science and mathematics in real practices	G2, S2, S5, S9
			G2 . Ability to use information and communication technology purposefully and responsibly
			S2 . Ability to use knowledge in science and mathematics (including statistics)
			S5 . Ability to apply the knowledge of material science
			S9 . Ability to design civil engineering elements (e.g.: structural, geotechnical, water, transportation and highway, environmental engineering, and others)
PO2	Problem-solving skills	Identifying problems, analysing cause-effects and defining the solving method.	G6, G9, G11, S3, S4, S6, S7
			G6 . Ability to think critically, reflectively and innovatively
			G9 . Demonstration of problem-solving abilities
			G11 . Ability to conduct research
			S3 . Ability to interpret engineering drawings
PO3	New Technology adaptations	New technology, sustainability, effective application of modern tools in the local contexts	S4 . Ability to create processes to solve engineering problems
			S6 . Ability to carry out civil engineering analyses
			S7 . Ability to interpret engineering data
			S8, S11, S12, S13, S14
			S8 . Ability to use relevant design codes and regulations
			S11 . Ability to identify the appropriate construction technology and methods
			S12 . Ability to uphold safety measures
			S13 . Ability to evaluate the impact of engineering decisions
			S14 . Ability to integrate all civil engineering knowledge into a workable system.

Programme outcomes	Title	Descriptions	Competencies (Meta-Profile)
PO4	Ethics and social responsibility	Upholding professional responsibility in a moral manner	G3, G4, G7
			G3 . Ability to uphold professional, moral and ethical values
			G4 . Ability to demonstrate responsibility and accountability towards society and the environment
			G7 . Ability to understand, value, and respect diversity and multiculturalism
PO5	Teamwork and leadership	Leading teams and working collaboratively in diverse contexts	G1, G5, G12
			G1 . Ability to work collaboratively and effectively in diverse contexts
			G5 . Ability to communicate clearly and effectively
			G12 . Ability to demonstrate leadership attributes
PO6	Lifelong learning	Have resilience and keep learning by developing professionalism.	G8, S1
			G8 . Ability to carry out lifelong learning and continuous professional development
			S1 . Ability to show resilience
PO7	Project management and finance	Managing a project successfully with confidence	G10, G13, S10
			G10 . Ability to initiate, plan, organise, implement and evaluate courses of action
			G13 . Ability to apply knowledge into practice
			S10 . Ability to monitor the progress and quality of civil engineering works

IV. Summary of Mapping of CLO to PLO

Link of Programme learning outcomes with course learning outcomes

		Number of courses	Number of CLO
PO1	Scientific and engineering knowledge	11	11
PO2	Problem-solving skills	6	6
PO3	New Technology adaptations	3	3
PO4	Ethics and social responsibility	2	2
PO5	Teamwork and leadership	5	5
PO6	Lifelong learning	6	6
PO7	Project management and finance	5	5

V. Structure of curriculum

Master of Materials and structures		
Institute of Technology of Cambodia		
	1 year master's	
Courses	Semester 1	Semester 2
Core courses	UE1 – Stability and non-linear mechanics	
	UE2 – Law of non-linear mechanical behaviour of materials	
	UE3 – Numerical methods	
	UE4– Material Characterisation (plus large)	
Elective courses (3 courses to be chosen)	UESP1 – Advanced Mechanics and hydraulics of soils and rocks	
	UESP2 – Durability and Resilience of materials	
	UESP3 – Composite steel structure	
	UESP4 – Advanced Deep excavations	
	UESP5 – Advanced Materials (heritage,..historical,..)	
	UESP6 : Mécanique de la mise en forme.	
	UESP7 : Mechanical systems	
Final work		Research

VI. Self-reflection on the Tuning methodology

After participating in several workshops with the Tuning Academy team comprised of different universities and experts, I have learnt a lot and understand that the Tuning methodology is a good tool that we can use in developing any curriculum in order to fit the new market trend. I have used the Tuning methodology to revise the current master's course at my university in order to expand its enrolment capacity. The purpose of the revised programme is to enrol not only civil engineers but also mechanical engineers and others who are interested in doing research in materials and structures. We have had some difficulty in implementing certain areas of the Tuning methodology as my university has no experience with it and we usually work on content-based courses. Tuning Methods are based on the list of competencies determined by the board of directors and courses must be designed in a manner that can produce the desired competencies. The course structure should be well designed: lectures, placements, working examples, etc. The teaching method should also be defined in order to produce the designed competencies. All professors or lecturers must be oriented in the material before they can teach the course. As the method is new for Cambodia and is a very effective tool for developing education for the new century market, this method should be taught to all Cambodian universities and academies in order that academics, professors, lecturers and practitioners understand the methods and know the role of each in education.

11. INSTITUT TEKNOLOGI SEPULUH NOPEMBER, INDONESIA

PROGRAMME DESIGN (REVISED PROGRAMME) Bachelor of Engineering (Civil Engineering) Institut Teknologi Sepuluh Nopember

Institut Teknologi Sepuluh Nopember (ITS) is a state university located in the city of Surabaya, Indonesia. In 2017, ITS ranked 5th best in Indonesia based on the assessment of the Ministry of Research, Technology and Higher Education (Kemristekdikti) of Indonesia and ranked in the top 10 universities in Indonesia in the QS World University Ranking. Apart from the aspects of education and management, ITS has a strong commitment to environmental management, one of which is the Smart Eco-Campus Programme.

One of the oldest departments in ITS is the Civil Engineering Department. The Civil Engineering Department of ITS has undergraduate study programmes and postgraduate programmes. The curriculum of the Department of Civil Engineering ITS (DCE-ITS) was designed based on Regulation of the Ministry of Research, Technology and Higher Education of the Republic of Indonesia No. 44/2015 on National Standards of Higher Education (SN-DIKTI). This standard sets forth that the formulation of learning outcomes must refer to the description of learning outcomes of the Indonesian Qualification Framework (KKNI). SN-DIKTI states that the description of learning outcomes consists of Knowledge Mastery, Attitudes, General Skills and Specific Skills. Civil engineering undergraduate programmes in Indonesia must meet the minimum learning achievements specified in the SN-DIKTI. Therefore, the curriculum must be prepared by considering accreditation standards.

The duration of the Bachelor of Engineering (Civil Engineering) programme is 4 years (8 semesters). The total credits of the bachelor's programme is 144 credits. The curricula for undergraduate programmes contain:

- National Compulsory Course
- ITS Compulsory Course
- Study Programme elective courses
- Enrichment courses

The structure is as follows:

1. General educations course: 18 credits
2. Basic science and mathematics: 20 credits

3. Programme core course: 100 credits
4. Elective course: 6 credits

The consistency of the curriculum prepared is seen through a matrix between learning outcomes that will be achieved with the instructional materials provided. Achievement of learning outcomes in the learning process is achieved not only with teaching materials, but also with learning methods, learning aids, evaluations and other activities.

No	Code	Course	Credits	ATTITUDES										KNOWLEDGE MASTERY										SPECIFIC SKILLS										GENERAL SKILLS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
				A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	KM1	KM2	KM3	KM4	KM5	KM6	KM7	KM8	SS1	SS2	SS3	SS4	SS5	GS1	GS2	GS3	GS4	GS5	GS6	GS7	GS8	GS9	GS10	GS11	GS12	GS13																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
SEMESTER I																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
1	KM18-4101	Mathematics 1	3																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							

No	Code	Course	Credits	ATTITUDES								KNOWLEDGE MASTERY								SPECIFIC SKILLS					GENERAL SKILLS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
				A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	KM1	KM2	KM3	KM4	KM5	KM6	KM7	KM8	SS1	SS2	SS3	SS4	SS5	GS1	GS2	GS3	GS4	GS5	GS6	GS7	GS8	GS9	GS10	GS11	GS12	GS13																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
SEMESTER V																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
1	RC18-4501	Structure Steel Building	4													1	1					1	1							1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

CURRICULUM STRUCTURE OF BACHELOR OF CIVIL ENGINEERING - INSTITUT TEKNOLOGI SEPULUH NOPEMBER SURABAYA - INDONESIA									
No.	Level 1		Level 2		Level 3		Level 4		
	Semester 1	Semester 2	Semester 3	Semester 4	Semester 5	Semester 6	Semester 7	Semester 8	
1	Mathematics 1 (KM18-4101)	Mathematics 2 (KM18-4201)	Introduction of Geospatial Information (RW18-4901)	Steel Structure Elements (RC18-4401)	Structure Steel Building (RC18-4501)	Bridge Engineering (RC18-4601)	Technopreneur (UG18-4915)	Insight and Technology Applications (UG18-4916)	
Credit	3	3	2	3	4	2	2	3	
2	Physics 1 (SF18-4101)	Physic 2 (SF18-4202)	Modelling and Analysis of Structure (RC18-4301)	Concrete Structure Elements (RC18-4402)	Structure Concrete Building (RC18-4502)	Design of Reinforced Concrete Building (RC18-4602)	Steel Bridge Design (RC18-4701)	Procurement and Contract for Construction Project (RC18-4801)	
Credit	4	3	3	3	3	2	2	2	
3	Religion (UG18-4901-6)	Chemics (SK18-4101)	Building Material and Technology (RC18-4302)	Hidrology (RC18-4403)	Drainage (RC18-4503)	Irrigation and Water Structure (RC18-4603)	Decision Making Techniques (RC18-4702)	Enrichment	
Credit	2	3	4	3	3	4	3	3	
4	Indonesian (UG18-4912)	Pancasila (UG18-4911)	Fluid Mechanics and Hydraulics (RC18-4303)	Railway Engineering (RC18-4404)	River Engineering (RC18-4504)	Coastal Engineering and Port Planning (RC18-4604)	Airport planning and Design (RC18-4703)	Intership (RC18-4802)	
Credit	2	2	4	2	2	4	2	2	
5	Citizenship (UG18-4913)	English (UG18-4914)	Transportations and Traffic Design (RC18-4304)	Construction Managements (RC18-4405)	Construction Equipment and Methods (RC18-4505)	Project Cost and Schedule Control (RC18-4605)	Academic Report Writing (RC18-4704)	Final Project (RC18-4803)	
Credit	2	2	3	2	3	2	2	6	
6	Basic Statistic (RC18-4101)	Computer Programming (RC18-4201)	Civil Engineering Drawing (RC18-4305)	Soil Mechanic and Foundation (RC18-4406)	Embankment and Earth Retaining Structure (RC18-4506)	Highway Design (RC18-4606)	Elective Courses		
Credit	2	2	3	4	5	5	6		
7	Statically Determinate Structure (RC18-4102)	Mechanics of Materials (RC18-4202)							
Credit	3	3							
Total Credits	18	18	19	17	20	19	17	16	144
		BASIC SCIENCES		STRUCTURE	TRANSPORTATION			NATIONAL COURSES	
		WATER RESOURCES & MANAGEMENT		CONSTRUCTION MANAGEMENT				FACULTY COURSES	
		GEOTEKNIQUES		INSTITUTE/UNIVERSITY COURSES					
		SUPPORTING/FINAL PROJECT/INTERSHIP							

The Tuning method provides 10 effective steps in curriculum design. There are differences between the Tuning method and the method that we have implemented in the past in the definition of learning outcomes. The Tuning Method involves the students in the competency survey for collecting information about expected competency from a civil engineering graduate. The survey results from lecturers, students and stakeholders using the Meta-Profile method compiled a learning outcome consisting of specific and generic competencies. The Programme Learning Outcome (PLO) is achieved through a learning process from courses and other planned structured activities. Each subject has several Course Learning Outcomes (CLO) that must be achieved. By using a matrix between the CLO and the PLO, the consistency of the programmes prepared can be seen.

Peer review by colleagues in the civil engineering team during meetings is very helpful in designing a programme. By using the programme structure of each Civil Engineering course in the different universities in Southeast Asia, we can easily make comparisons in the programme and use them for collaboration in the double degree programme in the future.

