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TACEESM 2020|23

Transforming Architectural and Civil Engineering Education towards a Sustainable Model - TACEESM

FINANCIAL AND INSTITUTIONAL SUSTAINABILITY STRATEGIC PLAN

(National University of Architecture and Construction of Armenia (NUACA) Foundation)

E+ CBHE - Application No 618883-EPP-1-2020-1-IT-EPPKA2-CBHE-JP - TACEESM
Project coordinator University "G.d'Annunzio" of Chieti-Pescara, Italy - international@unich.it

I. Mechanisms of the NUACA Plan to ensure the TACEESM project Sustainability

The Sustainability Plan of the NUACA TACEESM project is intended for the period after the end of the project lifetime. Its mechanisms aim to ensure the sustainability of its main results, achieved by the end of the project, particularly:

- developed 6 new courses are taught continuously within the curriculum on "073101.01.7 – Architecture" (3 of them are taught at the Bachelor study program level, and 3 - on Master study program level;
- the developed courses teaching materials are used by the teaching staff;
- the BIM new course teaching materials supports the BIM Master Degree Program;
- the established BIM laboratory equipment, as well as the acquired literature support the continuation of the new BIM MSc program;
- the teaching personnel trained with updated methodologies, and teaching-research equipment and material resources are involved in daily activities.

The dissemination and exploitation activities are planned to support the sustainability of TACEESM project results at the NUACA, particularly:

- events (organizing the meetings, seminars, round tables with high education policy makers, labor market representatives and other relevant stakeholders, etc.) aimed to increasing the interest to operating BIM study program;
- the online Platform developed within TACEESM project is in used continuously and popular among the users;
- continued development BSc/MSc courses;
- the stakeholders network developed within the TACEESM project is extended continuously and cooperation with field stakeholders is strengthen;
- continued cooperation with project partners through student and staff mobility, research cooperation and possible joint degrees and new projects.

Sustainability of the BIM MSc program will be based on:

- attractiveness, ensured by communication, quality assurance, permanent curricula evaluation and update, students' employability, employers' awareness;
- operational capacity based on the interconnection and involvement of the partner universities;
- NUACA will maintain the formed BIM laboratory and the new teaching environment and provide dedicated staff and regular financial resources.

The NUACA will work in a view to continuously improve the BIM study program, to increase its attractiveness and therefore realize students' recruitment. The main tasks are:

- evaluation of the study program by the main stakeholders (students, academic staff, employers) and adapted to meet the requirements of these stakeholders.
- promotion of students' employability and alignment with the labor market expectations.
- maintenance of strong interconnection and long-term stable cooperation between partners.

The success and sustainability of BIM MSs program is highly connected to the number and quality of students enrolled. Appropriate efforts will be made to increase the number of applicants and therefore the number of enrolled students based on settled requirements. In connection with this the criteria of students' selection will be updated to insure the high quality

of admitted students. Besides the financial stability will be provided through the identification of alternative funding sources (involvement of state funding, participation in new European or bilateral funding programs, find suitable public scholarships for local and international students, search for private scholarship from companies or foundations).

II. Academic & Institutional Sustainability

1. ***Comments on Courses/Study Programs created by the NUACA within the TACEESM Erasmus+***

Within the TACEESM Erasmus+ project the National University of Architecture and Construction of Armenia (hereinafter: NUACA) created 6 new courses for the existed curriculum on "073101.01.7 – Architecture" and one new BIM Management Master Degree Program.

The syllabi and teaching materials have been developed by the NUACA instructors for the following 6 new courses:

- BIM Technology (teaching on Bachelor Level, 2 ECTS)
- Architectural projection of contemporary construction systems (teaching on Bachelor Level, 3 ECTS)
- Territory Improvement and engineering development of area (teaching on Bachelor Level, 2 ECTS)
- Sustainable architecture (teaching on Master Level, 2 ECTS)
- Project management for architects (teaching on Master Level, 2 ECTS)
- Contemporary methods of preservation of historical environment (teaching on Master Level, 4 ECTS)

BIM Technology

The aim of the course is to endow the future Armenian architects with such sustainable and fundamental knowledge which would enable them to cooperate with the specialists of other building industry branches to the best advantage, such as constructors, specialists of electro mechanics, infrastructure engineers and others in steadily changing conditions of construction market, with BIM technologies from the very beginning stage of design up to the construction end and exploitation/operation. Mastering these technologies, they will acquire skills so as to contribute to the following important factors:

- improving of the design process quality and efficiency, quick and harmonious application of design changes as a result of collaboration with engineers of different professions;
- improving the quality and efficiency of the construction process itself, optimization of workflows;
- significant reduction of construction duration and cost price;
- preliminary removal of design errors (clash detection).

The students will acquire such sustainable and state-of-the-art skills that will enable them to become required, wanted and competitive specialists not only in the Armenian but also gradually narrowing international work markets.

Autodesk Inc. Company's Architecture, Engineering & Construction Collection, Inventor, Navisworks, Dynamo, BIM 360 packages as astounding development tools in the fields of architecture and construction (as well as in the fields of industry, mechanical engineering, etc)

are considered leading in the world practice. Thanks to this course Armenian students will become familiar with the whole arsenal of advanced BIM technologies so that to be competitive and required when entering a professional life.

Architectural projection of contemporary construction systems

The aim of the course is to arm the students with general knowledge about the loads and impacts influencing the structures and the behavior of load-bearing elements of their resistive structure (strength, rigidity and stability). Another goal is to present the students peculiarities of the work of contemporary construction systems and focus on their right choice which will contribute to the reduction of the design-construction work duration, effective use of building materials as well as the development of creative thinking. By the end of this course the students will get the knowledge on the subject studied and numerous skills, particularly:

knowledge about:

- the work and calculation methods of load-bearing elements and construction systems of structures, main physicomechanical properties of materials used in bearing elements, types of loads and forms of impact as well as the way they are transmitted to all parts of the structure.
- application, analysis of different construction systems and evaluation of their advantages and disadvantages.
- work analysis of non-standard structures and construction systems.
- work of the non-standard architectural structures and main calculation principles.

Skills:

- to make a an architectural solutions to provide a harmonious with the effective work of construction systems of structures which will result in reduction of material costs;
- to work with other specialists participating in the project, particularly with architectural (engineer) designers and builders;
- to master the most important rules of structural systems and clearly present the role and significance of bearing elements and constructive system of the structure.

Territory Improvement and engineering development of area

The goal of the course is to acquaint the students with the current problems of urban development, the main directions of their solving, the urban surroundings, as well as the interaction of the internal structural elements of cities, the external environment, the establishment of their harmonious interactions. The course discusses the problems of urban surroundings development field knowledge formation, the modern theory of urban improvement, which relate to the field of engineering improvement of lands and transport. The course work is implemented by the students during the course study. It refers to the preparation of a vertical plan of a city street section. During the work, the problems of vertical planning of the city street are solved, the volume of earthwork, slopes of the precincts are calculated, as well as the design norms of the city street are used.

After the course study students will know the main ways of solving the current problems of improvement in the field of urban development, the details of the organization of the transport

sector, the design of the components of the unified system of infrastructure, the knowledge of the relevant means used in the field of urban improvement. Students will be able to apply in a practice the knowledge in solving the problems of vertical leveling, horizontal-vertical leveling of urban areas, engineering arrangement and improvement problems.

Sustainable architecture

Nowadays the main challenges cast on architecture and urban planning have changed. Their fundamental idea is to create environment without damaging nature. The goals of the course are to acquaint the students with semantic approaches to “Environment Maintenance”, “Basics of Green Design”, “Reduction of nature protection damages”, “Bioclaimatic design”, “Use of recyclable building materials” and design of “Ecologically sustainable” buildings and cities.

At the end of the course study the following outcomes are expected:

- semantic learning of the Sustainable Architecture concept
- analysis of current problems, application of instruments and diagnosis
- possible solutions and approaches to the problems
- use of sustainable architecture approaches in newly constructed facilities
- ability to organize and manage topic discourse
- competence to critique the research conducted
- efficient presentation competence
- team work skills.

Project management for architects

The goal of the course is to form the students` knowledge and skills in the field of project-oriented management in the process of developing and implementing design solutions, as well as investment and construction activity based on applying modern techniques and methods of project management that will meet the requirements of consumers and society as well as requirements for students earning a master's degree within the framework of the RA National Qualifications Framework (NQF), which will ensure their effective professional activity in the future or at the next stage of study.

As a result of course study, the master must:

know:

- the theoretical fundamentals of project management,
- basic concepts, definitions, functions and methods of project management.

be able to:

- use project management methods in the design and implementation of design solution,
- apply modern models of project management in investment and construction activities,
- organize of research and design work,
- manage the project team,
- work with a computer as a means of managing project information,
- use information and computer technologies as a tool in design and scientific research,
- work with information in global computer networks,
- develop a strategy for the actions of the creative team in specific market conditions,

- monitor the project situation,
- use of methods of administrative and managerial and communication work,
- coordinate design and approval work,
- interact with related specialists, public and state organizations.

Contemporary methods of preservation of historical environment

The aim of this course is to bring knowledge and professional skills to students through theoretical and practical work in the field of preservation of historical structures. Many standards in the field of restoration / protection have changed over the years. It is no longer possible to define conservation by universal standards and it is necessary to take into account the differences between cultures. The actual structure alone cannot be only criterion of authenticity: customs, traditions and all historical strata are equally worthy of preservation. During this course study, students will gain the ability to see and recognize a monument, the ability to design plans within a historical environment, experience working on a monument restoration and gain experience in work on preservation projects.

Upon completion of the course, future professionals should be able to work responsibly in the field of conservation / restoration of cultural heritages, as well as in an environment where there is an historical element.

The details of teaching and assessment methods upon each of above mentioned new course are presented in syllabus of each course.

Master Program in BIM Management

Building Information Modelling (BIM) in Design, Construction and Operations is fast becoming the industry standard approach to designing, analysing, and managing building lifecycle. In this Master course students will learn a holistic approach to everything from design and construction to maintenance, operation, and sustainability. The course will be taught by industry and research experts using state-of-the-art BIM software.

A unique feature of this course is that students have the opportunity to be placed with a company to deliver a BIM Organizational Strategy and a BIM Implementation Plan. They will also provide companies with BIM research that has real business value producing an organizational strategy and implementation plan to ensure their BIM alignment with business strategy. Students will research a BIM-related topic in-depth by their choice for their Master degree thesis.

The MSc in BIM Management is challenging, as we cover a lot of subjects, and prepare students in all aspects of BIM, so they will be better equipped for employment. Students will learn to understand the complete building lifecycle, exploring innovative sustainable and collaborative practices in building information modelling and management, and examine a range of existing and emerging BIM issues.

This Master program is intended for people who have at least a bachelor level in engineering and architecture. This program will enable students to contribute significantly to any consulting or contracting organization as a BIM manager, reducing costs and increasing profits. It will provide the knowledge and practice skills that are in-demand by government and industry, providing them with a competitive edge in the industry.

This MSc will provide students with the necessary training, skills and hands-on experience to become successful in the dynamic and highly competitive fields of BIM.

The MSc in BIM Management is a postgraduate taught program delivered over three terms for a total of 90 credits. Students will undertake core modules that will make 51 credits in total which will cover the core skills they need. They will also be able to choose from a wide range of optional modules to a total of 9 credits. After successfully completing the core and optional modules students will proceed to master thesis/research stage, to a total of 30 credits.

The modules shown below are an example of the typical curriculum and will be reviewed prior to the 2021/22 academic year. The final modules will be published by September 2022.

Core Courses

1. Theory of BIM and Integrated Project Delivery (3 ECTS)
2. Building Information Modelling (BIM) Management (3 ECTS)
3. BIM software integration (6 ECTS)
4. 3D Modelling and Interoperability in BIM Environment (15 ECTS)
    a. 3D-BIM (Virtual and Augmented Reality) (3 ECTS)
    b. 4D-BIM (Schedule Optimization) (3 ECTS)
    c. 5D-BIM (Cost Modelling) (3 ECTS)
    d. 6D-BIM (Environment Sustainability Assessment) (3 ECTS)
    e. 7D-BIM (Facilities Management) (3 ECTS)
5. BIM and BIG Data (Geographical Information Systems, GIS) (5 ECTS)
6. Continuous Process Improvement (Quality and Safety Standards) (6 ECTS)
7. BIM Project Planning (4 ECTS)
8. Building Energy Modelling (3 ECTS)
9. Building and Infrastructure Information Modelling (3 ECTS)
10. BIM Capstone Project (3 ECTS)
11. Master Thesis (30 ECTS)
    a. Research Methodology (5 credits)
    b. Work Term (5 ECTS)
    c. Dissertation (Civil, Structural, Geo environmental, Water) (20 ECTS)

Optional Courses

Students should collect 9 credits from the below presented elective courses:

1. Energy Design for Buildings (3 ECTS)
2. BIG Data and AI in Civil Engineering (3 ECTS)
3. Risk and Hazard Management (3 ECTS)
4. Waste Management and Recycling (3 ECTS)
5. Construction Project Management Practice (3 CREDITS)
6. Construction Contract Law (3 CREDITS)
7. Building Integrated Renewable Energy System (6 ECTS)
8. Smart Cities (6 ECTS)

The courses are distributed under specializing, elective and research disciplines. The education is carried out in a cyclical manner (by modules). During each cycle (module) the students study a number of courses which are combined with theoretical, practical, project

design classes as well as students' individual work. The students are required to attend the lectures, work on individual or team projects and present the results orally or in written form.

The student's individual work component is a significant part in the process of the study program outcomes which is provided by the execution of the assignments envisaged within the given course.

The final project, Master's Thesis which is compulsory in order to receive a qualification, is offered by the teaching staff in the form of a topic list, mainly according to the labor market demand. It enables the student to focus on the theme he/she is interested in, use the knowledge and skills obtained during the years of education, get acquainted with research techniques of literature and apply architectural project development skills.

After completion the education by "BIM Management" Master Program the graduates are awarded by the qualification degree Master of Engineering.

III. Financial Sustainability

The objective threats listed below are really challenges to provide the financial sustainability in the field of high education at whole in the country, and in particular for TACEESM project after the end of the project lifetime:

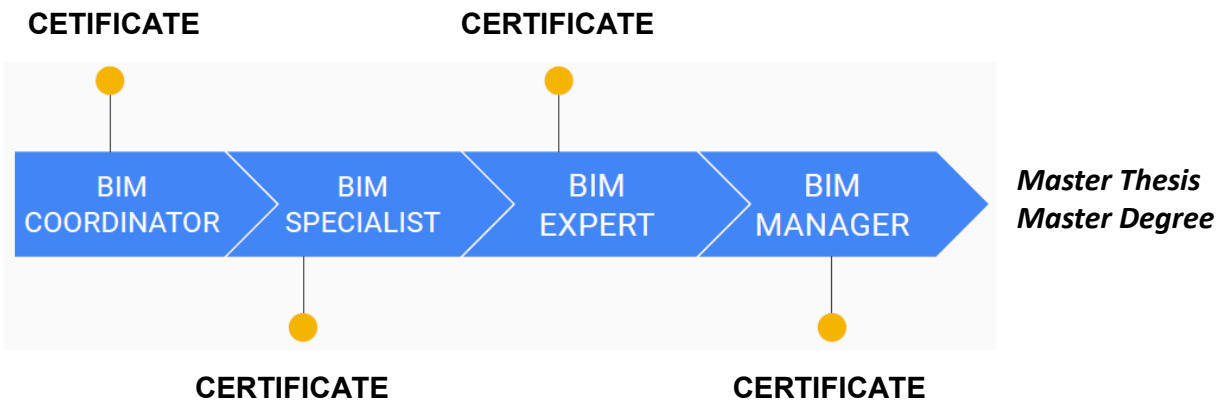
- disruption of study programs implementation normal process because of the pandemic situation, country's unstable economic and political situation, population outflow and insufficient student enrolment,
- lack of state priority definitions and proper policy towards the high education study programs,
- insufficient financial means for the accreditation of the university high education study programs.

The main financial sources for the study programs operating at the NUACA are tuition fees paid by students. That is why financial sustainability of BIM MSs program and using of created 6 new courses is highly connected to the number of students enrolled. Appropriate efforts will be made to increase the number of applicants and therefore the number of enrolled students based on settled requirements. In alignment with this the financial stability will be provided through the identification of alternative funding sources (involvement of state funding, participation in new European or bilateral funding programs, find suitable public scholarships for local and international students, search for private scholarship from companies or foundations).

Another component of financial sustainability is the structure of "BIM Management" Master Program. The TACEESM Project team of NUACA structured the Master Program based on certificate programs. Particularly, the student who is enrolled in the Master Program should pass 4 certificate programs during year and collect 60 ECTS:

1. BIM Coordinator
2. BIM Specialist
3. BIM Expert
4. BIM Manager

To receive a qualification of Master of Engineering student should develop the final project, Master's Thesis and defend it publicly (30 ECTS). Anyone is allowed to not continue his/her education after successful completion of certificate program. He/she will receive an appropriate certificate.



The NUACA team of TACEESM Project thinks that the above mentioned structure of Master Program, that is completely is fee based, will attract more students not only in Master Program, but also in Certificate Programs.