YANGON UNIVERSITY OF ECONOMICS
MASTER OF DEVELOPMENT STUDIES PROGRAMME

A STUDY ON INTEGRATION OF HUMANITIES AND SOCIAL SCIENCES IN ENGINEERING EDUCATION OF MYANMAR

AUNG MYINT MYAT
EMDevS-3 (16th Batch)

JANUARY, 2021

YANGON INISITUTE OF ECONOMICS

MASTER OF DEVELOPMENT STUDIES PROGRAMME

A STUDY ON INTEGRATION OF HUMANITIES AND SOCIAL SCIENCES IN ENGINEERING EDUCATION OF MYANMAR

A thesis submitted in partial fulfillment of the requirements for the

Master of Development Studies (MDevS) Degree

Supervised by	**Submitted by**
Daw Pa Pa Kyaw	Aung Myint Myat
Associate Professor	Roll No. 3
Department of Economics	EMDevS 16th Batch
Yangon University of Economics	(2018 - 2020)

JANUARY, 2021

YANGON UNIVERSITY OF ECONOMICS
DEPARTMENT OF ECONOMICS
MASTER OF DEVELOPMENT STUDIES

This is to certify that this thesis entitled **"A STUDY ON INTEGRATION OF HUMANITIES AND SOCIAL SCIENCES IN ENGINEERING EDUCATION OF MYANMAR"** submitted as the requirement for the Degree of Master of Development Studies has been accepted by the Board of Examiners.

BOARD OF EXAMINERS

Dr. Cho Cho Thein
(Chairman)
Professor and Head
Department of Economics
Yangon University of Economics

Dr. Kyaw Min Htun
(Examiner)
Pro-Rector (Retired)
Yangon University of Economics

Dr. Tha Pye Nyo
(Examiner)
Professor
Yangon University of Economics

Dr. Zin Zin Shwe
(Examiner)
Associate Professor
Department of Economics
Yangon University of Economics

Daw Pa Pa Kyaw
(Supervisor)
Associate Professor
Department of Economics
Yangon University of Economics

ABSTRACT

In Myanmar, the role of liberal studies has been off-tracked in engineering education for a long time. However, humanity and social science (HSS) courses are added in the engineering curriculum to attain the required credit units of general studies to meet the requirements of Washington Accord in 2017. The aim of this empirical study is to clearly understand the current status of HSS studies in Myanmar engineering education system and to observe the perceptions of engineering students and teachers to HSS courses. Descriptive method with explanatory sequential survey design, using primary data obtained from surveys and focus group studies was used in this study. The study found that the time is right for integration of HSS studies in traditional techno centric education by Myanmar Engineering Council provided an excellent framework to keep on the right track. The suggestion in this study is to enhance student experience, curriculum mapping, and support the outcome-based education system by making alliance between engineering universities and other institutions, upgrading the knowledge and skills of HSS teachers with regular trainings, providing proper and flexible time-management to teach HSS in the classes and supporting the strong outcome-based engineering education from policy makers.

ACKNOWLEDGEMENTS

First, I would like to express my gratitude to Professor Dr. Tin Win, Rector of Yangon University of Economics and Professor Dr. Ni Lar Myint Htoo, Pro-Rector, Yangon University of Economics, for giving me an opportunity to attend Master of Development Studies Program. Then I wish to express my sincere thanks to Dr. Charlie Than, president of Myanmar Engineering Council, who believed in, and whole-heartedly supported, the outcome-based education for Myanmar engineering system and leads the accreditation process all the way through its different stages. I also thank him for his encouragement and helping me find many literature reviews including history of Myanmar engineering education, national curriculum guidelines using in different universities of foreign countries and the essential concepts of quality education system. As one of the central gatekeepers within this field of study the research study has benefited greatly from his many contacts. Without his support this study would never have come into being.

Second, I would like to acknowledge my debt to Dr. Kyaw Min Htun, the retired Pro-rector at Yangon University of Economics, and who has inspired me with his grateful lectures, motivations and tremendous guidelines.

Moreover, my deepest thanks to Dr. Cho Cho Thein, program director of the master of development studies program. In the earlier days of this work, she provided me the conceptual frameworks and advices to bear the quality research study.

And I am highly indebted to my supervisor, Daw Pa Pa Kyaw, Associate Professor, Yangon University of Economics for her effective supervision and providing worthy advices throughout the preparation of this thesis. I absolutely believe that I could not make this study come out.

Finally, I am very thankful to my family, wife Maythu Hlaing, and daughter Thoon Tharyar Myint Myat. This has been a family effort, through two years of attending Master of Development Studies program and encouraging me all the time. I cannot do all these works without the family support.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ABET	Accreditation Board for Engineering and Technology
B.E	Bachelor of Engineering
BioT	Bio-Technology
ChE	Chemical Engineering
CoE	Center of Excellence
CU	Credit Unit
EC	Electronics and Communications
EEAC	Engineering Education Accreditation Committee
EP	Electrical Power
GA	Graduate Attribute
HSS	Humanities and Social Science
IEA	International Engineering Alliance
MEngC	Myanmar Engineer Council
MoE	Ministry of Education
MoST	Ministry of Science and Technology
MP	Mechanical Power
NT	Nuclear Technology
OBE	Outcome-based Education
SLT	Student Learning Time
STEM	Science, Technology, Engineering and Mathematics
TexE	Textile Engineering
TU	Technological University
WA	Washington Accord

CHAPTER I
INTRODUCTION

1.1 Rationale of the Study

In Myanmar, three-step ladder-like Engineering Education System was began in 2000 as a new technical education system. This system is to give 2 years of technician training (for Diploma), another 2 years of technologist education and training (for a degree in technology), followed by another one year of engineering education to those who wanted to earn an engineering degree. A student must have attended 3 kinds or levels of technical-related education and training to become an all-rounded engineer. As a matter of fact, Myanmar engineers must have to attend five years to attain their Bachelor Degrees. For a long time, Myanmar engineering education system only focused on the science, technology, engineering and mathematics (STEM) and left out to align with general education curriculums.

In 2017, the new transformation has been made in the engineering education system and technological universities opened the 6-year Bachelor of Engineering (B.E) programmes. The role of humanity and social science subjects are also considered and integrated to the curriculums. The mission of engineering education is to educate and train students systematically to become well-rounded engineers, specialists and researchers who can effectively contribute to the building of a modern, developed nation with high standard of engineering education and training. Another purpose of producing engineering students is that they can think rationally approach and solve complex engineering problems systematically. As similar in Europe and the United States as, Myanmar Engineering Council has established the engineering criteria specifying the broad outcomes required of accredited engineering programmes and within these criteria it is clear that the wider interests of society become the concern of the engineer.

Myanmar Engineering Council has adopted the engineering accreditation criteria based on EC 2000 and integration of HSS into engineering subjects has recently become a compulsory part of the curriculum of degree programs. However, the process of integration in engineering degree programs, in particular in practice-oriented engineering degree programs, has been characterized by a good deal of doubt and hesitation resulting in a remarkable delay when teaching in the humanities and social science courses.

In Myanmar, humanities and social sciences subjects are in very introductory stage for technological students as well as teachers. Only technological focus knowledge, practices and core competencies are not good enough to solve complex problems, meet the relative needs of society and figure out the environmental issues. In fact, the current status of engineering education needs a lot of improvements and changes. In the light of the above observations of global megatrends, the aim of this study thus is to discuss at an institutional level some of the complexities and didactic/pedagogical problems in integration HSS into engineering curricula in Myanmar.

This study proposes to explore these questions within the framework of the recently introduced assessment of graduating student performance based on twelve programme outcomes or graduate attributes, as defined by the M.Eng.C (*Engineering Programme Accreditation Manual, Policy, Procedure, Guidelines*, 2018). These twelve graduate attributes cover a wide range of the knowledge, skills and attitudes expected of an accredited Myanmar engineering programme graduate including discipline-unique understanding and talents (engineering knowledge base and design), in addition to non-technical abilities and attitudes (individual and teamwork, communication, professionalism, the effect of engineering on society and the surroundings, ethics and equity, economics and project management, and lifelong learning). In this study, the author made empirical research to discover the mechanisms and reasons which may have made delays and ineffectiveness in teaching and learning HSS courses.

1.2 Objectives of the Study

The main objectives of this study are (i) to describe the current status of humanities and social science studies in engineering education and (ii) to observe the perceptions and expectations of engineering students and teachers on HSS studies in Technological Universities (TU).

1.3 Methods of Study

This study mainly utilizes descriptive method analyzed by both quantitative and qualitative approaches to understand the research problems using primary and secondary data. The information, facts and figures used in this study are from Ministry of Science and Technology (MoST) and Myanmar Engineering Council (MEngC). In this study, some necessary articles about the role of humanities and social sciences in engineering education systems from U.S, Europe and, Myanmar statistical yearbooks, text books, annual reports, data collection surveys on education sectors of Myanmar, reports and national education guidelines from International Engineering Alliance (IEA), Accreditation Board for Engineering Technology (ABET), and other available records are used to study. Necessary analysis has been made and then findings and suggestions are presented in Chapter (V).

1.4 Scope and Limitations of the Study

Among thirty-three technological universities in Myanmar, the student survey feedbacks can be collected from 125 engineering students in twenty-one universities including two center of excellence (COE) universities, YTU and MTU. The engineering students from civil, mechanical power, electronics and communication, and electrical power majors are selected to take the survey and participate in the interviews. For those who teach HSS studies in TUs, eighteen teachers from West Yangon Technological University (WYTU), University of Technology (Yatanarpon Cyber City), Technological University (Taunggyi) and Technological University (Mawlamyine) are willingly participated both in online surveys and in telephone interviews. The scope of this study is to observe the perceptions and expectations of engineering students and teachers on HSS studies in Technological Universities. The perceptions of people from industry and policy makers are beyond the scope of this study.

1.5 Organization of the Studies

This study is presented through five chapters. Chapter (I) presented the introductory part comprising the rationales of the study, the objectives of the study, the method of the study, the scope and limitations of the study and the organization of the studies. Chapter (II) presented the literature review on the role of engineers in societal contexts, importance of HSS Studies in engineering education and the evolution of HSS studies. Chapter (III) expressed the current Myanmar Engineering Education System and the role of HSS Studies. Chapter (IV) is to present the survey data and analytical results of engineering students and teachers. The final chapter, Chapter (5) presented the conclusion where findings and suggestions are presented.

CHAPTER II
LITERATURE REVIEW

2.1 Engineering Education for Human Capital

The importance of integration of Humanity and Social Science courses into Engineering Education is the main intention of this study. As a capital good is generated from the concept of "human capital" that requires a high quality of human skills to obtain development. Human skills are as important in productive input of development process of natural wealth. Since engineering education plays an active role in both creation and improvement of human capital, its relevance and importance to economic growth and development.

The best investment a country or government can give to the people, is to give them quality education. This means universities are teaching them how to fish but not giving them fish only. Indirectly, human capital contributes to growth productivity and employment; and for this to happen, it requires knowledge, skill, and right attitudes of talented engineers. According to the concept of Schumpeter has in mind when describing "by 'development' therefore, people shall understand only such changes in economic life as are not forced upon it from without but rise by its own initiative from within"(Schumpeter, 1934). According to the theory observes education and training as a key factor of human resources and development that influences economic growth. The originating of new growth theories is therefore significant in the introduction of the active role of human capital in the growth of economies. According to the Spillovers theory of technology, the economic growth and income of many countries as country productivity depend on the available important of new technologies and scientific knowledge accumulated and these have create differences among countries in global economic growth market competitiveness as was described by Eaton and Kortum (2002); Klenow and Rodriguez-Clare (2005).

According to Todaro and Smith (2003), human capital is the term economists usually use for both education and other human capacities that can raise productivity when increased. Therefore, Engineering and technology are the two closely related human capital components that work together to make the individual more productive and develop economic growth of a country.

Humanitarian engineering is highly multidisciplinary. It requires a broader foundation of knowledge than traditional engineering. Like engineering, it includes all the physical sciences (e.g., physics and chemistry), life sciences (e.g., biology), and mathematics/statistics; however, it also includes parts of all areas of social science. Compared to the traditional engineer, a good humanitarian engineer needs to know more about people, and in particular social human groups of all sizes, and how they interact. Humanitarian engineers need to know how to collaborate in diverse groups, where diversity means inclusion of experts outside engineering, members of a community, both genders, and other cultures and races. Most humanitarian work gets done on the back of relationships" between people, and large structural problems of social justice require large diverse groups of people working together for their solution (Passino, 2016).

2.2 Definitions of Engineering, Humanities and Social Sciences

2.2.1 Etymological Basis of "Engineering"

Etymologically, engineering seems to derive from similar roots to technology, a term which was given a philosophical basis in ancient Greece (Cuomo, 2007; Mitcham & Schatzberg, 2009) through the root techne—productive skill or art—which was one of Aristotle's intellectual virtues (Aristotle, VI-4). Techne includes the skills of making and creating that are in modern definitions of engineering. While engineering as defined today did not exist in ancient Greece, nor is the evolution of modern definitions obvious, the influence of ancient writings on Western thought seems to remain. Engineering has the Latin etymological root *ingeniare* which means to devise or contrive(*The Engineer of 2020: Visions of Engineering in the New Century*, 2004).

As the words engineer and engineering came more into civilian use the definitions begin to diverge between countries and cultures. In the English-speaking world, the first modern, civilian definition of engineering is generally acknowledged to arise from the charter of the British Institution of Civil Engineers. As rational science become predominant in the 19th and 20th centuries the knowledge from scientific discoveries was increasingly incorporated into industrial products and processes. Additionally, industrial production was becoming increasingly mechanized across the 19th century and this mechanization picked up rapidly during the Gilded Age so that engineers became more closely associated with industry.

A “global engineer," or an engineer with “global competency," is one who can easily work across international borders. Understanding other languages, cross-cultural communications, how to work in cross-cultural relationships, and how to take into account local “context" are the key skills of a global engineer; however, a global engineer sometimes has to understand international business, technology policy, intellectual property, and trade policy. Of course, the global engineer must understand history, politics, economics, religion, etc. of the country/ culture they are working with. (Downey et al., 2006).

2.2.2 Humanities

The humanities are the study of what it means to be human. Subjects within the humanities look at human existence, history, culture, thought and creativity. Someone who tries to understand what happened in the past is studying history. Someone who tries to understand how traditions or social practices (for example, marriage) differ between cultures is studying anthropology(Jagger & Simpson, 2018).

Studying the humanities helps us to think about, and understand, what it means to be human. Subjects like history and philosophy help us to think critically about where ideas about human knowledge and behavior have come from. Those subjects also encourage us to think about how the world should be and how people should behave. The humanities also help us to appreciate human creativity. Thinking creatively has contributed to scientific discovery, law, arts, music and literature. Critical and creative thinking are skills that are also useful in the social and natural sciences. Subjects that are usually considered to be within the humanities include ethics, philosophy, anthropology, history, languages, literature, art and music(Jagger & Simpson, 2018).

2.2.3 Social Sciences

Social science is the study of peoples and societies. Social refers to the relationships between people in a society and Science is the organized and systematic study of things and how they work. Social science tries to understand how society works. It looks at how people in society relate to each other and to their environment. It can include the study of individuals, families, groups, organizations or whole countries. For example, a social scientist might want to understand why some people in society are rich and others are poor, or how building a dam on a river will affect the lives of people who live by the river(Boyer Commission on Educating Undergraduates in the Research University, 1998).

People have different ideas about how society is or should be. This makes social science different from natural science like biology, chemistry or physics. For example, we know humans need food and oxygen to survive. These are scientific facts. Social science studies human behavior and relationships and the effects that they have on society. Many things about people and society are more difficult to claim as 'facts'. For example, how people's views about religion or politics affect development. It is likely that social scientists will get different answers depending on who they ask(Jagger & Simpson, 2018).

Studying social science is valuable for personal, community, work and education reasons. Social science studies human behavior and relationships. We are all human and we all experience or relate to the things studied in social science. Learning about different issues and how they affect people helps us see things from other points of view and in new ways. That is important for understanding (and for being part of) the communities that we live in.

2.3 Importance of Teaching Liberal Studies in Engineering Education

Identifying or predicting the attitudes, skills and knowledge on the way to be the obtained of tomorrow's engineers is a tough task, despite the fact that there appears to be a consensus in the current literature on the engineering profession that, beside the traditional scientific and technical skills, a "socio-cultural approach" is highly needed. By this, A. Kolmos (Christensen et al., 2006) means that the social sciences and the humanities are core components in the engineer's formation in that they can help him/her develop specific skills, dispositions and habits to exercise a self-critical reflection. However, if the needs of companies regarding engineering competencies may converge with the needs of society on a number of fundamental criteria, e.g. technological expertise, creativity, leadership, good communication, lifelong learning abilities, environmental awareness, etc., they diverge on other crucial points. Society needs autonomous engineers with a sense of responsibility and reflective skills that enable them to be critical of that they or their firms are doing and how they are doing it. Autonomy, responsibility and reflectiveness are also publicly valued by companies, but in practice they are often closely demarcated or perverted: the engineer's autonomy is increasingly impaired by all kinds of controls and bureaucratic procedures; his/her loyalty to the organization often conflicts with his/her responsibility toward society or even his/her profession, despite occasional cases of whistleblowing; as for reflectiveness, it is generally instrumentalized by the enterprise as practice-oriented reflection in order to solve a problem or improve a method.

If engineers are to help the developing nations, they have to learn how the communities they wish to help perceive their own needs. This applies equally to our own societies and the problems they face. Such understanding can only be acquired from a more general education in the humanities and social sciences. It is as if engineers are seen as technicians who serve the system and are there to be controlled, so if they do not change that will continue to be the case.

One notable difference in engineering curricula of the US and many countries of the EU (France, and for a limited period the UK, appear to be exceptions) is that, in the US, students are required to accumulate a significant number of credits in the humanities and social sciences (HSS). While the history shows a recognition, on the part of those responsible for establishing the first programmes, that to be a considered professional, some measure of the humanities must be an integral part of the curriculum (H.P.Hammond, 1939). Aims and Scope of the Engineering Curriculum, that the Humanities and Social Sciences received explicit and significant status as a "stem" to be offered in parallel with the student's technical track. Hammond's report recommended that the humanities and social sciences be given "...a minimum of approximately 20% of the student's educational time. This allotment should be at least the equivalent to one three-hour course extending throughout the curriculum, and on the average somewhat more." (Quoted in ASEE Report, 1956). This recommendation became the norm, though the 20% was indeed treated "approximately". The general rule took the form of one HSS course per semester for each of the eight semesters a student was expected to complete for the Bachelor's degree. The importance of "liberal education" as part of the engineer's "professional identity" was re-enforced in the cited Grinter Report on the Evaluation of Engineering Education, done for the ASEE and published in 1955. By looking at the subject of instructional goals even more broadly, one concludes that the engineer should be a well-educated man. An engineer must be not only a competent professional engineer, but also an informed and participating citizen, and a person whose living expresses high cultural values and moral standards. Thus, the competent engineer needs understanding and appreciation in the humanities and in the social sciences as much as in his own field of engineering. He needs to be able to deal with the economic, human, and social factors of his professional problems. His facility with, and understanding of, ideas in the fields of humanities and social sciences not only provide an essential contribution to his professional engineering work, but also contribute to his success as a citizen and to the enrichment and meaning of his life as an individual."(Grinter, 1995, p. 7)

2.4 Purpose of Liberal Studies in Engineering Education

Discussions of the importance of disclosing future engineers to the humanities and social sciences, as well as offering them with soft abilities know-how date back at least seventy years; and humanities and social sciences content has turn out to be mandated with the aid of the various accrediting bodies chargeable for engineering curricula. In the U.S.A, the Accreditation Board for Engineering and Technology (ABET) requires a general education element that enhances the technical content material of the curriculum and is steady with the program and institution targets, even as additionally requiring documented student consequences that show a wide schooling important to recognize the impact of engineering solutions in a global, economic, environmental, and societal context(ABET, 2015).

Reiner (1975), Bradley (1985), Hersh (1997), Nussbaum (1997), Badley (2003), Boren (2004), Brint et al. (2005), Berube (2006), and Lind (2006) have all spoken to this point that liberal studies are very important to teach in engineering curriculums. And whilst its focus was not solely on university education the Padeia Proposal as a system of liberal education originating from Adler and Van Doren

(1988) should be mentioned as well as the work of the Boyer Commission on Educating Undergraduates in the Research University (1998).

In recent years, many educators and policy makers have called for a greater integration between humanity and social science(HSS) courses and the disciplines of science, technology, engineering and mathematics(STEM) and, to be precise, for an extra partnership between engineering and the liberal education as a way to foster greater cultural and social context, and increase flexibility and adaptability in students (Wendy Marie & John, 2013, pp. 21-37). This encourages the inclusion of HSS courses in the engineering curriculum, is neither recent nor is it limited to a particular region.

Engineering Criteria 2000 or EC 2000 is the new set of criteria that Engineering degree programs must assure in order to be accredited by the Accreditation Board for Engineering and Technology (ABET) (Soundarajan, 1999). EC 2000 emphasizes intuitions from the HSS that are needed by faculty and students as well as employers and that are required for the practice of engineering in an increasingly complex world. The EC 2000 criteria originate with the conviction that the HSS are integral to engineering education rather than an external requirement that students can meet by taking a course in writing, ethics, or project management. “Integral” here is taken to mean indispensable, necessary to the whole, and indivisible from that whole.

Badley is concerned that their culture is “bombarded with competing ideologies” (2003, p.480) one of which is the primacy of the career preparation function of the university. Already in 2003 Badley (p.483) asked “what is education for?” In answering his own question, he suggests that: “the current answer appears to be that the purpose of education, even higher education, is simply to help society become more economically productive and competitive (p.483).” He buttresses his argument with Rhodes (2001) claim “that professionalism has now shifted the function of the university from that of providing students with an opportunity for education to that of acquiring employability” (Badley, 2003, p.486). Indeed the philosopher Wolff has argued that such a shift is detrimental to the fundamental role of the university and that consequently the education of the professions should not even reside within the modern university (Wolff, 1992).

Some authors, (Beder, 1999), (H.Williams, 2002), (Christensen et al., 2006), and (Hyldgaard Christensen et al., 2007), have argued that future engineers will have to face up to a long term convergence between technical and liberal education to meet the needs of the future labor market where purely technical competencies are increasingly becoming insufficient. Other authors have argued that convergence between technical and liberal education is necessary to provide future leadership for engineers (Grimson et al., 2008; Heywood, 2007; National Academy of Engineering, 2004) . All derive their arguments from key developments in the global knowledge economy.

Devon and Liu (2002) have presented a short and instructive list of trends of the global knowledge economy which translate into challenges for engineering education:

i. People become increasingly interconnected and geographically mobile. National economies become more and more interdependent.
ii. Information is a new currency.
iii. Decentralization of power, reduction of hierarchy, and increasing complexity.
iv. Globalization of economy, workplace and culture, including international standards (ISO).
v. Strengthened influence of multinational corporations which increasingly operate as transnational players.
vi. Functionalizing of relationships – the extent to which we know and relate to people only as an extension of our work
vii. Diversification of relationships; multicultural and multinational teams become the norm
viii. Continuous change in technology and organizational structures

In the US the teaching of a number of the above skills and competencies is traditionally referred to as “liberal education”. Both in Europe and in the US the responsibility for teaching such skills to engineering students is generally left to academics trained in the humanities and the social sciences (Steneck et al., 2002). In the western hemisphere, the role of humanities and social sciences has been designated as being very important in the engineering education for over 70 years.

In 2005 the Association of American Colleges and Universities launched its LEAP (Liberal Education and America’s Promise) initiative to speak to “the aims and outcomes of a twenty-first-century college education" (National Leadership Council for Liberal Education and America's Promise, 2007, p. 1). In many respects LEAP echoes the work of the Enterprise Learning initiative referred to earlier (Heywood, 1994). The LEAP initiative identified the following essential learning outcomes (p.3) summarized as follows:

Table (2. 1): The Essential Learning Outcomes by LEAP Initiative

	The Essential Learning Outcomes
	Beginning in school, and continuing at successively higher levels across their college studies, students should prepare for twenty-first-century challenges by gaining:
i.	Knowledge of human cultures and the physical and natural world through study in the sciences and mathematics, social sciences, humanities, histories, languages, and the arts
	Focused by engagement with "big questions", both contemporary and enduring
ii.	Intellectual and practical skills, including inquiry and analysis, critical and creative thinking, written and oral communication, quantitative literacy, information literacy, teamwork and problem solving
	Practiced extensively, across the curriculum, in the context of progressively morechallenging problems, projects, and standards for performance
iii.	Personal and social responsibility, including civic knowledge and engagement-local and global, intercultural knowledge and competence, ethical reasoning and action, foundations and skills for lifelong learning
	Anchored through active involvement with diverse communities and real-world challenges
iv.	Integrative learning, including synthesis and advanced accomplishment across general and specialized studies
	Demonstrated through the application of knowledge, skills, and responsibilities to new settings and complex problems

Source: Association of American Colleges and Universities (2005)

2.5 Review on Previous Studies

In many countries, there is a requirement for humanities and social sciences in the curriculum as a general educational requirement. In Croatia, humanities and social sciences have been integrated from the 1980s to the nowadays into the curriculum of Faculty of Mechanical Engineering and Naval Architecture at University of Zagreb. It is mentioned that humanity and social science courses are continually integrated in mechanical engineering program as legitimate, but separate unit, poorly integrated in the main engineering courses (Dubreta, 2014).

In Australia, the expansion of the non-technical areas, specifically humanities and social sciences, has been slow to take anchor within the schools, departments and faculties of engineering in Australia. It is argued that this is essentially a problem of academic culture, operating within engineering schools and faculties in Australia, that is based on scientific norms derived from science and the idea of cultural change is explored. The acquisition through education of humanities and social sciences cannot be regarded just as an extension of knowledge capital. It provides professional engineers with means of new way of critical thinking and inquiry (Rojter, 2010).

There is a general international acknowledgement concerning the value of humanities and social sciences in engineering education to enhance workplace discourses and raise the social standing of the profession(Sharma, 2013). Grinter suggested that 30 percent of engineering curricula in the United States be allocated to core humanities and social science disciplines (Grinter, 1995). Heitmann in his overview of European engineering education found that 20 percent of allocation to humanities and social sciences was adequate (Heitmann, 1995). The Accreditation Board for Engineering and Technology (ABET), a body responsible for accrediting professional engineering courses in the United States, set aside a minimum of 12.5 percent of engineering curriculum that had to be allocated to humanities and social sciences if these courses were to be accredited.

In response to reviews into engineering education in Australia for greater inclusion of humanities and social sciences, the Institution of Engineers Australia, which accredits engineering courses in Australia, recommended that 9 percent of the curriculum be set aside to subjects concerned with management and ethics and further 15 percent be set aside to other areas which could incorporate humanities and social sciences (Johnson, 1996; Williams, 1988). Theoretically the humanities and social content of engineering curricula could exceed the minimum requirement in the United States. The manufacturing engineering course had the highest allocation, in Australia, of engineering curriculum to management, humanities and social sciences of 19.8 percent well below the recommended 24 percent of which only 7.8 percent consisted of humanities and social sciences. The courses in civil engineering at University of Melbourne and chemical engineering at University of Sydney could meet the minimum requirement in the United States for the allocation of engineering curricula to humanities and social sciences, and this was optional through choice of appropriate electives by students. In terms of humanities and social sciences the Australian universities were well short of best practice in engineering education found in the United States and the European Community (Rojter, 2004).

In Canada, the CEAB presently requires students to take a minimum of 225 accreditation units (AU) in complementary studies defined to include humanities, social sciences, arts, management, engineering economics and communication. These courses must incorporate elements dealing with: the impact of technology on society, central issues, methodologies, and thought processes of the humanities and social sciences, oral and written communication, health and safety, professional ethics, equity and law, as well as sustainable development and environmental stewardship(Canadian Engineering Accreditation Board, 2014). While programme hours and objectives are the same, each institution can decide on its own approach on how to implement these AUs. To understand the nature and variability of complementary studies implementation, the authors reviewed the Web sites of the 43 Canadian institutions with accredited engineering programmes. For each accredited institution they considered curricula, programme descriptions, programme guides, and academic calendars available on their Web sites (Canadian Engineering Accreditation Board, 2014).

The number of compulsory and elective complementary studies courses varies across institutions, as does the range of courses engineering students can take to fulfil their complementary course requirements. Among compulsory complementary courses, business and economics are the most common and found in most schools. In addition, 33 institutions require an engineering and society course. Usually offered as an historical or philosophical survey, the course tends to be taught by external departments at larger institutions and engineering faculty at smaller ones.

Communication courses are also widespread, with 27 institutions requiring at least one course in this field (university writing, professional communication or English literature). Eighteen institutions require ethics and law courses; and four schools require a course in environmental stewardship. Complementary studies electives also vary. Institutions, such as the University of Toronto, York University, the University of Alberta and the University of Guelph allot four or more complementary studies electives, while some have no free complementary studies electives. When offered, the range of electives depends on institutions, and most engineering programmes take advantage of resources at their institutions to offer courses in anthropology, geography, history, philosophy, women's studies, English and classics. As a general trend, smaller and more specialised institutions offer a limited number of complementary study electives, while larger and more educationally diverse institutions offer greater choice.

To present the previous studies of engineering education system in Myanmar, the people, academia, officials from other countries, many international nongovernmental organizations (INGOs), and non-governmental organizations (NGOs) such as the UN, UNESCO, and the ILO have mostly addressed the importance of Technical Vocational Education and Training (TVET) in Myanmar in creating skilled labors that corresponds to the current trend in economic growth. However, the studies on Myanmar engineering education system and the linkage between HSS studies and engineering courses cannot be found in the past literatures.

CHAPTER III

MYANMAR ENGINEERING EDUCATION SYSTEM AND HSS STUDIES

3.1 Brief History of University Engineering Education in Myanmar

In Myanmar, the engineering education was established in 1923 and now it has been in existence for over 90 years. Initially, instructors and lecturers from India came to Myanmar and gave lectures on engineering. Then, Myanmar engineers were sent to foreign countries (e.g. Europe, United States of America) to facilitate them for the programs in engineering education in Myanmar. After gaining independence, most of the scholars were sent to the technological universities of the United States of America. When they came back, the teaching system in engineering was changed from the British System to the US System. Since 1958 when the caretaker government gained power, most scholars were sent to the East European countries such as Russia, Yugoslavia, Czechoslovakia, East Germany and Hungary. When the scholars came back to Myanmar, they tried to change the engineering education of Myanmar based on the East European Education System. Until now, the university laws in practice are based on the East European education laws. However, in spite of the era and system changes, Rangoon Institute of Technology, the leading institute in engineering education in Myanmar, still uses the education system which is based on the US Education System. In 1988, throughout the period of the military government, many technological universities and colleges emerged (Charlie Than, 2015).

3.1.1 Historical Review on Myanmar Educational Movements, 1923-1964

Engineering education in Burma started with the opening of an engineering department at Rangoon University. Before Rangoon University was founded in 1920, the two constituent colleges then affiliated to Calcutta University offered only some subjects in Arts and Science. When Rangoon University was opened, more subjects in

Arts and Science such as Oriental Studies, History, Geography, Economics, Geology, Forestry, Education and Engineering were offered to the students.

The Engineering Department of the Rangoon University was established at the end of 1923-24 academic years. It started offering engineering degree courses in the 1924-25 academic years. The Department of Engineering was formed in 1923 and the first engineering program (in Civil Engineering) was inaugurated in 1924 (Nyi Hla Nge, 2017).

At first, the lecturers and instructors were from India, which is also the colonial country under Britain. Thus, at that time, both the education system and engineering education system were mainly based on British system. Then, Myanmar Engineers were sent to foreign countries such as Europe and the United States of America, to be able to facilitate the programs in engineering education in Myanmar. Therefore, the engineering education system of Myanmar started to change from British system to US System but it was not as strong yet. Thus, a contradiction between education systems had arisen since then (Charlie Than, 2015).

After high school, a student had to attend for 2 years either Intermediate Arts (I.A.) or Intermediate Science (I. Sc.) course at the University, depending on the Arts or Science subject combination chosen by the student (Nyi Hla Nge, 2017).

After I. Sc., those who wanted to become engineers could apply for engineering specialization at the Faculty of Engineering which required another 4 years to earn the B.Sc. (Eng.) degree. Therefore, to get an engineering degree, it took 10 years in High School + 2 years as I. Sc. student + another 4 years as engineering student, totaling 16 schooling years. That system had existed up to year 1964, when the so-called New Education System was introduced in Myanmar (Nyi Hla Nge, 2017).

After gaining independence in 1948, most of the scholars were sent to technological universities in the United States of America. When they came back, the engineering education system was changed from the British system to the US system.

Since the caretaker government gained power in 1957, the scholars were sent to East European countries such as Russia, Yugoslavia, Czechoslovakia, East Germany and Hungary. Those scholars tried to change the engineering education of Myanmar according to the education system of East Europe. At present times, the university laws in practice are still based on the East European education laws.

Despite the changes of system over the ages, Rangoon Institute of Technology which is a leading institute in engineering education in Myanmar, still uses the education system based on the US Education system.

3.1.2 Historical Review on Myanmar Educational Movements, 1964-2009

The new 6-year Bachelor of Engineering (B.E.) undergraduate engineering programs were introduced in 1964 to replace the former program of I. Sc. (2-Years) + Engineering proper (4-Years) for obtaining B. Sc. (Eng.) degree. The Bachelor of Engineering (B.E.) programs were opened at Rangoon Institute of Technology (RIT), which became an independent, full-fledged professional institute of university status.

Master of Engineering (M.E.) programs were introduced in 1968 at RIT, which was the only engineering university in Myanmar up to 1991. The name RIT was later changed to YIT and then to YTU, the current name. In 1991, the second engineering university called Mandalay Institute of Technology (MIT) was established in the northern part of the country. The name MIT was later changed to MTU, which is the current name.

In 1996, a student riot originated in YIT which later spread across the country, leading to an unlimited suspension of regular undergraduate programs at YIT and MIT. That was a turning point in the history of engineering education in Myanmar.

The Ministry of Science & Technology (MoST) was formed in late 1996 and YIT and MIT were transferred from the Ministry of Education to the Ministry of Science & Technology in 1997. While the undergraduate programs were closed, YIT (YTU) and MIT (MTU) devoted their time and effort to post-grad programs.

In late 2000, the Ministry of Science & Technology formulated a new technical education system. The idea was to give 2 years of technician training (for a Diploma), another 2 years of technologist education and training (for a degree in technology), followed by another 1 year of engineering education to those who wanted to earn an engineering degree. A student must have attended 3 kinds or levels of technical-related education and training to become an all-round engineer-cum-technician.

This kind of not-well-defined education philosophy compounded by lack of well-qualified and experienced teachers, scarce laboratory equipment, rapid expansion of technological institutions across the country, inefficient teaching and assessment methods, and slack quality assurance procedures have led to the mass production of engineering graduates and technicians of questionable quality.

The complaints of end users such as industries, design offices and construction companies about the quality of technical education of the country could be heard very often. The outcome of that education system was very questionable. So, it was felt or believed by senior engineers and many stakeholders that the technical or engineering education need to be reviewed and reformed urgently.

In 1988, throughout the period of the military government, many technological universities and colleges emerged. During this era, Chinese government provided the scholarship programmes for higher education institutes in Myanmar. At that time, the developed countries emphasized on outcome-based education by accessing, accrediting the standard of education system to ensure the further development of the country. Hence, the international agreements, such as Bologna Process and Washington Accords, for accreditation of education systems were developed through the signing of European countries, United States of America, and so on. While in Myanmar, due to the lack of access to engineering education accreditation and laws regarding with the engineering profession to protect the public property, the quality of the engineering education was a decline resulting in the public criticism.

3.1.3 Myanmar Engineering Education Movements, 2009-2020

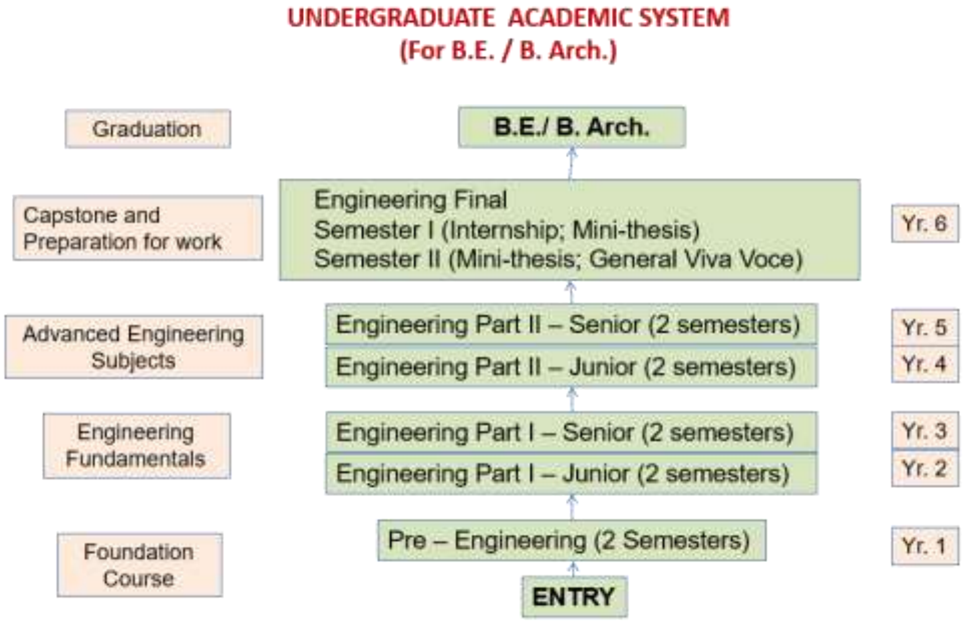
In 2009, with the political changes in Myanmar, in order to improve Engineering Education in Myanmar, with the help of the Federation of Engineering Institutions of Asia and the Pacific (FEIAP), the professionals attempted to establish Accreditation procedures for engineering education through Myanmar Engineering Society (MES). FEIAP is an independent umbrella organization for the engineering institutions in the Asia and the Pacific region, the objectives of FEIAP were to encourage the application of technical progress to economic and social advancement throughout the world; to advance engineering as a profession in the interest of all people; and to foster peace throughout the world. Later, Myanmar Higher-Education System put an effort to change into the outcome-based education system by approaching with the Bologna Process (BP). Unlike Myanmar Higher-Education System, the standard of Engineering Education System was tried to improve according to Washington Accord (WA) as the institutions and societies helping are also in accordance with WA. In order to precisely understand the two education systems: the “Bologna Process” and the “Washington Accord”, an overview of each system and a comparison between them will be explained.

In 2012, the permission to reopen the undergrad programs at YTU and MTU was granted by the Government. The Ministry of Science & Technology decided to open six-year B.E. programs at YTU and MTU for a limited number of top-ranking students, and the two universities were designated to be the technological centers of excellence (COEs) in Myanmar.

About that time, the new technological universities (TUs) that were established across the country in the preceding decade were using the mixed curriculum consisting of technical, technological and engineering components of education and training with only slight modifications of the original system, such as the extension of the third part of the ladder-like technical education system from 1 year to 2 years in 2012-13 and the total duration of the three-step program became 6 years instead of five.

In 2013, the first part, the technician education part, of the original 3-part system was detached and only two parts are left in the curriculum of TUs. In 2014, six-year B.E. programs were initiated in TUs by detaching the technician and technologist parts altogether. Now all TUs are uniformly offering six-year B.E. programs. The Ministry of Science and Technology which was established in 1996 is also reorganized under the Ministry of Education as Ministry of Education (Science and Technology) in April 2016.

Figure (3.1): Current Engineering Education System



Source: Myanmar Engineer Council (2018)

3.2 Quality Assurance in Engineering Education

"Quality in the sense of achieving academic excellence has always been a central value in higher education" (Schwarz and Westerheijden 2007, p. 4). Institutions of higher education have their beginning relied on the reputation of their faculties to attract students and scholars and to give credibility to their degree programs, their graduates, and their researches. However, the way Quality Assurance's key components, Accreditation and Evaluation or Assessment, are defined has a great influence on its implementation and impact. Assessment is about language regarding the nature of teaching, learning, and appropriate inquiry and power regarding how higher education is organized and rewarded (Ewell 1989). Four very broad traditions in higher education comprise the key strands of the historical, philosophical, political, and social foundations of Quality assurance. The first is academic peer-review-based Accreditation, the second is governmental oversight, the third includes the Scientific Education and Management Movements, and the fourth is the Accountability movement. Unless these different traditions and their related language and power implications are clearly understood and addressed, it is likely that conflicts will arise that could severely inhibit the potential positive impact of Engineering Education Quality Assurance as it spreads around the world.

3.2.1 Bologna Process

The Bologna Process is a series of ministerial meetings and agreements between European countries designed to ensure comparability in the standards and quality of higher education qualifications. Through the Bologna Accords, the process has created the European Higher Education Area, in particular under the Lisbon Recognition Convention. It is named after the place it was proposed, the University of Bologna, with the signing of the Bologna declaration by Education Ministers from 29 European countries in 1999, forming a part of European integration. The BP/EHEA activities cover all higher education programmes at the undergraduate (BS) and graduate (MS) levels. Engineering education, as a subset of the higher education, will have to meet or surpass the overall BP/EH expectations at the BS and MS levels. All BP/EHEA signatories have to work on a continuous basis in order to minimize or eliminate significant differences in programmes and accreditation processes.

Within the larger Bologna process, the standards and guidelines for Quality Assurance in higher education have been developed by the European Association for Quality Assurance in Higher Education (ENQA 2007). However, there is still considerable variation in accreditation standards and practices across Europe and Russia.

3.2.2 Washington Accord

The Washington Accord is an international accreditation agreement for professional engineering academic degrees, between the bodies responsible for accreditation in its signatory countries. Established in 1989. The Washington Accord covers undergraduate engineering degrees under Outcome-based education approach. Engineering technology and postgraduate programs are not covered by the accord. Only qualifications awarded after the signatory country or region became part of the Washington Accord are recognized. The accord is not directly responsible for the licensing of Professional Engineers and the registration Chartered Engineers, but it does cover the academic requirements that are part of the licensing processes in signatory countries. The number of signatory countries and potential member countries as there in 2014 is 17 and 5 respectively.

The major concerns regarding accreditation in Asia-Pacific higher education systems are inconsistency from country to country, lack of mutual recognition, and slow rate of development and implementation. While countries like Australia and New Zealand have quite well-developed QA systems, only recently other countries in this part of the world have taken steps to establish QA schemes comparable to those just described. For example, within the last few years the Japan Accreditation Board of Engineering Education (JABEE), the Accreditation Board for Engineering Education of Korea (ABEEK), Institute of Engineering Education Taiwan (IEET), the Institute of Engineers, Singapore and Myanmar Engineering Council (M.Eng.C) joined the Washington Accord group.

Table (3.1): Comparison Between Washington Accord and Bologna Process

	Washington Accord	Bologna Process
No. of Countries	17	47
Signatories	Professional Associations	Governments (Minister of Education)
Accreditation	National Criteria of WA countries	National Criteria until EHEA criteria are developed
Programme Levels Covered	BS level only	Through MS level to account for various combinations of *short* and *long* BS and MS programmes
Recognition of Degrees	National Criteria	National Criteria plus Diploma Supplement until EHEA criteria are fully developed

Source: Charlie Than (2015)

3.2.3 Myanmar Engineering Council (M.Eng.C)

The Myanmar Engineering Council (M.Eng.C)is a non-governmental, legally Incorporated, uncontested accreditation agency. It registers graduates and professional engineers under the Myanmar Engineering Council Law in November, 2013. The pre-requisite for registration as a graduate engineer is a qualification in engineering recognized by the Council. There has been an increasing need and demand for accreditation of educational programmes in engineering due to the growing number of students seeking assurance on the standards of programmes being offered by Institutions of Higher Learning (IHL)and the emergence of more IHLs providing education in engineering. Myanmar has been approved of provisional status in Washington Accord at International Engineering Alliance Meetings 2019 in Hong Kong dated on 12th June 2019.

The Engineering Education Accreditation Committee (EEAC) was delegated by the M.Eng.C (Myanmar Engineering Council) to be the body for accreditation of engineering programmes. It is a non-governmental organization and has the support of stakeholders in the engineering profession.

M.Eng.C has a duty to ensure that the quality of engineering education/ programme of its registered engineers attains the minimum standard comparable to global practice.

Myanmar Engineer Council plays an important role to move forward the Myanmar engineering education to outcome-based quality education. The objectives of M.Eng.C are as follows:

i. To ensure that Engineers hold the safety, health, integrity, honor, and dignity of the engineering profession by using their knowledge and skill for the enhancement of human welfare
ii. To develop the Engineering Education in Myanmar and maintain the internationally recognized standards of professional competence and ethics that govern the award and retention of professional titles
iii. To develop the Engineering Education to attain the ASEAN standard, FEIAP standard, and the constitution of Signatory status in Washington Accord

3.3 Qualifying Requirements and Accreditation Criteria

An engineering programme shall be assessed by EEAC to enable graduates of the programme to register as graduate engineers with the MEngC. The assessment involves a review of qualifying requirements of the IHLs and an evaluation based on the following criteria.

Criterion 1 - Programme Educational Objectives (PEOs)

Criterion 2 - Graduate Attributes (GAs)

Criterion 3 - Academic Curriculum

Criterion 4 - Students

Criterion 5 - Academic and Support Staff

Criterion 6 - Facilities

Criterion 7 - Quality Management Systems

Due to the limited scope of the study, the author would focus the criterion 2 – Graduate Attributes in this chapter and discuss the role of humanity and social sciences among many technical subjects.

3.3.1 Graduate Attributes (GA) and Knowledge Profile

According to EEAC Manual, the curriculum shall encompass the knowledge profile as summarized in the table below:

A programme that builds this type of knowledge and develops the attributes listed below is typically achieved in 4 to 5 years of study, depending on the level of students at entry.

Graduate attributes are the qualities, skills and understandings a university community agrees its students should develop during their time with the institution. Graduate Attributes describe what students are expected to know and be able to perform or attain by the time of graduation. These relate to the skills, knowledge, and behavior that students acquire through the programme.

Table (3. 2): Knowledge Profiles Mapping in Engineering Curriculums

No.	Knowledge Profile
WK1	A systematic, theory-based understanding of the **natural sciences** applicable to the discipline.
WK2	Conceptually-based **mathematics**, numerical analysis, statistics and formal aspects of computer and information science to support analysis and modelling applicable to the discipline.
WK3	A systematic, theory-based formulation of **engineering fundamentals** required in the engineering discipline.
WK4	Engineering **specialist knowledge** that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.
WK5	Knowledge that supports **engineering design** in a practice area.
WK6	Knowledge of **engineering practice** (technology) in the practice areas in the engineering discipline.
WK7	**Comprehension of** the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the professional responsibility of an engineer to public safety; the impacts of engineering activity: economic, social, cultural, environmental and sustainability.
WK8	Engagement with selected knowledge in the **research literature** of the discipline.

Source: (*Engineering Programme Accreditation Manual, Policy, Procedure, Guidelines*, 2018)

Students of an engineering programme are expected to attain the following GAs:

(a) Engineering Knowledge - Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to the solution of complex engineering problems;

(b) Problem Analysis - Identify, formulate, conduct research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences (WK1 to WK4);

(c) 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 (WK5);

(d) Investigation – Conduct investigation of complex engineering problems using research-based knowledge (WK8) and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions;

(e) Modern Tool Usage - Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering problems, with an understanding of the limitations (WK6);

(f) 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 engineering problems (WK7);

(g) Environment and Sustainability - Understand and evaluate the sustainability and impact of professional engineering work in the solutions of complex engineering problems in societal and environmental contexts. (WK7);

(h) Ethics - Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice (WK7);

(i) Individual and Team Work - Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings;

(j) 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;

(k) Project Management and Finance - 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 in multidisciplinary environments;

(l) Life Long Learning - Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

When we overview and distinguish graduate attributes into four groups, it goes as following:

To meet the criteria and achieving the listed goals and outcomes clearly depends upon a fundamental and thorough interaction of technical coursework with classes in the HSS and with experiential learning. Specifically, the criteria identify intellectual skills needed by engineering graduates that are related to the study of HSS subjects and that cannot be achieved through math, basic science, engineering science, and engineering design courses before Myanmar Engineer Council law was published in the history of engineering education. The HSS are most obviously essential to achieving the following outcomes:

(f) The Engineer and Society

(g) Environment and Sustainability

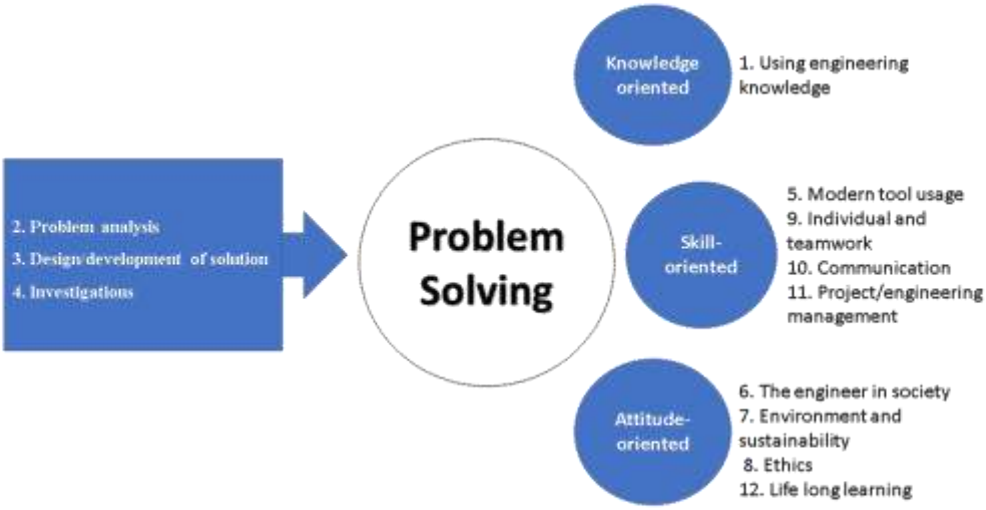
(h) Ethics

(j) Communication

(i) Individual and Team Work

Although the HSS contribute most obviously to the criteria outlined above, they can also contribute in less obvious but still important ways to the achievement of the other outcomes. Specifically, the HSS provide intellectual foundations and specific skills that contribute to the ability to function on multidisciplinary teams (Criterion j) and a recognition of the need for, and an ability to engage in, lifelong learning (Criterion l). Critical thinking skills and knowledge of technology and culture and intellectual and cultural perspectives are definite assets in sophisticated thinking about the processes of problem definition and systems design (Criterion c).

Figure (3.2): Overview of Graduate Attributes



Source: Charlie Than(2020)

3.3.2 Undergraduate Academic Curriculum

The academic curriculum and curricular design shall strongly reflect the philosophy and approach adopted in the programme structure, and the choice of the teaching-learning (delivery) and assessment methods. The curricular approach, the educational content and the teaching-learning and assessment methods shall be appropriate to, consistent with, and support the attainment or achievement of the GAs. A balanced curriculum shall include all technical and non-technical attributes listed in the GAs, and there shall be a balance between the essential elements forming the core of the programme and additional specialist or optional studies (electives) (*Engineering Programme Accreditation Manual, Policy, Procedure, Guidelines*, 2018).

The engineering curriculum includes:

(1) Lectures on natural and mathematical sciences, computer science, engineering principles, engineering analysis and design, professional engineering practice, humanities and social science including ethics, management, business and economics

(2) Tutorial classes

(3) Laboratory work

(4) Projects (individual and group work)

(5) Industrial training [vacation time in year (2) to year (5) – 4 weeks per year]

(6) Internship (final year – first semester – 8 weeks continuously)

(7) Mini-thesis (final year – first and second semesters – 6 months)

(8) General Viva Voce (final year – second semester)

3.3.3 Credit Unit Requirements for HSS in B.E. Curricula

The academic programme component must consist of a minimum total 135 credits (not including credits for remedial courses) based on a 14-weeks of teaching semester, made up as follows:

i. A minimum of 90 credits shall be engineering courses consisting of engineering sciences and engineering design/projects appropriate to the student's field of study.

ii. The remaining SLT credits shall include sufficient content of general education component (such as mathematics, computing, languages, general studies, co-curriculum, management, law, accountancy, economics, social sciences, etc.) that complements the technical contents of the curriculum.

One credit hour is defined as:

i. One hour per week of lecture (50 minutes + 10 minutes break) with at least one hour of independent study per week for each lecture hour

ii. Two hours per week of laboratory work or workshop practices

iii. Two hours per week of supervised and compulsory tutorial sessions

Table (3.3): Breakdown of Credit Units (CU)

Sr.	Name of Engineering Degree	CU for Core Engg. Subjects	CU for Maths & Sciences	CU for H & SS	Total CU
1	B.E (Civil)	136.0	60.0	31	227.0
2	B.E (Mech)	116.5	60.0	31	207.5
3	B.E (EP)	131.0	60.0	29	220.0
4	B.E (EC)	136.0	60.0	31	227.0
5	B.E (CEIT)	136.0	60.0	28.5	224.5
6	B.E (Mce)	139.0	60.0	33	232.0
7	B.E (Chemical)	117.5	79.5	31	228.0
8	B.E (Tex)	128.0	67.0	34.5	229.5
9	B.E (Mining)	133.5	60.0	38	231.5
10	B.E (Pet)	109.5	60.0	33	202.5
11	B.E (Met)	124.5	71.0	31	226.5
Mean		127.95	63.41	31.91	223.27
Percentage CU		57.31%	28.40%	14.29%	100%

Source: Nyi Hla Nge (2017)

At present, 155 credit units (credit hours) or more is required for the B.E. / B. Arch. degree, without counting the first year (the foundation year), or 200 credit units (credit hours) or more for all six years. Humanities and Social Sciences accounts for 30 credit units or more, in addition to 60 credit units or more for Maths and natural sciences. Engineering courses alone account for 110 credit units or more in the current curriculum for six years.

3.4 Outcome-based Education with HSS Studies

Under HSS discipline, six subjects are mainly conducted in the technological universities. These are as follows:

1. Engineering Ethics
2. Engineering Communication
3. Environmental Science
4. International Relation
5. Health and Safety
6. Engineering Management

When considering the role of HSS in engineering education, twelve graduate outcomes of a graduate engineer are vital and accreditation process is also important. Myanmar Engineer Council is acting as the regulatory body in the accreditation process and it is now attempting to steer the current engineering education to be outcome-based education (OBE) system.

OBE is an educational philosophy that states education ought to aim at giving students a particular, minimum level of knowledge and abilities as the major educational outcomes. Also, OBE is an educational process that involves assessment and evaluation practices to reflect the attainment of certain specified outcomes (or attributes) in terms of individual student learning. Once having decided what are the key attributes or outcomes students should be able to do and master, both course structures and curricula are designed to achieve those outcomes. OBE focuses on what students can actually do after they are taught with the following key questions:

i. What do we want the students to learn or be able to do? (Outcomes and Motivation)
ii. How best can we help students to learn or achieve it? (Delivery and Resources)

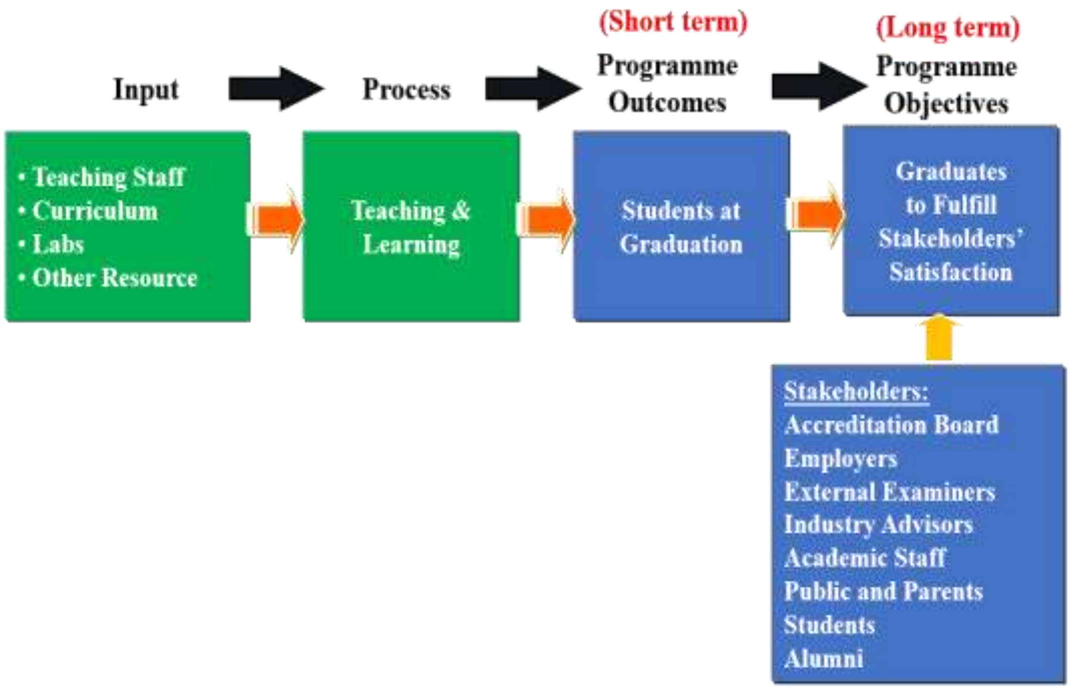
iii. How will we know whether the students have learnt or achieved it? (Assessment and Evaluation)

iv. How do we close the loop for further improvement? (Continuous Quality Improvement (CQI))

OBE can develop an engineer as a lifelong learner, a knowledgeable person with deep understanding, complex thinker, creative person, active investigator, effective communicator, participant in an interdependent world, reflective and self-directed learner.

According to figure (5.1), OBE can foster shifting from measuring input and process to include measuring the output (outcome).

Figure (3.3): Outcome-Based Education System

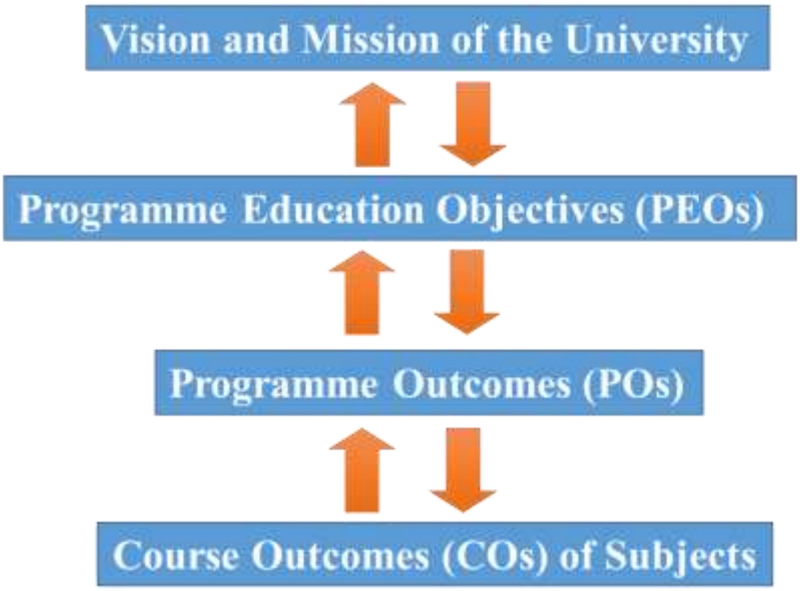


Source: Charlie Than (2020)

This OBE approach also commits the all-inclusive policy recommendation of national education strategic plan for education (2016-2021). Not only teachers and learners but also accreditation board, employers, external examiners, industry advisors, academic staff, public and parents, and alumni should also be included as stakeholders in outcome-based education while teaching humanities and social sciences.

In the model hierarchy of OBE, the vision and mission of university should be stated first and then programme education objectives (PEOs), programme outcomes (POs) and course outcomes (COs) should be clearly defined in order.

Figure (3.4): Model Hierarchy of OBE



Source: (*Engineering Programme Accreditation Manual, Policy, Procedure, Guidelines*, 2018)

The characteristics of OBE curricula are as follows:

i. It has programme education objectives (PEOs), programme outcomes (POs), course learning outcomes or unit learning outcome (ULO) and performance indicators

ii. It is objective and outcome driven, where every stated objective and outcomes can be assessed and evaluated

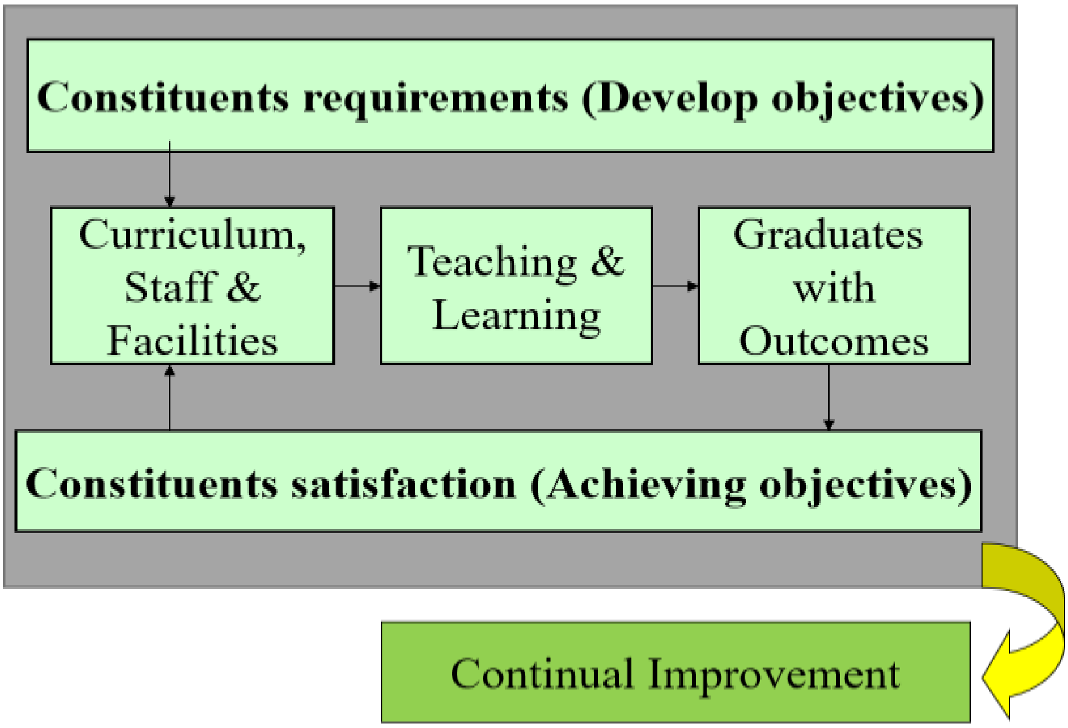
iii. It is centered around the needs of the students and the stakeholders (example: Internal: teacher, student and university; External: employer, alumni, Regulatory body)

iv. Every learning outcome is intentional_and therefore the outcomes must be assessed using suitable performance indicators.

v. Every learning outcome is intentional and therefore the outcomes must be assessed using suitable performance indicators.

vi. Every learning outcome is intentional and therefore the outcomes must be assessed using suitable performance indicators.

Figure (3.5): Continual Quality Improvement (CQI) in OBE



Source: Charlie Than (2020)

According to figure (5.3), the essential facts to gain the success of outcome-based education are in the following:

i. The desired outcomes are determined first with the curriculum, instructional materials and assessments designed around to support and facilitate the intended outcomes.

ii. All curriculum and teaching decisions are made based on how best to facilitate achievement of the desired final outcomes

iii. The student's achievement is based on demonstrable measurables

iv. Multiple instructional and assessment strategies need to be utilized to meet the needs of each and every student

v. Adequate time and needed assistance are to be provided so that each student can reach the maximum potential

The core concept of CQI is to say as the institutions want, to do as they say, to prove the quality and outcomes as their visions and missions and to make continuous improvement. In other words, it can be said as PDCA (Plan, Do, Check, Action) cycle for quality assurance education system.

Figure (3.6): Essential Components of OBE

Source: (Charlie Than, 2020)

According to figure (5.3), the essential components of OBE are considered to add while planning to teach courses. The essential components are as follows:

i. Effective Programme Education Objectives (PEOs)
ii. Effective Programme Outcomes (POs)
iii. Well Defined and Aligned Course Outcomes (COs)
iv. Practical Assessment Tools
v. Effective Assessment Planning and Execution
vi. Robust Evaluation Planning and Execution
vii. Continuous Quality Improvement (CQI) procedures and actions

CHAPTER IV
ANALYSIS ON THE PERCEPTIONS OF ENGINEERING STUDENTS AND TEACHERS

4.1 Survey Profile

This chapter will reveal the results of analysis on the collected data. As the main objective of the research is to obtain the perceptions of engineering students on humanity and social science subjects integrating to the engineering education, the primary data is collected through the semi structure questionnaires with interview to undergraduate and graduate students. The study has been done through the discussions with small groups of engineering students to examine, in detail, how they think and feel about the humanity and social science subjects. Each focus group is composed of 6 to 12 participants who are purposively selected and they provide the kind of information of interest to the author. The questionnaires consist of three sections for students: Section-1(Knowledge), Section-2(Skills) and Section-3(General competencies/Attitude) and one section for teachers: Section-1 (Teaching Objectives in HSS courses).

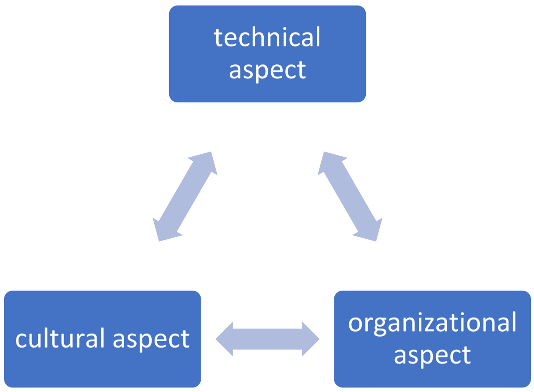
The ultimate goal of this study is to help find the role of HSS studies in the techno-centric engineering courses. There are currently 33 technological universities and Myanmar Engineering Council has enforced to gain the outcome-based education in all universities. This study made the analysis on the opinions and survey answers of engineering students and teachers from technological universities. After thorough empirical research, the author intends to make some recommendations and suggestions to improve and deliver quality tertiary technology education.

This study focused on the current status and situation of Myanmar Engineering Education System while merging traditional techno-centric curriculums to HSS courses, improving the qualifications of Myanmar Engineers who are competent in their professional skills and who can think globally and act locally while considering the society, sustainable development and economic impacts from engineering designs.

In the context of this study, questionnaires are developed based on Arnold Pacey’s concept of technology practice as an integrative framework that is useful for thinking about the ways that heterogeneous elements and different forms of knowledge are integrated in engineering practice. This framework allows engineers to think in terms of the interactions of a given technical component with other aspects of the larger system required for successful implementation of new technology.

In The Culture of Technology (Pacey, 1983), Arnold Pacey presents an analytical framework that focuses on the heterogeneous elements that make up any particular set of technology-related practices. This framework both recognizes the complexity and diversity of inherent in all technological systems and makes that complexity and diversity manageable by categorizing the elements according to three distinct but related aspects: technical, organizational, and cultural. The relationships among the three aspects are represented schematically below.

Figure (4.1): The Elements of Any Set of Technology-Related Practice



Source: (Pacey. 1983)

Firstly, the technical aspect, which is primarily tangible, includes tools, machines, natural resources (including live ware), products and waste by-products, along with the knowledge, skill, and technique pertinent to using or transforming materials. Knowledge and skills that are pertinent to the technical aspect are developed through instruction in mathematics, the basic sciences, the engineering sciences, and engineering design (MSES/D) subjects.

Secondly, the organizational aspect, which is primarily institutional, includes business and government, unions, professional societies, schools and universities, and other institutions designed to accomplish tasks. An understanding of the organizational aspect is developed through the HSS, typically with a stronger contribution from the social sciences, including elements such as organizational behavior, although the humanities also make a significant contribution.

Thirdly, cultural aspect consists primarily of widely held beliefs that affect the development, use, and misuse of technologies. Examples include perceptions about technology and progress or the level of acceptable risks in technologies, or the appropriate motives for innovation. The cultural aspect includes values, goals, ethical codes, assumptions, perceptions, symbols, images, aesthetics, and worldview. The humanities have the largest role to play in developing an understanding of the cultural aspect, but the social sciences also have a strong contribution to make.

4.2 Characteristics of Respondents and Survey Design

Non-technical components, HSS courses, are integrated to the engineering curriculum in 2017. In Myanmar, Myanmar Engineering Council (MEngC) presently requires to take a minimum of 135 credits of which 90 credits must be engineering courses so that the remaining SLT credits shall include sufficient content of general education component (such as mathematics, computing, languages, general studies, co-curriculum, management, law, accountancy, economics, social sciences, etc.) that complements the technical contents of the curriculum. In this setting the current research work has made an attempt to study the actual perceptions of engineering students on HSS courses.

Among total population of engineering students 6680, 125 engineering students are randomly selected to answer the online survey questions and interviewed through virtual meetings. The sample size calculation is based on 95% confidence level because teachers and administrators from technological universities helped send the survey forms to their students who are studying HSS courses in the undergraduate level and some are recently graduated. At the same time, the margin of error is 8.7% in this study.

Table (4.1): Demographic Characteristics of Respondents

No.	Particular	No. of Respondents		
		Categories	Frequency	Percentage (%)
1	Level	Graduated	40	32
		Undergraduate	85	68
2	Gender	Male	61	48.8
		Female	64	51.2
3	Discipline	Civil	42	33.6
		EC	58	46.4
		EP	11	8.8
		Mechanical	14	11.2

Survey Data (2020)

Table (4.1) indicates that 85 (68%) engineering students are undergraduate and 40 (32%) are graduated. Out of 125 students, 61(48.8%) are male students and 64 (51.2%) are female. According to the limitation of the study, only four disciplines including Civil, EC, EP and Mechanical majors are selected to be focused.

In the teaching side of HSS studies, eighteen teachers from West Yangon Technological University (WYTU), University of Technology (Yatanarpon Cyber City), Technological University (Taunggyi) and Technological University (Mawlamyine) who are currently teaching humanity and social science subjects help this study to find the perceptions and current issues and challenges of teaching HSS in technological universities.

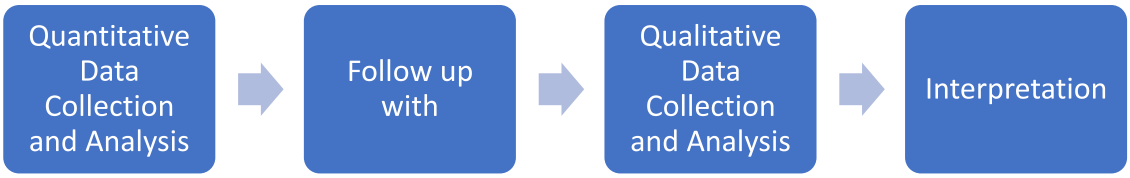
The objectives of deploying these surveys are to get clearly understanding of the role of humanities and social science studies in engineering education, to observe the perceptions and expectations of engineering students and teachers in technological universities (TU) and to understand the students' satisfaction level on the humanity and social science courses while integration to the engineering education.

Furthermore, the research used the explanatory design since the research problems are quantitatively oriented and the participants are also available for second data collection. Quantitative component can make the qualitative approach more acceptable to quantitative-biased audiences. The data collection for two phases are conducted in November and December, 2020. Another reason for using this design is that new questions emerged from quantitative results.

During the study the data collection has been done only through online survey forms and online focus group interviews for both engineering students and teachers who are responsible for teaching HSS Studies In addition, the questionnaires were developed based on the twelve graduate attributes and three major domains (attitude, skill and knowledge). Then the questionnaires were uploaded to google form and distributed to engineering students and teachers through emails.

The questionnaires are designed to answer comfortably and finish within five to ten minutes for students and five minutes for teachers. The Likert scales in questionnaires were used to find the quantitative results with mean scores. As a matter of data security, the announcements are made in advance before taking the surveys and focus group surveys to remind the participants that their opinions are secure. In surveys and interviews, all the questions are linked to the twelve graduate outcomes and three domains (knowledge, skills and attitudes) and close with open-ended questions asking for any additional ideas from students and teachers. The surveys avoid loaded or leading words or questions to receive the actual responses from participants. Moreover, the questionnaires for students are translated to Burmese language to head off the confused and unfamiliar words within questionnaires.

Figure (4.2): The Explanatory Sequential Design



4.3 Survey Analysis on Engineering Students

First of all, the students were questioned regarding to knowledge of professional rules and interactions. According to the table (4.2), 88(71%) students agreed that they are familiar with health, environment and safety (HES) as a basis for a good work environment. Other 30 (24%) students answered they neither agree nor disagree. Only seven (6%) students said that they are not familiar with HES. It is important to again awareness and familiarizations that human, environmental and other ethical considerations are essential in the development and implementation of new technology. One aspect of this awareness is that recognition of the influence of socio-humanistic considerations on technology-related decisions made by engineering designers, managers of technology-based enterprises, and various branches and agents of government. As former CEO and chairman of Martin Marietta Norman Augustine expressed it, 'many of the greatest challenges for engineers today come from non-engineering sources. That's why I choose to call today's age the "Socio-engineering Age."'("Graduating Engineer," January, 1995).

4.3.1 Survey Analysis on Knowledge of Engineering Students

(i) Knowledge of Professional Rules and Interactions

Like many other professionals, engineers appear in the chain of causalities leading to global problems. They also belong to the groups from which remedies for these problems are expected. Yet – and again this may be compared to other professionals – when practically dealing with their immediate stakeholders (such as clients, employers, authorities), this knowledge often remains unmentioned or hidden.

Table (4. 2): Knowledge of Professional Rules and Interactions (n=125)

Particular	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Health, Environment, and Safety (HES)	0 (0%)	7 (6%)	30 (24%)	31 (25%)	57 (46%)	4.10
Relevant rules and agreements	1 (1%)	10 (8%)	30 (24%)	44 (35%)	40 (32%)	3.90

Source: Survey Data (2020)

According to the table (4.2), 88(71%) students agreed that they are familiar with health, environment and safety (HES) as a basis for a good work environment. Other 30 (24%) students answered they neither agree nor disagree. Only seven (6%) students said that they are not familiar with HES. It is important to again awareness and familiarizations that human, environmental and other ethical considerations are essential in the development and implementation of new technology. One aspect of this awareness is that recognition of the influence of socio-humanistic considerations on technology-related decisions made by engineering designers, managers of technology-based enterprises, and various branches and agents of government. As former CEO and chairman of Martin Marietta Norman Augustine expressed it, ‘many of the greatest challenges for engineers today come from non-engineering sources. That’s why I choose to call today’s age the “Socio-engineering Age.”’("Graduating Engineer," January, 1995).

As stated in table (4.2), 84(67%) students accepted that they have knowledge of relevant rules and agreements and the intentions behind these; this also includes employee and employer rights and duties. Other 30(24%) students mentioned ‘neither agree nor disagree’ and 11(9%) students said that they did not have this knowledge after they learnt humanity and social science subjects.

By looking at the means of two questions, HSS subjects prepared them to gain the enough knowledge for health, environment and safety as well as relevant rules and regulations. Creating a sustainable development that provides a safe, secure, healthy life for all peoples is a priority for the Myanmar engineering community. Since most of TU students have this knowledge, it is important that Myanmar engineering education must increase its focus on sharing and disseminating information, knowledge and technology that provides access to minerals, materials, energy, water, food and public health while addressing basic human needs. Engineers must deliver solutions that are technically viable, commercially feasible and, environmentally and socially sustainable.

(ii) Basic Knowledge of Business Organization, Value Creation, Productivity, and Profitability

As many other professions, technical knowledge alone is not enough and it goes far more into building a successful engineering career. They also need business skills that also needs to be considered; as engineers advance to more higher management positions, they will gain more responsibilities, which could be in the form of managing projects, teams and budgets. In order to both reach these more senior positions and ensure that they are able to perform their duties effectively, engineers need to demonstrate a strong set of business skills. As an engineer moves up the career ladder, it is not unusual for them to use fewer engineering skills and more business skills.

Table(4.3): Basic Knowledge of Business Organization, Value Creation, Productivity, and Profitability (N=125)

Particular	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Familiarity with how businesses are organized	5 (4%)	22 (18%)	55 (44%)	23 (18%)	20 (16%)	3.25
Basic management theory	10 (8%)	22 (18%)	48 (38%)	23 (18%)	22 (18%)	3.2
Familiarity with the way businesses create value in terms of their stakeholders	6 (5%)	18 (14%)	42 (34%)	33 (26%)	26 (21%)	3.44
Familiarity with the different definitions of profitability from business economic and social economic perspectives	19 (15%)	24 (19%)	50 (40%)	21 (17%)	11 (9%)	2.85
Market analyses and how a market's need for products and services	14 (11%)	17 (14%)	45 (36%)	32 (26%)	17 (14%)	3.17

Source: Survey Data (2020)

According to table (4.3), most of the students are ambiguous since 55(44%) in the familiarity with how businesses are organized, 48(38%)students in the survey question about basic management theory, 42(34%) for familiarity with the way businesses create value in terms of their stakeholders, 50(40%) in familiarity with the different definitions of profitability from business economic and social economic perspectives and 45(36%) for market analyses and how a market's need for products and services chose "neutral" which means neither agree nor disagree. 27(20%) students are not familiar with how businesses are organize. 32(26%) students replied that they do not have knowledge of basic management theory. 24 (19%) students are not familiar with the way businesses create value in terms of their stakeholders – focusing particularly on employers. 43(34%) students are not very familiar with the different definitions of profitability from business economic and social economic perspectives. 31(25%) students responded that they have not knowledge of market analyses and how a market's need for products and services affect demand, prices, income, and profitability.said that they did not have enough knowledge regarding to business and economics. Remaining students agreed that they can absorb these knowledge during their schooltime.

In the focus group interview, the author asked the interviewees about the curriculum and department of teaching business and economics. One of the things the study found out is that the curriculum is not uniform in all technological universities. Some of the universities use the curriculum published by Moat Oo education and some use the other ones differently. And all the technological universites in Myanmar cannot be facilitate their own HSS departments. Even in the C.O.E universities like YTU and MTU, they are still planning to have humanities and social science department only. That is why faculties teaching engineering subjects have to deliver the lectures to students even though they are not subject matter experts.

By looking at the means of questions stated in Table (4.3), engineering students are satisfied to gain the knowledge of familiarity with how businesses are organized, business management theory, familiarity with the way businesses create value in terms of their stakeholders, and market analyses and how a market's need for products and services. However, mean score (2.85) mentioned that HSS subjects should be prepared more to provide the enough knowledge regarding to business familiarity with the different definitions of profitability from business economic and social economic perspectives.

(iii) Basic Knowledge of Business Economics

Engineers often work together with professionals from entirely different areas. Therefore, it is important for the engineers to understand enough of these other areas, where technology is used, to obtain good results. Engineering economics is a field that addresses the dynamic environment of economic calculations and principles through the prism of engineering. It is a fundamental skill that all successful engineering firms employ in order to retain competitive advantage and market share. Many technological universities across the world have integrated courses in engineering economics for their students, thereby providing them with the tools to optimize profits, minimize costs, analyze various scenarios, forecast fluctuations in business cycles, and more.

Table (4. 4): Basic Knowledge of Business Economics (N=125)

Particular	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Business economics	14 (11%)	28 (22%)	45 (36%)	20 (16%)	18 (14%)	3.00

Source: Survey Data (2020)

From the survey results in table (4.4), 45(36%) students neither agree nor disagree that they have knowledge about business economics and 42(33%) answered the denial of acquiring this knowledge. Only 38(30%) students chose 'agree and strongly agree' options. During three focus group interviews, students from Hmawbi, Myitkyina, and WYTU engineering students mentioned that there is no specific curriculum to learn engineering economics until the final year is over. Only students from Thanlyin technological university students said that they have got the chance to learn microeconomics and macroeconomics in one semester at final year. However, the teachers are from the engineering departments and pedagogies, explanations, and lecture preparations are vulnerable to meet the expectations of engineering students.

Despite the importance of this field, technological universities in Myanmar are unable to effectively teach economic concepts to engineering students in ways they are able to understand because of the mean (3.0) expressed in Table (4.4). By promoting a more engaging and holistic learning approach, students can have the opportunity to become the engineers who understand the most important areas in business economics: preparation and analysis of financing, cost calculation and pricing, basic methods of business economic analysis, and profitability assessments of investments.

(iv) Knowledge of Innovative Processes and Entrepreneurship

Engineering has meant the transformation of "inventions" into "innovations" by means of what is customarily thought of as an evolutionary process (e.g. Basalla, 1988). Unlike Darwinian evolution, however, innovation is a process of not so natural, that is to say, artificial selection; and the interesting questions in relation to engineering contexts thus revolve around where the selection takes place, who is doing the selecting, and for what reasons.

Technology has shifted the societal framework by lengthening our life spans, enabling people to communicate in ways unimaginable in the past, and creating wealth and economic growth by bringing the virtues of innovation and enhanced functionality to the economy in ever-shorter product development cycles. Even more remarkable opportunities are fast approaching through new developments in nanotechnology, logistics, biotechnology, and high-performance computing. At the same time, with tightening global linkages, new challenges and opportunities are emerging as a consequence of rapidly improving technological capabilities in such nations as India and China and the threat of terrorism around the world.

Table (4.5): Knowledge of Innovative Processes and Entrepreneurship (N=125)

Particular	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Innovation and innovative processes	13 (10%)	24 (19%)	47 (38%)	30 (24%)	11 (9%)	3.02
Correlation between development and improvement	6 (5%)	12 (10%)	36 (29%)	41 (33%)	30 (24%)	3.62
Basic knowledge of entrepreneurship	16 (13%)	23 (18%)	53 (42%)	20 (16%)	13 (10%)	2.93

Source: Survey Data (2020)

The survey results in table (4.5) presents about the knowledge of innovations and innovative processes. 41(32%) students replied ‘agree’ whereas the rest are not sure and disagree on that. In the question 10, 71(57%) students understand the correlation between development and improvement of technical products and services, and organizational changes, management forms, and professional collaboration while others are ambiguous and disagree. In the next question, only 33 (26%) students agreed that they have basic knowledge of entrepreneurship in existing and established businesses and recognizes organizational and project structures that stimulate innovation and entrepreneurship. By looking at the mean values (3.02 and 3.62) about innovation and correlation between development and improvement, students are willing to know these knowledge. In the area of entrepreneurship, students are not satisfied the current level of teaching so that teachers and curriculum design team should consider to reinforce the current curriculums regarding to entrepreneurial knowledge.

In South East Asia, Myanmar is still a developing country and needs to cope with the development of other countries which are going in the galloping speed and it must prepare for the new wave of change. Needless to say, innovation is the key and engineering is essential to this task; but engineering will only contribute to success if it is able to continue to adapt to new trends and educate the next generation of students so as to arm them with the tools needed for the world as it will be, not as it is today. Most of the students in the focus group interview pointed out that the lectures should have been more practical and reveal the real-world situations.

(v) Knowledge about Establishing and Executing Projects

As the study addressed in chapter 3, project management and finance are one of the graduate attributes or outcomes. Society expects a lot from engineers. They are expected to have a strong scientific background; competent technical skills; a sharp awareness of the social concerns linked with their profession roles; a deep appreciation for safety and security; an ethical sense and appropriate behavior; an openness to other cultures; a willingness to be both geographically and professionally mobile; adequate project management and finance skills too.

Project management, finance, risk and change are the essential management actions in support of engineering activity. In Washington accord, engineers must have a knowledge and understanding of management and business practices, such as risk and change management, and understand their limitations.

Table (4.6): Knowledge about Establishing and Executing Projects (N=125)

Particular	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Managing, organizing, and leading project work	7 (6%)	16 (13%)	44 (35%)	38 (30%)	20 (16%)	3.38
Knowledge of the entire process	5 (4%)	22 (18%)	45 (36%)	34 (27%)	19 (15%)	3.32
Familiarity with different forms of team and different roles	7 (6%)	16 (13%)	54 (43%)	29 (23%)	19 (15%)	3.30
Knowledge of project finance	13 (10%)	27 (22%)	45 (36%)	28 (22%)	12 (10%)	2.99
Project management tools, reporting, and inter-group communication	9 (7%)	23 (18%)	44 (35%)	34 (27%)	15 (12%)	3.18

Source: Survey Data (2020)

According to the table (4.6) survey results, 58(46%) students agreed that they know how to manage, organize, and lead project work, 44(35%) are ambiguous and 22(19%) said that they cannot do these tasks after learning in humanity and social science classes. 53(42%) students have the knowledge of the entire engineering process, 45(36%) not sure and 27(22%) disagree. Then, 48(38%) students are confident that they have knowledge of how to cooperate with different forms of teams and what the challenges are. Other 54(43%) expressed ambiguous and 22(19%) students did not have confident. Moreover, 40(32%) students said that they have financial knowledge while 45(36%) are not sure and 40(32%) disagree. For the next survey result, 49(39%) students agreed that they have knowledge of project management tools, reporting, and inter-group communication (oral and written). However, 44(35%) students chose the response ‘neutral’ and 32(25%) said that they are not good at them. Regarding to the knowledge about establishing and executing projects, engineering students are partially confident so that implementations on teaching methods, curriculum and practical labs can make improvement to increase the level of understanding, applications and creativity on these knowledges. All the means except the one with the knowledge of project finance are above the average mean score (3.0) pointed out that students are satisfying to learn the knowledge about establishing and executing projects.

4.3.2 Survey Analysis on Skills of Engineering Students

(i) Skill to Access Profitability and Economic Risk

Efforts have been made around the globe to analyze the skill sets of modern engineering professionals. Modern engineers are expected to play more complex roles than the traditionally technical roles attributed to engineers. For example, modern engineers must be able to function as businessmen, to communicate effectively, and to possess social and environmental awareness. A successful and effective engineer in the modern workplace must possess a reasonably balanced set of both technical skills and professional skills. Engineering curricula must be able to keep up with the evolving requirements of modern engineering professionals in order to produce successful graduates.

A recent study in India emphasized the increasing importance placed on professional skills in the continued employment of modern engineers. The same study highlighted the responsibility of educational institutions in the development of these professional skills (Vyas & Chauhan, 2013). Similarly, a recent study in Australia found that employers demanded engineering graduates with improved business abilities, stronger communication skills, and more professional behavior. The study also suggested that these concerns could have been alleviated through the improvement of engineering curricula (Symes et al., 2013).

Table (4. 7): Skill to Access Profitability and Economic Risk (N=125)

Particular	Strongly Disagree	Disagree	Neutra l	Agree	Strongly Agree	Mean
Ability to read and interpret accounting data	20 (16%)	30 (24%)	51 (41%)	11 (9%)	13 (10%)	2.74
Ability to calculate cost and set prices	4 (3%)	17 (14%)	46 (37%)	33 (26%)	25 (20%)	3.46
Ability to use basic techniques in business economic analysis	19 (15%)	27 (22%)	52 (42%)	15 (12%)	12 (10%)	2.79
Ability to evaluate profitability and economic risk of investments	17 (14%)	30 (24%)	48 (38%)	17 (14%)	13 (10%)	2.83

Source: Survey Data (2020)

Regarding to table (4.7) survey results, 50(40%) students are not able to read and interpret accounting data. 51(41%) are not sure about this skill and 24(19%) students only choose the 'agree' and 'strongly agree' options. However, 58(46%) students said that they can calculate cost and set prices, 46(37%) are not sure and 21(17%) only disagree to the question. Continuously, 46(37%) students are not able to use basic techniques in business economic analysis, 52(42%) are ambiguous and only 27(22%) agree to the question. Then, the survey result in table (4.7) express that students are not able to evaluate profitability and economic risk of investments. 47(38%) students said that they do not have this skill, 48(38%) students chose the response of neutral, and 30(24%) agree to the question. According to table (4.7), the average mean scores except the ability to calculate costs and set prices are under 3.0 and it leads the educators to consider and emphasize at skills to access profitability and economic risk.

(ii) Skills of New Approaches, Innovation, and Entrepreneurship

In this study, historical debates in literature reviews and the role of HSS in engineering education have been discussed in Chapter (II) and the development of Myanmar engineering education system and the contribution of HSS were mentioned in Chapter (III). According to the twelve graduate attributes, engineers need to be trained to solve the complex issues occurring in the society and broadly emphasize the economic, organizational, and social contexts of engineering. Since Myanmar is still in the stage of developing countries, the role of engineers is essential in infrastructure development, product/design innovation and economic development. At the same time, the entrepreneurial mindset should be equipped in the early days of university time. As a matter of that, engineers will contribute their skills in projects and works which impact in the society and public directly or indirectly.

Table(4.8): Skills of New Approaches, Innovation, and Entrepreneurship (N=125)

Particular	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Master creative techniques and has an experimental attitude	0 (0%)	6 (5%)	38 (30%)	33 (26%)	48 (38%)	3.98
Ability to recognize economic, organizational, and social consequences	1 (1%)	9 (7%)	41 (33%)	34 (27%)	40 (32%)	3.82

Source: Survey Data (2020)

Regarding to being able to contribute to new approaches, innovation, and entrepreneurship through my participation in development and realization of sustainable and socially useful products, systems, and solutions, 81(61%) students are confident that they master creative techniques and have an experimental attitude so that they may contribute to innovative and entrepreneurial endeavors, 38(30%) ambiguous and remaining 6(5%) students disagree. For question 22, 74(59%) students agree that they are able to recognize economic, organizational, and social consequences when they develop technical solutions so that the technology becomes part of a sustainable and socially useful development, 41(33%) ambiguous and 10(8%) only disagree. The average mean scores above 3.0 for these two questions expressed that students are satisfied to learn skills of new approaches, innovation, and entrepreneurship at the current curriculums.

(iii) Communication and Teamwork Skills

Candidates should practice teamwork during their studies, as this is a typical way of working in engineering. Communication is a key concept and in today's global society, it is particularly important that engineers are able to communicate effectively orally and in writing, in Burmese and in English. Because of the increasing complexity and scale of systems-based engineering problems, there is a growing need to pursue collaborations. Regarding to being able to communicate orally and in writing about his/her discipline both with multidisciplinary teams of experts across multiple fields. Essential attributes for these teams include excellence in communication (with technical and public audiences), an ability to communicate using technology, and an understanding of the complexities associated with a global market and social context. Flexibility, receptiveness to change, and mutual respect are essential as well. For example, it already is found that engineers may come together in teams based on individual areas of expertise and disperse once a challenge has been addressed, only to regroup again differently to respond to a new challenge.

Table (4.9): Communication and Teamwork Skills (n=125)

Particular	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Oral and written communication, scientific writing, reporting and documentation	6 (5%)	14 (11%)	58 (46%)	34 (27%)	13 (10%)	3.27
Ability to express myself to peers in Burmese and English	3 (2%)	25 (20%)	49 (39%)	28 (22%)	20 (16%)	3.30
Ability to define goals and achievements	1 (1%)	10 (8%)	43 (34%)	45 (36%)	26 (21%)	3.68
Ability to collaborate and effectively communicate in groups	0 (0%)	5 (4%)	31 (25%)	45 (36%)	44 (35%)	4.02

Source: Survey Data (2020)

In the survey results in table (4.9) mentioning the skill at oral and written communication, scientific writing, reporting and documentation, 47(37%) students agreed, 58(46%) ambiguous and 47(37%) disagree. Then, 48(38%) students said that they are able to express myself to peers in Burmese and English, 49(39%) are not sure and 28(22%) responded 'disagree'. For question 25, 71(57%) students agreed that they are able to define goals and achievements while others 43(34%) are not sure and 11(9%) disagree. Moreover, 89(71%) students said that they are able to collaborate and effectively communicate in groups when they responded the survey question. 31(25%) students are not sure and 5(4%) students disagree. The average mean scores above 3.0 for these two questions expressed that students considered that they satisfied to learn skills of new approaches, innovation, and entrepreneurship at the current curriculums.

All students in the focus group survey viewed proficiency in these skills as essential to becoming an effective engineering professional. One group even saw soft skills as more important than technical ones (in particular, communication and individual and teamwork). In terms of their own experience of the curriculum, students felt that most of their exposure to the soft skill graduate attributes had come from their engineering courses and, in particular, from their participation in design project courses, but recognized the role of humanity and social science courses particularly in enhancing their communication skills, as well as their ability to write and speak to both technical and non-technical audiences.

Shared knowledge is a stipulation for development. Communicating knowledge to peers and others is important. Today's globalized world demands that communication typically occurs in a foreign language, through different channels, and with an understanding for other cultures. Communication tools may be oral, written, digital, and visual (reports, research articles, popular natural science articles, posters, featured articles, social media, computer tools, and other technological solutions/tools. Several businesses operate in an international market and use English as a working language.

Learning is a complex process. It entails not only what students know but what they can do with what they know; it involves not only knowledge and abilities but values, attitudes, and habits of mind that affect both academic success and performance beyond the classroom. In terms of attitudes and values, the authors propose that engineers be willing to participate, be concerned about environmental preservation, hold a commitment to quality and productivity, and be involved in service to others. According to these authors, engineers must make decisions that take into account "the social, ethical, and moral consequences of those decisions" (Rugarcia et al. 2000, p. 10).

4.3.3 Survey Analysis on Attitudes of Engineering Students

(i) Attitude on Professionals, Economic, Ethical, and Social Considerations

Humanity and Social Science courses are a helping profession; hence, it is necessary to understand the basic theory of how to help people. Learning how to help one person provides many ideas about how to help multiple people in a community. There are a range of challenges in community development (e.g., oppression), and perspectives on how to approach community development.

Table (4.10): Attitude on Economic, Ethical, and Social Considerations (N=125)

Particular	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Ability to use my experience from project work and project management	3 (2%)	5 (4%)	52 (42%)	47 (38%)	18 (14%)	3.58

Source: Survey Data (2020)

In table (4.10), regarding to being able to initiate smaller projects, and through proper management, conserve human, professional, economic, ethical, and social considerations, 65(52%) students claimed that they view the project as part of a unit and are able to use their experience from project work and project management to find comprehensive solutions whereas 52(42%) chose 'not sure' and 8(6%) said 'no'. The average mean, 3.58, also expressed that students can view the project as part of a unit and are able to use their experience from project work and project management to find comprehensive solutions.

Participatory community development is proposed as an approach that will help with many of the difficulties in humanitarian engineering, including identifying needs, getting the job done in a way that fits the community's desires, empowering people, promoting ownership, and making sure that there are people in place for technology operation and maintenance. Teamwork involving visitors and community members can be enhanced by following some basic principles (e.g., good and frequent communications). Effective project management can make a project run smoothly and help avoid the risks of failure.

(ii) Attitude on Interdisciplinary Correlation

Based on ABET 2000 criteria, engineering graduate outcomes emphasize on the attitude domain of engineering students too. Regarding to interdisciplinary correlation, engineers have to work together with other engineering disciplines and professional from different fields and levels. So, engineers should have the ability to identify and discuss the value system and working habits of other professional culture. And then, they need to find the opportunity to learn how to negotiate and find common ground between different ways of defining problems, value systems and working habits.

Table (4.11): Attitude on Economic, Ethical, and Social Considerations (n=125)

Particular	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Profession-wide understanding of the significance of technology and is able to include this in interdisciplinary work	2 (2%)	10 (8%)	46 (37%)	46 (37%)	21 (17%)	3.59

Source: Survey Data (2020)

Regarding to being able to recognize an interdisciplinary correlation between economics, management, ethics S, society, technology, and the environment, 67(54%) students responded that they have a profession-wide understanding of the significance of technology and is able to include this in interdisciplinary work. On the other hand, 46(37%) are ambiguous and 12(10%) chose ‘no’ option. The average mean, 3.59, mentioned that students have a profession-wide understanding of the significance of technology and are able to include this in interdisciplinary work. While certain basics of engineering will not change, the global economy and the way engineers will work will reflect an ongoing evolution that began to gain momentum a decade ago. The economy in which we will work will be strongly influenced by the global marketplace for engineering services, a growing need for interdisciplinary and system-based approaches, demands for customization, and an increasingly diverse talent pool.

(iii) Attitude on Cultural Competency

In Myanmar, there are many ethnic groups and different cultures in various regions. Additionally, Myanmar has located in the strategic geographical location between the two large countries, China and India and gain a tremendous opportunity to come billions of dollars for investment. Nation-wide projects for infrastructure development, logistics, urbanization, and rural development are necessary to help the country GDP and sustainable growth of the economy. As the study revealed that the practice-oriented engineering programmes are not enough to produce the well-rounded engineers who are competent in three domains; attitude, skill and knowledge. Although growth has been gained by building, designing and operating the physical properties, it is important not to compromise the environment, social values, community development and other cultural assets. So engineers should have the ability to identify and discuss how differences in cultural back grounds have bearings on problem definitions of both engineers and non-engineers.

Table (4.12): Attitude on Cultural Competency (n=125)

Particular	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
I am open to other cultures and dissimilarities, both nationally and internationally	0 (0%)	2 (2%)	18 (14%)	31 (25%)	74 (59%)	4.42
I have knowledge of the most important cultural differences engineers face in places that interact with Myanmar industry.	5 (4%)	14 (11%)	44 (35%)	36 (29%)	26 (21%)	3.51

Source: Survey Data (2020)

Regarding to comprehend the meaning of cultural competencies, most of Myanmar can be considered as open and liberal-minded people because 105 (84%) students answered the survey question that they are open to other cultures and dissimilarities, both nationally and internationally. Also, in the next question, 62 (50%) students claimed that they have knowledge of the most important cultural differences engineers face in places that interact with Myanmar industry. The average means, 4.42 and 3.51, pointed that Myanmar engineering students are open-minded people and they have no conflicts with dissimilarities, both national and internationally and they accept that they have knowledge of the most important cultural differences engineers have to face in places that interact with Myanmar industry.

4.4 Survey Analysis on HSS Teachers

In each and every market, there are two main factors to be considered and they are supply and demand. So, finding the perspectives of teachers (supply) and their teaching experiences in the HSS courses are also important when it comes to the supply of knowledge, skills and good attitude to the engineers in demand side. This also provided us with the dual perspective on the issue, both from the teachers as well as the student point of view.

In the previous sections, students' responses and discussions through focus group interviews are analyzed and revealed in details. In this section, to represent the group of teachers who are teaching humanity and social science courses, eight teachers from WYTU, Taunggyi TU and UTYCC are requested to take survey questions and allow the telephone conversations in order to find their perceptions and difficulties related to teaching of HSS courses. The questionnaires are separated into two parts, one for teaching objectives and one for contextual questions. Assessing learning in ways that are consistent with the learning objectives of a course and integrate is very important and stated course objectives with long-range curricular goals.

To align with the twelve graduate outcomes and to produce the good engineers who are responsible for their action, workplace, community and society, these subjects should have the very important objectives while teaching in the classrooms. The author attempted to find the teachers' attitudes by asking 16 questions on the objectives of teaching HSS subjects. There are three scales including minor importance (Scale 1), moderately importance (Scale 2), and essential (Scale 3).

Table (4.13): Perceptions of Teachers on HSS Studies (n=18)

Particular	Minor Importance	Moderate Importance	Essential	Mean
Gaining factual knowledge (terminology, classifications, methods, trends)	0 (0%)	11 (61%)	7 (39%)	2.4
Gaining an understanding of theories, fundamental concepts, or other important ideas.	0 (0%)	10 (56%)	8 (44%)	2.4
Learning to understand professional/ scholarly literature	2 (11%)	10 (56%)	6 (33%)	2.2
Learning to interpret primary texts or works.	2 (11%)	12 (67%)	4 (22%)	2.1
Developing skill in critical thinking	0 (0%)	5 (28%)	13 (72%)	2.7
Developing skill in problem-solving	0 (0%)	6 (33%)	12 (67%)	2.7
Developing skill in critical/analytical writing	1 (6%)	9 (50%)	8 (44%)	2.4
Developing creative capacities	0 (0%)	9 (50%)	9 (50%)	2.5
Learning techniques and methods for gaining new knowledge in this subject	0 (0%)	14 (78%)	4 (22%)	2.2
Developing the ability to conceive and carry out independent work.	1 (6%)	11 (61%)	6 (33%)	2.3
Developing the ability to work collaboratively with others	0 (0%)	7 (39%)	11 (61%)	2.6
Developing skill in expressing ideas orally.	1 (6%)	8 (44%)	9 (50%)	2.4
Gaining an understanding of the relevance of the subject matter to real-world issues.	0 (0%)	12 (67%)	6 (33%)	2.3
Gaining an understanding of the historical and social context in which the subject has developed.	0 (0%)	13 (72%)	5 (28%)	2.3
Gaining an understanding of different views and perspectives on the subject.	1 (6%)	11 (61%)	6 (33%)	2.3
Discovering the implications of the course material for understanding myself (interests, talents, preconceptions, values, etc.)	0 (0%)	12 (67%)	6 (33%)	2.3

Source: Survey Data (2020)

When summing up overall average scales, teachers mostly accepted that all these objectives are moderately important and essential. In the first survey question, eleven out of eighteen teachers (61%) said that gaining factual knowledge (terminology, classifications, methods, trends) are moderately important and seven came out with essential importance. In the follow-up survey, some teachers pointed out that engineering students are not familiar with terms and terminologies using in these six HSS courses and it is also a challenge to students.

Then, ten teachers (56%) responded that gaining an understanding of theories, fundamental concepts, or other important ideas are moderately important and the remaining eight (44%) said that it is essential. However, some teachers confessed that they are not the subject matter experts to teach all those subjects. So, they said that engineering teachers also need more teaching trainings to improve their understanding on theories and fundamental concepts. E.g. teachers are now delivering the basic concepts about microeconomics, macroeconomics, economic indicators, taxes and fiscal policy and international trade in one of the HSS courses. In focus group interview with teachers, a few teachers felt that even they are not clearly understanding on these concepts.

According to table (4.13), two teachers (11%) said that learning to understand professional/scholarly literature are in minor importance, 10 teachers (56%) in moderately importance and only six teachers (33%) claimed that it is essential. By looking at the average mean score (2.22), most of the engineering teachers think that teaching students to learn extensive literatures is important.

Moreover, twelve teachers out of eighteen (67%) accepted that learning to interpret primary texts or works is moderately important, two teachers (11%) sit in the side of minor importance and the remaining four teachers (22%) in essential side. In the focus group interview, some teachers explained that only one teacher have to teach all six subjects within one semester (four months) in their university. It would be very difficult to cover all texts and activities and manage to understand all of them in the short period.

Regarding to survey results from table (4.13), 13 teachers (72%) accepted that developing skill in critical thinking is essential and 5 teachers chose ‘moderately important’. At the same time, 12 teachers (67%) responded that developing skill in problem-solving is also essential and 6 teachers (33%) replied that it is moderately important. When it comes to developing skill in critical and analytical writing, only one teacher (6%) thought that it is minor important and the remaining 17(94%) teachers are in the side of 'moderately important and essential'. According to the mean score(2.7) out of 3.0, almost all the teachers have no doubt that developing skill in critical thinking is essential to teach their students. Critical thinking and problem solving are the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action.(as quoted in Jessop, 2002, p. 141).Also in focus group interviews, all teachers accepted that critical thinking and problem-thinking skills in HSS courses should be taught to the engineering students as the courses provides the fruitful experiences to not only engineers but also society. It is a long-term investment for teaching HSS courses as well.

About developing creative capacities, nine teachers (50%) came up with the answer that it is an essential skill and nine teachers (50%) responded that it is moderately important. Understanding the needs of society and meeting those needs in a technologically sound and sustainable manner, whilst keeping within the constraints set by citizen stakeholders, is a fundamental goal for engineers. To set and reach this goal requires creative capacities, strong critical thinking, problem-solving and analytical writing skills.

As mentioned in table (4.13), fourteen teachers (78%) believed that learning techniques and methods for gaining new knowledge is moderately important and four teachers (22%) said that it is essential. In the next question, eleven out of eighteen teachers (61%) claimed that developing the ability to conceive and carry out independent work is moderately important, six (33%) chose essential and one (6%) responded as minor importance. Traditionally, the type of engineer that engineering system produced is supposed to work in a company. He should be able to put things together and make them work. He is not supposed to question philosophically what he is doing and why he is doing. In HSS courses, teachers educate students to be able to take an independent stand be it at a technical, economic, device or company level. It is sound wisdom to know how these things relate to each other.

According to table (4.13) survey results, eleven out of eighteen teachers (61%) responded that developing the ability to work collaboratively with others is essential and other seven teachers (39%) said “yes” to moderately importance option. According to the mean score(2.6) out of 3.0, almost all teachers agreed that this collaborative skill is a must to teach students and it is vital in communication with project stakeholders, community members and even policy makers. “Cooperation" is the process of working together to the same end" and “teamwork" is the combined action of a group of people, especially when effective and efficient” (The New Oxford American Dictionary). Following (Maxwell, 2001), typically, a team is needed when a single person cannot achieve some task, or cannot achieve it within some time constraint, by themselves. When a team is formed to complete some tasks, team goals are defined, vision is established that guides and reinforces good performance, and hopefully shared values emerge as these help a team guide itself to success. Of course, these attitudes are developed in engineering communication classes.

Besides, nine teachers (50%) said that developing skill in expressing ideas orally is essential and eight teachers (44%) responded “moderately importance” answer and only one said that it is minor importance. Engineers and technology professionals are always under-represented at the highest levels of governmental and policy decision making. This creates a challenge to the engineering profession in establishing a true dialogue between decision makers and engineers. In turn, this also creates a challenge to those charged with the responsibility for the education of engineers to ensure that their graduates are capable of participating in the dialogue.

In addition, 12 teachers (67%) believed that gaining an understanding of the relevance of the subject matter to real-world issues is moderately important and six teachers (33%) chose the response “essential”. In the follow-up conversations, some teachers mentioned that students who were fast learners mostly understand the relevance between subject and real-world problems but for the slow learners it was difficult to grasp all concepts as the teacher could not establish that personal connect with all the students and understand and handle their problems individually. Somewhere the teacher’s inability to handle all the contents satisfactorily due to her lack of confidence and knowledge in all areas of social science also appeared as an obstacle.

Furthermore, 13 teachers (72%) responded that gaining an understanding of the historical and social context in which the subject has developed is moderately important and 5 teachers (28%) said that it is essential. According to ABET 2000 criteria, Graduates should have the broad education necessary to understand the impact of engineering solutions in a global social context and knowledge of contemporary issues (ABET, 2015). Moreover, the recognition of a broad-based education of future engineers has a world-wide endorsement.

Then, 11 teachers (61%) said that gaining an understanding of different views and perspectives on the subject is moderately important, 6 teachers (33%) chose “essential” and 1 teacher (12.5%) only chose “minor importance”. So, most teachers agreed that the idea of “reasonable pluralism" (a variety of people with different views) should be developed within the class. Otherwise, it is impossible for a well-ordered society to have all its members agree on a comprehensive doctrine (a religious one). Yet, it is possible in a democracy for citizens to hold different comprehensive perspectives and there to exist agreement on political conceptions of justice.

At the final question mentioned in table (4.13),12 teachers (67%) came up with the response that discovering the implications of the course material for understanding himself/herself (interests, talents, preconceptions, values, etc.) is moderately important and the remaining six teachers (33%) said that it is essential. Moreover, teachers explained that they are responsible for teaching their own engineering major subjects as well as HSS courses since there is no HSS department in each university. In order to train engineering faculties to teach HSS courses, they were requested to attain HSS trainings in places such as Mandalay Technological University (MTU) for TUs in upper regions of Myanmar and University of Hanthawaddy (UH) for TUs in lower regions of Myanmar. Most of the teachers are newbies to HSS courses and they only had to attend two weeks in MTU and three months in UH. As a matter of that, teachers are trying to their best to equip students with the quality training materials by looking at the overall mean values over 2.0 at all the survey questions.

By looking the average means at the surveys and focus group interviews to both engineering students and teachers, it is obvious to conclude that students are very interested to learn HSS studies and teachers are also endeavouring to fulfil the knowledge, skills and attitudes of students to meet with twelve graduate outcomes and to become all-rounded engineers. However, every system is not perfect and continuous improvement needs to be done through the proper monitoring and evaluation to the system. The findings and suggestions will be discussed in Chapter V.

CHAPTER V
CONCLUSION

This study has explored the current role and value of the humanities and social sciences in the engineering education systems of Myanmar. The six focus group sessions with graduating students from technological universities, as well as the written surveys of undergraduate and graduate students have provided valuable insight into the attitudes and perspectives of students related to the general studies requirement mandated of all Myanmar accredited engineering programmes. The study can conclude that the time is right for integration of HSS studies in traditional techno centric education as the newly defined soft skill graduate attributes by Myanmar Engineer Council provided an excellent framework to keep on the right track. While the responses of engineering students in surveys did not vary much when it came to explaining the usefulness of general studies courses, students who participated in the focus groups discussions that were organized around graduate attributes ended up reflecting more deeply on the place general studies courses did and could have in their curriculum. Thinking back on their undergraduate experience, the students in the focus groups demonstrated a strong grasp of the soft skill graduate attributes, yet saw their humanities and social sciences courses as a missed opportunity brought on by their lack of understanding of the purpose of these courses, as well as practical challenges associated with the heavy workload and busy schedule of a demanding curriculum.

5.1 Findings: The Concerns and Challenges from the Perspective of Students

Students' responses and learning experiences about HSS courses were consistent among participants and suggested that these courses are valuable and instrumental in the integral and comprehensive education of engineers, but that more explicit and clear explanations of the objectives and functioning of HSS studies would make this process more intentional and consequently less frustrating and challenging for the students.

In all focus groups, it became apparent that using the graduate attribute framework creates an awareness of the importance of the soft skills and allows students to reflect in a structured and fruitful way on the relative contributions made by difference aspects of their programme, including the engineering courses, HSS courses and their experiences outside the classroom setting. In all focus groups, it rapidly became evident that students had generally placed little importance on their HSS courses. They indicated that the purpose of the HSS studies requirement had not been explained very clearly during their degree, nor had the courses themselves been presented as particularly relevant or important to their development. Many participants were even surprised to find out that the HSS studies requirement was part of the accreditation process and not an institutional choice. Students generally felt that this lack of understanding had contributed to their attitude and approach to their HSS courses requirement, that is, as one of the hurdles to get over. This attitude was expressed in statements such as: …the focus is on engineering courses. Unless you are interested in it, you just get by, and I only took them because I had to.

Among six focus group interviews, there are engineering students from 21 universities in the total of 33. It has found that different universities use the different curriculums to teach six subjects relating to humanities and social sciences. Many participants expressed that it would have been beneficial to have the opportunity for greater guidance when learning HSS courses. For students who are very interested to learn and make the effort to maximize the opportunities provided by the HSS courses, there had been practical barriers.

Starting from 2017, the newly added HSS courses are integrated to engineering curriculums to meet the engineering criteria and the requirements of Washington accord as mentioned in the literature review and overview of engineering education system in Myanmar. There are only six main topics including engineering ethics, engineering communication, health and safety, environmental science, international relation and engineering management and courses are provided only in the first semester of the final year. It is difficult to absorb all the knowledge and core values in these subjects and can lead to the cramming, ineffective learning experience and fatigue to the students.

According to the literature review, it is an obvious that the role of humanities and social sciences cannot be left in the engineering curriculums. Globalization of engineering is intimately linked to development of universally recognized graduate attributes and accepted accreditation processes. So, linking local attributes to global attributes and promoting human development, in a socially inclusive and environmentally sustainable manner, is the greatest challenge of our era. However, many engineers responded that they are not even familiar with the terms of "sustainable development goals" of United Nations and "Myanmar Sustainable Development Plan". At the same time, some of the students also noted that they have to study microeconomics, macroeconomics, development, economic indicators and international trade while many of them confessed that they have not grasped the opportunity to learn these topics. So, the curriculum alignment across all universities is essential to figure out the current status.

Finally, students emphasized the importance of models and the faculty's own behavior, stating several times that in order for them to truly internalize the soft skill graduate attribute, it is important for faculty members themselves to exemplify these skills. Examples provided included dress code and behavior (professionalism), keeping course material current and up-to-date (lifelong learning), effective lectures and presentations (communication skills), and adequate referencing of material (ethics).

5.2 Findings: The Concerns and Challenges from the Perspective of Teachers

Many questions have been provoked in the recent times regarding the quality of engineering education in Myanmar. However, the concern is not unique to this country only. Worldwide, there is deep heart-searching about what the future courses of engineering education should be. In less developed countries, it is even more relevant because of the special socio-economic problems and severe resource constraints. While there is no denying the fact that the technical content in the curriculum in most of the engineering institutions in Myanmar is of world standard, the question maybe asked if the system is producing engineers with concern for the society and with ethical values. On a wider sociological level, it has also been claimed that the need to develop as a balanced individual and to understand the impact of technology upon daily life requires a broader understanding of the social context in which engineering operates.

Regarding to the HSS curriculums, teachers also confessed that the curriculums for six HSS subjects are different from universities. At the time of introducing HSS studies to teach in the final year of engineering curriculum, two or three teachers from TU are sent to the HSS trainings for two weeks in Mandalay in upper-Myanmar regions and for three months in lower-Myanmar regions. Many teachers pointed out that they are mainly teaching core engineering subjects in their disciplines respectively and the duration of HSS training on teachers is too short and require more continuous learning environment even for teachers. Although there are HSS departments in countries like India, Australia, Canada, US in technological universities, TUs in Myanmar have the many constraints as budgets, human resources, to establish the separate HSS departments. Only COE universities are planning to set it up. Another important finding in this study after interviews with teachers is that those who attended HSS trainings have to teach all six subjects as well as their core engineering one in the classroom and it make them overloaded and difficult to manage effective teachings.

The current HSS courses are all conducted only in the first semester of final year so that teachers face the challenge of meeting the deadline to complete the curriculum. The Social Science curriculum is so vast that the teachers face a tough time to make both ends meet. In this case, most students and teachers suggested that HSS studies should be added more than the current situation and deliver them necessarily in the early years of engineering studies.

Moreover, teachers expressed that they have to teach a huge size of class in HSS courses and it is far from the effective teaching in HSS courses. Administration operates from the profit maximization point of view as a result we usually find over crowded classes in Myanmar. Such a classroom does not yield good results as the student-teacher ratio is large. Social Science is a subject which requires continuous interaction between the teacher and the taught. If the class size is large the discussion and interaction with all the students becomes practically impossible. Those students who are not an active participant in the discussion tend to lose interest in the topic and find themselves disconnected with the class. Size of the class is a big challenge to be overcome by the teachers as they have to deliver their best within the framework provided by the institution.

For Social Science subjects considered as dry content subjects the teacher plays a crucial role. A teacher should be well qualified and trained to deal with the content in an interesting manner highlighting the relevance of the content which she is delivering. Most of the time students lose interest in the subject due to the improper ways of the delivery of the content. Hence the quality of teachers should be of prime concern of any institute. This could be ensured by encouraging teachers to spend time on research work and attend seminars or conferences, to keep themselves updated about the latest trends in their subject, which most of the institutions do not encourage as they involve the teachers in so many clerical jobs.

5.3 Suggestions

These findings suggest multiple areas for further consideration. First, engineering educators need to reconsider the effects of existing HSS studies' knowledge valuations. Given that the majority of curricula focus on engineering science and marginalize design and/or non-technical issues, some might suggest inverting the imbalance. Achieving integration on a large scale will necessarily transform faculty and student culture, a broad and ambitious goal that is perhaps best approached incrementally.

The current HSS curriculums are also not aligned from one technological university to another and the curriculum mapping system needs to be revised. Such a revised system would mean each academic unit, including engineering departments, would need to show its unique contribution to the goals of helping to foster better engineers, citizens, and human beings. This proposal also requires that faculty be more strategic about interdisciplinary collaborations, deciding which partnerships will yield better solutions to particular types of problems. Since humanitarian and community development problems are complex, faculty collaborations must include partnerships across the academic spectrum, which challenge disciplinary identities. Further, students who see successful instances of interdisciplinary problem solving among faculty may be more likely to pursue such collaborations in the future. The suggestion is that students begin to question the content of their engineering knowledge and its relationship to who they are and who they can be and that faculty facilitate such inquiry and reflection. Each student must decide what it means to be ethical in engineering education, considering that one has the responsibility of understanding the limitations and opportunities inherent in the bodies of knowledge that one is studying and deploying strategies to be and become an agent for positive social change.

As mentioned in the literature review, the role of humanities and social sciences is essential in engineering education. In the part of discussion, the Myanmar Engineering Education System in the study, HSS studies have been integrated in the curriculums. Compared to U.S and Europe engineering systems, there are only six subjects added under HSS in the final year of bachelor's degree and these subjects are considered as the compulsory ones. The reason why the current education system provides only six subjects as HSS studies is that there are not enough teachers who are specialized in these areas and no HSS department in TUs. The recommendation to solve this current issue and develop sustainably is to make alliance between engineering, humanities and social sciences educators. So, the educators who are subject matter experts in areas like economics, international trade, international relation, philosophy and management from other universities can visit to TUs for directly teaching HSS studies in the engineering classrooms or making teacher trainings to engineering educators as the short-term solution. For the long-term development, national policy makers in engineering education should consider to develop the virtual learning environment as a center of HSS studies using the cloud-hosted eLearning solutions. There are currently many technological universities at abroad facilitating their learners and teachers using the robust open-source learning platform like MOODLE (Modular Object-Oriented Dynamic Learning Environment) and Open Edx.

The current engineering education system needs to encourage interaction between academia and industry as a way of helping engineering faculty keep in touch with the inherently integrative nature of engineering practice and the dynamics of the contexts of engineering practice. Industry and academia need each other in ways that few understand, acknowledge, or appreciate; developing a useful understanding of integration is a prime example of this fact.

As mentioned in Chapter (III), the outcome-based education system proposed by Myanmar Engineering Council can foster to produce the good engineers who are not only proficient in technology, science and engineering, but also consider the social inclusion, environmental design, sustainable development, empowerment of the absolute needs of poor people in different regions of the world. When the national curriculum team designs and updates the HSS studies curriculums, they should broadly give the opportunity to include faculties and professionals from different universities, specialties and disciplines, many stakeholders as many as possible including accreditation board, employers, external examiners, industry advisors, and alumni as well.

REFERENCES

ABET. (2015). *Criteria for Accrediting Engineering Programs. Effective for Reviews of the 2016-17 Accreditation Cycle*. ABET.

Adler, M. J., & Van Doren, G. (1988). *Reforming education : the opening of the American mind*. Macmillan ; Collier Macmillan.

Aristotle. Nichomachean Ethics. *VI-4*.

Badley, G. (2003). Integrating Culture and Higher Education: A Pragmatist Approach. *European Educational Research Journal*, *2*, 477 - 495.

Beder, S. (1999). Beyond technicalities: Expanding engineering thinking. Journal of Professional Issues in Engineering. http://ro.uow.edu.au/cgi/viewcontent.cgi?article=1117&context=artspapers

Berube, M. (2006). What's liberal about the Liberal Arts? *New York Times Book Review*. https://www.nytimes.com/2006/09/10/books/review/Wolfe.html

Boren, M. E. (2004). On the importance of literary studies in making responsible citizens. *International Journal of Humanities and Peace*, *20*(1).

Boyer Commission on Educating Undergraduates in the Research University. (1998). *Reinventing Undergraduate Education*. http://files.eric.ed.gov/fulltext/ED424840.pdf

Bradley, J. P. (1985). Why Liberal Arts? *International Social Science Review*.

Brint, S., Riddle, M., Turk-Bicakci, L., & Levy, C. S. (2005). From the Liberal to the Practical Arts in American Colleges and Universities: Organizational Analysis and Curricular Change. *The Journal of Higher Education*, *76*(2), 151-180. https://doi.org/10.1080/00221546.2005.11778909

Canadian Engineering Accreditation Board. (2014). Accreditation Criteria and Procedures. 13-35.

Charlie Than. (2015). Development of the Engineering Education Accreditation in Myanmar. https://www.academia.edu/13651362/Engineering_Education_Accreditation_Development_in_Myanmar

Charlie Than. (2020). *Outcome Based Engineering (OBE) Education: Example from UTAR*. Presentation at Myanmar Engineer Council.

Christensen, J., Henriksen, L. B., & Kolmos, A. (2006). Engineering science, skills, and Bildung. In J. Christensen, L. B. Henriksen, & A. Kolmos (Eds.), *Engineering science, skills, and Bildung* (pp. 7-19). Aalborg Universitetsforlag.

Cuomo, S. (2007). *Technology and culture in Greek and Roman antiquity*. Cambridge University Press.

Devon and Liu. (2002). *Global change and the management of engineering education*

Downey, G. L., Lucena, J. C., Moskal, B. M., Parkhurst, R., Bigley, T., Hays, C., Jesiek, B. K., Kelly, L., Miller, J., Ruff, S., Lehr, J. L., & Nichols-Belo, A. (2006). The Globally Competent Engineer: Working Effectively with People Who Define Problems Differently. *Journal of Engineering Education*, *95*(2), 107-122. https://doi.org/10.1002/j.2168-9830.2006.tb00883.x

Dubreta, N. (2014). Integration of Social Sciences and Humanities into Mechanical Engineering Curriculum. *Interdisciplinary Description of Complex Systems*, *12*, 137-150.

Eaton, J., & Kortum, S. (2002). Technology, Geography, and Trade. *Econometrica*, *70*(5), 1741-1779. www.jstor.org/stable/3082019

The Engineer of 2020: Visions of Engineering in the New Century. (2004). The National Academies Press. https://doi.org/10.17226/10999

Engineering Programme Accreditation Manual, Policy, Procedure, Guidelines. (2018). M. E. Council. http://www.myanmarengc.org/sites/default/files/EEAC%20Manual%20%2820 18%29_0.pdf

Graduating Engineer. (January, 1995). *CEO in Focus: The Philosopher Engineer*.

Grimson, W., Murphy, M., Hyldgaard Christensen, S., & Ernø-Kjølhede, E. (2008). *Philosophy matters in engineering studies*. https://doi.org/10.1109/FIE.2008.4720424

Grinter, S. (1995). Final Report of the Committee on Evaluation of Engineering Education. *Journal of Engineering Education*, *46*, 25-60.

H.P.Hammond. (1939). *Report of committee on aims and scope of engineering curricula*

H.Williams, R. (2002). *Retooling: A Historian Confronts Technological Change*.

Heitmann, G., John, V. (1995). SEFI Curriculum Development GroupEducating the Whole Engineer. The Role of Non Technical Subjects in Engineering Curricula. 135-140.

Hersh, R. H. (1997). Intention and Perceptions A National Survey of Public Attitudes Toward Liberal Arts Education. *Change: The Magazine of Higher Learning, 29*(2), 16-23. https://doi.org/10.1080/00091389709603100

Heywood, J. (1994). *Enterprise Learning and its Assessment in Higher Education*.

Heywood, J. (2007). Think about how others think . Liberal Education and Engineering. *2007 37th Annual Frontiers In Education Conference - Global Engineering: Knowledge Without Borders, Opportunities Without Passports*, T3C-20-T23C-24. http://archive.fie-conference.org/fie2007/papers/1365.pdf

Hyldgaard Christensen, S., Meganck, M., & Delahousse, B. (2007). *Philosophy in Engineering*.

Jagger, S., & Simpson, M. (2018). *Social Science and the Humanities: A foundation course for Myanmar Learners*. Mote Oo Education.

Jessop, J. L. P. (2002). Expanding our students' brainpower: idea generation and critical thinking skills. *IEEE Antennas and Propagation Magazine, 44(6)*, 140–144. https://doi.org/10.1109/MAP.2002.1167273

Johnson, P. c. (1996). *Changing the Culture: Engineering Education into the Future*.

Klenow, P. J., & Rodriguez-Clare, A. (2005). Externalities and Growth. In (Vol. 1, pp. 817-861). Elsevier. https://doi.org/DOI:

Lind, M. (2006). Why the Liberal Arts Still Matter. *THE WILSON QUARTERLY*. https://dornsifecms.usc.edu/assets/sites/1/docs/advising/why_liberal_arts_still_matter.pdf

Maxwell, J. C. (2001). *The 17 Indisputable Laws of Teamwork: Embrace Them and Empower Your Team*. Maxwell Motivation.

Mitcham, C., & Schatzberg, E. (2009). Philosophy of Technology and Engineering Sciences. In A. Meijers (Ed.). North-Holland. https://doi.org/10.1016/B978-0-444-51667-1.50001-X

National Academy of Engineering. (2004). *The Engineer of 2020: Visions of Engineering in the New Century*. The National Academies Press. https://doi.org/doi:10.17226/10999

National Leadership Council for Liberal Education and America's Promise. (2007). *College learning for the new global century* Association of American Colleges and Universities.

Nussbaum, M. C. (1997). *Cultivating humanity : a classical defense of reform in liberal education / Martha C. Nussbaum*. Harvard University Press.

Nyi Hla Nge. (2017). *An overview of engineering education in Myanmar*.

Pacey, A. (1983). *The Culture of Technology*. MIT Press.

Passino, K. M. (2016). *Humanitarian Engineering: Advancing Technology for Sustainable Development* (3 ed.). Bede Publishing. https://hebook.engineering.osu.edu/sites/hebook.engineering.osu.edu/files/uploads/Edition3/humanitarian-engineering-3rdedition.pdf

Reiner, L. B. (1975). Why Liberal Arts? *Cresset*.

Rhodes, F. H. T. (2001). *The Creation of the Future: The Role of the American University*. Cornell University Press.

Rojter, J. (2004). The Role of Humanities and Social Sciences in Engineering Practice and Engineering Education.

Rojter, J. (2010). The allocation to the study of humanities and social sciences in Australian engineering education. In *SEFI 2010 : diversity unifies - diversity in engineering education*. European Society for Engineering Education. http://vuir.vu.edu.au/9915/

Schumpeter, J. (1934). Economic Development and Entrepreneurship. https://www.panarchy.org/schumpeter/development.html#top

Sharma, R. K. (2013). Lending Human Touch: The Role of Humanities in Engineering Education. *3*.

Steneck, N. H., Olds, B. M., & Neeley, K. A. (2002). Recommendations for Liberal Education in Engineering: A White Paper from the Liberal Education Division of the American Society for Engineering Education. https://www.researchgate.net/publication/278157388_Implementing_Liberal_Education_in_Engineering_Studies_in_Denmark

Symes, M., A.Thomas, G., & Ranmuthugala, S. (2013). *Graduate Attributes: Industry and Graduate Perceptions* International Conference on the Education and Professional Development of Engineers in the Maritime Industry, Singapore http://ecite.utas.edu.au/83311

Todaro, M. P., & Smith, S. C. (2003). Economic development. http://catalog.hathitrust.org/api/volumes/oclc/49531118.html

Vyas, P., & Chauhan, G. S. (2013). The Preeminence of Soft Skills: Need for Sustainable Employability. *International Journal of Social Science & Interdisciplinary Research*, *2*(5).

Wendy Marie, C.-P., & John, C. (2013). Towards New Literacies and Social Justice for Engineering Education. *International Journal of Engineering, Social Justice, and Peace*, *2*(1). https://doi.org/10.24908/ijesjp.v2i1.3516

Williams, B. S. (1988). *Review of the Discipline of Engineering*.

Wolff, R. (1992). *The Ideal of the University (Philanthropy and Society)*. Transaction Publishers.

Appendix A

Survey Questionnaire for Engineering Students

Name:

Email:

Phone:

University:

Major:

Graduation Year:

---

1. Knowledge

Regarding to knowledge of professional rules and interactions,

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
You are familiar with Health, Environment, and Safety (HES) as a basis for a good work environment.					
You have knowledge of relevant rules and agreements and the intentions behind these; this also includes employee and employer rights and duties.					

Regarding to basic knowledge of business organization, value creation, productivity, and profitability.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
You are familiar with how businesses are organized in terms of corporate and company units, and in terms of function, market, and projects.					
You have knowledge of basic management theory.					
You are familiar with the way businesses create value in terms of their stakeholders – focusing particularly on employers.					
You are very familiar with the different definitions of profitability from business economic and social economic perspectives.					
You have knowledge of market analyses and how a market's need for products and services affect demand, prices, income, and profitability.					

Regarding to basic knowledge of business economics,

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
You understand the most important areas in business economics: preparation and analysis of financing, cost calculation and pricing, basic methods of business economic analysis, and profitability assessments of investments.					

Regarding to knowledge of innovative processes and entrepreneurship,

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
You have knowledge of innovation and innovative processes and what it means to meet the increasing demands for change and adjustment, both in industry and management, and how this increases value creation and productivity.					
You understand the correlation between development and improvement of technical products and services, and organizational changes, management forms, and professional collaboration.					

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
You have basic knowledge of entrepreneurship in existing and established businesses and recognizes organizational and project structures that stimulate innovation and entrepreneurship.					

Regarding to knowledge about establishing and executing projects,

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
You have knowledge of how one may manage, organize, and lead project work.					
You have knowledge of the entire process – from the idea, via planning and executing, to assessment and post-completion work.					
You are familiar with different forms of team (self-managed, interdisciplinary, and multicultural), different roles (project leader, member, expert), and what challenges this may include, as well as group processes, and collective and individual responsibility.					
You have knowledge of project finance.					

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
You have knowledge of project management tools, reporting, and inter-group communication (oral and written).					

2. Skill

Regarding to being able to assess profitability and economic risk,

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am able to read and interpret accounting data.					
I am able to calculate cost and set prices.					
I am able to use basic techniques in business economic analysis.					
I am able to evaluate profitability and economic risk of investments.					

Regarding to being able to contribute to new approaches, innovation, and entrepreneurship through my participation in development and realization of sustainable and socially useful products, systems, and solutions,

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Master creative techniques and has an experimental attitude so that I may contribute to innovative and entrepreneurial endeavors.					
I am able to recognize economic, organizational, and social consequences when I develop technical solutions so that the technology becomes part of a sustainable and socially useful development.					

Regarding to being able to communicate orally and in writing about his/her discipline both in Burmese and in English, and can contribute in interdisciplinary collaborations and in public debates

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am skilled at oral and written communication, scientific writing, reporting and documentation, and is able to use sources and references effectively and correctly.					
I am able to express myself to peers in Burmese and English.					

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am able to define goals and achievements.					
I am able to collaborate and effectively communicate in groups.					

3. Attitudes

Regarding to being able to initiate smaller projects, and through proper management, conserve human, professional, economic, ethical, and social considerations,

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I view the project as part of a unit and is able to use my experience from project work and project management to find comprehensive solutions.					

Regarding to being able to recognize an interdisciplinary correlation between economics, management, ethics, society, technology, and the environment,

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I have a profession-wide understanding of the significance of technology and is able to include this in interdisciplinary work.					

Regarding to comprehend the meaning of cultural competencies,

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am open to other cultures and dissimilarities, both nationally and internationally.					
I have knowledge of the most important cultural differences engineers face in places that interact with Myanmar industry.					

4. Open-type focus group interview questions (6-8 respondents per interview)

i. Do you think HSS studies are useful to help your personality, knowledge, skills and attitudes?

ii. Do you agree that the HSS lectures can explain you well about knowledge, skills and attitudes mentioned in Section 1,2 and 3? Why or Why not?

iii. Do you think HSS studies are extra burdens to you?

iv. How do you understand "Sustainable Development" and do you know UN Sustainable Goals?

v. Do you know "Myanmar Sustainable Development Plans"? What is it?

vi. What is your suggestion to improve the current engineering education system with HSS studies?

Appendix B

Survey Questionnaire for HSS Teachers

Name:

Email:

Contact No.:

Institution:

Subject Name:

1. Course Objectives

On each of the objectives listed below, rate the importance of this objective in our course by clicking the radio button on the following scale.

	Minor Importance	Moderate Importance	Essential
Gaining factual knowledge (terminology, classifications, methods, trends)			
Gaining an understanding of theories, fundamental concepts, or other important ideas.			
Learning to understand professional/scholarly literature			
Learning to interpret primary texts or works.			
Developing skill in critical thinking			
Developing skill in problem-solving			
Developing skill in critical/analytical writing			
Developing creative capacities			

	Minor Importance	Moderate Importance	Essential
Learning techniques and methods for gaining new knowledge in this subject			
Developing the ability to conceive and carry out independent work.			
Developing the ability to work collaboratively with others			
Developing skill in expressing ideas orally.			
Gaining an understanding of the relevance of the subject matter to real-world issues.			
Gaining an understanding of the historical and social context in which the subject has developed.			
Gaining an understanding of different views and perspectives on the subject.			
Discovering the implications of the course material for understanding myself (interests, talents, preconceptions, values, etc.)			

2. Open-type interview questions (30 minutes per each interviewee)

(i) Which subject are you teaching now? Do you believe that you are subject matter expert in this HSS subject?

(ii) Are engineering students interested in learning HSS studies?

(ii) Which curriculum are you using to teach in this subject? Is it the same one with other universities?

(iv) How many weeks did you attend HSS studies before taking responsibility to teach this course? Do you think it can provide satisfactory knowledge and training materials?

(v) Do you satisfy the current engineering education with HSS studies? Why?

(vi) Are you overloaded to manage on teaching HSS subjects?

(vii) Which institutional support need to improve the current engineering education with HSS studies? And any other suggestions…?