MULTIDISCIPLINARY COLLABORATION IN THE CURRENT ARCHITECTURE, ENGINEERING, AND CONSTRUCTION EDUCATION OF ETHIOPIA

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ABSTRACT

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The architecture, engineering, and construction (AEC) industry realizes the significance of multidisciplinary collaboration, as a result, the industry has been improving its work trends towards a more collaborative way. However, such improvement has yet not been fully adopted in the academic sector. Since universities are one of the main resources for the job positions in industry, the current state of curriculum plays an important role on preparing future practitioners and helping to change the industry to a more collaborative trend. Therefore, understanding how multidisciplinary collaboration is being addressed in the curriculum is essential. The purpose of this research is to investigate if multidisciplinary collaborative approach is being addressed in the current Ethiopian AEC education sector towards the enhancement of collaborative, communicative and coordinative skills of the students. Data is collected from multiple sources by using different collection methods in order to have a comprehensive understanding about the existing curriculum. Addis Ababa University (AAU), the first university in Ethiopia with highest number of students in the AEC faculties, is taken as a representative case study. A survey on the students, interviews with academicians, and a comprehensive curriculum review of the available AEC departments have been completed. Convergence triangulation method is used to analyze the data collected from various sources simultaneously. Result of analysis indicates that various modules, courses, and programs are available that help the students acquire cross disciplinary and theoretical knowledge, however not enough practical multidisciplinary activities are available. The research also provides insights on the potential of the current AEC curriculum towards achieving a multidisciplinary education system.

Keywords: Multidisciplinary Collaboration, Architecture Engineering and Construction Education, Multidisciplinary Education System, Curriculum

ÖZET

ETİYOPYA'NIN GÜNCEL MİMARLIK, MÜHENDİSLİK VE İNŞAAT EĞİTİMİNDE ÇOK DİSİPLİNLİ İŞBİRLİĞİ

Mimarlık, mühendislik ve inşaat (AEC) endüstrisi multidisipliner işbirliğinin öneminin farkındadır, sonuç olarak sektör daha işbirlikçi bir şekilde çalışma eğilimlerini geliştirmektedir. Ancak, bu tür bir gelişme akademik sektörde henüz tam olarak benimsenmemiştir. Üniversiteler sanayideki iş pozisyonları için ana kaynaklardan biri olduğundan, müfredatın mevcut durumu gelecekteki uygulayıcıların hazırlanmasında ve sektörün daha işbirlikçi bir eğilime değiştirilmesine yardımcı olmada önemli bir rol oynamaktadır. Bu nedenle, müfredatta multidisipliner işbirliğinin nasıl ele alındığını anlamak esastır. Bu araştırmanın amacı, mevcut Etiyopya AEC eğitim sektöründe öğrencilerin işbirlikçi, iletişimsel ve koordine edici becerilerinin geliştirilmesine yönelik multidisipliner işbirlikçi yaklaşımın ele alınıp alınmamasını araştırmaktır. Mevcut müfredat hakkında kapsamlı bir anlayışa sahip olmak için farklı toplama yöntemleri kullanılarak birden fazla kaynaktan veri toplanır. Etiyopya'da AEC fakültelerinde en fazla öğrenciye sahip ilk üniversite olan Addis Ababa Üniversitesi (AAU) temsili vaka çalışması olarak alınıyor. Öğrencilerle ilgili bir anket, akademisyenlerle yapılan görüşmeler ve mevcut AEC bölümlerinin kapsamlı bir müfredat incelemesi tamamlandı. Yakınsama nirengi yöntemi, çeşitli kaynaklardan toplanan verileri aynı anda analiz etmek için kullanılır. Analiz sonucu, öğrencilerin disiplinler arası ve teorik bilgi edinmelerine yardımcı olan çeşitli modüllerin, derslerin ve programların mevcut olduğunu, ancak yeterli pratik multidisipliner aktivitenin mevcut olmadığını göstermektedir. Araştırma ayrıca mevcut AEC müfredatının multidisipliner bir eğitim sistemine ulaşma potansiyeli hakkında da fikir vermektedir.

Anahtar Kelimeler: Multidisipliner Işbirliği, Mimarlık Mühendisliği ve Inşaat Eğitimi, Multidisipliner Eğitim Sistemi, Müfredat

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3 C's - Collaboration, Coordination and Communication

AAIT - Addis Ababa Institute of Technology

AAU - Addis Ababa university

AEC - Architecture, Engineering, and Construction industry

AGC - Associated General Contractors of America

BIM - Building information modeling

CA - Construction automation

CAD – Computer aided design

CDP - Collaborative design process

COTM - Construction and Technology Management

DB - Design-build

DBB - Design Bid Build

EIABC - Ethiopian Institute of Architecture, Building Construction and City Development

ES - Education system

GOT - Georgia institute of Technology.

HDP - Higher Diploma Program

HVAC – Heating, Ventilating, and Cooling

IES - Intra disciplinary education system

IDP - Integrated design process

IPD - Integrated Project Delivery

IT - Information technology

IWE - Interdisciplinary work environment

MC – Multidisciplinary collaboration

MDP – Multidisciplinary professionals

MES - Multidisciplinary education system

MOSHE - Ministry of Science and Higher Education

PDM - Project delivery method

TVET - Technical and vocational education and training

URPL – Urban planning and design

CHAPTER 1

INTRODUCTION

Architecture engineering and construction (AEC) industry involves multidisciplinary professionals, and for better productivity, effective collaboration, communication, and coordination between the professionals is essential (Kamara, Anumba, and Cutting-Decelle 2006). Over the last decades the AEC industry have been implementing a traditional collaborative approach which is characterized by a linear process where one professional will hand over an ongoing project to the next after finishing his own task and the other professional also does the same up to project completion (Eastman et al. 2008). However, the traditional collaborative approach is characterized by fragmented documentation and communication between professionals. Therefore the process is prone to error, and omissions in construction documents have the potential to later create unforeseen field cost, delays, and eventual lawsuits between project teams (Mengesha and Jeakale 2016). However, the AEC industry started to realize the significance of multidisciplinary collaboration and has been working towards improving its work trends towards a more collaborative way (Ma, Zhang, and Li 2018). The industry started to develop new project delivery methods such as Design Build (DB), Integrated Project Delivery (IPD), Concurrent Engineering (CE), and implement collaborative tools and processes such as Building Information Modeling (BIM) and Integrated Design Process (IDP) that incorporate and leverage real-time collaboration, coordination, and communication among the various stakeholders.

Nevertheless, the problem is that the improvement of the industry towards a multidisciplinary collaborative work trend is highly observed in the market rather than the academia. Different researchers have observed that AEC education sector is lagging to implement multidisciplinary collaborative approach which enhance the collaborative, communicative and coordinative skills of the students. For instance O'Brien, Soibelman, and Elvin (2003) noted that university and college students in their respected fields spend most of their education time working on individual projects that doesn't help them to build multidisciplinary communication or teamwork skills. Boyer and Mitgang (1996) observed that the AEC education curriculum being used does not usually include or

encourage multidisciplinary collaboration, rather it trains students to focus only on their own discipline. Their report showed that among the surveyed architectural alumni only 46% felt their school prepared them to work cooperatively in interdisciplinary / multidisciplinary teams. According to Macdonald and Mills (2013) multidisciplinary collaborative approach is not reflected in the current AEC education system, where students of separate disciplines are educated in isolation from the others. As a result, this lack of multidisciplinary collaborative educational approach would potentially have an effect towards the advancement of the construction industry to a more collaborative work trend. Therefore, the purpose of this research is to investigate if multidisciplinary collaborative approach is being addressed in the current Ethiopian AEC education sector toward the enhancement of collaborative, communicative and coordinative skills of the students.

1.1. Aim, Objective, and Research Questions

Lagging to adopt multidisciplinary collaboration in the AEC education sector is a problem which is addressed by different researchers and countries. Similarly, the aim of this research is as well to investigate if multidisciplinary collaborative approach is being addressed for the collaborative, communicative and coordinative skills of students in the Ethiopian AEC education sector. The objective is to thoroughly inspect the current university level education curriculums of the available AEC departments in the country through comprehensive curriculum review, and later understand and evaluate the perception of students and academicians. In order to meet the objective and achieve the research aim, finding answers for the research questions below was necessary:

➢ Is there any intention to address the collaborative, communicative and coordinative skills of the students in the current AEC curriculums?

➢ Are there any expected multidisciplinary collaborative skills that the students will acquire within the existing curriculums?

➢ Are there any available modules, courses or projects that help the students develop multidisciplinary collaborative skills?

➢ What is the perception of students, academicians regarding the multidisciplinary collaborative approach of the current AEC curriculums and multidisciplinary education system in general?

1.2. Scope

This research investigated whether a multidisciplinary collaborative approach is being addressed in the university level AEC education curriculum of Ethiopia. Since the country is following a harmonized curriculum between universities of similar departments, one representative university that include all the available AEC departments in the country is taken as a case study. In this research a comprehensive curriculum review has been made on the recent updated curriculums of all the departments from the case university. Apart from that, students and academicians from the university were surveyed and interviewed to include their perception about the educational approach of the current curriculum. This research does not entail curriculum design, rather it evaluates the strength, weakness, opportunity, and threat of the current curriculum towards supporting a multidisciplinary education system.

1.3. Organization of the Thesis

This thesis is organized in to five main chapters. In the first chapter introduction about the topic of the study is presented including the problem that the research investigates. This is followed by the purpose of the research. The scope of the research is presented after clearly stating the aim, objectives, and research questions. In the second chapter summary of reviewed literatures is presented. Primarily the types of collaboration in the education system are presented. Following different educational approaches are stated and the one that is related with the notion of this research is discussed. Finally, previous research that can be used as benchmarks is identified and presented. In the third chapter research design and methodology is presented, by providing information on the location, case studies, and respondents. Following surveying, sampling and data collection methods are presented in detail, and this chapter is finalized by stating the response rate of the data collection. In the fourth chapter the collected data is presented both in text and tabulated format, followed by the data analysis. In the fifth chapter the summarized output of the analysis is provided. And in the conclusion section discussions regarding the research questions and the result of SWOT analysis is presented. Finally, recommendations are stated accordingly.

CHAPTER 2

LITERATURE REVIEW

In this section the concept of collaboration, its types and way of application are discussed. Following, different educational approaches are discoursed and the one that is related to the notion of this research is investigated thoroughly. Finally, previous research that can be used as benchmarks are identified. The benchmarking literature review helped the research to understand where to look while investigating Ethiopia's AEC education curriculums.

2.1. Collaboration in the AEC Industry

In the AEC industry various professionals work together to deliver a facility, and to be successful on their endeavor they need to effectively collaborate with each other. According to Rahman et al. (2014) collaboration enhances information sharing , on time delivery, quality project accomplishment, and improved interaction among project members. Collaboration has always been an essential part of the AEC, however its effectiveness depends on how to implement it (Amarnath, Sawhney, and Uma Maheswari 2011). According to its implementation collaboration can be categorized as; the traditional process, and the collaborative process (Thomassen 2011).

The traditional process is generally characterized by a linear process where one professional will hand over an ongoing project to the next after finishing his own task and the other professional also does the same up to project completion. This linear process in which the design process follows unidirectional path is called truncated serial or "over-the-wall" approach (Elvin, 1998). This approach have been widely used for a long period of time and is still being used currently in the AEC industry (Eastman et al. 2008). Some examples of delivery method having such characteristics is the design bid build (DBB) and design build (DB)methods.

Whereas the collaborative process is an approach that is characterized by an integrated and collaborative work between multidisciplinary professionals from the project inception up to completion. This includes frequent discussions, information

exchange and constant iteration starting early in the design stage. This way professionals get early feedback about the things that must be considered, and late changes can be avoided. An example of delivery method having such characteristics is the integrated project delivery (IPD) and integrated design process (IDP) methods.
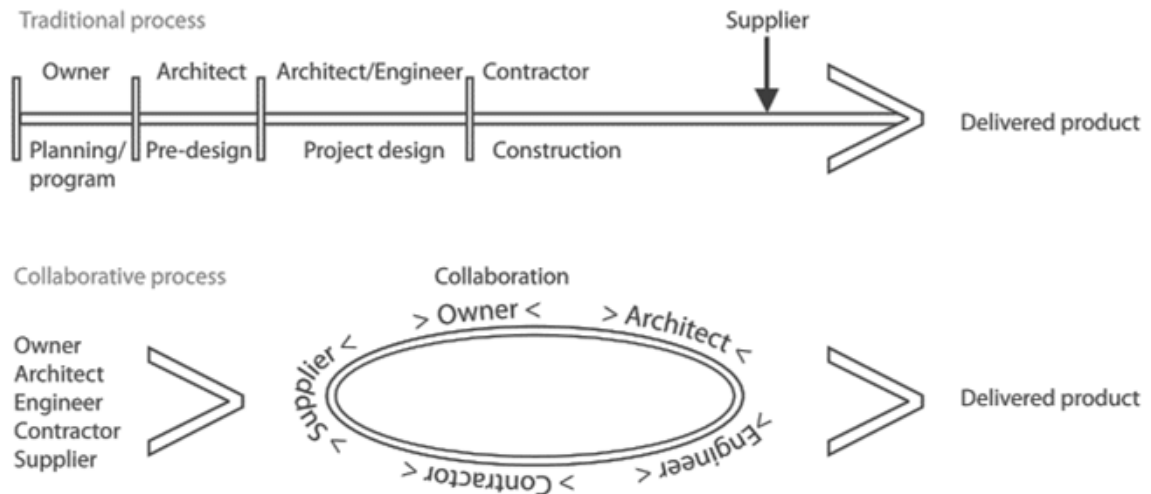
Figure 2.1. Traditional vs. collaborative process (Source: Dansk Byggeri 2005)

In this research, multidisciplinary collaboration is described as the collaborative process where professionals perform continuous discussions, information exchange and constant iteration starting early in the design stage up to completion.

2.2. Education System (ES)

To understand the multidisciplinary collaborative nature of the AEC education sector, it is necessary to understand and identify the educational approach that is currently being used. In this section the different types of educational approaches have been addressed, and the one that is related with the notion of this research is explained.

2.2.1. Intra-, Inter-, Trans-, Cross- and Multidisciplinarity

According to Jensenius (2012) based on the knowledge acquisition and observation perspectives of multidisciplinary participants there are different types of

educational approaches; intra, inter, cross, trans and multidisciplinary educational approach. From the definition given by Jensenius (2012) Intradisciplinary implies analyzing phenomena from one perspective, whereas Interdisciplinary means analyzing phenomena by combining techniques and knowledge from different perspective. Multidisciplinary entails people collaborating from different disciplines each participating according to their knowledge. Whereas, Cross disciplinary is about working on a discipline by using different knowledge and input from other disciplines and Transdisciplinary is about combining various disciplines to create new output beyond the individual perspective of each discipline.
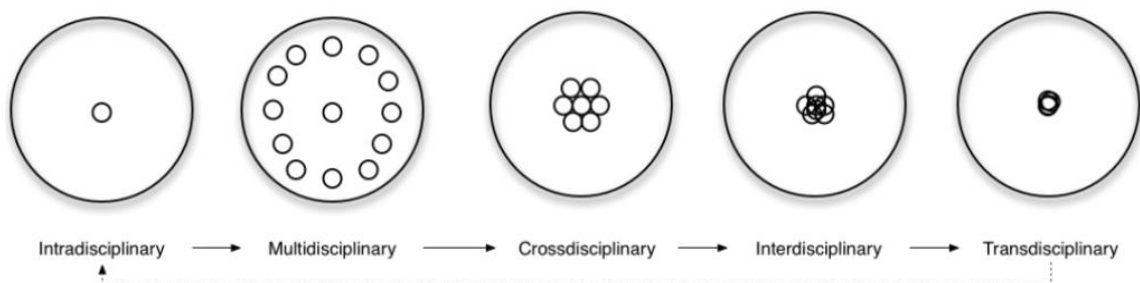
Figure 2.2. Different types of educational approaches (Source: Jensenius 2012)

According to Savoiu (2014) the education sector is experimenting on various disciplinary methods that help on to understand natural phenomena from different perspectives and acquire new knowledge. The traditional way of uni or intradisciplinary approach have been used to come up with new findings and knowledge acquisitions still now by observing things from a single perspective, however due to nature is interlinked with one another observing things from one point of view might be misleading. Therefore, the education sector started experimenting on various disciplinary methods such as inter, multi, cross and transdisciplinary approach for understanding things and acquiring knowledge more conclusively. These new approaches are starting to help the future education sector to observe things from different perspectives, to share and merge knowledge to understand natural phenomena and to acquire a synthesized approach on experimenting things that rises from the joint work of disciplines (Lombardo 2010).

2.2.2. Intradisciplinary Educational System (IES)

Currently in the AEC education sector the traditional way i.e., intradisciplinary educational approach is still being followed. Even if the industry is shifting towards a multidisciplinary collaborative working approach the education sector is still lagging to adopt multidisciplinary collaborative educational approach between the available AEC department (Macdonald and Mills 2013). O'Brien, Soibelman, and Elvin (2003) observed that currently university and college students in their respected fields spend most of their education time working on individual projects even if the endeavor on their respective field requires a collaborative work trend for the sorrow understanding about the full building life cycle. This in return made them to develop more of an individual skill rather than multidisciplinary teamwork skills. Also according to Macdonald (2012) in the construction industry, where various professionals are required to work collaboratively, professionals are learning individually in separated campus like architects in one campus, engineers, and contractors on another. This in return created the architect engineer contractor division that become hard to bridge.

Similarly, research has showed that even if the industry is moving towards a collaborative work environment, the academia is somehow not responsive to this change and this will in return make the new graduates less competitive on the shifting industry (MacDonald and Mills 2011).

2.2.3. Multidisciplinary Education System (MES)

Regarding the problem that AEC education sector is lagging to adopt collaborative educational approach different researchers have tried to experiment other types that are responsive to the collaborative nature of the AEC industry. From the types of education approach described in section 2.2.1, the one that is closely related to the nature of AEC industry is the multidisciplinary education system. According to Jensenius (2012) multidisciplinarity means approaching an issue from multiple perspectives, or if it is a project, working collaboratively by team members from various disciplines. In this case a construction project is a good example where it requires the collaboration of professionals that are specialized on various fields of building construction such as Architects, Engineers, Contractors, Urban planners, and others.

Multidisciplinary education system for the AEC industry is a technique of educating students the relation of their fields with others, the limit of their responsibilities, how to work together with other professionals as a team, making decisions by considering the other professions, giving quick feedback for the information needs of others. In general, multidisciplinary education system (MES) for the AEC industry means the system of teaching students on how to interactively collaborate, coordinate, and communicate with professionals in various AEC fields (Amarnath, Sawhney, and Uma Maheswari 2011). Some of the professionals in AEC are:

- Architecture – Architects, Interior and Urban designers.
- Engineering – Civil, Mechanical, Electrical, and Water engineers.
- Construction – Construction and Technology Managers (COTM).

Various researchers in different countries have tried to show the relevance and requirement of multidisciplinary collaborative educational approach for the AEC industry. For instance, Boyer and Mitgang (1996) showed a new perspective towards the requirement of a collaborative AEC education curriculum, MacDonald and Mills (2011,2012 and 2013) tried to research the existing curriculum and propose a framework for adopting a multidisciplinary courses that include IPD and BIM, O'Brien, Soibelman, and Elvin (2003) have tried to introduce capstone course called collaborative design process (CDP), Irizarry, Meadati, and Gheisari (2010) have surveyed the need for an interdisciplinary AEC education curriculum and so on.

In addition to proving the requirement they have also experimented a multidisciplinary collaborative educational approach by using various means. On the AEC education sector different countries are researching and experimenting on an inter and multidisciplinary education system. For instance, Irizarry, Meadati, and Gheisari (2010) at the Georgia institute of Technology (GOT) explores the need and challenges for an interdisciplinary AEC education system by setting out a survey on students and alumni then collected an online petition from senior professionals regarding the curriculum amendment for an interdisciplinary education. But prior to the survey, they have prepared a workshop to generally understand the perception of various related professionals on the concept of an interdisciplinary education, which led them to come up with a curriculum centered in AEC integration. However, survey results showed that there is misconception between industry professionals and the surveyed respondents. The survey result showed that interdisciplinary work environment (IWE) is beneficial for collaboration and communication between multidisciplinary professionals, project

sustainability and enhancement of information technologies, whereas the collected petition from the industry professionals showed that due to integration there will be a concern on lack of specialization, time needed for education and employment, the difference between the current degree offered and that of after integration.

Furthere more, O'Brien, Soibelman, and Elvin (2003) experimented a collaborative design course in an active and reflective way. University of Illinois and University of Florida have designed a capstone design course called collaborative design process (CDP) for AEC students, in which multidisciplinary gradute students collaborate from remote location via internet to design a fascility. This is done by setting up teams from architecture, structural enginner and constrcution management departments to generate design, schedule and budget and come up with their own workflow or design process by using information technology (IT) and commercially available softwares. They have finally obseved that even if students are teamed up to design the facility in a collaborative/integrative manner, they were persistantly using "over-the-wall"/truncated serial approach in which each team member perform his/her task and hand over the result to the next member. This resulted a very low design iteration and information exchange between them. The major barriers to adopt integrative design method observed were one, communication barrier among students, since the team was distributed (architects at Illinois and contractors at Florida) and there was a limitation of the required communication technology they faced communication problem this play a great role on the prominent architect-contractor division. Two, lack of knowledge about the information needs of others. Three, lack of integrative knowledge and abilities within and across discipline in which engineers and project managers are only comfortable to give feedback after architects had developed highly detailed design rather than providing an early feedback. Four, cultural expectations vary with individual and discipline. Meaning that sometimes architects consider themselves as the leader of the project and start to see the others as their consultants not as their team members, this state of mind made the integrative design process hard to manage. On the other hand, one group collaboratively worked with the interior designer and came up with the most functional space among all the other groups, this demonstrates the potential of team collaboration. Whereas, from the students perspective the ability of the group to have effective meeting, effective scheduling and managing the design process and meeting schedule are very crusial. In addition, teams are needed to develop team building practice and better plan the workflow or the deisgn process before they began working. However, limitation of existing

technology were frustrating since the available ones were comfortable to implement the over the wall method, rather than an integrated project deliver method.

Moreover, MacDonald and Mills have performed three consecutive research in 2011, 2012 and 2013, and identified the reasons in which the market is changing towards a collaborative work trend and the academics is not, then they also designed a framework to help the education curriculum adobt multidisciplinary collaborative teaching.

According to their prior researches MacDonald and Mills (2011 and 2012) the reason in which the market is changing, and the academics is not, is due to the market is continuously facing pressure from potential clients and the government whereas the academics is highly resisting. Among some of the reasons for the resistance: (1) since the current curriculum is crowded there is a question on how to fit new ones, (2) the reluctance of changing a habit that is developed for many years, (3) the fear of the academic professionals to involve themselves on new concept that they are not familiar with, (4) since such advancements are proliferating in a fast pace the academics is somehow overwhelmed to cope up with, (5) the Architect, Engineer, Contractor school's division is not simple to bridge since they developed working in silos and mistrust from one another. And there is also question raised on who will be responsible to administer the new cross disciplinary courses and lastly the minimum number of students that are going to attend per class is fixed.

On the following research Macdonald and Mills (2013) came up with a framework design called IMAC to adress the problem that the acadamia is lagging to adapt collaborative education approach. IMAC is a collecion of consequtive process that will able an education facility to educate its students the collaborative work trend by using BIM technologies and processes. On this framework "I" stands for illustration in which students will be educated on how to illustarate their idea by using BIM tools. "M" stands for maupulation, students will be learned to interact and manupulate existing models regarding their profession. "A" stands for application, students will be educated on how to apply the theoretical knowledge that they aquired on their educational training regarding their disciplines. For example architects will be subjected to developing a BIM model from scratch by considering the information requirement of others, engineers will take that BIM model and extract the information they need and perform various analysis. Whereas the construction managers will develop 4D and 5D schedule of the design. And finally "C" stands for collaboration, during this time students will be subjected to team

work that consists of multidisciplinary members and start to solve real world problems together.

Accordingly findings of the reviewed litratures in this section and othres regarding to multidiscplinary collaboration educational approache are summerized in Table 2.1.

Table 2.1. Summary of litratures regarding multidisciplinary AEC education

Author date information	Research topic	Summary of result or findings
(Irizarry, Meadati, and Gheisari 2010)	The need and challenges for interdisciplinary education in AEC	interdisciplinary work environment (IWE) is beneficial for collaboration and communication between multidisciplinary professionals, project sustainability and enhancement of information technologie
(O'Brien, Soibelman, and Elvin 2003)	Collaborative design processes (CDP): An active and reflective learning course in multidisciplinary collaboration	communication barrier among students, lack of knowledge about the information needs of others, lack of cross disciplinary knowledge and abilities, cultural expectaions were challenges faced during implementing CDP
(MacDonald and Mills 2011)	The potential of BIM to facilitate collaborative AEC education	curriculum is crowded, reluctance of changing habit, academics is overwhelmed to cope up, Architect, Engineer, Contractor school's division are the reason of the resistance by the academics to adopt new collaborative educational approach
(Macdonald 2012)	A Framework for Collaborative BIM Education Across the AEC Disciplines	"IMAC" Illustration, Manipulation, Application and Collaboration framework has been developed to assist educators in benchmarking their own curricula and to develop strategies for improvement.

(cont. on next page)

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Table 2.1 (cont.)

(Macdonald and Mills 2013)	An IPD Approach to Construction Education	The AEC education should learn the effective implementation of collaborative techniques and processes and need to teach both the students and academicians
(Fruchter 1999)	A/E/C teamwork:a collaborative design and learning space	A/E/C course experimented to teach new generations on how to team up and work with mutidisciplined professionals.
(Boyer and Mitgang 1996)	A New Future for Architecture Education and Practice. A Special Report.	interdisciplinary education and practice among the students is among one of the 7 goals defined by the report which is required for the furture of an architectural education
(Lombardo 2010)	Multidisciplinary and interdisciplinary approaches to futures education	inter and multi-disciplinary appraoach help to create a holistic educational experience that taps into the human mind.

From the reviewed literatures in this section, we understand that previous studies are available regarding the adaptation of multidisciplinary education approach towards the collaborative, communicative and coordinative skills of AEC students. As a result, multidisciplinary education approach can enhance collaborative education between various AEC departments which can play a great role on the production of students that can be competitive on the already shifting industry (Mazzetto 2018).

2.2.4. Benchmarks for Evaluation

In this section literature that can be used to benchmark multidisciplinary collaborative education approach is extracted from the research reviewed in section 2.2.3. These benchmarks helped this research to identify where to look while reviewing AEC education curriculum of Ethiopia, and to evaluate its potential towards MES.

Generally, in the AEC education sector, apart from trial courses, projects, and limited application, finding a well-defined collaborative curriculum is a challenge. Therefore, the benchmarks extracted for this research are collected features from trial courses, projects, and limited application experimented by different researchers in different cases.

Starting from the intention of the reviewed literatures in section 2.2.3, common focus has been the introduction of a multidisciplinary collaborative educational approach in the AEC education system. This intention was for the introduction of collaborative, communicative, and coordinative skills of multidisciplinary students so that they can be a good input in the currently shifting construction industry towards a more collaborative work trend.

Different researchers have come up with their own techniques to incorporate multidisciplinary collaborative educational approaches. For example, Bozoglu (2016) have tried to incorporate a collaborative module for an integrated design process which help the students understand about collaborative tools and processes such as BIM. Irizarry, Meadati, and Gheisari (2010) introduced jointly taught courses, lectures, and open dialogues between AEC universities. O'Brien, Soibelman, and Elvin (2003) introduced a capstone course called collaborative design process (CDP) where students from AEC department of different university team up and design a single facility by using an integrated design approach. Whereas Macdonald (2012) proposed a framework that will help the AEC education curriculum to follow to teach students to collaborate by using BIM as a design process and collaboration tool. Graham and Geva (2001) experimented an interdisciplinary design studio by focusing on the design build project delivery method (PDM) where design, engineering and construction tasks are performed by a single company.

However, beyond the experiment of different modules, courses, and programs the researchers in the above paragraph tried to evaluate the success of their method by collecting the perception of different involved parties such as students, academicians, practicing professionals, and market stakeholders. This way they tried to create awareness throughout the industry and collected everyone's comment on a multidisciplinary collaborative educational approach for further advancement.

Therefore, here in this study the intention, rationale and expected outcomes of the current AEC curriculums in relation to collaborative, communicative, and coordinative skills of students and the availability of different modules, courses and programs

regarding cross department collaboration are the benchmarks to evaluate the multidisciplinary collaborative approach of the current AEC education curriculums of Ethiopia. In addition, the perception of involved parties such as students and academicians regarding the current curriculums is also included.

CHAPTER 3

METHODOLOGY

This section described the scientific and systematic way used in this thesis work. In Section 3.1 the type of research design, framework and research methodology are presented. The location in which the research took place, and the type of case study chosen in which respondents are selected from is described in section 3.1.1. Consequently, the kind of respondents selected from the case study is specifically addressed under the 3.1.2. Finally, the type of surveying method is described thoroughly in Section 3.2, including the way of sampling and data collection techniques.

3.1. Research Design and Framework

The research design falls under the exploratory category since this research investigated the availability of a multidisciplinary collaborative approach in the current Ethiopia's AEC education curriculum. Exploratory type of a research is usually performed to identify the existence of a particular phenomenon in a certain event (Swaraj 2019).

Following to identifying the research design, framework of the design, which includes the data source, method of data collection and analysis, is described. In this research, where the aim was to investigate if multidisciplinary collaborative approach is being addressed in the Ethiopian AEC education sector, I preferred to evaluate the issue from a different aspect. Among the major data source that is used to understand the education system is the curriculum. By reviewing the curriculum, itself I was able to identify features that implicates multidisciplinary collaboration. However, from the benchmark in the literature review the perception of involved parties such as students, and academicians could give an additional information on the effectiveness and application of multidisciplinary collaboration in the curriculums. Therefore, beside reviewing and evaluating the education curriculum of the AEC departments, the observation of both the academicians and students is also incorporated.

However, in order to collect data from the above multiple sources, mixed data collection techniques which entail both quantitative and qualitative approaches were used. Quantitative data collection method i.e., questionnaire is used in order to gather the perception of students about the current education curriculum regarding collaboration. Whereas quantitative data collection techniques such as interview is used to understand the perception of academicians regarding the collaborative nature of the curriculum and comprehensive document review is implemented on the curriculum itself to have a firsthand and detailed information on the available features which might help the students to acquire multidisciplinary collaborative knowledge and skills.

Following, the information collected from different data source by using multiple data collection methods are analyzed simultaneously in order to have a comprehensive understanding if multidisciplinary collaborative education is being addressed in the current AEC education system of Ethiopia, and this method of analysis is known as Convergence triangulation method. According to Mathison (1988) Convergence triangulation method allows a researcher to have a comprehensive understanding about a single phenomenon by simultaneously analyzing the data collected from various source by using different techniques.

In the following section, the case study that is used for this research is described in detail. The types of respondents that can give necessary information for this research are chosen from the case study, and the reason of selecting these respondents is described as well. Since it is not feasible to cover the whole country, the technique of narrowing down the scope of the study area is described in the case study section as well.

3.1.1. Case Study

Ethiopia is a developing country located in the east Africa having a total of 42 universities which are both private and governmental. The country is following a nationwide harmonized curriculum where universities with similar departments use the same education curriculum throughout the country. This specific scenario gave the chance for this research to narrow down the scope, choose and investigate one AEC related university as a representative case study. This means understanding the case of that university can provide representative information of the others in the country.

From the 42 universities that are available in the country, the majority of universities are located in the city Addis Ababa. Addis Ababa is the capital, largest and most urbanized city of Ethiopia where a lot of national and international activities are occurring (Wikipedia 2021). However, from the 17 universities located in this city, one of the first and the oldest governmental university that contains the highest number of students is known as Addis Ababa University (AAU).

AAU is the first higher educational and research institutions in Ethiopia which has been the leading center in research, teaching-learning, and community services. AAU is a branched-out organization that includes 10 colleges, 4 institutes (with both teaching and researching services), and 6 research institutes (dedicated primarily for research purposes). Among them the ones that are related with the AEC fall under the institution category which are Addis Ababa Institute of Technology (AAIT) and Ethiopian Institute of Architecture, Building Construction and City Development (EIABC).

AAIT is an institution under AAU that is responsible for all the engineering fields, and it was the first engineering institution throughout the country. This institution includes schools/departments of civil and environmental engineering, electrical, mechanical engineering, and other engineering fields having a total number of 10284 students. In addition to the above fields the institute have also organized new school for multidisciplinary engineering. This department is organized with an intention of collaborative participation between all engineering field to produce a single product and this will be developed through various national and international collaboration between various institutions.

EIABC is an institute of technology under the supervision of AAU that is responsible for the development of industries in the fields of Architecture, Design, Construction, Urbanism, Environmental Planning, Management and Technology. This institute have a total of 7000 students.

Therefore, this research will continue by using AAIT and EIABC as the two institutes, which represent all the AEC department in the country, as a case study.

3.1.2. Respondents

From the above case studies and supporting information on the literature review three type of respondents are chosen for this research: students, practicing academicians, and curriculum revisors.

The students are from 4th year 2nd semester students and 5th year graduate alumni (students returned from internship). The reason that I am targeting post internship students is because they are the ones that have some industry experience due to the internship program that is prepared by the universities. Therefore, this will help us to get comment from the students weather their educational training was enough for their future career to work in a multidisciplinary work environment. Usually, the university/institutes that they are learning in is expecting the students to have the ability to function in a multidisciplinary team setup after they graduate but the truthfulness or success of the universities is going to be checked after the survey.

Practicing academicians are the ones who works both inside the universities and in the market. This kind of situation is highly observed in the case of Addis Ababa where a professional works on both academics and the market. Therefore, I believed that they will be a good source to get information regarding the relationship of the academics to the market like if or if not, the academics is preparing the students for the market. In addition to that they can also comment on whether the industry is shifting towards the collaborative work trend like the countries showed on the literature review plus how much collaboration is crucial and how can it be implemented in the AEC industry from their experience regarding the research area (Ethiopia).

The last category is the curriculum revisors, who are also academicians with a mandate to participate in the curriculum ratification or revision process. Mostly chair holders or department heads have such an authority where they follow and perform curriculum related tasks such as curriculum revision. Therefore, I believe that they can be a good input to give information regarding the intention and rationale of the AEC curriculums (weather it is designed in an integrated manner or not) and other information like how the collaboration is being addressed in the current education curriculum, how the current curriculum is helping the students to prepare for the market and alike.

3.2. Data Collection

After identifying the type of respondents, in this section the sample size technique and calculation is presented in detail to identify the representative sample of respondents from the total population. Following, the type of surveying method is described thoroughly, and the data collection technique and the response rate is presented as well.

3.2.1. Surveying Method

Surveying methodology is used to extract, structure, and organize relevant information gathered from the respondents. In this research as mentioned in section 3.1, two types of data collection are used: survey questionnaire and interview. The interviews were held to thoroughly understand the current situation of the education and market practice from the academicians whereas the survey questionnaire was used to cover wide range of the students from every department and collect their perception regarding the education curriculum.

3.2.1.1. Survey Questions

As described in section 3.1, questionnaire with close ended questions is used to collect the perception of the students about the current curriculum. Among the various types of close ended questions the one that are used to measure the knowledge and familiarity of the respondents about a given issue are multiple choice variety, true – false, yes – no questions and so on (Glasow 2005). There for the YES/NO question type is selected for this specific research since we needed a clear understanding of the current curriculum weather there is a collaborative approach or not, but just for an additional choice SOMEHOW is added for the kind of situation that collaborative approach is somehow being practiced but it is not well applied, organized, and formal.

Due to the wide spread of COVID-19 virus the best way to collect data from large amount of population was by using online questionnaire platform, such as Google Form. Google form is among the online platforms that can be used to create a web-based forms for data collection purpose. It is often used to make surveys, prepare quizzes and other

fillable forms. The prepared survey form for this research was shared by using a link that is generated by the app itself, and this made it easily accessible to various respondents. Later the gathered data was organized on a spread sheet and used for further evaluation.

The survey questionnaire for this research has been prepared for the post internship students. The questions have been prepared in the manner that the respondents will answer them simply by saying YES, NO or SOMEHOW, and this made the questionnaire easier for the respondents to answer. The survey questionnaire can be found on APPENDIX A.

3.2.1.2. Interview questions

Referring to the section 3.1 a structured interviews with open-ended questions are prepared to understand the perception of the practicing academicians and curriculum revisors about the current curriculum, the market, and the relationship in between.

The reasons for choosing interview are: (1) there will be a good chance of describing the intent of each question, (2) there will be a two-way discussion among the interviewer and interviewees, and this helped me to get broader and conclusive information and avoid any ambiguous responses instantly.

Interview questions for the practicing academicians can be found on APPENDIX B and Interview questions for the curriculum revisors can be found on APPENDIX C.

3.2.2. Sampling Methods

Following selection of respondents from the chosen case study and preparing the survey questions, sampling method was required to be identified in order to distribute the survey questionnaires. Since it was difficult to address the whole population identifying representative sample was necessary. The total number of post internship students is collected from the registrar office of both institutes and summarized in Table 3.1.

Table 3.1. Total number of post internship students in AAIT and EIABC.

AEC related departments	Number of post intern students in each department
AAU	
AAIT	
Civil and Environmental engineering	181
Electrical and computer engineering	167
Mechanical and industrial engineering	205
Multidisciplinary engineering	-
EIABC	-
Architecture	89
Construction and technology management	152
Urban planning and design	-
Total number of post intern students	**794**

From the information in Table 3.1 the total amount of post intern AEC student is 794. In order to calculate the representative sample size from the total populations, I used the table from Gill and Jhonson (2010) research. By using 95% Confidence Level, 5% Margin of Error and 50% Variance of the population the sample size for approximately 800 people will be 260 as showed on Table 3.2.

Table 3.2. Sample size based on accuracy (Source: Gill and Jhonson 2010)

	Variance of the population P=50%					
	Confidence level = 95%			Confidence level = 99%		
	Margin of error			Margin of error		
Population Size	5	3	1	5	3	1
600	234	384	565	314	452	579
700	248	423	652	340	507	672
800	**260**	457	738	362	557	763
1000	278	516	906	398	647	943

After calculating the sample size for the total population, it was necessary to decide how to distribute the questionnaires to those 260 respondents and this step is called sample framing technique. The technique that is used for this research was Stratified random sampling. This is a method of sampling in which the respondents are labeled by a strata or subgroup (gender, company size, occupation…) and the questionnaire will be distributed and collected among the groups (Taherdoost 2018). In our case the strata will be departments.

According to stratified random sampling technique each stratum or department in our case, should have proportional opportunity to be selected. Therefore, the first calculation was to identify the percentage proportion of each department from the total amount of population. For example, for the Architecture department students the total number of post intern students is 89, therefore, to find the proportion of the Architecture department from the total population 89 is divided by 794 and then multiplied by 100.

- Total number of Architecture student = 89
- Total number of populations = 794
- Percentage proportion of Architecture students from the total number of populations can be calculated as (89/794) *100 = 11%.

Therefore, by using similar calculation the percentage proportion of the other departments is presented in Table 3.3. Next in order to find the sample size of each department the percentage proportion of each department was multiplied to the sample size of the total population which is 260. For example, in order to find the sample size of the Architecture department we have to multiply 11% * 260 ≈ 29. Similarly, the sample size for each department is calculated and presented in Table 3.3.

On the other hand, for the interview part the method used to select respondents is known as Quota sampling. Quota sampling is a non-random sampling in which respondents will be specifically selected based on their characteristics (Davis 2005). In this research as mentioned in section 3.1.2 respondents for the interview are two kinds where they are selected by their authorities or by their involvement on the market, which are practicing academicians and curriculum revisors. Therefore, I chose one person per each category from all the available AEC departments in the respective university. Meaning, for the curriculum revisors one person each from architecture, COTM, URPL, civil, electrical, and mechanical department and also for practicing academicians one person from each department were interviewed, which makes it a total of 12 interviews.

Table 3.3. Sample size calculation for each strata / department

Name of University	Name of Institutes	Name of Departments	Number of post intern students	Percentage Proportion	Sample size for each department
Addis Ababa University (AAU)	EIABC	Architecture	89	11%	**29**
		COTM	152	19%	**50**
		URPL	0	0%	**0**
	AAIT	Civil	181	23%	**59**
		Electrical	167	21%	**55**
		Mechanical	205	26%	**67**
		Multi-disciplinary	0	0%	**0**
Total Number of populations			794	100%	**260**
Sample Size			260		

3.2.3. Data Collection

In general, three type of data collection is implemented in this study, one is by using online survey (questionnaire), the other is face to face interview and finally document review has been performed.

The online survey consisted of 20 multiple choice questions. The aim was to conduct the survey with 260 students from AAIT and EIABC. The students are required to give their perception about the current education curriculum and a multidisciplinary education approach. Since the questionnaire is prepared using an online platform, which is Google Form it is also distributed online among the respondents. This has been done by requesting the phone and email address of every student in each department from the registrar office of the institutes. The office became cooperative after receiving the "letter of cooperation" which is prepared and authenticated by the academic staff of Izmir institute of technology (IZTECH).

Whereas for the interview section I approached in person, both the practicing academicians and curriculum revisors from each department and performed interviews that took 30 min up to two hours. The total number of interviews performed were 12 and each interview session took place by using local language of Ethiopia, which is Amharic, for better understanding. In addition, every interview has been recorded and documented

for transcription and analysis purpose. Every respondent has also signed a consent form which is submitted to IZTECH. This whole data collection process has been implemented starting from February 2021 up to the end of July 2021.

The last data that has been collected was the curriculum of every department. This data is taken from a government office known as Ministry of Science and Higher Education (MOSHE) that is responsible for the development of science and higher education in Ethiopia. MOSHE has the mandate of collecting and controlling curriculums and graduate profiles of every science and technology departments whether the curriculum is fulfilling the market's needs, students are meeting the intended graduate profile and other education quality-based supervisions. As I heard from interviewing curriculum revisors they are required to send their revised curriculum to MOSHE for supervision, if there is anything that should be corrected it will be sent back to the university for further amendment, this way this governmental organization will be a mediator between the market, the students, and the academics.

3.2.4. Response Rate

Response rate is the number of willing respondents participated from the total survey distributed for the research (Taherdoost 2018).

$$Response\ Rate = \frac{Number\ of\ Responses}{Number\ of\ Invites}$$

Figure 3.1. Response rate calculation formula (Source: Ramshaw 2017)

The online survey is distributed to the undergraduate students that are registered in EIABC and AAIT. The total number of registered students is 794, each department having their own percentage. Therefore, the response rate is also calculated accordingly.

According to Table 3.4 I was able to achieve response rate of above 70% which is acceptable to continue according to Ramshaw (2017). Therefore, the research continued to analyze the data by using the answered questionnaire from 260 students and 12 interviewees, the rest is the curriculum review of the six departments.

Table 3.4. Response rate calculation

For Questionnaire	Arch	COTM	Civil	Electrical	Mechanical	Total
Number of Invites	35	65	77	72	78	327
Number of Responses	29	50	59	55	67	260
Response Rate (%)	**82.8**	**76.9**	**76.6**	**76.4**	**85.9**	**72.8**

CHAPTER 4

DATA PRESENTATION AND ANALYSIS

In this chapter, primarily data from the questionnaire, interview and document review is presented then the method and process of data analysis is followed. As described in Chapter 3, the data collected are from three sources by using three methods, questionnaire has been distributed to students, interview is made with practicing academicians and curriculum reviewers then finally curriculum review has been made and the summery of these data is presented in this section.

4.1. Data Presentation

In this section the data collected from the questionnaire, interview and curriculum review are summarized both in table and text format, but if detailed questions are required the reader can refer on the Appendix section.

4.1.1. Questionnaire Data

Below on Table 4.1 the questions that the students are asked on the online survey form are presented in short form and their response are categorized numerically according to each department. The bold numbers indicate the maximum response rate according to the specific question. For example, on the first question that says "my education prepared me for my career in terms of collaboration" significant number of students from all department said no, this way the Table 4.1 can be interpreted for the rest of the questions.

Table 4.1. Summary of the online survey distributed to the students

University		AAIT			EIABC	
		Civil	Electrical	Mechanical	Architecture	COTM
My education prepared me for my career in terms of collaboration	NO	**38**	**34**	**40**	**15**	**31**
	YES	4	4	6	7	3
	SOMEHOW	17	17	21	7	16
Learned information requirements of others	NO	**28**	**41**	**36**	**14**	**28**
	YES	10	2	16	8	6
	SOMEHOW	21	12	15	7	16
Learned BIM or other collaboration tools	NO	**44**	**41**	**42**	5	**6**
	YES	8	3	9	9	**28**
	SOMEHOW	7	11	16	**15**	16
Learned technical drawing	NO	2	2	8	2	1
	YES	**39**	**39**	**42**	**20**	**33**
	SOMEHOW	18	14	17	7	16
Learned job demarcation between professionals	NO	5	7	9	2	8
	YES	**33**	**28**	**40**	**17**	**30**
	SOMEHOW	21	20	18	10	12
There were collaborative teaching-learning trends with other dep't	NO	**35**	**28**	**44**	**16**	**30**
	YES	7	14	9	6	10
	SOMEHOW	17	13	14	7	10
Learned to work in multidisciplinary environment	NO	**33**	**27**	**40**	**12**	**27**
	YES	9	10	14	9	7
	SOMEHOW	17	18	13	8	16
Learned about benefits of multidisciplinary work trends	NO	**34**	**31**	**43**	**14**	**29**
	YES	10	10	9	9	9
	SOMEHOW	15	14	15	6	12
Learned about other building science	NO	12	10	10	4	9
	YES	**35**	**30**	**41**	**17**	**26**
	SOMEHOW	12	15	16	8	15
Learned use of IT for collaboration	NO	**29**	**27**	**31**	**17**	**26**
	YES	13	13	16	6	11
	SOMEHOW	17	15	20	6	13
There were multidisciplinary group assignments	NO	**39**	**35**	**48**	**17**	**31**
	YES	14	11	9	9	10
	SOMEHOW	6	9	10	3	9
Have friends from other dep't in campus	NO	19	17	18	10	17
	YES	**40**	**38**	**49**	**19**	**33**
Have friends from other Dep't outside campus	NO	**36**	**32**	**49**	**21**	**30**
	YES	23	23	18	8	20

(cont. on next page)

Table 4.1 (cont.)

Educate or work assignments together	NO	**45**	**39**	**52**	**23**	**27**
	YES	3	6	10	0	8
	SOMEHOW	11	10	5	6	15
I know about multidisciplinary education system MES	NO	**28**	**43**	**63**	**17**	**34**
	YES	16	4	3	4	3
	SOMEHOW	15	8	1	8	13
MES is being implemented in the current curriculum	NO	**43**	**42**	**52**	**19**	**36**
	YES	3	0	0	2	2
	SOMEHOW	13	13	15	8	12
MES shall be incorporated into the current curriculum	NO	0	0	0	0	1
	YES	**48**	**42**	**52**	**24**	**35**
	SOMEHOW	11	13	15	5	14
MES enhance the use of IT for collaboration	NO	2	5	7	0	0
	YES	**42**	**44**	**56**	**25**	**44**
	SOMEHOW	15	6	4	4	6
MES will be beneficial for the AEC industry	YES	**49**	**41**	**55**	**26**	**39**
	SOMEHOW	10	14	12	3	11
IT will facilitate MES	YES	**46**	**39**	**56**	**23**	**39**
	SOMEHOW	13	16	11	6	11

Table 4.1 shows that:

➢ Statistically significant number of students said that their prior education

- Equipped them with the knowledge of technical drawing (which is the communication media of AEC professionals).

- Equipped them with the knowledge of job demarcation between various AEC professionals.

- Taught them about other building science other than their discipline

- But didn't prepare them well for their career in terms of collaboration

- Didn't educate them the information requirement of other related discipline

- Didn't teach them collaborative tools and processes like BIM except the architecture department and COTM department.

- Didn't incorporate collaborative teaching-learning with other AEC departments.

- Didn't taught them the benefit of multidisciplinary work trend

- Didn't train them to work in multidisciplinary work environment

- Didn't teach them the use of IT for collaboration

- Didn't incorporate multidisciplinary group assignments

- The data have also indicated that
  - Students have friends from other departments in campus but barely have fiends from other campus and they do not usually educate or help each other on assignments.
  - Students barely know about the word and concept of Multidisciplinary education system (MES).
  - After students read the description about MES and understand the meaning of it on the survey form 90% of them said that it is not being implemented in the current curriculum and they agree
    - that MES shall be incorporated into the current curriculum
    - that MES will enhance the use of IT for collaboration
    - that MES will be beneficial for the AEC industry and
    - that IT will also facilitate MES

4.1.2. Interview data

In this section interview data of both the practicing academicians and curriculum revisors are summarized and presented in both a tabulated and text format.

4.1.2.1. Interviews with Practicing Academicians

Below on Table 4.2 the interview question and answer that is made with practicing academicians is coded and presented accordingly. The questions that are asked during the interview are presented in short form under the "Questions column" and their response are categorized according to each department. Their transcribed answers are categorized and coded in order to find a pattern or useful information that can be an input for the research. For example, on the third question that says "practice MC? How?" "Discussion" can be extracted from majority of the respondent's answer, this way the Table 4.2 can be interpreted for the rest of the questions.

Table 4.2. Coded table of the interview made with practicing academicians

INTERVIEW QUEATIONS		CODE OF RESPONDANTS (FROM PRACTITIONERS)					
INTERVIEWEE INFORMATION	Question column	PR 1	PR 2	PR 3	PR 4	PR 5	PR 6
	University	EIABC	EIABC	EIABC	AAIT	AAIT	AAIT
	Market	Senior Architect	Urban planner	COTM	Electrical engineer	Civil engineer	Mechanical engineer
	Academics	Lecturer	Lecturer	Lecturer	Lecturer	Lecturer	Lecturer
INFORMATION ABOUT THE ORGANIZATION WORK TREND	PDMs in your company	DBB and partial BIM	DBB, DB and IDP	DBB, DB	DBB	DBB or DB	DB
	list of professionals working together	Civil, Architect, Sanitary, Electrical	Urban planners, Architects, Engineers and Contractors	Civil, Architect, Sanitary, Electrical, COTM	Only Electrical	Civil, Architect, Sanitary, Electrical, mechanical, COTM	Civil, Architect, Sanitary, Electrical, mechanical, COTM
	Practice MC? How?	Yes! Mini discussion and Revit	Yes! Periodical discussion and teamwork	Yes! discussions and feedbacks	No	Yes! Discussion and feedbacks	Yes! Discussion, Teamwork, and feedbacks, have project management team
	Is MC effective and efficient?	Somehow	Somehow	Somehow	No!	Somehow	Somehow
	A. If yes, how did you achieve MC?	Professional availability and collaboration tool like Revit and Auto CAD	Professionals' availability, collaboration training, work nature	Professionals' availability, work critics, and project management	-	timely discussion, collaboration tools such as Auto CAD	Professional availability, collaboration training
	B. If no, the problem (root cause)?	lack of collaborative professionals	lack of collaborative professionals	lack of collaborative professionals	work in silos	lack of collaborative professionals	lack of collaborative professionals
	how to improve collaboration?	Hiring experienced and collaborative professionals	create awareness about use of collaboration	Being open minded and cooperative	Work with multidisciplinary professionals	Hiring experienced and collaborative professionals	Hiring open minded and collaborative professionals

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Table 4.2 (cont.)

		PDMs on market	DB and BIM (as a tool)	DBB and DB	DBB and DB	DBB	DBB and DB	DBB and DB
INFORMATION ABOUT THE OUTSIDE MARKET	How is MC on market	Professionals are trained on the market	regarding Urban planning projects 75% is collaboration	challenged by personal behavior & unprofessionalism	Highly challenged by personal behavior and unprofessionalism	Professionals are trained on the market	Professionals are trained on the market	
	Discussion regarding BIM, and Revit for collaboration	BIM and Revit for collaboration by Association of Ethiopian Architects	Urban planning association was creating awareness with in these 2 years	Various BIM based panel discussions is being made	No to my knowledge	No to my knowledge	Knowledge transfusion with foreign companies	
INFORMATION ABOUT THE RELATION BEWEEN THE MARKET AND THE ACADEMICS	How academics respond to the market?	Conflict of interest	Conflict of interest	Education lacks to fulfill every need of the market	Education is trying its best to meet the needs of the market	Education is trying its best to meet the needs of the market	Education sector is trying its best to meet the needs of the market	
	How do they inter feed each other?	Very minimal	They do not	Very minimal	by evaluation and feedback	by evaluation and feedback	by evaluation and feedback	
	Is academics providing capable students	No!	No!	No!	No!	No!	No!	
	How the academics addressing MC	new education approach, internship	Cross disciplinary and holistic courses	Holistic and management courses	Cross disciplinary and common courses	Cross disciplinary & common courses	Cross disciplinary and common courses	
	Suggestion for improvement?	educational training regarding collaboration	Multidisciplinary assignments/projects should be developed	Extracurricular activities regarding collaboration	Incorporating educational training regarding collaboration	Incorporating educational training regarding collaboration	Incorporating educational training regarding collaboration	

Table 4.2 (cont.)

	Know about MES	Somehow!	No!	No!	No!	Somehow!	No!
	Education systems need MES?	Yes!	Yes!	Yes!	Yes!	Yes!	Yes!
	Will it be beneficial for the AEC industry? How?	Yes!	Yes!	Yes!	Yes!	Yes!	Yes!
	How?	instead of training new graduates' market can focus on its productivity	There will be a collaborative output from multidisciplinary minds	instead of training new graduates' market can focus on its productivity	will ease down the burden of the market and enhance productivity	will reinforce the market and leads to enhance productivity	will ease down the burden of the market and enhance productivity
	agree addition of MES in the education system?	Yes!	Yes!	Yes!	Yes!	Yes!	Yes!
	MES graduate be beneficial for the market?	Yes!	Yes!	Yes!	Yes!	Yes!	Yes!
	How?	Can enhance the productivity of teamwork	will be able to smoothly collaborate with existing professionals	Will be able to manage teamwork and spirit	will add one quality on students graduate profile that the market is requiring	Will be able to coordinate with other professionals	will help to create a product in an integrated manner

The data collected from the interview made with the Practicing academicians is categorized in to two, which is information regarding the status of the market and information related with the relationship between the market and the academics.

About the status of the market the interview data indicates Ethiopia's AEC market is showing some changes towards a collaborative work trend. As it has been observed in the data:

➢ Companies started to use the Design Build (DB) project delivery method where they incorporate multidisciplinary professionals to perform both the design and construction task, sometimes they even start from the urban analysis.

➢ Some are even practicing BIM as a tool to collaborate with foreign companies.

➢ Companies start to practice integrated design process by incorporating early feedbacks and timely discussions with multidisciplinary professionals at different stages of the design.

➢ Associations like the Ethiopian Urban planning association have been working on proliferating the concept of collaboration in the past 2 years.

➢ And various panel discussions have taken place regarding BIM for collaboration and other collaborative work trend have been performed with foreign companies.

➢ The companies themselves also believe that they are somehow achieving collaborative workflow by hiring multidisciplinary professionals, training them on how and when to collaborate and also by using collaborative tools like BIM software, Revit as an example.

However even the data indicates that Ethiopia's AEC market is showing some movement towards a collaborative work trend the companies said that they are highly facing problems due to lack of professionals equipped with the ability to work in a multidisciplinary environment.

➢ Among the challenges that the companies are facing during multidisciplinary collaboration is personal behavior, destructive criticism, persistence to change, unable to accept others idea, lack of understanding, communication and conflict resolution ability are some of them. In general, there is lack of collaborative professionals.

➢ And some said that still now it is the responsibility of the market to teach graduate professionals on how to work collaboratively with other professionals, which is time taking task that negatively affects the company's productivity.

According to the data practicing academician suggested that multidisciplinary collaboration in the market can be improved by hiring experienced professionals and if available trained professionals regarding multidisciplinary collaboration.

Whereas about the relationship between the market and academics the data indicates Regarding the academic approach the interview data shows two different things based on the universities (departments).

➢ In EIABC

- The academics is focusing more on emerging technologies, theoretical approaches, and design philosophies whereas the market highly needs personal, technical, and collaborative skills.

- The data also showed that the universities are focusing on equipping the students with personal skill but not regarding technical and collaborative skills.

- Word for word an interviewee said that *"there is a conflict of interest between the academics and the market."*

➢ In AAIT

- The curriculum is very integrated with the market where there is continuous evaluation of the curriculum and graduate profiles by various stakeholders and big companies on the market, this is done in order to enhance the work opportunity of the students.

- This way made the big companies confident enough to take employees (graduate students) directly from the university.

➢ However, regarding multidisciplinary collaboration the data showed the education system is highly focusing on equipping the students with personal skills rather than collaborative.

➢ In general, from both universities the interview data showed that most of the respondents believe that the academics is not providing capable students to the market regarding multidisciplinary collaboration.

➢ Yet, the data doesn't show that the academics is not trying to address this problem rather with the intention of teaching one professional about the other aspect of building science they have provided the students cross disciplinary courses like integrated design course, introduction to engineering profession course, fresh man common courses and additional programs like internship where students will be exempt to the market to practice what they learned and how the market works. Also,

the education sector is trying a new type of teaching learning system like Higher Diploma Program (HDP) where collaboration between students is valued, and instructors will be a mediator.

➢ According to the data respondents do not have the full understanding about the concept of MES. However, after I have described about it, they fully agree on the addition of such an approach in the current curriculum. And they also agreed that it will be highly advantageous for the link between the market and the academics.

➢ Respondents even agreed that by using such an approach in the AEC education sector the market can focus on its productivity instead of teaching graduate professionals on how to collaborate. Even for the newly graduate professionals there will be a good employment opportunity since they fulfilled one of the market requirements.

According to the data practicing academician suggested that multidisciplinary collaboration in the education sector can be improved by incorporating educational training regarding collaboration, multidisciplinary assignments/projects and extracurricular activities since the curriculum cannot respond to every need of the market.

4.1.2.2. Interviews with Curriculum Revisors

Below on Table 4.3 the interview question and answer that is made with curriculum reviewers is coded and presented accordingly. The questions that are asked during the interview are presented in short form under the "Questions column" and their response are categorized according to each department. Their answers are categorized and coded in order to find a pattern or useful information that can be a good input for the research. For example, on the fifth question that says "how is the link implemented" "cross disciplinary courses" can be extracted from majority of the respondent's answer, this way the Table 4.3 can be interpreted for the rest of the questions.

Table 4.3. Coded table of the interview made with curriculum revisors

		NAME OF RESPONDANTS (FROM CURRICULUM RATIFIERS / REVIEWERS)					
	Questions	CRP1	CRP2	CRP3	CRP4	CRP5	CRP6
INTERVIEWEE INFORMATION	Organization	Chair Holder, EIABC	Chair Holder, EIABC	Chair Holder, EIABC	School Dean, AAIT	School Dean, AAIT	School Dean, AAIT
	Department	Architecture	URPL	COTM	Electrical Engine.	Civil Engine.	Mechanical Engine.
	Task	Curriculum revisor	Curriculum revisor	Curriculum revisor	Curriculum revisor	Curriculum revisor	Curriculum revisor
INFORMATION ON CURRICULUM RATIFICATION/ REVIEW PROCESSES	Participants on the revision process	academicians, practitioners, stakeholders	Academicians, stakeholders and other depart. chair holders	academicians, practitioners, stakeholders	Staff members, Graduation committee, practitioners, (MOSHE)	Staff members, Graduation committee, practitioners, (MOSHE)	Staff members, Graduation committee, practitioners, (MOSHE)
	How is it reviewed?	inter department revision and open for external feedback	inter department revision and open for external feedback	inter department revision and open for external feedback	inter department design, open for external feedback, assessment by industry stakeholders and MOSHE	inter department design, open for external feedback, assessment by industry stakeholders and MOSHE	inter department design, open for external feedback, assessment by industry stakeholders and MOSHE
INFORMATION ABOUT THE CURRICULUM	Rationale of the curriculum	Produce skillful professionals	Create Skillful and problem solver professionals	Produce skillful professionals	Create responsible, skillful, and problem solver professionals	Providing professionals in multiple Civil streams to widen employment opportunity	Create competitive professionals in mechanical tasks to increase employment opportunity
	Is there any link with other AEC departments?	Yes!	Yes!	Yes!	Yes!	Yes!	Yes!
	how is the link implemented?	Cross disciplinary and integrated projects	Cross disciplinary and holistic courses	Cross disciplinary and holistic courses	Common courses	Cross disciplinary and common courses	Cross disciplinary and common courses

(cont. on next page)

Table 4.3 (cont.)

How is current curriculum beneficial for the market?	provide professionals equipped in personal skills	Full fill the need and solve problem of the countries master plan	Provide skilled site managers to control the whole construction process	provide professionals regarding the need of the market	provide professionals regarding the need of the market	provide professionals regarding the need of the market
How beneficial for the student?	training students with experimental behavior	Students already know their job in the market	grant knowledge to manage construction site	increase employment opportunity	increase employment opportunity	increase employment opportunity
How is MC being addressed in the current curriculum?	Internship, integrated projects, and holistic courses	Cross disciplinary and holistic courses	Holistic and management courses	Common courses	Cross disciplinary and common courses	Cross disciplinary and common courses
Should the curriculum be improved for the sake of collaboration? How?	Yes, Various stakeholders must show interest and involvement in the curriculum review	yes, by including multidisciplinary assignments or projects	Yes, by introducing extracurricular activities like seminars, competition, workshops	yes, by including multidisciplinary assignments or projects and cross campus collaboration	Yes, by introducing in campus and cross campus extracurricular activities	Yes, it would be complete if the curriculum is designed in collaboration with EIABC
Your taught about multidisciplinary education	important to teach students how to communicate	will help to create generation believes in a teamwork	good approach to maintain the integrity of related departments	help to create knowledge of working together	provide collaborative skills to work with other professionals	teaching value of teamwork to between professionals in
Suggest MES?	Yes!	Yes!	Yes!	Yes!	Yes!	Yes!
How to implement	multidisciplinary lectures, collaborative assignments, common projects.	curricular or extracurricular activity like that of internship	Through common courses and extracurricular activities	multidisciplinary lectures, collaborative assignments, common projects.	multidisciplinary lectures, collaborative assignments, common projects.	multidisciplinary lectures, collaborative assignments, common projects.
Why are AEC departments divided?	Administrative and personal interest	Administrative and personal interest	Confusion on the nature of the departments,	Confusion on the nature of the departments,	Administrative and personal interest	Administrative and personal interest
Suggestion?	Coordination	Collaboration	Communication	Collection	Collaboration	Collaboration

From the interview made with the Curriculum revisors about the AEC curriculums the interview data indicates that the country is using a previously designed curriculum which are currently being revised and updated every 5 years. In addition, detailed information is given below regarding the curriculum in each institute.

- In EIABC
  - The curriculum is intended to be designed in an integrative manner and a more market responsive way however it is not being implemented because the invited stakeholders doesn't show any interest, even one respondent forwarded his idea for the reason that they do not show any interest, he said "it is because they are invited voluntarily (without any payment) thus the stakeholders prefer to run their business rather than participating on such events."

- In AAIT
  - The curriculum is being revised according to the feedbacks of big companies and stakeholders that exist on the market, the companies show high interest and follow up the graduate profile, plus they will comment on it and curriculum will be amended accordingly. This step makes the companies confident enough to directly hire students from the university.

- However, the common thing that is observed from the data is that in both universities the curriculums are not reviewed or revised in and integrated or collaborative manner, meaning only academicians of that specific department, stakeholders and companies do involve, others will be contacted later (only if they are required to give a cross disciplinary course) and feedbacks.

- But still, the data showed that the curriculum is designed to keep the link with other departments and provoke multidisciplinary collaboration through holistic courses (building science in general), cross disciplinary courses and common pre-engineering courses. For example, Civil students learn design course, Architecture students learn structural design and so on.

- According to the respondents the main aim of the current curriculum is to produce a self-sufficient, competitive, skillful, responsible, problem solver, knowledge full students on multi-stranded engineering sector that can serve their country and themselves.

- According to the curriculum reviewers they believe that the current curriculum helps the market on the one hand by providing skilled, problem solver professionals who are aware of their responsibility and have the capability of site management and

ability to fulfill other market requirements. And on the other hand, provide students with futuristic and experimental behavior which already have some insight about their job on the market and increase their employment opportunity by continuously updating the curriculum regarding the need of the market.

➢ However, the data shows that the curriculum revisors advises the improvement of the education system for the sake of collaboration both in curricular and extracurricular activities which can be made both on cross department and cross campus collaboration. Starting from designing the curriculum together up to providing multidisciplinary projects and assignments.

➢ The data indicates that the curriculum revisors have a good insight about multidisciplinary education where some said that it is about teaching students how to collaborate, communicate and coordinate smoothly with other professionals or in a team set up and some said that it might also create an integrated AEC department.

➢ And among their suggestion on how to implement MC is trough incorporating curricular and extracurricular projects, assignments, lectures, and workshops.

➢ However according to the data one more thing that is observed by the curriculum revisors is the division between the two universities as architecture and engineering, according to their thoughts this has created a gap between the professionals during their carrier. As mentioned by most respondents the reason of their separation is personal, political, and administrative issues which has no connection with the nature of the departments. Rather the respondents support the collection and collaboration of all AEC department because as they said collecting them is introducing a way for students to collaborate understand and interact with each other. In addition, to adequately use resource like lecturers and laboratories.

➢ Though, one other point that is raised from two respondents is the nature of the departments, meaning that design fields are more of subjective whereas engineering fields are objective. This made them believe that the architecture-engineering division came from the above reason.

4.1.3. Curriculum Review

On this section curriculums of AEC departments such as civil, electrical, mechanical, architecture, urban and construction technology departments will be

reviewed regarding with the topic of this research which is multidisciplinary collaboration. In Ethiopia as it is stated on the curriculum itself and by the curriculum reviewers, the curriculum is updated every five years so in this research the most recent ones are reviewed. The major things that are noted during the review are the background and rationale of the curriculum, professional and graduate profile, outcomes of the programs and courses/modules.

Regarding the background and rationale of the curriculum I reviewed the main goal that each curriculum is trying to achieve, and the reason that the previous curriculums are revised in order to identify if there are any points regarding multidisciplinary collaboration, communication, or coordination among the AEC students and departments. By reviewing the outcome of the curriculums, I tried to investigate if there are any expected outputs from the curriculums of every department regarding multidisciplinary collaboration, communication, or coordination among professionals. Whereas by looking into the professional/graduate profile, I tried to observe if there are any abilities the students will earn by learning with the current curriculums regarding multidisciplinary collaboration, communication, or coordination and finally I also tried to identify any collaborative modules, courses and programs or multidisciplinary activities that might help students of the AEC departments to gain a multidisciplinary knowledge and skills. Therefore, I believe that reviewing the curriculums of the various AEC departments from the above angles might help to understand on what level and by what means is multidisciplinary collaboration trying to be achieved in the investigated universities.

As a disclaimer in this curriculum review section, there are no any additional thoughts or information added personally, rather important information is extracted from curriculums of every department and presented.

4.1.3.1. Architecture

In this section the architecture department's curriculum is reviewed and summarized. Information regarding the intention, rationale and outcome of the current updated curriculum, graduate profile of the students, available modules, programs, and courses in relation to multidisciplinary collaboration is presented.

4.1.3.1.1. Background and Rationale of the Curriculum

Architecture is one of the key professions involved in shaping the built environment and urban space. According to the curriculum architectural education should have two basic purposes, which are to produce competent, creative, critically minded, and ethical professional and to produce professionals who are intellectually mature, ecologically sensitive, and socially responsible. In addition to that architectural education should also aspire to improve the quality of architectural output in general and architectural practice in particular and this can be done by fostering good contacts with practices.

Structuring the education towards the needs, challenges, and opportunities of Ethiopia and the contemporary globalizing world is the intention of the curriculum in general. But according to the curriculum, this can be achieved by providing a solid foundation in the understanding of economic, cultural, and environmental issues, plus strengthening the social responsibility of students, training students to work in team and communicate ideas in any media which will enable them to play their role as generalists and coordinator of interdisciplinary programs. Defining closer links between practice and theory as a continuous exchange of needs and ideas between the academic and the professional spheres will also help to achieve the above intention.

As stated in the curriculum, the rationale of this new adopted curriculum is the result of a discussion among representatives of different universities of Ethiopia based on the previous curriculum of EIABC. The revision which is taking place now is initiated by two fundamental facts which are harmonization and modularization. To improve the educational quality, Ethiopian ministry of education is running to have a harmonized curriculum throughout the nation. Based on this fact, representatives from all universities of Ethiopia were asked to come together and come up with a central curriculum which all can implement. Whereas the curriculum became modularized to enable learners to achieve the required competency after the compilation of some specific module as per the culture of the discipline/Architecture.

4.1.3.1.2. Professional Contexts / Graduate Profile

As it is mentioned the Ethiopian architectural curriculum follows the European standard where the acquisition of different abilities is stated. Among the expected abilities that the students will quire:

- An ability to create architectural designs that satisfy both aesthetic and technical requirements.
- Having Knowledge of the fine arts as an influence on the quality of architectural design,
- An adequate knowledge of the history and theories of architecture and the related arts, technologies, and human sciences,
- An adequate knowledge of urban design, planning and the skills involved in the planning process,
- An understanding of the relationship between people and buildings, and between buildings and their environment.
- An understanding of the profession of architecture and the role of the architect in a multidisciplinary team setup.
- An understanding of the structural design, constructional and engineering problems
- An adequate knowledge of physical problems and technologies so as to provide them with internal conditions of comfort and protection against the climate,
- The design skills necessary to meet building users' requirements within the constraints imposed by cost factors and building regulations,

4.1.3.1.3. Modules, Courses, and Programs

As mentioned in the rationale section, the architecture curriculum is structured in modules. Under the modules there are specific courses that will help the students achieve the general objectives of the modules. So, here in the architecture department among the listed 39 modules 13 are found to be related to multidisciplinary collaboration and they are presented in detail accordingly.

Table 4.4. Module and course list of Architecture department

Modules	Courses
General Studies	Communicative English Skill
	Basic Writing Skill
Economics and Civics/Logic	Civics and Ethical Education
	Reasoning and Logic
Graphic Communications	Communication Skills I - IV
Computer Aided Design	Professional CAD I
	Professional CAD 2
Project	Integrated Design Project I - IV
Professional Practice	Professional Practice I
	Professional Practice II
Workshops	Building workshop, I - II
Theory and Design of Structures	Theory and Design of Structures
	Advanced Building Structures
Building Sciences	Architectural Science I - IV
Urban Design and Planning	Basic Urban Design
	Introduction to Urban planning
Construction Management	Construction Management
Internship	Internship
Thesis	Bachelor Thesis Project

1. **Communicative and writing Skill** - is about educating students on how to smoothly communicate and convey their ideas to and with various professionals on their future endeavor both through oral and written form.

2. **Civics and Logic**

   2.1. **Civics and Ethical Education** - is about creating morally matured professional that is responsible while making decisions and taking actions.

   2.2. **Reasoning and Logic -** is about creating logical and open-mind professionals that weighs ideas and people rationally and that have logical reasoning skill in their day-to-day life

3. **Graphic Communications** - this course is intended to give the ability to act and to communicate ideas through speaking, numeracy, writing, sketching, drawing, and modelling with other professionals.

4. **Computer Aided Design** - This module will lead the way for students for a more complex usage of professional CAD software's for a more realistic presentation of their projects. And also, will enable them to present and share their architectural works it among other professionals. Autodesk AutoCAD and Revit are given in this course.

5. **Projects**

   5.1. **Integrated Design Project I** – the rationale of this course is understanding the integration of architectural design, construction, and structural design. The teaching and learning techniques include input lectures from architectural, construction and structural design team, Studio project handled jointly by the three teams, seminars and study visit are also part of this course.

   5.2. **Integrated Design Project I**I - this course is about understanding the integration of architectural design, urban design, and landscape design. The teaching and learning techniques include input lectures from architectural, urban, and landscape design team. Studio project handled jointly by the three teams, seminars and study visit are also part of this course.

   5.3. **Integrated Design Project III and IV-** deals with understanding the technological dimension of architecture with the focus of building sciences and services such as HVAC. And appropriate technology and cost-efficient methods. Studio project handled jointly by the three teams, seminars and study visit are also part of this course.

6. **Professional Practice** – this module is intended to give orientation toward a career in architectural practice. The role of an architect in the construction industry and in the making of the built environment, the relation and communication techniques of architects with other AEC professionals and entities such as client, other architects and AEC professionals, contractors, and other experts. It also includes about teaching teamwork and the role of various members.

7. **Workshops**

   7.1. **Building workshop, I – II** - Provide a practical understanding of building materials, construction techniques and structures through practical experience.

8. **Theory and Design of Structures** - This course introduces structural building systems and provides an understanding of basic and advanced structural engineering.

It also introduces the impact of the structural engineering discipline on the architectural design.

9. **Building Sciences -** this course is all about understanding any building related services like lighting, plumbing, sewage, heating, cooling ventilation/air conditioning/ and acoustics.

10. **Urban Design and Planning** - This course aims to equip students with theoretical, methodological, and practical skills to deal with complex urban design and planning problems.

11. **Construction Management** – this course is intended to enable students to understand principles and related topics of management such as human resource, finance…

12. **Internship** – this program will be able to provide the opportunity for expansion of knowledge and acquaintance with industry in the field of architecture and construction industry, typically aiming at developing practical skills related to the industrial in one or several of the following fields (depending on the type of industry and company profile) can be Design, Construction/Supervision or Management.

13. **Thesis -** The thesis is a comprehensive Architectural Design project which necessitates the coordination of other fields in the building design process. It comprises program preparation and design of buildings containing spatial, functional, and social aspect. A research paper will be produced which includes a complete construction document (drawing and written documents).

4.1.3.2. Civil Engineering

In this section Civil Engineering department's curriculum is reviewed and summarized. Information regarding the intention, rationale and outcome of the current updated curriculum, graduate profile of the students, available modules, programs, and courses in relation to multidisciplinary collaboration is presented.

4.1.3.2.1. Background and Rationale of the Curriculum

Civil engineering is also among the department that requires research, team working, leadership and business skills. The Civil Engineering School aims to produce

professionals equipped with relevant knowledge, skills and attitude that would contribute to the development of the country. Therefore, this is a profession by which many Ethiopians would be nurtured to serve the country.

As stated in the curriculum the concern on competence-based education has been advocated more widely in the 21st century. Quality education and international competition are challenging the educational institutions and their curricula. In view of that, the higher education sector has been internationalized; hence, institutions and disciplines are expected to compete on a global level. Creating strong link between professional practice, institutional design, program curriculum and implementation are the rationale of the curriculum. This, in turn, implies that the move towards competency-based education is very essential for curriculum organization and, students centered learning-teaching strategy. Therefore, to improve the educational quality, Ethiopian ministry of education is running to have a harmonized and modularized curriculum.
The purpose of the harmonization is to:

- Avoid confusion of graduates and the job market
- Make degrees comparable and readable
- Increase international competitiveness
- Share resources of all types
- Improve the relationship among stakeholders
- Serve the purpose of National Qualification Framework (NQF)

Whereas the purpose of modularization is to organize, group and structure the existing courses based on their general intention. Common courses as common and discipline specific courses as professional.

4.1.3.2.2. Graduate Profiles

The developed professional profile clearly indicates that Civil engineers need a good grasp of mathematics and design, and the ability to manage and liaise with a wide variety of people. Students are supposed to think in all dimensions and communicate ideas effectively. This kind of engineering is suited to people who are practical with a creative characteristic. Hence, the graduates from the Civil Engineering Department are expected to have the following profile:

- An ability to apply knowledge of mathematics, science in a specialized area

related to civil engineering

- An ability to critically analyze and interpret data, in major Civil Engineering areas, Structures, Transportation, Water resources, and Environmental.

- An ability to analysis and design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, constructability, and sustainability, in selected major Civil Engineering area.

- An ability to function in multidisciplinary teams,

- An ability to communicate effectively, orally and in writing.

- An understanding of professional and Ethical responsibilities of civil engineers in relation to public and private institutions.

- Recognize of the need for professional licensure and life-long learning. A broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

- An ability to use the Techniques, skills, modern Engineering Tools, and software necessary in selected major Civil Engineering area, such as Structures, Transportation, Water Resources, or Environmental.

- An understanding of professional practice issues such as project management and interactions between the development, design, and construction professions.

- An understanding of the role of the leader and leadership principles and attitudes.

4.1.3.2.3. Modules, Courses, and Programs

Civil engineering curriculum is structured in modules with a general goal, under these modules there are specific courses that will help the students achieve the general goal of the modules. So, among the listed 33 modules 9 modules are found to be related to multidisciplinary collaboration and they are presented in detail accordingly.

Table 4.5. Module and course list of civil engineering department

Modules	Courses
Basic communication skills	Communicative English Skills
	Basic Writing Skills
Civics and Ethics Education	Civics and Ethical Education
Reasoning and Logic	Introduction to Logic
Basic Engineering Skills	Introduction to Engineering Profession
	Engineering Drawing
Workshop Practice	Workshop Practice
Advanced Engineering	Computer Programming
Building Engineering	Building Construction
	Fundamental of Architecture
Industry Practice	Internship
Research/ Project	Integrated Civil Engineering Design
Contract management	Construction Management

1. **Basic Engineering Skills**

   1.1. **Introduction to Engineering Profession -** this course will enable students to understand engineering profession as a whole Interrelations and distinction among other engineering fields, science and technology, technical professional levels, qualifications and duties & responsibilities of technicians, technologists, and engineers (carrier structures and levels).

   1.2. **Engineering Drawing -** is about educating students the common language between professionals in the AEC industry. It will teach students how to draw and read building plans and drawings. It will also introduce drafting software packages such as AutoCAD.

2. **Building Engineering**

   2.1. **Fundamental of Architecture -** The course includes introduction to architecture with regards to climatic condition, landscape architecture and aesthetic design. It also deals with the drawing of architectural, structural, plumbing, electrical and connection detail aspects. Reviewing of plans and drawing of other engineering structure are also included in the course.

3. **Research/ Project -** In this module students will perform a comprehensive design project using their knowledge acquired from pervious modules with a team approach requiring interaction with practitioners, development of a team project report and a formal presentation.

4. **Construction Management** – is a course which will able the students to understand functions of management, roles of managers and levels of management in construction and fully understand project management knowledge areas such as integration, scope, time, cost, quality, human resource, communication, risk, and procurement management. And the students will have the ability to understand functions of management, roles of managers and levels of management in the overall construction management process and much more.

4.1.3.3. Construction and Technology Management

In this section Construction and Technology Management (COTM) department's curriculum is reviewed and summarized. Information regarding the intention, rationale and outcome of the current updated curriculum, graduate profile of the students, available modules, programs, and courses in relation to multidisciplinary collaboration is presented.

4.1.3.3.1. Background and Rationale of the Curriculum

The notable economic growth and the consecutive rapid expansion of construction industry in Ethiopia and becoming a complex and risk-laden venture results in high demand for having professionals on the field of construction technology and management. According to the curriculum, gaps are observed in construction technology, construction engineering and construction management on the execution of construction projects. Inefficiencies in construction projects management, inadequacies in the adaptations of various construction technologies and techniques, etc. call for having an integrated profession beyond the design aspect at all phases of project life cycle. Moreover, the expansion of infrastructure, the rapid urbanization, the transformation to industry, etc. require more effective and efficient construction professionals that are able to operate beyond the design and engineering aspects.

The program is aimed primarily at training professionals required for managing constructing projects with efficient and effective management system, administer contracts, conduct researches to identify real problems on site pertaining to construction management, methods & materials, and find better solutions It will produce well qualified managing engineers knowledgeable in construction engineering areas of structural, geotechnical and highway engineering, at the same time those graduates will also have extensive knowledge of construction technology and project management skills, and can be actively engaged in the planning, development and management of construction or infrastructure projects.

4.1.3.3.2. Graduate Profile

Graduate profiles are statements that describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and attitude that the students acquire through the program. Some of the profile of B.Sc. graduates of Construction Technology & Management is presented as follows:

❖ Read, analyze, and understand technical drawings and specifications.

❖ Conduct inspection and supervision by checking and measuring works for accuracy and fit to specification.

❖ Ensure that construction projects are executed as per the design & specification.

❖ Manage efficiently construction works and integrate constraints and requirements of both manpower and construction machines.

❖ Administer contracts, make legal agreements uphold construction codes and maintain professional ethics.

❖ Graduates will demonstrate an ability to apply current knowledge and adapt to emerging application of mathematics, science, engineering, and technology related to construction methods and design.

❖ Graduates will demonstrate the ability to communicate (graphically, verbally, and nonverbally) and function effectively in teams.

❖ Graduates will demonstrate sufficient understanding of professional, ethical, and social responsibilities, and show a respect for diversity and knowledge of contemporary professional, societal, and global issues.

4.1.3.3.3. Modules, Courses, and Programs

COTM curriculum is structured in modules with a general goal, under these modules there are specific courses that will help the students achieve the general goal of the modules. So, among the listed 29 modules 11 are found to be related to teamwork or multidisciplinary collaboration and they are presented and described accordingly.

Table 4.6. Module and course list of COTM department

Modules	Courses
Communication Skills	Communicative English Language Skills
Humanities, Social Science and Natural Science	Critical Thinking
	Introduction to Emerging Technologies
	Moral and Civic Education
Basic Engineering Skills	Engineering Drawing
	Workshop Practice
	Computer Programming
Drafting and Construction Working Drawing	Construction drafting and Working Drawing
	Computer Aided drafting
Architectural planning and design	Architectural planning and design
Resource Management	Human resource Management in Construction
Internship	Internship
Construction Technology	Modern Construction Technology and BIM
Project	Holistic Project and Introduction to Construction Profession

1. **Drafting and Construction Working Drawing -** Students shall be able to read, able to draft and able to work on computer-based designs.

    1.1. **Construction drafting and Working Drawing** –As the main communication language in construction is drawing, drafting, and working drawing are basic for construction technology. After the completion of this module the students will prepare design drafts and able to communicate with graphics.

1.2. **Computer Aided drafting** - The objective of the course is to give hands on practice and theoretical knowledge of how to use computers for drafting. At the end of the course, the students should be able to demonstrate the use of Auto CAD.

2. **Architectural planning and design -** This module emphasizes on one of the skills associated with building technology which could be said as aesthetics and architecture. Building construction technology is very close to the work of architects to build any type of structures. Hence, a basic knowledge about the field of Architecture is important for construction technology graduates.

3. **Resource Management in Construction** – it is about how to manage resources allocated for the specific project optimally including human resource.

4. **Appropriate Construction Technology**
   4.1. **Modern Construction Technology and BIM** - The course is designed for students to gain knowledge over the recent advances in construction technology. It also presents a basic grounding on BIM technology and its benefits, potential applications in construction industry, and likely implementation issues. The course includes teaching them about Integrated design and construction, Use of BIM, BIM execution plan, creating a BIM model, group collaboration tools, clash detection, 4D, 5D, and 6D applications with BIM, and MEP placement in buildings.

5. **Project**
   5.1. **Holistic Project -** an interdisciplinary project work. In this Course students are expected to apply skills learned in the areas of construction and management previously as well as in the same semester to develop an ideal or real project and plan it from inception to completion. Accordingly, students will be given incomplete Architectural drawing and then they will be expected to do the under listed specific tasks.

4.1.3.4. Electrical Engineering

In this section Electrical engineering department's curriculum is reviewed and summarized. Information regarding the intention, rationale and outcome of the current updated curriculum, graduate profile of the students, available modules, programs, and courses in relation to multidisciplinary collaboration is presented.

4.1.3.4.1. Background and rationale of the curriculum

Since the inception of electrical engineering department in the late 1950's, it has trained most of the Electrical, Electronic and Computer Engineers in the country. However, in recognition of the growing influence from the market and need in the development of the country's educational systems, the school currently runs the following undergraduate programs in 5 different streams namely Electronic Communication Engineering, Computer Engineering, Electronics Engineering, Industrial Control Engineering, Power and Energy Engineering.

The current version is basically a refinement of the previous program with additional emphasis on relevant and practical training, and with strong linkage with the industry. The curriculum includes courses that would help students acquire practical and innovative skill, communication, and managerial skills. Furthermore, recently from the government sector (MOSHE) there have been a proposal on the development of some fresh man courses to consolidate the students' educational background for higher learning while providing important knowledge in Physics, Psychology, logical and critical thinking, geography, and history of Ethiopian and the horn, civics, emerging technologies and physical fitness then on the rest year of their education period engineering courses and practice oriented courses/modules will be given. The total duration to study and graduate from electrical engineering department is Five years or ten semesters.

4.1.3.4.2. Program Outcomes

The ability and skill that an electrical engineering graduate students will have after graduation is stated as follows:
- Able to understand the state of art techniques, devices, software, protocols.
- Proceeding in methodical approach to solve problems.
- Being a team member communicative, cooperative, and transparent.
- Working independently, assuming responsibility.
- Leading, motivating, and caring professionals.
- Managing the project, productions, manpower and resources cost effectively.
- Learning life-long, improving the skills, and exploring new areas.

4.1.3.4.3. Modules, Courses and Programs

Electrical engineering curriculum is also structured in modules with a general goal, under these modules there are specific courses that will help the students achieve the general goal of the modules. So, among the listed 46 modules 7 are found to be related to teamwork or multidisciplinary collaboration and they are presented accordingly.

Table 4.7. Module and course list of Electrical engineering department

Modules	Courses
Basic communication skills	Communicative English Language Skill
Common courses	Reasoning and Critical Thinking
	Introduction to Emerging Technologies
	Moral and Civic education
Basic Engineering Skills	Engineering Drawing
	Introduction to engineering profession
	Workshop
Computing	Computer Programming
Modern Trends in Electronics Engineering	Modern Trends in Electronics Engineering
Project and Presentation	Semester Project
Internship	Industry Internship

1. **Basic communication skills** - is about educating students on how to smoothly communicate and convey their ideas to and with various professionals on their future endeavor. At the end of this course, students will be able to express themselves, listen and comprehend to talks, read, and understand texts written in English, write in English as academically and socially desirable, learn and develop their English on their own, learning to learn: the language and the skills.

2. **Common courses**

   2.1. **Reasoning and Critical Thinking -** is about creating logical and open-mind professionals that weighs ideas and people rationally and that have logical reasoning skill in their day-to-day life.

   2.2. **Introduction to Emerging Technologies -** This course will enable students to explore current breakthrough technologies in the areas of Artificial Intelligence, Internet of Things and Augmented Reality. Besides it will prepare them to use technology in their respective professional preparations.

   2.3. **Moral and Civic education** – is about creating morally matured professional that is responsible while making decisions and taking actions.

3. **Basic Engineering Skills**

   3.1. **Engineering Drawing** – is about educating students the common language between professionals in the AEC industry. It will teach students how to draw and read building plans and drawings. It will also introduce drafting software packages such as AutoCAD.

   3.2. **Introduction to engineering profession** – this course will enable students to understand engineering profession as a whole like the interrelations and distinction among other engineering fields, science and technology, technical professional levels, qualifications and duties & responsibilities of technicians, technologists, and engineers (carrier structures and levels).

4. **Modern Trends in Electronics Engineering** - This course is intended to have a dynamic content in which the main objective is to help students get an up-to-date knowledge and be acquainted with.

5. **Semester Project** – this project will be given to the students on their final years with the intention that students will collectively use the whole lesson they have used to addresses specific problem areas in their field of specialization.

4.1.3.5. Mechanical Engineering

In this section Mechanical Engineering department's curriculum is reviewed and summarized. Information regarding the intention, rationale and outcome of the current updated curriculum, graduate profile of the students, available modules, programs, and courses in relation to multidisciplinary collaboration is presented.

4.1.3.5.1. Background and Rationale of the Curriculum

As mentioned in the curriculum, starting from the inception of mechanical engineering (1963) in Ethiopia up to the last reviewed curriculum of the department in 2018 more than 2000 students are graduated from this department. However, recently stakeholders and employers have expressed their concerns that graduates of this department lack practical and innovative skills. This lack has been coupled by deficiency in communication and managerial skills of the graduates. Therefore, it is believed that there needs to be a revision in the curriculum and all the necessary changes are believed to be addressed in the updated version.

As mentioned in the curriculum the rationale/objective of Mechanical Engineering Education up to now was to educate trainable, broad-based mechanical engineers that can fit in the different applications areas of mechanical engineering. The curriculum has been revised several times using the experience of the staff gained from USA, England, Germany, and Italy. Though there have been several attempts to accommodate the needs of the local industry, it was not done in a strategic way to fill the skill gap of the graduates. In fact, it was supposed that the industries have to streamline graduates to their particular area by giving them practical on-the-job training for about one year. However, the School was able to recognize that most of the industries that have been employing mechanical engineers are small and medium-sized and do not have senior engineers for coaching the new recruits. As a result, the school is convinced that it is necessary to make the education more practice-oriented and focused to the different areas of industrial applications in order to make the engineers more productive.

As a reference, the major changes which were made in 2013 (older curriculum) include the following:

a. More practice-oriented courses were added.
b. The practical education aspect of each course was enhanced and made explicit
c. A six-month industrial internship was introduced in the 8th semester.
d. The education is streamlined to different areas of employment.

4.1.3.5.2. Graduate Profile

Regarding the student's strong background during the five year/ ten semester study period a B.Sc. mechanical engineering graduate can accomplish the following tasks after a brief period of on-job training:

➢ Represent machine and parts drawing manually and/or with CAD software

➢ Understand operating principles of machinery and systems

➢ Design small machinery, piping and other systems

➢ Conduct strength analysis of machine components

➢ Plan production process and assembly of parts

➢ Determine and optimize production costs

➢ Determine lay-out of machinery and supervise machinery installation.

➢ Manage maintenance of equipment

➢ Control quality of products

➢ Optimize energy utilization in plants

➢ Manage operation of thermal power plants, renewable energy, and HVAC systems

4.1.3.5.3. Program Outcomes

An undergraduate Mechanical Engineering program is designed to provide to the students a sufficiently broad and deep base of the following requirements:

1. Design a system, component, or process to meet desired needs within realistic constraints.

2. Ability to function in multidisciplinary team

3. Ability to communicate effectively

4. Ability to identify, formulate and solve engineering problems

5. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

4.1.3.5.4. Modules, Courses and Programs

Mechanical engineering curriculum is also structured in modules with a general goal, under these modules there are specific courses that will help the students achieve the general goal of the modules. So, among the listed 32 modules 9 are found to be related to teamwork or multidisciplinary collaboration and they are presented accordingly.

Table 4.8. Module and course list of Mechanical engineering department

Modules	Courses
Common courses	Basic English Skills
	Civics and Ethical Education
	Reasoning Skill
	Introduction to Emerging Technologies
Basic Engineering Skills	Engineering Drawing
Computing and Programming	Computer Programming
General Workshop Practice	Workshop
Electrical Engineering	Electrical Engineering
Industrial Internship	Industrial Internship

1. **Engineering Drawing** – is about educating students the common language between professionals in the AEC industry.
2. **Electrical Engineering** – is a cross disciplinary course that will help mechanical engineers understand about the relationship of their field with the electrical one.
3. **Industrial Internship** – This module is intended to provide a platform for the students to practice their knowledge, so that they can gain pre-job experiences and develop their professional abilities. As a part to holistic development the students are going to join a project covering the ideas of many of the courses that they have studied; Such projects if done by the students, definitely, will improve their practical knowledge and ability to carry the future challenges in the field of mechanical engineering. Moreover, it might sometimes involve the students to work in a multidisciplinary team setup.

4.1.3.6. Urban Planning and Design

In this section Mechanical Engineering department's curriculum is reviewed and summarized. Information regarding the intention, rationale and outcome of the current updated curriculum, graduate profile of the students, available modules, programs, and courses in relation to multidisciplinary collaboration is presented.

4.1.3.6.1. Background and Rationale of the Curriculum

Urban Planning is a technical and political process concerned with the development and design of land use and the built environment, including the infrastructure passing into and out of urban areas, such as transportation, communications, and distribution networks. The training of an urban and regional/design planner starts with an undergraduate course in urban and regional planning. Urban planning and related programs are offered by different Ethiopian public institutions. Among them the oldest and the first one is EIABC, Addis Ababa University. This university is giving the Urban planning and design department under the name "Urban and Regional Planning" for over 60 years.

Due to the current Ethiopia's reform of education sector in accordance with the national vision and national development goals, the curriculum was supposed to amend the existing curriculum corresponding to new education development roadmap and changes in program structure. According to draft Ethiopian Education Development Roadmap, it is observed that the curricula of higher education institute (HEI) are not geared toward the development of employability and other lifelong learning skills among graduates like practical, communication and managerial skills. In line with new roadmap, the curricula revision for undergraduate Urban and Regional Planning program is intended to strengthen old modular approach by focusing on the above-mentioned skills. To attain these, the committee come up with a harmonized version of the old curriculum on the basis of the following considerations.

- Harmonizing the curriculum with the new freshman (Pre-engineering) program
- Exemption of some previous common courses and redundant courses
- Introduction of new courses believed to increase competency of the program

4.1.3.6.2. Graduate Profile

A career in urban and regional planning requires knowledge of planning philosophy, analytical methods, problem formulation and resolution, law and local government, and the aesthetic, cultural, social, economic, ecological, and physical characteristics of human settlement. Because of the interdisciplinary emphasis of the program and the ever-evolving roles of the professional planner graduates can expect to perform several types of activities in a variety of settings over their careers. They will be specifically concerned with:

- The use of land in the city, in the suburbs, and in rural areas
- The design of the city and the surrounding region so as to facilitate the activities in which people need and desire to engage.
- Settlement systems and the location of human activities in urban and regional space
- The distribution of resources, benefits, and costs among people.
- The anticipation of change and its impact on how people do and can live.
- Participation of citizens in planning processes which affect their future; and

4.1.3.6.3. Required Competences of Urban and Regional Planners

Urban planners have to work individually, in teams, in small and large groups and for this there will be requirements of skills to be productive. Below are some of the required skill sets.

- **Analytical skills:** Urban and regional planners analyze information and data from a variety of sources, such as market research studies, censuses, physical studies, and environmental impact studies. They use statistical techniques and technologies such as Geographic Information Systems (GIS) in their analyses to determine the significance of the data.
- **Communication skills**: Urban and regional planners must be able to communicate clearly and effectively because they interact with colleagues and stakeholders, prepare research reports, give presentations, and meet with a wide variety of audiences, including public officials, interest groups, and community members.

- **Decision-making skills:** Urban and regional planners must weigh all possible planning options and combine analysis, creativity, and realism to choose the appropriate action or plan.
- **Leadership skills:** Urban and regional planners must be able to manage projects, which may include overseeing tasks and planning assignments.
- **Software skills:** Urban and Regional Planners must be skilled on design software's such as AutoCAD, GIS, illustrator, InDesign, Photoshop, Revit, etc.…

Project Management skills: Managing resources (personnel, financial and IT). Before work commence, it is vital to identify a team with the right mix of skills and realistically estimate the time frame and budget required to get the job done

4.1.3.6.4. Modules, Courses and Programs

URPL curriculum is also structured in modules with a general goal, under these modules there are specific courses that will help the students achieve the general goal of the modules. So, among the listed 29 modules 10 modules are found to be related to teamwork or multidisciplinary collaboration and they are presented accordingly.

Table 4.9. Module and course list of urban planning and design department.

Modules	Courses
General Courses	Communicative English Language Skills I, II
	(Logic) Critical Thinking
	Introduction to Emerging Technologies
	Moral and Civic Education
	Computer programming
Graphical communication	Sketching, Drafting and Descriptive Geometry
Computer Aided Design	AutoCAD
Basic Architectural Design	Basic Architectural Design I, II
Internship	Internship
Urban Infrastructure	Building Construction Technology for Urban Planner
Professional Practice	Professional Planning Practice

1. **General Courses**
   1.1. **Communicative English Language Skills** - This course will help the students to participate effectively in group discussions and team assignments and able to communicate orally and in written form.
   1.2. **(Logic) Critical Thinking** - is about creating logical and open-mind professionals that weighs ideas and people rationally and that have logical reasoning skill in their day-to-day life.
   1.3. **Moral and Civic Education** - is about creating morally matured professional that is responsible while making decisions and taking actions.
2. **Graphical communication** - This course aims at developing the skills needed for documenting designs using drawings and for performing graphical analysis of two dimensional and three-dimensional problems.
3. **Computer Aided Design** - The objective of this course is to introduce CAD and basic Application areas. Students will work on AutoCAD to carry out basic drawing tasks and practical urban project using AutoCAD software.
4. **Basic Architectural Design** – this course is about understanding of the basic dimension of architecture, gaining knowledge of the interdependence of construction and composition ability to design a building according to a given construction system and present a project with the appropriate media.
5. **Internship** - This module is intended to provide a platform for the students to practice their knowledge, skills, and attitudes so that they can gain pre-job experiences and develop their professional abilities. Such projects will improve students' practical knowledge and ability to carry the future challenges in the field of URPL. Moreover, it might sometimes involve the students to work in a multidisciplinary team setup.
6. **Building Construction Technology for Urban Planner** – the objective of this course is to enable the students understand stages of construction and their planning requirements, construction methods, materials, technique, and process.
7. **Professional Planning Practice** – this course is given with the intention of teaching planning ethics and equip with tools for successful practice in planning profession. Understanding the role and responsibilities of professionals involving in the planning sector, knowing how to interact with planners and stakeholders in the city and region such as politicians, bureaucrats/ administrators, media, judiciary, academia, NGOs, civil society, and other involved parties.

4.1.3.7. Summarized Data of Curriculum Review

On this section a summarized table is prepared for the above curriculum review. Information that will be useful to proceed the research are collected from curriculum of every department, structured, and summarized in a tabular format for ease of understanding.

Table 4.10. Summarized data of the curriculum review

Topic	Department					
	Architecture	**Civil**	**COTM**	**Electrical**	**Mechanical**	**URPL**
Rationale of the current updated curriculum	• Train students for teamwork and communication through various means.	• Creating strong link between professional practice and educational training	• Training professionals required for managing constructing projects with efficient and effective management system	• Create strong linkage with the industry. • Emphasis to help students acquire practical, communication, and managerial skills.	• Create strong linkage with the industry. • Emphasis to help students acquire practical, communication, and managerial skills.	• Emphasizing towards the development of employability and lifelong learning skills like practical, communication and managerial skills.

Table 4.10 (cont.)

Graduate profile and expected outcome of the curriculum	• Ability to contribute and establish the appropriate influence in a multidisciplinary team setup.	• Ability to function in multi-disciplinary team setup • Communicate effectively	• Ability to motivate and create an organization that work in team • Ability to communicate and function in a multidisciplinary team setup.	• Ability to be communicative, cooperative, and transparent team member. • Ability to be a leading, motivating, and caring professional.	• Ability to function in multi-disciplinary team setup • Communicate effectively	• Ability to have communication and software skills to interact with various market stakeholders and AEC professionals
Communication and behavior related modules/courses.	• Basic communication skills, • Civics and ethical education, • Logic, and reasoning	• Basic communication skills, • Civics and ethical education, • Logic, and reasoning	• Basic communication skills, • Civics and ethical education, • Logic, and reasoning	• Basic communication skills, • Civics and ethical education, • Logic, and reasoning	• Basic communication skills, • Civics and ethical education, • Logic, and reasoning	• Basic communication skills, • Civics and ethical education, • Logic, and reasoning

Table 4.10 (cont.)

Graphical communication courses	• Graphical communication (Drawing and sketches) • CAD & Revit	• Engineering drawing • CAD	• Construction drafting and Working Drawing • CAD	• Engineering drawing • CAD	• Engineering drawing • CAD	• Graphical communication (Drawing and sketches) • CAD
Cross/inter disciplinary courses	• Theory and Design of Structures • Urban design, and planning	• Fundamentals of architecture	• Architectural planning and design		• Electrical engineering	• Basic Architectural Design
Holistic projects and management courses	• Integrated design projects • Professional practice • Building science • Construction management	• Introduction to Engineering Profession • Building construction	• Holistic Project • Introduction to Construction Profession • Construction technology and BIM	• Introduction to Engineering Profession	• Introduction to Engineering Profession	• Building Construction Technology • Professional practice
Practical program	• Internship	• Internship	• Internship	• Internship	• Internship	• Internship

4.2. Data Analysis

As described in the methodology section, in this research a Convergence triangulation method is used to analyze and extract result from the different data. Convergence triangulation method allows a researcher to have a comprehensive understanding about a single phenomenon after investigating it by using multiple triangulation techniques (Mathison 1988). Unlike the sequential method, in convergence method the data gathered from various sources by using different techniques will be reviewed and analyzed simultaneously (Hong et al. 2017). Here in this section also the data gathered from questioning the students, interviewing the practicing academicians and curriculum revisors and reviewing the curriculum are analyzed simultaneously to have a comprehensive understanding if multidisciplinary collaborative approach is being addressed in the existing curriculum.

In this section I have tried to compare, contrast, match, and extract information (Triangulate) from the gathered data regarding multidisciplinary collaborative approach in the current AEC education sector. In order to do that, I looked into areas like the Rationale/reason and the anticipated outcomes of the current/updated curriculum, asses how the education sector is linked with the market, how multidisciplinary collaboration is being addressed both in the market and education sector, what modules, courses, projects, and programs are incorporated to practice multidisciplinary collaboration and how do the respondents perceive multidisciplinary education system in general.

4.2.1. Rationale of the Curriculum

I believe that understanding the general intention and rationale of the current updated curriculum might give an insight about the main goals that the education sector is trying to achieve. During the data collection period I observed that the Ethiopian AEC education sector is using a previously designed curriculum. However, to accommodate periodically advancements and improvements revision and amendment process will take place with in every five years. As showed in Curriculum Review the last updated curriculum of every department has been reviewed by the researcher. So, on these revised curriculums I was interested to investigate if there are any intention that might relate to multidisciplinary collaboration among the intention/focus area of each curriculum or

among the reasons to update the previous curriculum in each department. Information regarding the general intention of the curriculum and the rationale of the current update can be found from both the interview with curriculum revisors, and the curriculum review data.

Looking into the interview data it showed that according to the curriculum revisors' taught the collective intention of the AEC curriculum is to produce students that are "self-sufficient, creative, competitive, skillful, responsible, problem solver, knowledge full and multi-stranded". Whereas data from the curriculum review shows something more than that. Referring to Table 4.10 it can be understood that the intention of the updated curriculum is to create students with more practical, communicative, innovative, and managerial skills beyond their personal capabilities. The reason for this is due to the comments from market stakeholders saying that graduates of the previous curriculum lack practical, innovative, communication and managerial skills. The data from the interview made with practicing academicians also showed similar thing, which they have specifically stated that there is a lack of professional with basic communication, collaboration, and coordination skills which negatively affect their company's productivity.

Regarding the rationale of the current update, data from the curriculum review, specifically Table 4.10 indicated that beside other reasons for example architecture department has updated the curriculum to additionally focus on training students for better teamwork and communication ability. Whereas in COTM department focus has been given to the management and communication skills of the students throughout the whole construction process and in the rest departments the reason of the update was to improve the curriculum to focus more on the practical, communication and managerial skills of students by creating a strong link with the market. Therefore, in order to achieve these skills in the updated curriculum some modules, courses and programs are incorporated. For example, communication and behavior related modules are incorporated which contains courses like Basic communication skills, Civic and ethical education, Logic, and reasoning, graphical communication skills like drawing, sketches, and CAD. Practical program such as internship and workshops are also incorporated. For the managerial aspect of the curriculum some holistic modules are also incorporated such as introduction to engineering profession, professional practice, building construction process and holistic projects are among the additions.

So, in general from the above analysis the intention of the curriculum and the rationale of the current update can be collectively understood as following. The intention of every curriculum is beyond creating students with various personal skills, practical, innovative, communication and managerial skills are also becoming the main notion of the newly developed curriculums. The rationale of the current updated curriculum is also regarding to the above notion where the common reason to update the previous curriculum is to create a strong link with the market so that the education sector will be able to train students according to the market requirement for better employment opportunity. The required skill sets that are recommended by the market stakeholders are practical, communicative, innovative, and managerial skills.

In a multidisciplinary team setup where various composing ideas may arise from, it is crucial that team members have a good communication skill so as to collaborate and enhance team productivity. Therefore, regarding the intention and rationale of the current updated curriculum, communication skills are among the focus point that the education sector is trying to achieve, and this can be seen as a positive input towards achieving a multidisciplinary education system.

4.2.2. Outcome / Graduate Profile of the Curriculum

On this section the anticipated outcome of the curriculums and graduate profiles are evaluated regarding multidisciplinary collaboration. During the curriculum review, I observed that there are lists of things that are stated under the outcome of the curriculum and graduate profile of every department. According to the curriculum review the outcome of the curriculum is a list of skill sets that the curriculum is designed to help students achieve whereas the graduate profile is the skills that the students will acquire after learning by that specific curriculum. In this section I investigate if there are any anticipated skills that students are expected to acquire regarding multidisciplinary collaboration. However, in order to get the summarized output, I triangulated the data from all the three sources.

Information regarding the outcome of the curriculum, the expected skills that students will acquire, the students' beliefs on what they really acquired from their education period and the observation of practicing academicians regarding the

collaborative skill of students are simultaneously analyzed from the curriculum review, the questionnaire data, and the interview.

Looking at the outcome of the curriculum and graduate profile from Table 4.10 (summery of the curriculum review) it can be seen that beside the various list of things that the curriculum is trying to achieve, each department have the intention to train their students the ability to function and communicate in a multidisciplinary environment. For example, in the Architecture department among the listed outcomes of the curriculum, ability to contribute and establish the appropriate influence in a multidisciplinary team setup is one of them. Also, in civil, electrical, and mechanical department it is specifically stated that students are expected to acquire the ability to function and communicate effectively in a multi-disciplinary team setup. Whereas in the COTM department students are expected to acquire the ability to motivate, create and even lead an organization that work in team. And in addition to that in URPL department training software skills for effective communication are also the expected outcome of the curriculum. Therefore, from this it can be understood that collectively from every department the curriculums have the intention to train the students the ability to motivate, influence, function, communicate, cooperate, and interact effectively in a multidisciplinary team setup.

However, looking to the questionnaire data Table 4.1 students believe the opposite regarding the collaborative skills that they acquire from the curriculum. For example, regarding the questions whether they believe their education period prepared them in terms of multidisciplinary collaboration 61% of them said no! for the question that their education period taught them to work in a multidisciplinary work environment 56% of them said no! and for the question that whether their education period taught them about the benefits of multidisciplinary work trend 58% of them said no! also the data from the interview with the practicing academicians Table 4.2 supports the above data where practicing academicians do not believe that the education sector is providing capable students to the market regarding multidisciplinary collaboration.

In addition, looking into the interview data with the curriculum revisors it showed that according to their taught the collective outcome of the AEC curriculum is to produce students that are "self-sufficient, creative, competitive, skillful, responsible, problem solver, knowledge full and multi-stranded". Accordingly, in their response I noticed that the word collaborative is not stated even once, and this might imply that in the minds of the curriculum reviewer's collaboration didn't get that much of an attention like the other skills.

Therefore, here from the above paragraphs it can be understood that even if the ability to function and communicate in a multidisciplinary work environment is mentioned as the expected outcome of the current AEC curriculums, other data showed that attention is more given to other practical and personal skills. And this might create the gap between skills that students are expected to get and what they really got regarding multidisciplinary collaboration.

4.2.3. Multidisciplinary Collaboration in the AEC Curriculums

In this section multidisciplinary collaboration in the current curriculum of AEC departments is analyzed by using the data gathered from various sources. Since understanding if multidisciplinary collaboration is being addressed in the current curriculum is the notion of this research analyzing it in detail will be helpful. I asked students, practicing academicians and curriculum revisors about their observation regarding multidisciplinary collaboration in the current curriculums, and I reviewed the curriculums in relation with the same aspect. Following, the data from the above investigation is analyzed below.

Starting from the curriculum review as it is specifically stated in the program outcomes and graduate profile, Table 4.10, other than the personal and practical skills students are also expected to acquire the knowledge and ability to communicate effectively and function in a multidisciplinary team setup. According to the Curriculum Review one of the common reasons to update the previous curriculum of all departments was the current Ethiopia's reform of education sector in accordance with the national vision and national development goals. Regarding this the curriculums were supposed to amend the existing curriculum corresponding to new education development roadmap and changes in program structure. On this education development program new courses have been introduced regarding the basic skills that a student needs for higher education program. Among those the ones that are believed to be related with collaboration are basic communication skills, logical and critical thinking and civics and ethical education. According to Jutraz and Zupancic (2014) basic communication, critical thinking and ethical skills are required to be productive in a multidisciplinary team setup. Beside the above additional courses proposed by the government bodies there are also other cross disciplinary courses, holistic projects, and practical programs, which are believed to help

students acquire the cross disciplinary knowledge that will help them to function effectively in a multidisciplinary team setup.

Similarly, the data from the interview with curriculum revisors showed the same thing, where curriculum revisors also mentioned that the current curriculum is trying to achieve multidisciplinary collaboration by giving cross disciplinary courses among related departments, meaning course from one department is given to the other. For example, as it is showed on Table 4.10 structural design and urban planning is given for the architecture department, architectural design is given for both civil, COTM and URPL students whereas electrical engineering course is given for mechanical department students. This way they believed the curriculum keep students informed about other related building science.

However, in contrary to the above the questionnaire data showed opposite result, where more than half of the surveyed students believed to be equipped with the knowledge of job demarcation and personal responsibility but not that of multidisciplinary collaboration, benefits of it and how to perform in a multidisciplinary work environment/team setup. Also, from the interview data of the practicing academicians, they claimed that the curriculum is not providing a capable student regarding multidisciplinary collaboration rather it become the responsibility of the market to teach the graduates on how to collaborate, communicate and coordinate in a work environment. And this sometimes become a drawback to the companies' productivity, because according to their observation graduates lack basic communication and conflict resolution skills plus, they also show other negative behaviors such as destructive criticism, persistence to change and unwillingness to accept others' ideas during teamwork. However, on the other side practicing academicians didn't completely deny the effort of the current curriculum where for example, new teaching learning technique is being experimented the so-called higher diploma program (HDP) where creating collaboration and interaction between students to teach each other is one of its strategies. In addition, they also mentioned that the current education program is giving various cross disciplinary course from one department to other with an intention of creating awareness between students of related fields. Holistic and common courses are also among the improvements with the intention to teach students the common knowledge that they need to have while working together.

So, collectively from the above analysis even if data showed that students didn't believe they get what is expected from the curriculum regarding collaboration and the

market believes the curriculum is not creating collaborative professionals, the effort and improvement of the updated curriculums should be also taken under consideration.

4.2.3.1. Modules, Courses, and Programs

From the previous sections of this chapter, it is observed that the curriculums of all AEC departments are trying to equip the students the anticipated ability to perform in a multidisciplinary work environment. And according to the curriculum review this is being done by the introduction of various modules, courses and programs that can help students to have the ability of communication, collaboration, and coordination in a multidisciplinary team setup. Therefore, evaluating these courses, modules, and programs of the different departments will help to understand in what way multidisciplinary collaboration is tried to be addressed in the current education sector. Data from the curriculum review, interview with the curriculum revisors and questionnaire with the students will be used to analyze the general situation.

Referring to Table 4.10 of the curriculum review section modules, courses and programs are categorized by their objectives. As it is observed in the Curriculum Review section every department is following modularized curriculum. According to Rodriguez (2020) curriculum modularization means the grouping and categorization of various courses according to their objectives. This is also similar in the Ethiopian education curriculum. so, among the various available modules and courses in the AEC curriculum the ones that relates with the notion of this thesis are selected and analyzed as follows.

The first category is communication and behavior related modules. This module is a new addition in the current updates of every department which is proposed by the education related government body MOSHE due to the country's education reform in accordance with the national vision and development goals. The module consists of courses that specifically address the basic skills that a student should have for his/her higher education program. Among the various courses in this module Basic communication skills, civic and ethical education and logic, reasoning and critical thinking are the selected ones for this research. This is because I believe that the skill and knowledge that will be earned from these courses will be a good input to achieve the ability to effectively communicate in a multidisciplinary team setup. For example, basic communication skills have the objective of teaching the students the ability to express

themselves both orally and in written form wherever it is needed. Whereas logic, reasoning and critical thinking is about presenting one's own idea in a logical and reasonable way and critically evaluate and accepting others' ideas. Civic and ethical education is about creating morally sound professionals that takes responsibility and think about the effect of their decision on others. According to Fruchter and Townsend (2003) it is important that a team member should have the above qualities for a smooth communication and better productivity in a multidisciplinary work environment.

The second category is graphical communication skills. This module consists of courses that are useful for students to present ideas graphically and prepare digital documentation to collaborate with other AEC professionals. The courses that are available under this module are engineering drawing and computer aided design (CAD). Like the previous module these courses can also be found in all the AEC departments. The questioner data also showed similar thing where more than 65% of the students from all the department witnessed that they have learned "Engineering Drawing" course. According to the course description one of the objectives of Engineering drawing is to teach students about technical drawing as a language to communicate with other professionals in the AEC industry. This includes reading and understanding various drawings of different disciplines and also preparing their own by using their hand or computers (CAD). Regarding the detailed course description Autodesk Auto CAD is one of the software that is given for every department in their CAD course and additionally Autodesk Revit for the architecture department. And from what practicing academicians discussed during the interview, they use these software to collaborate among the various professionals in the building industry, and the same goes to other countries (Hansu, Qiwei, and Bin 2007).

The third category is cross disciplinary courses. These modules consist of various courses that are being given from one department to another related department, for example as presented on Table 4.10 architecture department students take structural and urban design course, civil, COTM and urban students take architectural design and course whereas mechanical students take electrical engineering course. From the interview data of both practicing academicians and curriculum revisors, I learned that this is a technique used by the education sector to create interdepartmental communication and aware students about relating AEC fields other than their own. And this information is also supported by the data from the questionnaire where 57% of students witnessed that they have learned building science subjects other than their own field.

The fourth category is Holistic projects and management courses. In this module various courses are found that teaches students about the whole building construction and management process. However, for this research management of human resource is taken into consideration. It is fact that various parties are involved in the whole construction process starting from professionals up to government bodies, market stakeholders and even the society, so it will be crucial for the involved parties to communicate, coordinate and collaborate to deliver a project successfully. And the objective of this module is to teach students both the building construction process and the collaboration and communication aspect of the construction process among various parties. The available courses in this module are Integrated/Holistic design projects, Professional practice, Building science and construction, Construction management, Introduction to Engineering/construction Profession, Modern construction technology and BIM. But not all the above courses are being given in every department. For example, professional practice is a course found in the architecture and urban department, in this department students are taught about the different parties that involves in the building construction industry, the individual responsibility of every professional, the involvement stage of different professionals and communication and conflict resolution techniques among them. The questionnaire data also indicates that more than 55% of architecture and urban students said their learned job demarcation of different professionals during their education period.

Integrated design project is also a course in the architecture department where students are taught the different aspects of building science such as the structural, lighting, plumbing and HVAC systems by professionals of the field then students are expected to design a project by taking the above science under consideration. And similar thing goes for the COTM departments, in the holistic design project students are expected to do a project starting from the design up to construction documentation and students are taught to learn how to use, instruct and manage different building construction professional in their construction management course. One more course that is given in the COTM department is modern construction technology and BIM. The objective of this course is to teach students about the recent advancements in construction and management technology. It presents a basic grounding on BIM technology and its benefits. The course includes teaching them about Integrated design and construction, use of BIM, BIM execution plan, creating a BIM model, group collaboration tools, clash detection, 4D, 5D, and 6D applications with BIM, and MEP placement in buildings. Also, on the

questionnaire data from fifty COTM students forty-six of them (88%) witnessed that they have learned BIM during their education period. However, in contrary to that, the data additionally showed that majority of architecture students also believe they "somehow!" learned collaboration tools and processes like BIM, but the course called modern technology and BIM was only found in the COTM curriculum. In this case, understanding the contradiction between the two data was necessary. Taking a close look at the course list of the architecture department there is a course called "computer aided design (CAD)". According to the course description it consists of teaching students a software called Autodesk Revit, and from the information gained both on the interview with practicing academicians, where they said they use Revit for modelling and collaborating with other staff member, and during BIM seminars Autodesk Revit is also discussed as one tool for collaboration, I grasped an understanding that such information might affected the perception of architecture students about collaborative tools in the AEC industry.

Moreover, Introduction to Engineering Profession is a course that is commonly given in the engineering departments in AAIT; civil, electrical, and mechanical. The objective of this course is to enable students to understand engineering profession as a whole like the interrelations and distinction among other engineering fields, science and technology, technical professional levels, qualifications and duties & responsibilities of technicians, technologists, and engineers (carrier structures and levels). 60% of the surveyed engineering students also witnessed that their education period equips them with the knowledge of job demarcation and personal responsibility.

Last but not list industry internship is one of the programs that is found in every AEC department. Internship is a program that exempt students to search for a company in the market that works on their field and get hired as an intern for at least 1 semester (6 month). This program is introduced with an intention of allowing students to link theory to practice in the workplace by doing real project, work with experienced engineers and develop a work discipline on the way. Moreover, the internship program is also intended to introduce students what their future carrier will be like and their position on the market. In the curriculum review its also mentioned that internship can also be a good way of enhancing connection between the market and the education sector. But during analyzing, I observed that an internship program can play a great role towards training students about multidisciplinary collaboration. As observed in the interview data with practicing academicians there are companies that in house different AEC professionals and practices multidisciplinary collaboration in some way, therefore by using the internship programs

student might have the chance to join such kind of companies and experience participating in a multidisciplinary work environment.

However, even if students are learning with such holistic and cross disciplinary courses the questionnaire data indicated one more thing, which is 65% of surveyed students collectively agreed that there are no multidisciplinary group assignments or projects that will able the students to work as a team from different AEC departments. Students also mentioned that despite their friendship from other departments most of them they do not work/help on assignments together. There are also no such assignments found during the curriculum review that goes beyond teaching cross disciplinary courses and let students solve problem together as a multidisciplinary team setup.

4.2.4. Multidisciplinary Collaboration in the Market

In this section the status of multidisciplinary collaboration in Ethiopia's AEC market is analyzed. I believed that understanding this aspect can give a general overview on the level of awareness and application of multidisciplinary collaboration in Ethiopia's AEC industry. The data collected from the interview with practicing academicians and curriculum revisors is used to analyze the above point.

Looking at the data of the interview with practicing academicians Table 4.2 information is collected regarding the work trend of different Ethiopian AEC companies and their belief toward the current market regarding multidisciplinary collaboration. For instance, question regarding the kind of project delivery methods that the companies use was asked and among the six respondents five of them said they use the design build method whenever it is necessary. Design build project delivery system is a method where a company takes a project to execute both the design and construction task (Eastman et al. 2008). And such type of PDM requires effective collaboration between multidisciplinary professionals. Therefore, this might mean two things, either the company need to in house all the required multidisciplinary professionals or need to collaborate with outsiders in order to deliver its promises. However, on the following questions where they are asked to list AEC professionals involved in their company among the 6 companies 5 of them already in house multidisciplinary AEC professionals such as architects, engineers, and construction managers. They also mentioned that they practice multidisciplinary collaboration work trend inside their companies through

performing periodical discussion, and teamwork among the available professionals. One respondent even claim that their company uses Autodesk Revit as a collaboration tool among the architectural and structural team.

Regarding their experience on the market, questions have been also asked concerning their observation on how multidisciplinary collaboration is being practiced on the market. Respondents mention that design bid build and design build are the two most widely used project delivery systems in the current Ethiopia's AEC industry. But to achieve the multidisciplinary work trend that the project delivery method requires, professionals are trend in the market with the basic communication, collaboration, and coordination skills. Apart from that during these days (the time where the research took place; 2021) various activities are taking place such as companies are trying to perform knowledge transfusion by working with foreign companies, BIM and collaboration related panel discussion has been taking place also urban planning association was working towards the proliferation of collaborative working trend through preparing seminars and panel discussions. However, it is also worth to mention that according to their observation both their companies and the market in general are being highly challenged by lack of collaborative professionals, personal behaviors, and unprofessionalism. And this data can be supported by a research done on challenges affecting the Ethiopian construction industry by Mengistu and Mahesh (2020) where lack of collaboration and professionalism were among the various factors that negatively affect the constructions productivity.

In general, it can be said that even if the market is facing drawbacks like lack of collaborative professionals the above data shows that Ethiopia's' AEC market is showing some effort towards a multidisciplinary work trend. And this is being done by in housing multidisciplinary professionals, collaborating with foreign companies, using collaboration tool/software, and executing a holistic project delivery method like the design build where both design and construction will take place in one company.

4.2.5. Link between the Market and Education Curriculum

Referring back to the Rationale of the Curriculum under the data analysis section where the common reason to update the previous curriculum is to train students according to the market need by creating a strong link with the market itself for better employment

opportunity. Therefore, analyzing the link between the market and the education sector will able me to understand how and by what means the education sector is trying to fulfill the need of the market regarding collaboration. For this analysis both the data from the curriculum review and the interviews is used.

Looking at the curriculum review data almost in all departments creating a strong link with the market and professionals practice is mentioned. For example, in the architecture department the curriculum aspires to improve the quality of architectural output by fostering good contacts with practices. In civil department, creating strong link between professional practice, institutional design, program curriculum and implementation are the rationale of the curriculum. In COTM department, the program is aimed primarily at training professionals the practical skill of managing constructing projects by focusing on the professionals practice of the market. Whereas in both electrical and mechanical engineering the reason to update the curriculum was by the comment of market stakeholders, companies, and employers. This process of commenting and amending that took place between the market and the academics can be also supported by the data gathered from the interviews. All the three respondents from practicing academicians and curriculum revisors of the engineering department in AAIT witnessed that there is a continuous evaluation and feedback on the curriculum and graduate profile by the market stakeholders and government bureaus, and this system created a confidence on the companies to hire graduates directly from the campus. This way curriculum revisors in AAIT believes that they keep the link between the education and the market. However, in the case of EIABC the interview data from curriculum revisors showed something different, which is even if there is an interest to evaluate the curriculum in an integrated manner with the market stakeholders, the representatives do not show any interest to participate on the evaluation process of the curriculum and provide feedback. The data form the interview with the practicing academicians also supported the above information, which all three respondents from EIABC said that the interaction of education sector and market is minimal. The reason that they give for their observation was the architecture and urban department specifically mentioned that there is a conflict of interest between the education sector and the market, and the reason they gave was the education sector is focusing on personal skills, futuristic and theoretical knowledge of students whereas, as the market need more of practical and collaborative professionals (as showed in section 4.2.4) also respondent from the COTM department

raised his concern that the curriculum might not be able to respond to every need of the market.

Moreover, one more additional observation regarding the curriculum evaluation and revision process is, even though the curriculum revisors mentioned that in the revision and evaluation process various academicians, practicing professionals, market stakeholders and government officials do participate, the curriculum in every department is still reviewed independently, meaning only the academicians, professionals and stakeholders of that specific department are participating but not from other disciplines rather professionals from other department will be needed to comment or come up with a course outline regarding a cross disciplinary course that he/she might give.

In general, from what is observed from the above analysis even if the intention of enhancing the employment opportunity and fulfilling the market's need through creating a strong link with the market itself and professionals practice is mentioned in every curriculum of the AEC departments the practicality of it is not similar for all the departments and the multidisciplinarity is not taken under consideration.

4.2.6. Perception about Multidisciplinary Education System

In this section the response of all respondents such as students, practicing academicians and curriculum revisors is investigated to understand their perception about multidisciplinary education system and this helped me to get an insight about the awareness level within the AEC industry in general. Information regarding the respondent's perception is analyzed from both the questionnaire and interview data.

Data from the questionnaire and interview with the practicing academicians implicates that both the students and practicing academicians do not have a clear knowledge about multidisciplinary education system, whereas the curriculum advisors had their own understanding and definition about it. For example, CRP1 (Curriculum revisor participant 1) Said that it is a system that will teach students how to communicate with other professional", CRP2 said that "it is a system that can create a generation that believes in a teamwork.", CRP3 said that "it is education method that help to maintain the integrity of related departments." CRP4 said that "it is a system that will help to create knowledge of working together with other professionals." Whereas CRP5 and CRP6 said that "it is about teaching collaborative skills for students to work with other disciplined

professionals" and "it is about teaching the value of different disciplined professionals in a teamwork" respectively. From their definitions it can be observed that their perception is not far from the definition presented in this research. Which is multidisciplinary education system (MES) for the AEC industry means the system of teaching and learning students on how to collaborate coordinate and communicate with professionals and stakeholders in various AEC fields (Amarnath, Sawhney, and Uma Maheswari 2011).

After the above question and presenting the definition of MES in the research respondents have been asked whether they believe such kind of system is being applied in the current AEC education sector or not. From the surveyed 260 students 74% of them said no! and other respondents also claimed that it is not being practiced in the current education curriculum and they agreed on the addition of such approach to the current education system. And the reasons for that was practicing academicians said that the market can focus on its productivity instead of teaching graduate professionals on how to collaborate. Whereas the curriculum revisors said that it can give an additional quality/skill for the graduates that will widen their employment opportunity and MES by itself will help the AEC departments to collaborate with each other. Furthermore, during the interview they have been also asked on how such system can be incorporated or implemented in the current education system, and they suggested incorporating educational training regarding collaboration, multidisciplinary assignments/projects, lectures, workshops, and extracurricular activities.

In addition, data gathered from the interview with curriculum advisors as well talks about the effect of the department category on the MC in the AEC industry. From the literature review section, I observed that there is an architecture – engineering division in the AEC industry of developed countries which emanated from the university structure where architecture university is separated with the engineering university (O'Brien, Soibelman, and Elvin 2003). This scenario has also been observed in Ethiopian context as showed in the case study section where EIABC incorporates architecture and design-based fields where as AAIT have engineering departments. So, in order to know the reason behind, a question has been incorporated to curriculum reviewers. Looking to their response, most respondents said that the reason of such division between architecture and engineering departments has no connection with the nature of the departments rather, it emanated from personal, political, and administrative issues. However, two respondents had different perspective, which they believe that this division is emanated from the nature of the departments. Meaning design fields are more of subjective whereas

engineering fields are objective, and they believe that this difference affected the whole structure of AEC.

Therefore, in general according to the above analysis it can be observed that among the respondents only the curriculum revisors have an understanding about multidisciplinary education system (MES). And their understanding was found to be close with the definition and concept of MES which is provided in the research. Moreover, according to the definition and concept of MES respondents witnessed that such system is not being applied in the current education curriculum and they agree on the addition of it. This is because they believed that such education system can equip students with a collaborative skill, minimize the markets workload regarding training graduates on how to collaborate and maintain the integrity of AEC departments. However, the architecture-engineering division observed in the AEC industry should be taken under consideration so that it will not be a drawback for an effective implementation of multidisciplinary education system in Ethiopia.

CHAPTER 5

SUMMARY, CONCLUSION AND RECOMMENDATION

This chapter includes the summarized output of the data analysis and the conclusion where I present discussions regarding the research questions and identifies the potential of the current curriculums towards a multidisciplinary education system by using SWOT analysis. At last, in relation to the output of the SWOT analysis the recommendation is presented.

5.1. Summary

The following are the extracted summaries from the data analysis regarding the the intention and rationale of the current updated curriculums regarding multidisciplinary collaboration, the expected outcomes of the curriculum and methods used to achieve multidisciplinary collaborative skills of students in every department, the status of multidisciplinary collaboration in Ethiopia's AEC market and its link with the education curriculum and lastly regarding the perception of students, practicing academicians and curriculum revisors regarding multidisciplinary education system.

So, in general from the analysis the intention of the curriculum and the rationale of the current update of every curriculum is beyond creating students with various personal skills, rather practical, innovative, communication and managerial skills are also becoming the main notion of the newly developed curriculums for students' better employment opportunity. In a multidisciplinary team setup where various composing ideas may arise from, it is crucial that team members have a good communication skill so as to collaborate and enhance team productivity. Therefore, regarding the intention and rationale of the current updated curriculum, communication skills are among the focus point that the education sector is trying to achieve, and this can be seen as a positive input towards achieving a multidisciplinary education system.

From the analysis it can be understood that in every department the ability to function and communicate in a multidisciplinary work environment is mentioned as the expected outcome of the current AEC curriculums, however students didn't believe they

get what is expected from the curriculum regarding collaboration and the market also believes the curriculum is not creating collaborative professionals. But this does not mean that there is nothing in the curriculums that is incorporated to address the above required skills. Various modules, courses and programs do exist that can help students to have the ability to function and communicate in a multidisciplinary team setup.

In the updated curriculum behavioral and communication modules, cross disciplinary, holistic and management courses and internship program exist that are believed to equip students communicative, collaborative, and coordinative skills. However, data showed that none of them consists enough multidisciplinary activities such as group assignments, projects, lectures, workshops multidisciplinary group assignments or projects that goes beyond teaching cross disciplinary courses and let students to work or solve problem collaboratively with other AEC departments together as a multidisciplinary team setup.

Regarding the status of multidisciplinary collaboration in the AEC market, the data shows that even if the market is facing drawbacks like lack of collaborative professionals, Ethiopia's' AEC market is showing some effort towards a multidisciplinary work trend. And this is being done by in housing multidisciplinary professionals, collaborating with foreign companies, using collaboration tool/software, and executing a holistic project delivery method like the design build where both design and construction will take place in one company. Furthermore, various activities such as knowledge transfusion by working with foreign companies, BIM, and collaboration related panel discussion, awareness creation towards collaborative working trend can also be some of the implications.

According to the analysis the scenario where the market stakeholders, companies, governmental offices, and the education sector work together on the evaluation, feedback and revision process of the curriculum might be a good indicator to show the link between the market and the education sector. However, the practicality of it is not similar for all the departments and the multidisciplinarity of it is not taken under consideration. Meaning the above process doesn't always take place in both institutes, even sometimes there might be a conflict of interest between the education sector and the market. According to the data this happened due to lack of interest observed in the market stakeholders to participate in the evaluation process of the curriculum. Moreover, in both universities the curriculum of each department is reviewed independently, meaning only the

academicians and stakeholders of that specific department are participating but not from other disciplines.

Regarding to the perception of respondents regarding multidisciplinary education system it can be observed that among them only the curriculum revisors have an understanding about multidisciplinary education system (MES). And their understanding was found to be close with the definition and concept of MES which is provided in the research. Moreover, according to the definition and concept of MES respondents witnessed that such system is not being applied in the current education curriculum and they agree on the addition of it. This is because they believed that such education system can equip students with a collaborative skill, minimize the markets workload regarding training graduates on how to collaborate and maintain the integrity of AEC departments. However, the architecture-engineering division observed in the AEC industry should be taken under consideration so that it will not be a drawback for an effective implementation of multidisciplinary education system in Ethiopia.

5.2. Conclusion

In this section, discussion regarding the research question is presented. This research investigates whether there is any intention to address the collaborative, communicative and coordinative skills of the students in the current Ethiopia's AEC education curriculums, if there are any expected multidisciplinary collaborative skills that the students will acquire by learning with the existing curriculums, if there are any available modules, courses or projects that help the students develop multidisciplinary collaborative skills and finally understand the perception of students, academicians and practicing professionals regarding the multidisciplinary collaborative approach of the current AEC curriculums and multidisciplinary education system in general. After finding answers for the research questions the potential of the current AEC curriculums towards achieving a multidisciplinary education system is also identified by using a SWOT analysis.

Regarding the first question where this research tried to identify if there is any intention of the current AEC curriculums to address the collaborative, communicative and coordinative skills of the students, the data analysis showed that the current AEC curriculums are not specifically designed in an interdisciplinary or multidisciplinary

manner to address the collaborative skills of the students However, addressing the communication skills of the students was among one of the reasons to update the curriculums, and from what is observed in corporatefinanceinstitute.com (2020) communication is among the basic skills required to perform in a multidisciplinary work environment. Therefore, it can be said that the intent of improving the curriculum for the communicative skills of the students can be considered as a positive input to achieve multidisciplinary collaboration.

The second question is regarding the expected outputs and skills that the students will acquire by learning with the existing curriculums. The data analysis showed that paper wise in every department it is mentioned that the students are expected to get the ability to function in a multidisciplinary team setup. However, from the response of the students, they do not believe that they have enough knowledge and practical collaborative skills to work in a multidisciplinary team setup. In addition, the practicing academicians also witnessed that the education curriculum is not providing collaborative professionals for the industry. Therefore, it can be said that even if it the ability to function in a multidisciplinary team setup is listed as the expected outcome of the investigated curriculums the practicality of it is under question.

Regarding the third question which is about identifying the availability of various modules, courses and program that might help the students to develop a multidisciplinary collaborative skill. As it is observed on the benchmark researchers tried to come up with collaborative capstone courses, multidisciplinary design projects, interdisciplinary studios and so on. In this research the data analysis also showed that different verbal and graphical communication modules, cross disciplinary courses and integrated design projects were available. However apart from equipping cross disciplinary and theoretical knowledge none of them consists enough practical multidisciplinary activities that let students to work collaboratively with other AEC departments together as a multidisciplinary team setup.

Finally, regarding the perception of involved parties such as students, academicians and practicing professionals regarding multidisciplinary education system (MES) the analysis showed that there is lack of awareness. From all the respondents only the curriculum revisors have a close understanding about MES. Moreover, according to the definition and concept of MES respondents witnessed that such system is not being applied in the current education curriculum and they agree on the addition of it. This is because they believed that such education system can equip students with a collaborative

skill, minimize the markets workload regarding training graduates on how to collaborate and maintain the integrity of AEC departments. However, they also mentioned that the architecture-engineering division observed in the AEC industry should be taken under consideration so that it will not be a drawback for an effective implementation of multidisciplinary education system in Ethiopia.

Finally, by using the output of the data analysis this research identified the potential of the current curriculums of the AEC departments towards achieving a multidisciplinary education system in Ethiopia by using a SWOT analysis. The strength weakness opportunity and threat of the current curriculum is described as follows.

5.2.1. Strength

From the updated curriculum of the AEC departments features that needs to be maintained for the future improvement of the curriculum towards a multidisciplinary education system are observed and described.

From what is observed during the analysis the intention and the rationale of the current updated curriculums of every department is beyond creating students with only personal skills, rather practical, communication and managerial skills are also becoming important. In a multidisciplinary team setup where various composing ideas may arise, it is crucial that team members have a good communication skill so as to collaborate and enhance team productivity. Therefore, the intention of the current curriculum to enhance communication skills of the students can be seen as a positive input towards achieving a multidisciplinary education system.

In addition, the ability to function and communicate in a multidisciplinary work environment is one of the commonly expected outcome and graduate profile of every department. Accordingly, various modules, courses and programs are found to be help full to achieve multidisciplinary collaboration skills. Communication and behavior related courses, cross disciplinary and management courses, holistic projects, and practical programs are those that are believed to help students acquire multidisciplinary knowledge and skills for an effective collaboration with different AEC professionals.

Furthermore, the analysis also showed that there is a good link between the education sector and the market, where the curriculum review process takes place in participation of both academicians and market representatives. Various invited and

practicing professionals, company owners and stakeholders have the opportunity to express their concerns and needs regarding the curriculum and graduate profile of students. Then responsible academicians and government officials will be the ones to discuss and amend the curriculum accordingly. This way the education sector believes that the needs of the markets are being achieved and companies will be confident enough to directly hire qualified students according to their requirements from the education institutes. So, this collaboration between the education sector and the market is observed as strength, where it needs to be maintained and applied towards the advancement of the current education sector to a multidisciplinary education system.

5.2.2. Weakness

In contrast to the strength some weaknesses have been also observed in the current curriculums of AEC departments that might be a drawback towards the advancement of the current education sector to a multidisciplinary education system.

As stated on the curriculum review the ability to function and communicate in a multidisciplinary work environment is one of the commonly expected outcomes of every department. However, regarding the perception of the curriculum revisors collaborative skills of the students didn't get that much of an attention like the other skills. Therefore, the gap created between the curriculum revisors' belief and the curriculums' intention might be a draw back for further advancement.

In addition, according to the curriculum in order to equip students the ability to function and communicate in a multidisciplinary work environment various communication and behavior related modules, cross disciplinary and management courses, holistic projects, and practical programs are incorporated. However, the analysis implicates that there are not enough multidisciplinary activities such as lectures, group assignments or projects that goes beyond teaching cross disciplinary knowledge and let students solve problem together as a multidisciplinary team setup. Therefore, such situation might act as a drawback for further advancement towards a multidisciplinary education system.

Last but not least, according to the data analysis enhancing the employment opportunity of students by fulfilling the market's need was the intention of the curriculum in every department. However, the practicality of it is not similar for all where in some

departments practitioners are not even willing to participate in the evaluation process, not only that but also while the curriculum evaluation process is taking place multidisciplinarity is not taken under consideration, meaning only parties from that department are involved. And this situation might loosen the integrity of AEC departments and as a drawback for further advancement.

5.2.3. Opportunity

During analyzing some opportunities are also observed which can be a good input towards the advancement of the current AEC curriculum to a multidisciplinary education system. According to the analysis communication and behavior related module is proposed by the government for every department regarding Ethiopia's reform of education sector in accordance with the national vision and development goals. This module consists of courses like Basic communication skills, Civic and Ethical education and Logic, Reasoning and Critical thinking. And I believe that the knowledge acquired from these courses might be a good input to achieve the ability to effectively communicate in a multidisciplinary team setup. Therefore, it can be said that whether it is intentional or unintentional the countries education reform program can be a good opportunity towards the advancement of the current education sector to a multidisciplinary education system.

In addition, the analysis also implicated that Ethiopia's' AEC market is showing some effort towards a multidisciplinary work trend and in accordance with this the market is looking for collaborative professionals. As per the curriculum review the education sector tries to meet the market requirement to enhance the students' employment opportunity. And in order to do that the curriculum of every department go through evaluation process by practicing professionals, market stakeholders and government bodies and get amended accordingly. So, this evaluation, feedback, and amendment process as per the market need is observed as an opportunity, where there might be a chance for the education sector to observe the markets evolution towards a multidisciplinary work trend and adapt similar approach for the education system too.

5.2.4. Threat

During analyzing how multidisciplinary collaboration is being addressed in the current curriculums of AEC departments, some situations have been observed that might be a threat towards the advancement of the current education sector to a multidisciplinary education system.

As observed in the analysis even if the curriculum is trying to achieve to equip its students the ability to function and communicate in a multidisciplinary work environment by incorporating various modules, courses and programs, the students' beliefs on what they really get from the curriculum are opposite. The majority claimed that their education period didn't prepare them well for their career in terms of collaboration, educate them about the information requirement of other related discipline, the benefit of multidisciplinary work trend, and train them to work in multidisciplinary work environment. Not only that but also practicing professionals claimed that the curriculum is not providing capable graduates in terms of collaboration. And this might mean that there could be a gap between what is written and what is practiced. Therefore, such kind of gap might be an obstacle for the advancement of the education sector.

Moreover, in the analysis it is also observed that among the respondents only the curriculum revisors have an understanding about multidisciplinary education system (MES). Under normal circumstance this could have been considered as a positive point, but in this situation students and professionals are also a constituent of the industry in general, so their lack of awareness about multidisciplinary education system might be a threat for future advancement.

Lastly, from what is observed in the literature review the architecture-engineering division in the education sector might have an effect in the market too, where architecture and engineering professionals develop prefer working in silos instead of collaborating to each other. Such kind of scenario have also been observed in the AEC industry of Ethiopia too. Where the educational institutes are separated because of some reasons. According to the thought of curriculum revisors, some said that it is because of personal, political, and administrative issues, whereas the others believe it is because of the nature of the departments where design fields are more of subjective whereas engineering fields are objective. But whatever the means is such division might be an obstacle for an effective adaptation of multidisciplinary education system in Ethiopia.

5.2.5. Summary of the Conclusion

The points raised in the conclusion discussed before, which are strength, weakness, opportunity, and threat of the current curriculum for a multidisciplinary education system is summarized and presented in a tabulated format below.

Table 5.1. Summery of the conclusion

The current updated curriculums of AEC departments	
Strength	✓ Communication skills of the students are among the focus point that the education sector is trying to achieve ✓ Equip students the ability to function and communicate in a multidisciplinary work environment ✓ Communication and behavior related courses, cross disciplinary and management courses, holistic projects, and practical programs ✓ Curriculum review process takes place with the participation of both academicians and market representatives
Weakness	✓ In the minds of the curriculum revisors, collaboration didn't get that much of an attention like the personal and technical skills. ✓ Not enough multidisciplinary activities found that goes beyond teaching cross disciplinary knowledge and let students solve problem together as a multidisciplinary team setup. ✓ Not all market representatives participate in the revision process ✓ The curriculum revision is intradisciplinary
Opportunity	✓ Ethiopia's educational reform help introduce new courses ✓ Ethiopia's' AEC market is showing some effort towards a multidisciplinary work trend and the market is looking for collaborative professionals.
Threat	✓ Misunderstanding between what the curriculum expects as an output and what students believe they got ✓ Only the curriculum revisors have an understanding about multidisciplinary education system ✓ Architecture-engineering division in the education sector might have an effect in the market too

5.3. Recommendations

The final section of the research includes recommendations based on the conclusion. Since the conclusion is presented in SWOT format, the recommendation is about maintaining the strength, improving the weakness, using the opportunity for further advancement, and avoiding the threat of the current curriculum so as to incorporate multidisciplinary education system in the AEC education sector.

Regarding the strength of the current curriculum, I observed that the AEC education sector is trying to create a strong relation with the market in order to enhance the employment opportunity of the students by equipping them with the necessary skills that the market needs. According to the feedback of the practicing professionals and market stakeholders other than practical and innovative skills the market also requires communication and managerial skills of the students. In a multidisciplinary team setup where various composing ideas may arise, it is crucial that team members have a good communication skill so as to collaborate and enhance team productivity. So, according to the feedback various communication and behavior related modules, cross disciplinary and management courses, holistic projects, and practical programs are incorporated in the newly updated curriculum. Therefore, the above-mentioned strength should be maintained and develop further for the advancement of the current education sector toward a multidisciplinary education system.

However, regarding the weakness the curriculum revisors recommends the equal participation of every professional and market stakeholders of each department in the curriculum revision process so that conflict of interest between the education and the market will be minimized. Not only that but also the curriculum revision would be better if it is multidisciplinary instead of the interdisciplinary approach where only academicians, practicing professionals and stakeholders from that specific department participate. Because according to Lloyd-Jones et al. (1998) in a multidisciplinary curriculum revision process, there will be an integrated collaboration between various parties of different departments on the overlapping areas, which will result an integrated output that manifest the relationship of AEC fields in the industry. In addition to the above both practicing academicians and curriculum revisors also recommend the addition of various curricular or extracurricular multidisciplinary activities such as lectures, workshops, assignments, and projects among the different AEC departments. Such

activities are believed that they will enhance the theoretical and practical knowledge of students regarding communication collaboration and coordination skills for a multidisciplinary work environment. The students also believe that IT will also facilitate multidisciplinary collaboration.

The opportunities observed from the analysis can be also a good support for the improvement of the education sector to a more collaborative approach. Following the educational reform of Ethiopia communication and behavior related modules have been incorporated in every department of the country. This will help the AEC education sector to equip its students with the basic communication, ethics, logic, and reasoning skills that might be a requirement for an effective multidisciplinary collaboration. Therefore, this improvement can be seen as an opportunity where some of the required skills for an efficient collaboration is already enforced by the government into the education sector. And this will ease the additional effort needed to foster a multidisciplinary education system in the current curriculum. Apart from that the countries development towards a multidisciplinary collaborative work trend will increase the desire of collaborative professionals and this will be of a great opportunity for the education sector to improve its teaching learning approach from interdisciplinary to a multidisciplinary system.

However various observed threats need to be dealt so that they will not be an obstacle for an advancement of the current curriculum towards MES. As observed from the analysis even if the expected outcome of every department is providing ability to function and communicate in a multidisciplinary work environment, the students respond the opposite. Therefore, regarding the above misunderstanding between the students' belief and the intention of the curriculum I recommend that the aim of the curriculum and the objective of each course should be introduced for the students in relation to the requirement and benefit of multidisciplinary collaboration so that they will be aware of the skill sets that they get after their educational training. Beside as mentioned in the third paragraph of this topic the curriculum should consist of practical multidisciplinary activities so that students will develop their theoretical knowledge to practical. In addition to that it can also increase the awareness of students about multidisciplinary education system. The last point that needs to be considered is the architecture engineering division of the institutes, however the recommended multidisciplinary curriculum revision process and coming up with an integrated curriculum for the AEC department might be able to minimize the gap created in-between.

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APPENDIX A

SURVEY QUESTIONNAIRE

Figure A.1. Google survey questionnaire for students of AAIT and EIABC

Figure A.1 (cont.)

Current Status *

◉ Graduate student

◯ 4th year post internship student

The university that you graduated from or you are currently learning in *

◯ AAIT - Addis Ababa institute of technology

◯ AASTU - Addis Ababa science and technology university

◉ EIABC - Ethiopian institute of architecture building construction and city development

◯ Other: _____

Department or field *

◉ Architecture

◯ Construction and technology managment

◯ Civil engineering

◯ Electrical engineering

◯ Mechanical engineering

◯ Water Supply and Sanitary Engineering

◯ Structural engineering

◯ Urban Planning and Design

◯ Landscape design

◯ Construction Materials Engineering

◯ Other: _____

Figure A.1 (cont.)

1. My education period has prepared me well for my career in terms of collaboration (teamwork) with multi-disciplined professionals (other than your field). *

Multi-disciplined (professionals) means it is a collection of various professionals with different departments/fields other than your own

- ○ YES
- ◉ NO
- ○ SOMEHOW

2. I have learned about the information requirements of AEC professionals other than my field. *

- ○ YES
- ◉ NO
- ○ SOMEHOW

3. I have learned collaboration tools and techniques that will help me to collaborate with other professionals, like BIM tools and processes (not only Revit but all the theories and concepts of BIM). *

- ○ YES
- ◉ NO
- ○ SOMEHOW

Figure A.1 (cont.)

4. I have learned the important skills of technical drawing which help as the language media between different professionals in the building life cycle, and this helps me to transfer my idea clearly to the other professionals. *

⦿ YES

◯ NO

◯ SOMEHOW

5. I have learned the job demarcation between the different professionals involved in building construction, and I clearly know what is required from me and others too. *

◯ YES

⦿ NO

◯ SOMEHOW

6. During my education period there was a good practice of collaborative (teamwork) teaching-learning trends with other multi-disciplined professionals. *

◯ YES

⦿ NO

◯ SOMEHOW

7. Did your academic training prepare you to work in a multidisciplinary environment? *

◯ YES

⦿ NO

◯ SOMEHOW

8. Did your academic training provide you knowledge about the benefits of multidisciplinary work trends? *

○ YES

◉ NO

○ SOMEHOW

9. Did your academic training provide you knowledge about other aspects of building science other than your field? *

◉ YES

○ NO

○ SOMEHOW

10. Did your current or past academic training provide you knowledge about the use of information technology (IT) for collaboration? *

○ YES

◉ NO

○ SOMEHOW

11. During your academic training was there a practice for multidisciplinary group assignments? *

○ YES

◉ NO

○ SOMEHOW

Figure A.1 (cont.)

12. I had/have friends from other construction fields inside the campus *

- ⦿ YES
- ◯ NO

13. I had/have friends from other construction fields outside my campus *

- ⦿ YES
- ◯ NO

14. Did you educate each other or work on assignments together? *

- ◯ YES
- ⦿ NO
- ◯ SOMEHOW

15. Do you know what a multidisciplinary education system (MES) means? *

Just say YES if you have a good idea of it, if NOT read the short description below

- ⦿ YES
- ◯ NO
- ◯ SOMEHOW

The description below will help you to answer the following 5 questions

Multidisciplinary education means as the name implies it is a technique of educating students the relation of their field with others, the limit of their responsibility, how to work together with other professionals as a team where it is required, making decisions by considering the other professions, giving a quick feedback for the information needs of others and much more. In general, it's educating students on how to collaborate, communicate and coordinate in a multi-disciplined team setup. (Amarnath, Sawhney, and Uma Maheshwari 2011b)

MES
stands for multi-disciplinary education system

16. Do you believe MES is being implemented in the current education curriculum? *

○ YES

◉ NO

○ SOMEHOW

17. Do you believe MES shall be incorporated into the current AEC education curriculum? *

◉ YES

○ NO

○ SOMEHOW

18. Do you believe MES would be beneficial to enhance the use of IT for team collaboration? *

◉ YES

○ NO

○ SOMEHOW

19. Do you believe MES would be beneficial for the AEC industry in general? *

◉ YES

○ NO

○ SOMEHOW

20. Do you think IT will facilitate MES? *

◉ YES

○ NO

○ SOMEHOW

End of Questionnaire.

APPENDIX B

INTERVIEW QUESTIONNAIRE 1

Table B.2. Interview questions for the practicing academicians

Interview about the existing work trend on the market regarding Multidisciplinary collaboration.	
Date:	Start & Finish Times:
Name:	Phone:
Department/Position:	Email:

The interview is estimated to take maximum 1 hour.

Interview answers will be organized depending on the interviewed person.

<u>INTERVIEWEE INFORMATION</u>

1. What is the organization you work for?
2. What is your job description?
3. What is your task in the organization?

<u>ABOUT THE ORGANIZATION WORKING PRACTICE.</u>

4. Can you mention the types of project delivery system your organization is practicing?
5. Can you name list of professionals that are working in your organization?
6. How do you practice multidisciplinary collaboration between professionals?
7. Do u think your organization is applying collaboration efficiently and effectively?
   a. If yes, how did you achieve it?
   b. If no, what do you think the problem is and its root cause?
   c. Do you have any suggestions on how to improve collaboration?

<u>ABOUT THE OUTSIDE MARKET</u>

8. Can you mention other project delivery systems that are being practiced on the market?
9. Can you name list of professionals that are generally involved in the building construction industry of Ethiopia?
10. How do you think multidisciplinary collaboration is being practiced on the market?
11. Is there any previous panel discussions/workshop held on AEC integration or any collaborative work trend?

ABOUT THE RELATION BEWEEN THE MARKET AND THE ACADEMICS

12. How is the academics responding to the market? And how do they inter feed each other?

13. Is the academics providing capable students to the market?

14. How do u think the academics is addressing the issue of multidisciplinary collaboration?

15. What will be your suggestion for improvement?

16. Have you heard about multidisciplinary education system (MES)?

17. Does the education system need such an approach?

18. Do you think it will be beneficial for the AEC industry? How?

19. Do u agree on the addition of MES in the current education system?

20. Do you think a graduate of MES be beneficial for the market? How?

End of interview.

APPENDIX C

INTERVIEW QUESTIONNAIRE 2

Table C.3. Interview questions for the curriculum revisors

Interview about the current education curriculum regarding Multidisciplinary collaboration	
Date:	Start & Finish Times:
Name:	Phone:
Department/Position:	Email:

The interview is estimated to take maximum 1 hour.

Interview questions will be organized from the following list of questions, depending on the interviewed person and/ or department.

INTERVIEWEE INFORMATION

1. What is your job description?
2. What is your task regarding the curriculum?

INFORMATION ON CURRICULUM RATIFICATION PROCESSES

3. Who are participating on the ratification process?
4. How is the curriculum being ratified? (Integrated or individual)

INFORMATION ABOUT THE CURRICULUM

5. What is the rationale behind the curriculum? (For your department)
6. Is there any link with other AEC departments?
7. If yes, how do u keep the connection with the other departments?
8. How is the current curriculum beneficial?

    a. for the market   b. for the students

9. How is multidisciplinary collaboration being addressed in the current curriculum?
10. Do u think there needs to be an improvement on the current curriculum? How?
11. What do u think about multidisciplinary education system/curriculum?
12. Do u suggest the introduction of collaborative courses in the curriculum?
13. How do u think multidisciplinary curriculum will be implemented?
14. How do u picture it happening?
15. What is the rationale between collecting AEC departments together or distributing them? What will be the advantage and disadvantage of it? **End of interview.**