561884-EPP-1-2015-1-DK-EPPKA2-CBHE-JP
Introducing Problem Based Learning in Moldova: Toward Enhancing Students' Competitiveness and Employability
www.pblmd.aau.dk

"BSc in Software Engineering" Pilot Student-Centered Active-Learning Study Programme

Technical University of Moldova

Work Package 3

Prepared by: Ciorba Dumitru (team leader), Dr., Associate Professor, TUM
Cojuhari Irina, Dr., Associate Professor, TUM
Gogoi Elena, Lecturer, TUM
Calin Rostislav, Lecturer, TUM

Evaluated by: Ivan Aaen, Professor,Department of Business and Management, AAU
Dr David Johnston, Academic Course Leader: Computing (PG), UoG

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

Chisinau, 2016

Table of contents

Tables

Figures

Annexes

1 INTRODUCTION

The aim of the project is to improve the higher education system in the Republic of Moldova by aligning it to the European higher education framework, enhancing the mobility of teaching staff and students, making sure that young specialists meet the needs of the labor market.

For this stage, the Moldovan team visited several partner universities in Europe to have a better understanding of the problem-based learning methodology / PBL and ICT study programmes. As a result of these visits, the team had the objective develop this comparative analysis report based on the study programmes provided at AAU, UOG and TUM. Based on this comparative analysis, the team has developed the PBL Bachelor's degree programme in the field of ICT.

Table 1: The team that developed the study programme

Study programme	**Pedagogical training**
National coordinator: Larisa Bugaian TUM rector: Viorel Bostan, Prof. Task-force team leader: Ciorbă Dumitru, associate Prof. Task-force team members: Victor Beşliu, associate Prof. Irina Cojuhari, associate Prof. Rostislav Călin, lecturer Mihaela Balan, lecturer	National coordinator: Larisa Bugaian TUM rector: Viorel Bostan, Prof. Task-force team leader: Maria Vasiliev, associate Prof. Task-force team members: Mariana Catruc, lecturer Mihaela Balan, lecturer Elena Gogoi, lecturer

2 LITERATURE ANALYSIS

2.1 INTRODUCTION

Problem based learning / PBL is an educational conceptual framework that is currently actively promoted in several university courses (Boud & Falchikov 2006; Dalsgaarda & Godska 2007; Sadlo 2014; McLoughlin & Luca 2002; Richardson 2005). PBL is an active learning methodology based on the investigation of real scenarios that promote long-term profound learning (Parkinson and St. George, 2003).

PBL is both a pedagogical approach and an educational conceptual methodology that simultaneously develops critical thinking and disciplinary knowledge, involves students in an active role in problem solving, provides a deeper, rich learning experience and confronts students with real situations (Blackburn, 2015).

Today higher education is different from the one that has been decades ago. The idea of placing the student at the heart of the study process brings profound changes to the higher education system.

There are various techniques that come in handy to adapt PBL to train engineers such as Agile-PBL, but the study (Zapater, et al., 2013) argues that the methodology itself is not sufficient to increase student motivation.

The PBL format assumes that „it is better for students to be able to apply knowledge in a new situation than to know answers to „old" questions" (Gentry, 2000, p. 6). PBL requires students to identify contextualized problems, investigate these problems and implement significant solutions. This method develops students' critical thinking and promotes creative skills. Motivation increases as students transfer knowledge to new situations. Teachers adopt the role of facilitators of learning, guiding the learning process and promoting a questioning environment (Blackburn, 2015).

2.2 POLITICS OF STUDENT-CENTRED PBL STUDY PROGRAMME AND CURRICULUM CHANGE

Problem-based learning is defined by Finkle and Torp in Savery & Duffy (1995) as „a curriculum development and an education system that simultaneously develops both problem-solving strategies and the basis of disciplinary knowledge and skills by placing students in the active role of finding solutions to problems faced with a poorly structured problem that reflects real world problems".

An important moment of PBL is that learning resulting from a resolution of the problem is often more important than the solution (Hirca, 2011).

Torp and Sage (2002), list three main features of PBL:

1. Involves students as beneficiaries in a problem situation.

2. Organizes curriculum around a holistic problem, facilitating student learning in relevant and connected ways.
3. Creates a learning environment where teachers train and guide student thinking by facilitating deeper levels of understanding.

Cognitive learning approach means that learning is organized around problems that will be solved within projects. It is a central principle for developing motivation. A problem (a miracle, an anomaly, contradiction, needs, etc.) creates the starting point for learning processes, places learning in a context, and bases learning on student experience.

Content approach aims at interdisciplinary learning, which can go beyond the traditional boundaries based on subject and methods. It is an exemplary practice, meaning that the learning outcome is exemplary for the general objectives of the curriculum.

Social approach is **team-based learning**. The aspect of team learning is at the basis of learning as a social act in which learning through dialogue and communication takes place. The social approach also refers to the concept of the participant oriented toeards learning, which indicates a collective ownership of the learning process and, in particular, the formulation of the problem.

Professor X.Y. Du and others (2009) proposed a series of PBL principles and important elements taken into account in the development of study / analytical programmes. (Figure 1, Figure 2)

Figure 1. PBL: Learning principles (X.Y. Du et al., 2009)

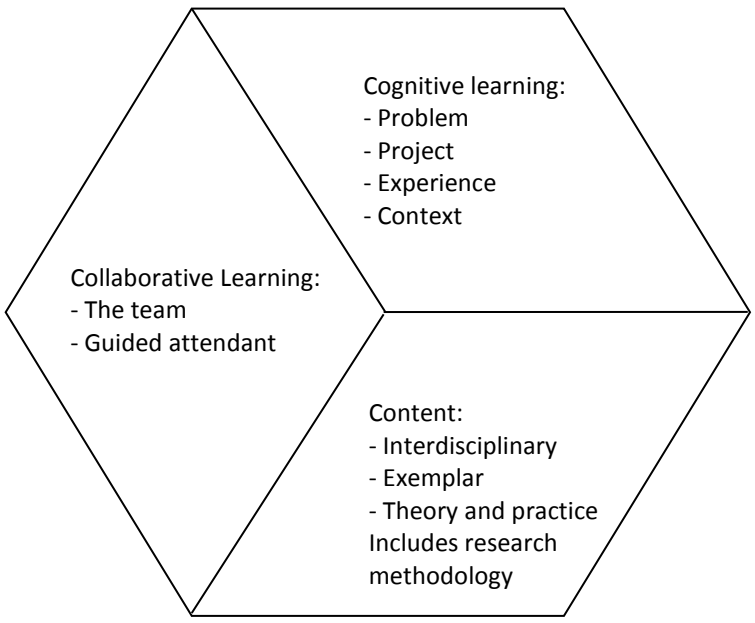


Figure 2. PBL elements for the curriculum

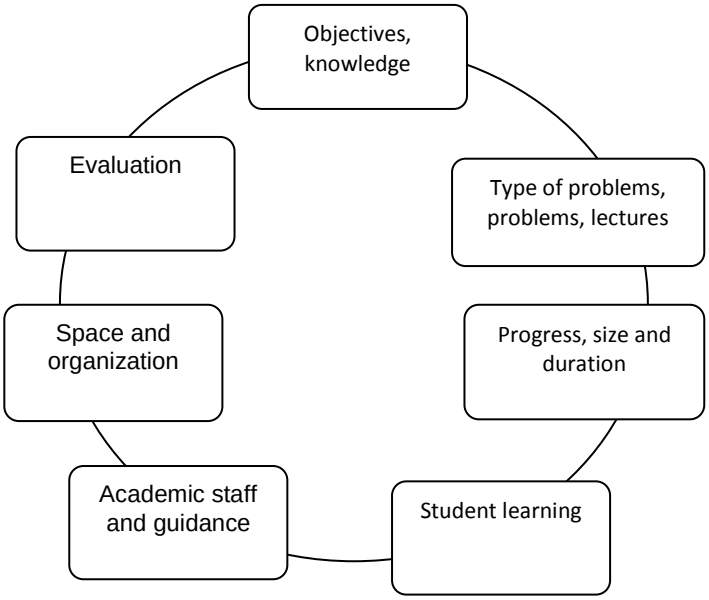


Table 2. Spectrum of PBL curriculum elements (X.Y. Du et al., 2009).

Curricular Elements	Disciplines and Teacher Oriented Approach	Innovative and student-centered approaches
Objectives and knowledge	Objectives of traditional disciplines Discipline knowledge	PBL and methodological objectives. Interdisciplinary knowledge.
Types of problems and projects	Problems - narrow, well-defined, discipline project, Bachelor's degree project. The course determines the project.	Open Well-defined problems. Problem based projects. Innovative projects. Project support courses.
Progress, size and duration	Progress is not visible. A minor part of the curriculum	Clear and visible progress. The major part of the course / curriculum.
Student learning	There are no support courses. Accumulation of knowledge. Collaboration for individual learning.	Support courses. Knowledge formation. Collaboration for innovation.
Academic staff and guidance	Is not coordinator. Supervision controled by the teacher.	Training courses. Coordinator / person to guide progress.
Space and organization	Traditional course management and lecture-based curriculum. Traditional structure of the library. Lecture halls for lectures.	Administrative support. The PBL curriculum. Library supporting PBL. Group workspaces.
Evaluation	Individual evaluation. Summative course evaluation.	Group evaluation. Formative evaluation.

2.3 CHANGING THE STUDENT-TEACHER RELATIONSHIP

Student centered teaching methods shift the activity focus from the teacher to the student and the role of teachers in PBL changes from a „all-knowing" to a mentor or guide. The teacher must rather pass on the control to the students and allow them to make their own way of answering, rather than pointing the way.

Quitting control is the part of the PBL for which teachers usually struggle most. However, not only the teacher has to change. Students also need to learn to see their teacher as a guide, not the person with all the answers. It is only after this partnership between student and teacher is formed that true learning can take place. „Teachers have a huge responsibility because they are the first contact point with their students and have an extraordinary influence on the way they learn." (Gentry, 2000, p. 11)

Changing the role of the teacher	
From	To
Knowledge transmitter	Guiding and supervising knowledge
Control of the learning process	Creating the environment for learning
Permanent expert	Collaborator, co-student
Learns to use ICT	Uses ICT to increase learning
Deductive / Explanatory	Interactive / Experimental
Changing the role of the student	
From	To
Student in passive role	Student in the active role of learning
Reproduction of knowledge	Production of knowledge
Teacher dependence	Autonomy of learning
Isolated learning	Learning through collaboration
Learning based on content only	Learning to learn / Think / Create and communicate

Changing the emphasis from teaching to learning can create a more interactive and engaging learning environment for teachers and students. This new environment also involves a change in the roles of both teachers and students. The role of teachers will change from a knowledge transmitter to a facilitator, a knowledge navigator, and sometimes a co-student. The new role of teachers requires a new way of thinking and understanding of the new vision of the learning process (Shyamal Majumdar, 2006).

2.4 PROBLEM-BASED AND ACTIVE LEARNING

Student centered teaching methods change the focus of activity from the teacher to the student. These methods include **active learning** where students solve problems, ask questions, formulate their own questions, discuss, explain, debate or suggest brainstorming sessions during the lesson; **collaborative learning**, where students work in teams on problems and projects under

conditions that ensure both positive interdependence and individual responsibility; **inductive teaching and learning**, where students are first presented with the challenges (questions or problems) and then they have to learn the course material in the context of solving the challenges.

Problem based learning (PBL) is an approach that encourages active learning through the creation of environments and tasks offered by social-constructivist learning theory (Mehdi Karami, et al., 2013). **Active learning** is generally defined as any training method that involves students in the learning process. In brief, active learning requires students to do meaningful learning and think about what they are doing. While this definition could include traditional activities, such as homework, in practice, active learning refers to the activities proposed in the classroom. The basics of active learning are student activity and involvement in the learning process. Active learning is often in contrast to the traditional lesson where students passively receive information from the instructor (Michael Prince, 2004).

2.5 IMPACT OF ICT ON THE LEARNING PROCESS

Nowadays, we experience a broad use of ICT in education and a lot of schools all over the world that have been equipped with technological facilities. Churchill (2009) states that ICT adds a new dimension to teaching efficiency by facilitating teachers' activities to do things that would not be possible in traditional lessons (Mehdi Karami, et al., 2013).

The main focus of ICT use in the learning process is to improve the learning process, motivate and involve students, promote collaboration, create a student centered culture. This allows moving towards an independent and autonomous teaching and learning model that will promote creativity and critical thinking. It is considered that students will be able to collect, select, analyze, organize, expand, transform and present their knowledge by using ICT in an active and authentic learning paradigm. Teachers will create a new, flexible, open and interactive learning environment. ICT should help teachers and students communicate and collaborate without barriers, make students autonomous, and allow teachers to bring the world into classroom activities.

A basic principle is that the use of ICT changes the distribution of information resources in the teaching and learning area and changes the relationship between educational participants (Shyamal Majumdar, 2006).

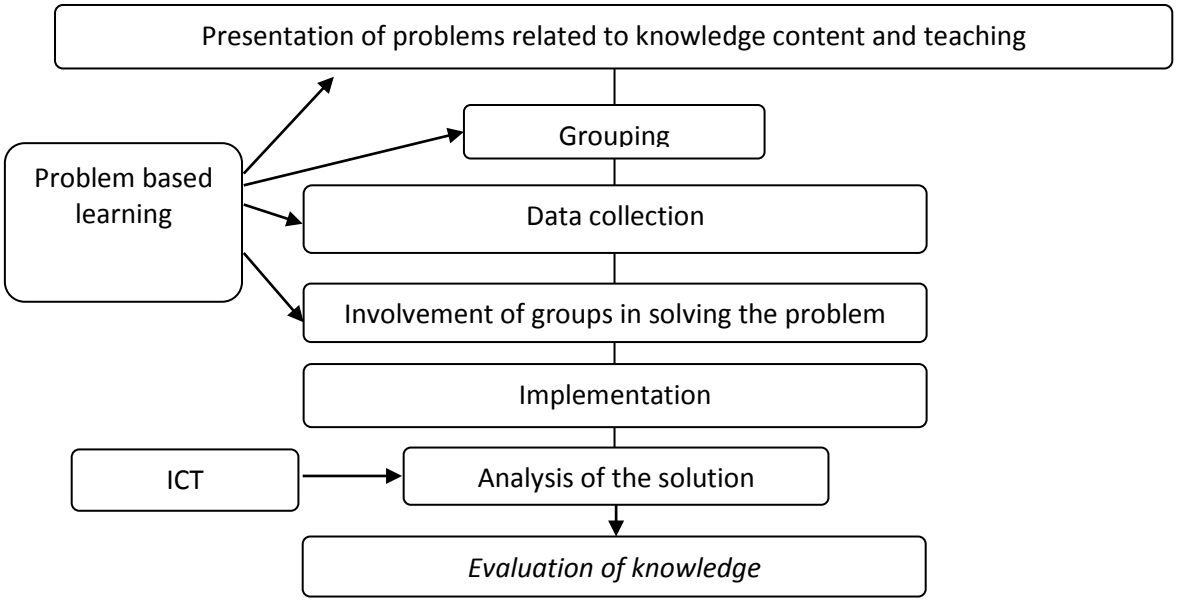
At the moment, we have a whole set of technological tools and possibilities to simplify traditional education, which can also be used for PBL methodologies:

- online storage, information and knowledge collecting and storing;
- eLearning, tools for presenting information and knowledge;
- ePractice / eSimulation, communication, teamwork, providing practical learning (a rich set of experiences and practical simulations, real cases and problems, including the use of technology and augmented reality);
- Integration, tools for processes and management of the learning system, with possibilities of integration and collaboration with other systems;
- mobile, the possibilities of integrating and using all mobile platforms and technologies.

Technology has enabled the development of student-centered education as well as PBL. Technology is a tool that allows students to access an almost unlimited amount of information. In

a student-centered class, students can become active by searching for information quickly and efficiently on the World Wide Web or by using research software. „When technology is thought of as a support tool or student project creation, the room begins to become student-centered."

Figure 3. The model proposed for integrating the PBL and ICT methodology (Mehdi Karami, et al., 2013)



2.6 CONCLUSIONS

Student-centered problem-based learning maximizes student involvement in the learning process. In a PBL lesson, students will be able to use the knowledge they have and apply them to a significant problem.

Students begin to see how their knowledge helps them solve the problems of life, thus giving them a love for learning and turning them into lifelong students. As education teaches to embrace this new type of teaching, teachers will have to learn to teach students the control of the problem. Teachers must take on a new role in the classroom; they themselves must become part of the learning process, acting as a guide or resource for students. Once a teacher learns to become part of the learning process and students are involved in the problem, knowledge flows freely and students learn to apply their knowledge in meaningful and productive ways.

3 METHODOLOGICAL ANALYSIS OF THE STUDY PROGRAMME PROVIDED AT TUM

3.1 INTRODUCTION

The study programme analysis is carried out in accordance with the methodological framework presented in Annex 1.

The Technical University of Moldova was founded in 1964, with the initial name „Polytechnic Institute of Chisinau", based on engineering and economic specialties transferred from the State University of Moldova. In the first year of study (1964 - 1965) the university had 5140 students (of which 2085 full-time students), grouped in 5 faculties: Electrotechnics, Mechanics, Technology, Construction, Economics. The teaching staff consisted of 278 teachers, of whom only 36 had teaching and scientific degrees. In the years to come, the university has grown both quantitatively and qualitatively, becoming a major educational, scientific and cultural center.

At present, the Technical University of Moldova has a contingent of approx. 9520 students (of which 6095 full-time students), who study at 64 specialties and specializations, within 9 faculties: „Energetics and Electrical Engineering", „Mechanical and Industrial Engineering and Transport", „Computers, Informatics and Microelectronics", „Engineering and Management in Electronics and Telecommunications", „Food Technology", „Textile and Polygraphy", „Cadastre, Geodesy and Constructions", „Architecture and Urban Planning", „Economic Engineering and Business".

Postgraduate education is also organized at TUM (1442 masters and 124 doctoral students), and there are also organized staff requalification and training courses.

In its 51 years of existence, over 78,387 specialists have been trained.

A technical-scientific library with reading halls, design rooms, computer centers operates within TUM.

3.2 THE SYSTEM

TUM is a state higher educational institution in the field of engineering in the Republic of Moldova and operates under the legal framework of the national education system operating under the Constitution of the Republic of Moldova (http://lex.justice.md/document_rom.php?id=44B9F30E:7AC17731), the Education Code (http://lex.justice.md/md/355156/), the Code on Science and Innovation of the Republic of Moldova (http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=286236), legislation in force, international agreements and conventions contracted by the Republic of Moldova, Charter of the Technical University of Moldova and internal normative acts (http://utm.md/administratia/acte-normative/#tab-id-1), developed in accordance with these. TUM is a non-profit university and financial autonomous institution, operating under self-management conditions, correlated with the principles of public accountability for the quality of the entire professional training, scientific

research and education services, with the efficient management of the financial means and the state patrimony.

3.3 UNIVERSITY MANAGEMENT

The executive manager of TUM is the Rector, who legally represents TUM in relations with third parties and runs the University. The Rector is the budget executor of TUM. Under the direct rector's subordination, the following are organized and operate:

a) The Secretariat of the Rectorate;
b) Department of Human Resources, Legal Services and Public Procurement;
c) Department of Informatization and Technical Information Services;
d) Department of Management, Economics and Finance, comprising: Department of Finance and Accountancy, and Planning Section.

The governing structures within TUM are:

a) University level: University Senate, Strategic and Institutional Development Council, Scientific Council, and University Administration Council;
b) The faculty council;
c) The department council;
d) The student self-government structure;
e) The Doctoral School Council.

f) The managerial positions within TUM are as follows:

g) the rector and vice-rectors - at the university level;
h) the dean and vice-dean - at the faculty level;
i) head of department / chair - at department / chair level.

The TUM Senate represents the university community and is the supreme governing authority of the Technical University of Moldova. The Senate has deliberation, decision-making and control functions and ensures the management of the University, in accordance with the legislation in force, with the principles of university autonomy, as well as with its own decisions.

Senate decisions are final and binding for all executive and administrative bodies of the University, as well as for the entire academic community. They can be modified by the Senate only.

Senate members are elected for a period of 5 years at the general meetings of faculties and departments by secret ballot. Senate members from among students and PhD students' representatives are elected at the general assembly of the respective group or representatives by secret ballot for a period of one year.

Composition of the Senate: a total of 101 people, including 59 teachers, 25 students and PhD students, 16 representatives of departments, services and centers, one member of the syndical committee of collaborators. Structure by sex: 72% men, 28% women.

The functional structures of the Senate are:

1 Office of the Senate

2 Standing committees:

- Competition Committee.
- Education and Quality Assurance Commission.
- Scientific Research and Student Creativity Committee.
- Budget, Finance and Resource Optimization Committee.
- Internationalization, Cooperation and Partnership Committee.
- Committee for social problem, extracurricular activities of students.
- Award Committee.
- Discipline, Integrity, and Ethics Committee.
- Committee for the control of the fulfillment of Senate decisions.

3 Special Committees.

Chairman of the TUM Senate is the rector of the University.

The Strategic and Institutional Development Council shall have the following competences and duties:

a) to coordinate the development of the Strategic and Institutional Development Plan encompassing the vision, mission, institution's development strategy and the main actions for a period of at least 5 years and to submit it to the Senate for approval;
b) to monitor and evaluate the efficiency of using the financial resources and to submit the educational institution's draft budget to the Senate for approval;
c) to approve the model-study contract and the amount of tuition fees;
d) to ensure the institutional management related to the intellectual property rights and technological transfer;
e) to take decisions, with the approval of the Senate, regarding:
   - development and consolidation of the institution's patrimony – decision to be approved with at least 2/3 votes of the Council members;
   - launch and closure of the study programmes – decision to be approved with at least 2/3 votes of the Council members;
   - methodology for remuneration and motivation of personnel;
   - entrepreneurship activities, public-private partnerships and cooperation with the businesses;
   - involvement in consortiums and mergence with other higher education institutions;
f) to organize and carry out the election for rector's vacancy, in line with the Institutional Regulation for organization and carrying out the elections.

The Scientific Council is the coordinating body for the research activity of the University.

Operational management of the university is ensured by the **Administration Council**, subordinated to the Senate.

The supreme governing body of the Faculties is the **Faculty Council**, which is elected for a term of 5 years and determines the development strategy of the Faculty.

The department / chair council ensures, under the coordination of its head, the operational management of the department / chair.

The Doctoral School Council ensures, under the coordination of its director, the operative management of the Doctoral School, in accordance with the institutional regulations for organizing and conducting doctoral studies.

The student self-government system is part of the university governance and has the following objectives:

a) promoting and representing the educational, professional, social, cultural, moral and economic interests of TUM students;
b) participation in the process of moral, professional, social, cultural and economic edification of students, in the spirit of the local academic tradition, in order to provide society with integral personalities;
c) representation of students in the process of institutional and financial administration as equal partners in decision-making, at any level where the student is a partner;
d) promoting the quality assurance culture in the University by participating in the process of improving the curriculum; the teaching-learning-research-evaluation process of students;
e) performace of socio-professional and cultural projects and programmes for students;
f) identifying students' specific problems and stimulating students' participation in student activity and decision-making and implementation processes;
g) establishing collaborative relations with other student organizations in the country and abroad.

3.4 FACULTY

The TUM structure comprises 9 faculties, 35 chairs, 18 departments, scientific research sections and laboratories, design and production units, computational, staff development and retraining centers, advanced technology implementation centers, scientific library, scientific publishing house, Administrative Administration Service and other structural subdivisions.

The organizational structure of TUM is established and adopted by the Senate of the University, in agreement with the Ministry of Education of the Republic of Moldova.

At TUM the studies are organized within 9 faculties: „Energetics and Electrical Engineering", „Mechanical and Industrial Engineering and Transport", „Computers, Informatics and Microelectronics", „Engineering and Management in Electronics and Telecommunications", „Food Technology", „Textile and Polygraphy", „Cadastre, Geodesy and Constructions", „Architecture and Urban Planning", „Economic Engineering and Business". The Technical College is part of the faculty of „Mechanical and Industrial Engineering and Transport".

The faculties (according to the TUM Statute) are university's didactic-scientific and administrative subdivisions, which aim at organizing and carrying out the training-education process in the first cycle (Bachelor), the second cycle (Master) and the third cycle (PhD), countinuous training courses of engineering staff, performance of educational and scientific research, innovation and development activities for one or more fields / specialties / specializations. The organizational structure of the faculty includes departments / chairs, didactic and scientific laboratories, centers and other subdivisions.

The department / chair is the functional academic unit that assures the production, transmission and capitalization of knowledge in one or more training / specialty fields.

At UTM there are branches that include special groups with the teaching of all disciplines in one of the modern languages. Within the Faculty of „Computers, Informatics and Microelectronics" there is the Francophone Branch „Informatics" and the Anglophone Branch „Computer Science and Electronics". At the Faculty of „Food Technology" there is the Francophone Branch „Food Technologies".

There are 28 specialized chairs and 7 general chairs, 8 (specialized) departments and 3 general departments, and 3 profile branches.

The training of those approx. 9520 full-time and part-time students is provided by approximately 733 teaching staff, two thirds having scientific-didactic degrees of „academician", „university professor", „university lecturer", „doctor habilitate", „doctor/PhD in science".

The University offers courses for 64 specialties and specializations in the first cycle, 62 master's degree specialties and 63 doctoral specialties, covering the needs of the national economy in engineering staff.

At UTM, studies are organized on the basis of the European Credit Transfer System (ECTS). The ECTS system facilitates the mobility of students and young specialists in the European area with the recognition of degree diplomas.

The following fundamental normative acts are at the basis of the organization of the study process: educational standards, specialty nomenclature, educational plans and study programmes.

Educational plans are approved once in 5 years by the Senate of the University and the Ministry of Education of the Republic of Moldova and are elaborated on the basis of the Framework Plan for Higher Education. The educational plan regulates: how to organize the studies within each specialty, courses to be taught (with the structure - course, laboratory, seminar, course project).

3.5 INTEGRATION OF DISADVANTAGED PEOPLE

Students with disabilities are supported by TUM through social scholarships and a number of places for students with disabilities (15% of the total budget places) are planned for admission.

Entries into the study blocks are provided with special entries for students with disabilities.

3.6 PHYSICAL ENVIRONMENT

The Technical University of Moldova has the appropriate material basis for the fulfillment of objectives. For the most efficient use of existing premises and the existing material base, the university's strategy is based on the concentration and structuring of the spaces, according to the didactic and scientific objectives of the faculties and sub-structures - chairs, research centers.

The faculties of the Technical University of Moldova are located in 11 blocks of study that are found in different districts of the city of Chisinau. The University Administration, the

Accounting, the Didactic-Methodological Department, the Department of Scientific Investigations and Technological Development, and the Human Resources, Secretariat and Public Relations Department are located in the block of study no.1.

TUM also includes the University Career Information and Guiding Center, the Center for Excellence and Acceleration in Design and Technologies „ZIPhouse", the Center for Technical-Scientific Research and Implementation of Advanced Technology „Etalon", the Didactic-Methodological and Production Center, TUM's Center for Recreation and Sport, TUM's library located within the study blocks of TUM.

3.7 STUDY PROGRAMME

The following fundamental normative acts are at the basis of the organization of the study process: educational standards, specialty nomenclature, educational plans and study programmes.

The study process is carried out in two cycles:

- cycle I – bachelor's degree studies;
- cycle II – master's degree studies.

Higher education corresponds to a certain number of ECTS transferable study credits: the duration of the bachelor's degree studies is 3-4 years and corresponds to 60 credits for one year of study; the duration of the master's degree studies is 1-2 years and corresponds to 60-90-120 study credits.

Higher education is organized through full-time and part-time education. Master's degree studies are usually provided through full-time education. The duration of studies in part-time education is one year longer than in full-time education.

The year of study in higher education starts on September 1 and has a duration of up to 42 weeks, divided into two relatively equal semesters, which includes two examination sessions and internships. Every semester the students attend 6 courses.

The study programme at each course consists of:

- The course, where the teacher explains the theoretical material according to the study programme, which is approved at the chair meeting and the faculty council.
- Seminar / practice where students solve problems (seminars / practical classes may be missing at some courses).
- Laboratories, where students receive individual tasks, have to solve them and draw up a report.

During 4 years of study, at some courses, students have 5 annual projects, where they have to solve a specific problem.

Starting with year 2, students have a summer internship when they are sent to companies, and they have a bachelor's degree internship in the last year.

Bachelor's degree studies are completed with a bachelor's degree exam and a bachelor's degree project / thesis.

Graduates who have passed the bachelor's degree exam and defended the bachelor's degree thesis are awarded the bachelor's degree title in the general profile/ field of study and are awarded the bachelor's degree diploma. Graduates who have not passed the bachelor's degree exam receive, upon request, a certificate.

Within UTM there are many study programmes covering various fields of engineering and engineering activities (Annex 2).

3.8 PEDAGOGICAL TRAINING LEVEL

As a result of studying the experience of the partners from the EU countries and the experience gained in the field of continuous training, the **University Center for Continuous Training** (CFC) was established, which is the functional academic unit of TUM providing continuous training of the specialists in the business environment and teaching staff in higher education and vocational education and training.

Continuous training activity at TUM takes place in the following main directions:

a) continuous training of teachers in institutions of vocational education and training (secondary technical and vocational education and training, post-secondary technical and vocational education and training, post-secondary non-tertiary technical and vocational education and training, higher eduction);
b) continuous training of managers, engineers, technicians and skilled workers at the request of economic agents;
c) training and retraining of unemployed and jobseekers;
d) organization of extracurricular courses for TUM students in the field of management and development of professional career, and orientation courses for high school graduates.

The Structure of the Center for Continuous Training includes:

a) the Department of Continuing Training of Teaching Staff from the Technical Institutions;
b) the Continuing Training Department of the staff in the national economy with specialized centers;
c) thematic and multidisciplinary courses for specialists' training at the request of economic agents and individuals interested provided within the ICT Excellence Center, Center for Excellence and Acceleration in Design and Technologies in Light Industry;
d) Modern language courses.

The Center for Continuous Training offers the following educational services:

a) short thematic training courses;
b) training / specialization courses;
c) multidisciplinary training / specialization courses;
d) re-qualification studies based on higher or secondary specialized studies to conduct a new professional activity;
e) professional re-qualification studies based on higher or secondary specialized studies to

obtain a new qualification.

The Department of Continuing Training of Teaching Staff provides educational services in the following areas:

a) initial training and continuous psycho-pedagogical training of the teachers from the institutions of secondary technical and vocational education and training, post-secondary technical and vocational education and training, post-secondary non-tertiary technical and vocational education and training, higher eduction;
b) courses for improving the pedagogical skills, thematic seminars for the managers of the institutions of secondary technical and vocational education and training, post-secondary technical and vocational education and training, post-secondary non-tertiary technical and vocational education and training;
c) counseling and support in developing the curriculum, teaching materials, textbooks for secondary and post-secondary technical and vocational education and training.

4 CROSS-CASE ANALYSIS

4.1 INTRODUCTION

The Technical University of Moldova, the Aalborg University, and the University of Gloucestershire were analyzed, according to the methodological framework presented in Annex 1: System Level, University Management Level, Faculty Level, Integration of Disadvantaged Students, Learning Environment, Pedagogical Training.

4.2 DATA COLLECTION

Here is the process of data collection within the university discussed; What data was collected, how, where, where are they stored, data access - any other actions related to data collection.

Table 3: Data collected

The methodological level of the analysis	Data sources	Relevant data	Reflections
System	http://www.edu.gov.md http://lex.justice.md/document_rom.php?id=44B9F30E:7AC17731 http://lex.justice.md/md/355156/) http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=286236 Government Decision of the Republic of Moldova no. 223 of 21.03.2011	- Constitution of the Republic of Moldova - The Education Code - The Code on Science and Innovation of the Republic of Moldova - Charter of the Technical University of Moldova Government Decision no. 983 of 22.12.2012 „On the way of financing the state higher education institutions under conditions of financial autonomy”.	TUM operates under the legal framework of the national education system operating under the Constitution of the Republic of Moldova, the Education Code, The Code on Science and Innovation of the Republic of Moldova, the legislation in force, the international agreements and conventions contracted by the Republic of Moldova, the Charter of the Technical University of Moldova. TUM operates under the conditions of university autonomy, in its own premises, with its own budget according to the legislation in force.

The methodological level of the analysis	Data sources	Relevant data	Reflections
University management	http://utm.md/administratia/ http://utm.md/administratia/senatul/ http://utm.md/administratia/biroul-senatului/ http://utm.md/administratia/consiliul-de-administratie/ http://utm.md/subdiviziuni-universitare/		The governing structures within TUM are: a) University level: University Senate, Strategic and Institutional Development Council, Scientific Council, and University Administration Council; b) The faculty council; c) The department council; d) The student self-government structure; e) The Doctoral School Council. The managerial positions within TUM are as follows: a) the rector and vice-rectors - at the university level; b) the dean and vice-dean - at the faculty level; c) head of department / chair - at department / chair level.
Faculty	http://utm.md/despre-utm/organigrama-utm/ http://utm.md/subdiviziuni-universitare/		The organizational structure of TUM includes the following components: faculties; departments / chairs; a doctoral school; research and / or design centers and laboratories; consulting centers; publishing house; student club; sports club; the center for continuous training of human resources; microproduction and service provision units; technology transfer incubators; other entities for production and transfer of knowledge and technology activities; administrative services.
Studies	Nomenclature of professional training areas and specialties for training in higher education institutions, 1st	The following fundamental normative acts are at the basis of the organization of the study process:	There are 28 specialized chairs and 7 general chairs, 8 specialized departments and 3 general departments and 3 profile branches.

The methodological level of the analysis	Data sources	Relevant data	Reflections
	cycle. FRAMEWORK PLAN for higher education (1st cycle – Bachelor's degree, 2nd cycle – Master's degree, Integrated studies, 3rd cycle - Doctorate)	educational standards, specialty nomenclature, educational plans and study programmes. Bachelor's degree programmes are organized by training area (specialties) in accordance with the Nomenclature. The Framework Plan is a component of state educational standards in higher education and sets out the general principles for organizing and conducting the study process in higher education institutions.	The University offers courses for 64 specialties and specializations/programmes in the first cycle, 62 master's degree programmes and 63 doctoral degree programmes, covering the needs of the national economy in engineering staff. The programmes for each course are discussed and approved within departments and then at the faculty council at the beginning of each academic year.
Integration of disadvantaged students			Students with disabilities are supported by UTM through social scholarships and 15% of budget places for students with disabilities are planned for admission. Entries into study blocks are provided with special entrances for students with disabilities.
Learning environment	http://utm.md/despre-utm/patrimoniu/ Decision of the Soviet of Ministers of the USSR no. 209 of 13 March 1964 on the organization of the Polytechnic Institute of Chisinau	The University has 11 blocks of study and centers: the Center for Excellence and Acceleration in Design and Technologies „ZIPhouse", the Center for Technical-Scientific Research and Implementation of Advanced Technology „Etalon", the Didactic-Methodological and Production Center,	The Technical University of Moldova has the appropriate material basis for the fulfillment of objectives. For the most efficient use of existing premises and the existing material base, the university's strategy is based on the concentration and structuring of the spaces, according to the didactic and scientific objectives of the faculties and sub-structures - chairs, research centers.

The methodological level of the analysis	Data sources	Relevant data	Reflections
		TUM's Center for Recreation and Sport, TUM's library located within the study blocks of TUM.	
Study programme	Education Law no. 547-XIII of July 21, 1995 Law no. 142-XVI of July 7, 2005 http://utm.md/procesul-de-studii/ http://utm.md/procesul-de-studii/licenta/ http://utm.md/procesul-de-studii/masterat/	The study process is carried out in three cycles: 1st cycle - bachelor's degree studies; cycle II - master's degree studies; cycle III - doctoral studies. The duration of the bachelor's degree studies is 3-4 years and corresponds to 60 credits for one year of study; the duration of the master's degree studies is 1-2 years and corresponds to 60-90-120 study credits. Bachelor's degree studies are organized through full-time and part-time education.	The year of study in higher education has a duration of up to 42 weeks, divided into two relatively equal semesters, which includes two examination sessions and internships. Every semester the students attend 6 courses and have a project at one or two courses in one year of study. The study programme at each course consists of direct and indirect contact hours, including theoretical hours, seminars and laboratories. Bachelor's degree studies are completed with a bachelor's degree exam and a bachelor's degree project / thesis.
Pedagogical training	http://utm.md/subdiviziuni-universitare/departamente-si-servicii/formare-continua/ Senate's decision of 22.04.2008	The Center for Continuous Training is a diversified structure of continuous training with specialized centers and with continuous training programmes: thematic courses of short-term training / specialization, multidisciplinary training / specialization courses with a duration of 72-500 hours, re-qualification courses based on higher or	Teachers who do not have the title of associate professor are obliged to attend the module of Psychopedagogy within the University Center for Continuous Training.

The methodological level of the analysis	Data sources	Relevant data	Reflections
		specialty studies for a new professional activity of 500-1000 hours, vocational re-qualification studies based on higher or secondary specialist studies to obtain a new qualification of more than 1000 hours.	

4.3 DATA ANALYSIS

Based on this methodology the teams collected and analysed the data and produced 6 (7) benchmark reports on study programmes and 4 benchmark reports on pedagogical training programmes.

Table 4: Cross-case analysis

Criteria, properties, indicators	TUM	AAU	UoG
L1: System level	It operates on the basis of the legal framework of the national education system operating under the Constitution of the Republic of Moldova, the Education Code, The Code on Science and Innovation of the Republic of Moldova, the legislation in force, the international agreements and conventions contracted by the Republic of Moldova, the Charter of the Technical University of Moldova.	- The Danish Agency for Higher Education deals with tasks in the general higher education sector, including student grants and loan schemes. - The Danish Accreditation Institution accredits higher education institutions. - The main positions that a university teacher can occupy is an assistant professor, a researcher, an associate professor, a senior researcher, a	The UoG, according to the Qualifications Framework for higher education, regulates student mobility conditions during the years of study. This is important in helping to increase the wider international experience. It is also important to note that the UoG conforms to the QAA (Quality Assurance Agency) for higher education, based on which the university accreditation takes place. It is worth mentioning that the opinion of several informal quality

Criteria, properties, indicators	TUM	AAU	UoG
		professor. - There is no fee for students from the EU / EEA and AAU partner universities. - As an international AAU student with a residence permit for Denmark, he/she is eligible for free medical assistance - just like any Danish citizen.	assurance agencies is important because their opinion is taken into account in the labor market. Therefore, UoG tries to adapt its courses according to their recommendations.
L2: University management level	1. Senate. The Senate represents the university community and is the supreme governing authority of the Technical University of Moldova. The Chairman of the Senate is the Rector of UTM. There is also the first Vice-Rector for Quality Management, Vice-Rector for Scientific Research, Vice-Rector for Financial Affairs, Vice-Rector for Continuing Education and International Relations, Vice-Rector for Administrative Service and Capital Constructions. 2. The Office of the Senate, which is responsible for managing the implementation of the Senate's	- The status describes the general purpose of Aalborg University and provides for the establishment of the management and organization. - The AAU Strategy for 2016-2021 defines the overall mission and vision of the university in the following areas: Research; Problem-based learning; Education; collaboration. - The Board of the University is the highest authority of the Aalborg University (AAU), the University Rector is responsible for every day university management. - The Rector / Vice-Rector and the AAU Director, deans, the director of the library.	1) The University Executive Committee. 2) The University is divided into faculties. 3) Students belong to a faculty.

Criteria, properties, indicators	TUM	AAU	UoG
	decisions. 3. The Administration Council. The operative management of the university is ensured by the Administration Council, subordinated to the Senate 4. The faculty councils, which ensure the operative management of the faculties.		
L3: Organization by Faculties / Departments	The TUM structure comprises 9 faculties, 35 chairs, 18 departments, scientific research sections and laboratories, design and production units, computational, staff development and retraining centers, advanced technology implementation centers, scientific library, scientific publishing house, Administrative Administration Service and other structural subdivisions. The faculties (according to the TUM Statute) are university's didactic-scientific and administrative subdivisions, which aim at organizing and carrying out the training-education process in the first cycle (Bachelor), the second cycle (Master) and the third cycle (PhD), countinuous	- The Academic Council has the right to express its opinion on all academic aspects of importance to faculty / SBI activities and has the obligation to discuss academic issues with the Rector. - Aalborg University doctoral schools are affiliated to the four AAU faculties. - Academic environments at faculties are organized in departments, schools and research centers. - The division into groups reflects the department's research profile and decentralized responsibility for research, planning and teaching.	Each faculty is responsible for a specific area, offering university and postgraduate courses and research activities for different areas. In addition to designing and offering various study programmes, faculties are also responsible for conducting research and marketing activities in various fields.

Criteria, properties, indicators	TUM	AAU	UoG
	training courses of engineering staff, performance of educational and scientific research.		
L4: Studies / programmes	Educational programmes are discussed and approved within the departments and then at the faculty council at the beginning of each academic year.	A school from Aalborg University (AAU) is a professional community that consists of one or more study councils. The tasks of the Study Council are to discuss and approve the programmes, guiding, and ensuring quality.	Courses can be easily reviewed in each academic year. The study council gathers and makes decisions about improving disciplines. These procedures do not require some approval at a higher level. Of course, there is a thin line separating the slight review from the in-depth review of topics, which already requires approval at a higher level.
L5: Integration of students with disabilities	Students with disabilities are supported through social scholarships and admission at TUM. TUM's blocks of studies provide for special entries that facilitate access to the study blocks.	The Student Counseling Service is an independent institution offering counseling related to the study process, psychological and social assistance.	UoG has a modern environment tailored to meet the needs of any student. Thus, for disadvantaged students, called people with special needs, UoG provides absolute accessibility to any of the study blocks providing the following facilities: 1) All doors in the hallway are automated with a button that is located at a lower level accessible to people moving on the wheelchair. 2) Sanitary rooms offer special facilities for people with disabilities. 3) Doors that can be easily opened by people with

Criteria, properties, indicators	TUM	AAU	UoG
			disabilities are provided. 4) In the UoG, "Student Aid Areas" are used to provide services to disabled students. A person who is attached to the student with special needs can also be offered.
L6: Learning environment / Infrastructure	The Technical University of Moldova has the appropriate material basis for the fulfillment of objectives. For the most efficient use of existing premises and the existing material base, the university's strategy is based on the concentration and structuring of the spaces, according to the didactic and scientific objectives of the faculties and sub-structures - chairs, research centers. The University has 11 blocks of study and centers: the Center for Excellence and Acceleration in Design and Technologies „ZIPhouse", the Center for Technical-Scientific Research and Implementation of Advanced Technology „Etalon", the Didactic-Methodological and Production Center, TUM's Center for Recreation and Sport, TUM's library located within the study blocks	- Aalborg University (AAU) has blocks of study located in Aalborg, Esbjerg and Copenhagen. - Researchers, professors, PhD students and students have access to the information facilities of the university. - UniFitness Aalborg is equipped with professional fitness equipment.	UoG has campuses located in Gloucestershire (Oxstalls) and Cheltenham (The Park). The Cheltenham campus is located in a former park so it is very green and aesthetic. There are several buildings on the Cheltenham campus. We visited Elwes (the largest building) and the Fullwoods building (a historic building). There are also some facilities on the campuses - canteen, pray room, first aid cabinets, sanitary facilities.

Criteria, properties, indicators	TUM	AAU	UoG
	of TUM.		
L7: Study programme	The duration of the bachelor's degree studies is 3-4 years and corresponds to 60 credits for one year of study. The year of study in higher education has a duration of up to 42 weeks, divided into two relatively equal semesters, which includes two examination sessions and internships. Every semester the students attend 6 courses and have a project at one or two courses in one year of study. The study programme at each course consists of direct and indirect contact hours, including theoretical hours, seminars and laboratories.	The teaching method is known as problem-based learning, which means that every semester students work in a group on a project.	The study programme lasts for three years with the four-year study option. This means that students can do an internship in the industry after the second year of study. After that, they return to the university to complete their final year of study. This is optional but recommended as it offers students the opportunity to have a year of experience indicated in their CV after graduation.
L8: Level of pedagogical training	Teachers who do not have the title of associate professor are attend to pass a module of psycho-pedagogical training in the amount of 60 transferable study credits	- Learning Lab that assures the development of teachers' teaching / learning skills at Aalborg University. - Academic English at a high level; Mandatory Certification for English language knowledge(assistant professors).	Teachers who teach must be certified by the HEA (Higher Education Academy)

Table 5: Reflections

	Common patterns	Variations
L1: System level	1. The study process in higher education is based on the European Credit Transfer System (ECTS). 2. Universities operate under conditions of university autonomy. 3. Accreditation of study programmes is done by Accreditation and Attestation Institutions, or Quality Assurance Agencies.	In UoG teachers in order to teach must be HEA (Higher Education Academy) certified
L2: University management level	Governance of Universities is done by the Rectors, Vice-Rectors and the Council / Senate / Executive University Committee	Financial autonomy of faculties, departments, schools.
L3: Organization by Faculties / Departments	The academic environment within faculties is organized in departments, chairs, centers.	At Aalborg University, the faculties also include schools that are professional communities and comprise one or more study boards, managing related study programmes. The school is run by a programme director, assisted by a study advisory board. The task of the study board is curriculum development, student guidance, quality assurance, etc. Within departments there is a great emphasis on science, where departments contain research centers on different themes. Teachers are actively involved in the research process, where the teaching workload is distributed according to criterion 60 (teaching) +40 (research). Financial autonomy of departments.

	Common patterns	Variations
L4: Administrative council	The curricula for each discipline are reviewed and approved by a special committee at the beginning of each academic year.	Teacher autonomy At Aalborg University, teachers have a freedom in organizing the course, where the main purpose is to achieve the objectives of the course.
L5: Integration of students with disabilities	Special entries that ease access to blocks.	1. The existence of the psychological counseling center. 2. Developed infrastructure for people with disabilities.
L6: Infrastructure	Blocks of studies, including faculties, departments, research centers, etc.	The study areas of the departments are focused on team work.
L7: Study programme	Educational plans are discussed and fixed by a specialized board.	1. At Aalborg University and UoG, the teaching methodology is based on the problem. 2. The Aalborg University has a freedom in changing the subjects taught, where the main purpose is to ensure the basic objectives of the course.
L8: Level of pedagogical training Criterion 1. Certification of teachers	1. Teachers who teach at TUM have to attend a psycho-pedagogical training module in an amount of 60 transferable study credits to get a certificate of psycho-pedagogical training. 2. Teachers within the UoG must be certified by the Higher Education Academy. 3. Teachers at Aalborg University must attend the introductory course in PBL.	Aalborg University requires mandatory English language certification (C1 level) for teachers who teach in English. This objective is achieved through a specialized center, called LACS - Center for Language and Communication Services.

5 "SOFTWARE ENGINEERING" STUDY PROGRAMME

5.1 INTRODUCTION

In 2017 it is planned to start the new study programme - Software Engineering (SE) within the Department of Software Engineering and Automatics of the Faculty of Computers, Informatics and Microelectronics, Technical University of Moldova.

Software Engineering (SE), along with Information Technology, is part of the science of information processing methods and tools (computing) to solve specific problems related to the organization of human activities. In relation to Information Technology, the Software Engineering programme is a more theoretical and oriented towards specialists training, whose core mission is the development of software production models and techniques, but the scope of which extends to both system infrastructure and organizational and information aspects of companies.

The bachelor's degree programme „Software Engineering" (field of System Engineering and Computers) is geared towards training engineers with a qualification corresponding to Level 6 of the National Qualifications Framework / European Qualifications Framework (NQF / EQF).

Table 6. Essential characteristics corresponding to level 6 of the NQF

Level	**Bachelor's degree (cycle 1) - Level 6 of the EQF / NQF**
Duration of studies	4 years
ECTS study credits	240 credits
Form of organization	full-time education
Access conditions	BAC diploma, Specialized secondary school diploma
Preconditions	Achievement of the of pre-university learning outcomes
Internships	Mandatory (25 ECTS)
Examination and evaluation rules	Current-formative evaluation; final - sumative are mandatory; The current-formative evaluation is done through seminars, internships, self-evaluation and evaluation of individual and / or team work; The methodology of final-summative evaluation is geared towards evaluating learning outcomes expressed in terms of competencies.
Final evaluation method	Bachelor's degree exam, defending of the bachelor's degree thesis
Certification	Bachelor's degree
Title awarded	*BSc in engineering*
Rights for graduates	Apply for master's degree programmes; Apply for continuous training programmes; Employment.
Body responsible for authorizing programmes	Ministry of Education, ANACIP

The programme will last 4 years, 8 semesters. It will be based on the Aalborg University study model and will be of the 4 + 1 type: 4 courses per semester of 5 credits each, and a project of 10 credits besides courses.

Problem-based learning involves active collaboration with the private environment for the training the specialist in the field of software engineering, thus providing for a half-yearly interaction with companies (when defining project problems).

There will be a focus on a new approach to teamwork and interdisciplinarity.

Organizing the programme in a PBL manner induces a well-defined topic to each semester and a supervisor (tutor) who coordinates the activities of teachers and students.

5.2 GENERAL DESCRIPTION OF THE PROGRAMME

The primary purpose of the study programme is driven by the need for well-trained engineers in line with the field of professional training, capable of delivering advanced software solutions and innovations applied to various areas of human activity.

The development of the educational plan aims at achieving student-centered learning, with the help of problem-based learning methodology and using active learning principles.

Table 7. General description of the programme

General field of study:	061 Information and communication technologies
Field of professional training:	0613 Development of programme products and applications
Study programme:	0613.3 Software engineering
Total number of ECTS study credits:	240
Title awarded:	BSc in engineering
Certification:	Bachelor's degree
Admission basis:	Baccalaureate diploma or an equivalent study document; higher education diploma
Language of instruction:	Romanian, Russian, English
Form of organization of education:	full-time education

The professional competencies to be developed by the study programme are determined by the definition of the Software Engineering study programme in accordance with the *ACM standard*, *the Association for Computing Machines* and the *IEEE Computer Society*, and involve a mix of skills to solve some problem categories outlined by *key competencies* regarding:

- the scientific and engineering fundamentals of information technologies;
- the organizational and informational aspects of the systems;
- application technologies;
- software development methods and technologies;
- architecture and infrastructure of computing systems.

Each semester has a well-defined theme and a supervisor (tutor) who coordinates the activities of teachers and students:

- Problem based learning of science, technology and society
- The engineering and scientific basics of computing
- The basics of applications development
- Formal languages and compilers
- Networks and security
- The Internet of Things (IoT)
- Information systems
- Bachelor's degree project.

The value of the PBL method applied in the Software Engineering study programme is based on the elaboration and solving of a project in a group, followed by a defence of its results, complemented by an examination of the disciplines studied according to the semester plan. This involves motivating factors for students, combining teamwork for problem solving (practical, theoretical activities) that, according to studies, improve the ability to reflect and communicate.

The examination committee will also include an external examiner, selected based on specific performance criteria. This factor increases the quality and transparency of evaluation, being an important element of higher education.

Teamwork allows students to learn to work in a group, and the synergy effect fills the gaps in students' knowledge. It is an effective learning method, activates past knowledge, intensifies learning especially where the problem-based approach applies in a relevant context.

Forms of organization of the study process combine judicially the direct contact activities between the teacher and the students. The optimization of students' training activities is done by working on semestrial projects, practical works / seminars and is ensured by:

- Organization of consultations;
- Carrying out projects by addressing current issues;
- Monitoring the results obtained in projects with the mentioning of the best results;
- Keeping the training activity under control through the current evaluation of teaching activities through current evaluations;
- Conducting and participation in public lectures;
- Performing optional subjects, etc.

5.3 PROGRAMME STRUCTURE

The unique theme concludes the modules of the semester (courses / lectures, seminars, other activities), giving them a common sense, a motivation to study, to which is added the semester project, which is allocated 10 ECTS credits (out of 30 per semester) and the other recommended subjects - other 20 credits. The approach allows the decongestion of the study programme from the modules offered by the department (compulsory or at free choice) and the offering of a greater academic freedom for students in projects, in the spirit of PBL principles.

Table 8. General characteristics of the SE educational plan

Requirements of the framework plan	PBL/SE
the theoretical hours / practical applications ratio	28/72
the length of internships	45 weeks (included in study semesters)
number of course units / optional modules	11
number of projects	8 (including the bachelor's degree project)
the number of exams per semesters of study	5
the number of transferable credits for one semester / year	30/60

The educational plan, by structure and content, corresponds to the provisions of the Framework-plan for Higher Education (Cycle I – Bachelor's degree):

- the disciplines are divided into categories: fundamental, training of general skills and competences, of socio-humanistic orientation, compulsory and optional, and disciplines at free choice;
- the calendar plan provides 30 weeks of study per year, divided into two semesters with 15 weeks each, two examination sessions each lasting three weeks at the end of semesters and three holidays, including Easter holidays;
- forms of evaluation include exams, tests, and semestrial projects. The total number is five;
- the educational plan provides for the allocation of ECTS credit points for each course unit. Thus, 1 credit point is allocated for 15 hours of direct contact plus 15 individual hours of work. Training within one year allows for the accumulation of 60 credits, and upon completion of the programme - 240 credits.

Table 9. Formative structure of the SE educational plan

Formative structure, degree of compulsoriness	Credited components	Framework-plan	PBL/SE
		%	
Compulsory	**Fundamental** course units / modules (F)	20 -35	29
Compulsory	Course units / modules of training **general** skills and compentences (G)	5 - 10	6
Optional	Course units / modules of **socio-humanistic** orientation (U)	5 - 10	6
Compulsory and optional	Course units / modules of orieantation towards the basic **speciality** (S)	30 – 40	58 (including internships 20 ECTS)
Compulsory	*Internships*	*10 - 12*	*14,6 (35 ECTS)*

The teaching-learning process is carried out based on the disciplinary curriculum, the academic courses, and the respective didactic project. The holder of the discipline has an important role in organizing the training process within each subject. Taking into account the provisions of the educational standard and the place of the discipline in the educational plan, the holder performs the following activities:

- determines the role, objectives and tasks of the discipline, indicating the knowledge, skills acquired by the students;
- elaborates the themes and the content of the lectures, seminars / laboratory works, tasks for individual work (verification papers), themes and content of the annual projects, subjects for the examination / colloquia;
- establishes the generic ties of the discipline with other precursor and subsequent disciplines, coordinates and guides the theme of individual works as a component part of the bachelor's degree project;
- sets out methods and means of assessment, criteria for assessing students' knowledge.

6 ACTION PLAN

6.1 INTRODUCTION

In 2017 it is planned to start the new study programme - Software Engineering (SE) within the Department of Software Engineering and Automatics of the Faculty of Computers, Informatics and Microelectronics, Technical University of Moldova.

In order to perform the enrollment to the specialty of September 1, 2017, the Study Programme needs to obtain provisional authorization for its operation, so the Educational Plan must be developed in accordance with the *Nomenclature of Professional Training and Specializations* and the Framework Plan. When developing educational plans, it is necessary to make orientation towards acquiring the ***learning outcomes*** and skills training provided by the National Qualifications Framework on cycles and by general fields of study / professional training fields.

It is anticipated that the new study programme will implement problem-based learning methodology and that the study model was taken from the Aalborg University.

6.2 STEPS TO BE TAKEN

In order to start the educational process based on the new study programme Software Engineering, the following steps need to be taken:

Step 1	***Inclusion of the new specialty in the Nomenclature of Professional Training Areas and Specialties for the Training of Staff in Higher Education Institutions, 1st cycle***
Step 2	Elaboration of the educational plan
Step 3	Approval of the study programme at: - Department / Chair - The faculty - The TUM Senate
Step 4	Internal and external evaluation of the study programme
Step 5	Obtaining authorization for provisional operation
Step 6	Advertising the new study programme
Step 7	Admission to the study programme

1. The Software Engineering specialty is a new specialty that is not in the *Nomenclature of Professional Training Areas and Specialties of 2005*, which is why it must be introduced and approved in the new *Nomenclature of Professional Training Areas and Specialties of 2017*.

2. Elaboration of the educational plan for the training of specialists in Software Engineering according to the provisions of the *TUM Regulation regarding the organization of studies based on the National Study Credit System,* having regard to the *Regulation on the organization of studies in higher education based on the National Study Credit System,* so that the programme is linked to national and international standards of training of specialists in the field and corresponds to the Framework Plan.

3. Approval of the study programme within the Department of Software Engineering and Automatics; Faculty of Computers, Informatics and Microelectronics, and TUM Senate.

4. The internal evaluation (self-evaluation) of the study programme to get the authorization for provisional operation shall be carried out autonomously by the Technical University of Moldova.

The external evaluation of the study programme for authorization for provisional operation is done by the National Agency for Quality Assurance in Professional Education (ANACIP) and is based on the analysis of the self-evaluation report of the programme.

5. The external evaluation committee shall verify, through a visit to the applicant institution, the fulfillment of the requirements with respect to accreditation standards, evaluation criteria and performance indicators, approved by ANACIP. If all accreditation standards "meet the requirements", the Governing Board of ANACIP proposes the **authorization for provisional operation** of the study programme for a period of five years.

The final decision on the authorization or non-authorization for provisional operation is adopted: by Government Decision, at the proposal of the Ministry of Education, based on the decision of the Governing Board of ANACIP.

6. Advertising of the new study programme through leaflets, the website of the Technical University of Moldova, social networks.

7. On the basis of the Order of the Ministry of Education of the Republic of Moldova on the organization of admission of 2017, admission will be made to the Software Engineering specialty.

6.3 CHANGING CONTENT

Step 1	**Elaboration of the educational plan**
Step 2	Identifying companies. Developing curricula.
Step 3	Preparing the infrastructure for teaching based on PBL methodology, using active learning methods
Step 4	Training teachers to teach based on PBL methodology

Step 1. Elaboration of the educational plan corresponds to the Framework Plan and is based on a linear progress determined by relations at the semester level rather than at the level of disciplines. Each semester has a well-defined theme and a supervisor (tutor) who coordinates the activities of teachers and students:

- Learning based on science, technology and society problems
- Engineering and scientific basis of calculation
- Basics of application development
- Formal languages and compilers
- Networks and security
- The Internet of Things (IoT)
- Information systems
- Bachelor's degree project.

The unique theme concludes the modules of the semester (courses / lectures, seminars, other activities), giving them a common sense, a motivation to study, to which is added the semester project, which is allocated 10 ECTS credits (out of 30 per semester) and the other recommended subjects - other 20 credits. The approach allows the decongestion of the study programme from the modules offered by the department (compulsory or at free choice) and the offering of a greater academic freedom for students in projects, in the spirit of PBL principles.

Step 2. Identifing companies that will assume to provide knowledge transfer support at the content level, teachers and internships for students.

Step 3. Preparing infrastructure for teaching based on the PBL methodology consists of purchasing equipment and preparing rooms, which will be team work-oriented.

Step 4. Teachers to provide the study programme will attend the introductory course in PBL.

.

7 CONCLUSION

The education system in the Republic of Moldova as a whole, and higher education in particular, is a legacy of the Soviet education system, which is based on the classical teaching approach.

Over the last two decades, a considerable effort has been made to adjust our national education system, in line with international standards, especially European ones.

Today, Moldova's higher education is part of the Bologna process, which means that our higher education is compatible with the European one, so that students and teachers have the opportunity to participate in mobilities under the Erasmus or Erasmus+ programmes. However, it would be inappropriate to say that the Moldovan educational system fully corresponds to the modern European education systems because the study process is not adapted to the needs of each individual student.

Therefore, the primary objective of the project to develop student-centered and problem-based programmes is achieved through the Software Engineering study programme. It is a programme developed according to the models studied at partner universities of the project but also corresponds to the national framework plan.

BIBLIOGRAPHY

1. Biggs J., Tang C. Teaching for Quality Learning at University. 4th Edition, Society for Research into Higher Education & Open University Press, 2011, 391 p.
2. Churchill D. "Educational applications of Web 2.0: Using blogs to support teaching and learning". British Journal of Educational Technology, vol. 40, no. 1, 2009, pp. 179-183. doi: 10.1111/j.1467-8535.2008.00865.x
3. Dalsgaarda C., Godska M. Transforming traditional lectures into problem□based blended learning: Challenges and experiences. Open Learning: The Journal of Open, Distance and eLearning, vol. 22, no. 1, 2007, pp. 29-42.
4. David Boud, Nancy Falchikov Aligning assessment with long-term learning. In Journal Assessment & Evaluation in Higher Education Vol. 31, No. 4, August 2006, pp. 399–413.
5. Du X. Y., De Graaff, E. & Kolmos, A. E. Research on PBL Practice in Engineering Education. Rotterdam/Boston/Taipei: Sense Publishers, 2009.
9. Finkle S. L., Torp L. L. Introductory documents. Available from the Center for problem-based Learning, Illinois Math and Science Academy, 1500 West Sullivan road, Aurora, IL 60506-1000.
10. Gentry E. Creating Student-centered, Problem-based Classrooms. In (Ed.), (p.). Huntsville: University of Alabama in Huntsville. Retrieved February 10, 2003, from http://aspire.cs.uah.edu/
11. Blackburn G. Innovative eLearning: Technology Shaping Contemporary Problem Based Learning: A CrossCase Analysis. Journal of University Teaching & Learning Practice, vol. 12, issue 2, 2015, from: http://ro.uow.edu.au/jutlp/vol12/iss2/5.
12. HIRÇA N. Impact of problem-based learning to students and teachers. Asia-Pacific Forum on Science Learning and Teaching, Volume 12, Issue 1, 2011.
13. Karami M., Karami Z., Attaran M. Integrating problem-based learning with ICT for developing trainee teachers' content knowledge and teaching skill. International Journal of Education and Development using Information and Communication Technology (IJEDICT), 2013, Vol. 9, Issue 1, pp. 36-49
17. McLoughlin C., Luca J. A learner-centred approach to developing team skills through web-based learning and assessment. British Journal of Educational Technology, vol. 33, no. 5, 2002, pp. 571-582.
21. Parkinson T. J., St. George A. M. Are the concepts of andragogy and pedagogy relevant to veterinary undergraduate teaching? Journal of Veterinary Medical Education, vol. 30, no. 3, 2003, pp. 247-253.
22. Prince M. Does Active Learning Work? A Review of the Research. Journal Engineering Education, 93 (3), 2004, pp. 223-231.

23. Richardson J. Students' approaches to learning and teachers' approaches to teaching in higher education. Educational Psychology: An International Journal of Experimental Educational Psychology, vol. 25, no. 6, 2005, pp. 673-680.

24. Sadlo G. Using problem-based learning during student placements to embed theory in practice, International Journal of Practice-based Learning in Health and Social Care , vol. 2, no. 1, 2014, pp. 6-19.

25. Schwartz P., Mennin S., Webb G. Problem – Based Learning. Case studies, experience and practice. British Library Cataloguing in Publication Data, 2001, 182 p.

26. Shyamal Majumdar, Ph.D. Emerging Trends in ICT for Education & Training. from http://www.unevoc.unesco.org/fileadmin/up/emergingtrendsinictforeducationandtraining.pdf

27. Torp L., Sage S. Problems as Possibilities: Problem-Based Learning for k-16 Education (2 ed.). Alexandria, WA: Association for Supervision and Curriculum Development, 2002.

28. Zapater M., Malagon P., de Goyeneche J.-M., M. Moya J. "Project-Based Learning and Agile Methodologies in Electronic Courses: Effect of Student Population and Open Issues. Electronics Journal, vol. 17, no. 2, 2013, pp. 82-88.

Annex 1: Analysis methodology

Each Task Force Team will store all collected data files in the project intranet https://pblmd-moodle.samf.aau.dk/. Task Force leaders are to make sure all data files and documents are stored in the project intranet.

1. Institutional fit-for-purpose

This part is concerned with exploring the relationship between internal university structures and study programmes, incl., how study programme development and support are integrated throughout the entire university. The cohesion of study programme development and support will be examined at university management, faculty/department, as well as the study board levels. Issues related to the integration of disadvantaged group of students as well as to available physical environment will be explored.

Each Task Force Team will employ this part of the methodology to develop a benchmark understanding of how student-centred teaching and learning at EU partner universities is imbedded into and related to overall institutional structure and later to explore the same relationship, fit-for-purpose at own universities.

NOTE: the questions below are separated into 6 levels; there might be an overlap between the levels. It is important when asking a question to consider its relationship with other levels and impact it might have on other areas within and across the levels.

System level:

- Does the University have power/authority to accredit/validate its own degrees? If so go to section below.
- If not what is the external process?
- What is the legal status of the accrediting body? How is it composed? Does it publish a guide and criteria for accreditation? Is this publicly available? Ask for a copy and include an analysis of key elements in your report.
- Does accreditation happen periodically? Is there a fast track for new degrees/areas of study? How long does the normal process take? Is accreditation institutional or subject based?
- How is it regarded by stakeholders?
- Is there a national system of Quality Assurance? Is it independent of accreditation? What is the legal status of the QA body? How is it composed? Does it publish a code of practice? If so obtain a copy or access and include an analysis of key elements in your report.
- How does the national QA body influence curriculum development and internal quality assurance? How is it regarded by stakeholders?
- Are there national subject benchmarks or equivalent which programmes have to address?[1]

[1] In the UK, and probably elsewhere, there are certain guidelines and constraints exercised from outside the HEI. These might be professional bodies (e.g. in the case of Law in England, where any qualifying Law degree has to be

- Are there any relevant guidelines or benchmark statements provided by government agencies which constrain or otherwise affect the delivery of programmes? Explain whether these benchmarks refer to the content, delivery or assessment of the programme.
- Which professional bodies have some input into the validation or oversight of the programmes and how are these processes carried out?
- Which external validating agencies are involved in the design of the programmes and how is this achieved?
- What are the arrangements for dual awards or professional recognition?

University Management Level:

- What is the governance, management and organizational structure of the university?
- Is there a University institutional strategy which incorporates a curriculum strategy with a focus on student centred learning or is there a separate curriculum (learning and teaching)strategy? Is there an institutional commitment to innovative learning and teaching, greater use of ITC, a focus on employability, internationalisation of the curriculum? Language acquisition, inter-cultural skills? Obtain or access the documents and include an analysis in your report?
- What is the key university structure/committee responsible for student-centred teaching and learning? What are its terms of reference? What is its membership?How often does it meet? Are there provisions for fast tracking urgent curriculum development? What delegated powers does it have and to which body is it accountable? Does it produce regulations/good practice guides for curriculum proposals? What is the relationship of this body to Faculties/ Schools/ Departments / Colleges in the University?
- Is there a separate committee and/or office for internal quality assurance and enhancement? What are its responsibilities and how is it resourced(number and level of staff full/part-time, academic or administrative?
- At what level in the University curriculum proposals can be initiated and possibly a definition of the various bodies to be sure that there is a consistent understanding of terms? If necessary, for each university create a Glossary of terms and respective provide definitions.
- What other bodies have an influence on curriculum development and approval e.g. Is there a requirement for a business case for all new programmes? Would the business case have to demonstrate how the proposal fits the University strategic plan? Which committee or senior manager needs to approve the business plan? Would service departments such as e.g. Finance, Estates, Library, Careers, Legal, Ethical expect/require to be consulted?]
- What learning and teaching and assessment approaches are used at the university? What differences are there between and/or within different subject areas/faculties?
- Is there an institutional graduate school? Does it have responsibility for both second and third cyles? What are its terms of reference? How does it relate to other bodies

validated by the Law Society); government agencies (e.g. the subject benchmark statements provided by HEFCE); or other validating agencies (e.g. EDAMBA etc.). This can be significant because these agencies sometimes dictate the curriculum and the assessment style (e.g. insisting on exams).

responsible for curriculum approval? [You might want to develop this with more on Doctoral Schools/Programmes]

- What public/published information is available on all aspects of the University curriculum policy and content? Is this available on the web site with open access? The content should be reviewed as part of the benchmarking.
- Do descriptions of programmes and modules contain clear statements of intended learning outcomes?Learning methods, assessment and assessment criteria? Do programme descriptions indicate potential employment routes post-graduation? Who monitors/is responsible for ensuring this?
- Are academic staff required to have a formal 'teaching' qualification? If so what bodies offer/validate the qualification? What formal requirements are there for continuing staff development and training? How is this monitored and assessed? Which body in the University has responsibility for this? Is the University Human resource department engaged in academic staff training and development? What standards are followed in pedagogical training of academics? Are there national common guidelines, pedagogical standards/methodologies to be followed? What training courses are organized for staff teaching skills development?
- How are students represented at the university level? What role do students play in the governance, management, organisation of the University? Note: it is important to understand how the students are appointed/ nominated to the relevant bodies and how they report back to their constituency.
- What KPIs are typically used at university level in relation to resourcing teaching and learning (such as, SSRs (staff student ratio); spend per student on library resources; time allowances for teaching and assessment; average class size etc)?
- What is the role of the students' union in the student-centred teaching and learning?
- How is student-centred teaching and learning supported by the university's mission statement?
- How, if at all, is student-centred teaching and learning promoted throughout the university?
- What is the role of continuous professional development (CPD) in supporting student-centred teaching and learning?
- What financial or administrative support is provided at university level to support student-centred teaching and learning approaches? These might include funding for pedagogic research, curricular development projects etc. and might be provided through central funds or through specific research units with budgetary autonomy.
- What is the overall leadership structure at university level for academic programmes including teaching, learning and assessment?

Faculty/department level:

- What are the communication structures and relationships between the higher management level at the university and the level of facultyand/or department related to student-centred teaching and learning?
- What is the role of faculty and/or department in the new study programme development?

- How do faculty share and access examples of good practice within departments?

Study board level:

- What is the structure and relationship of a Board of Studies (or other level) with the department, faculty and research centres within department?
- Is there a procedure for inter-disciplinary or multi-disciplinary programmes? Does this require the establishment of unique committees/boards and how do these relate to the overall structure? Are there problems in establishing such degrees? What are the problems?
- In depth review of assessment practice: the use of innovative methods of assessment e.g. peer assessment, the role of formative and summative assessment, types of assessment, blind and double marking, monitoring of assessment to ensure that it is effective in relation to the achievement of learning outcomes, mark distribution analysis both within a subject and between other subjects (i.e. across the University) to ensure equity and comparability, use of external examiners, marking systems with a clear definition of criteria (Note: the integration of assessment into the process of student centred learning and its relationship with learning outcomes is critical).
- What is the process for (a) the approval of a new degree programme – is there any difference between first cycle, second cycle and third cycle? (b) the approval of a new module in an existing degree? What level of change, enhancement in a degree programme or a module requires full institutional approval? How long does the process take for each of these? Note: Understanding the approval cycle is important.
- What role do students play in curriculum planning and development? Is there a difference in their role between the cycles? Note: it is important to understand how the students are appointed/nominated to relevant bodies and how they report back to their constituency.
- What procedures(if different from above) exist for developing new study programmes?
- How is e-learningimplemented and to what extent is it embedded within the programmes?
- How are staff members involved in managing and coordinating a particular study programme (programme coordinators, semester coordinators, supervisors)? How is this formalized?
- What is the process for annual monitoring and periodic review of programmes?
- Are there any performance indicators?
- What is the process for student feedback? How is this managed and what impact does it have? Does it result in feedback on outcomes to the students?

Integrating disadvantaged groups of students:

- Does the University have an office/staff dedicated for students with a disability? What are the responsibilities and resources of the office?
- What special arrangements are made for students with a disability (incl., according to UN Convention on the Rights of Persons with Disabilities)?
- What are the capacities of the university to work with studentsfrom disadvantaged backgrounds with regard to teaching approaches?

- What special approaches exist that are targeted at socially disadvantaged students?
- What approaches are followed for inclusion of students from non-academic backgrounds, if any?
- What academic support is available to students with learning disabilities?

Physical environment:

- Is the physical environment suitable/adapted for students with a physical disability? Is there a programme of adaptation for students with a physical disability?
- What student facilities exist that support student-centred teaching and learning: study group rooms, common rooms for students, extended university library opening hours, free wifi on campus, IT assistance for students

2. Study programme fit-for-purpose

This part is concerned with exploring a current study programme structure at each EU-partner Universitywith the focus on operational, functional details, normative and technical details.The level of analysis is a particular study programme.

Each Task Force Team will employ this part of the methodology to develop a benchmark understanding of structures, procedures and process related to the development and management of study programmes in EU partner universities as well as explore the same at their own university in respective pilot study programme.

Study programme level:

- To what extent does it reflect the institutional strategy? [See also above]
- To what extent does it reflect subject benchmark statements of the equivalent?
- Is it competence based?
- Does it focus on 'employability'?
- Is it subject to professional or regulatory accreditation (particularly important for Medicine but probably the case for other subjects)
- Does it emphasise innovation, research led learning, entrepreneurship, internationalisation?
- To what extent does it use IT and/or blended learning?
- What is the structure of the chosen programme? (workload, semesters, modules, student evaluations, staff evaluations, learning progression). It would be useful to determine whether this process applies to second cycle as well?
- How is the programme developed, enhanced and managed? What role do students play in the process? What role do employers play? Are other stakeholders consulted/engaged?
- Are former graduates/alumni consulted/engaged?
- What are the functions of the project coordinator, semester coordinator, teaching staff at the programme?
- What supporting documents exist in relation to the study programme? (course description, study regulations, guidelines, learning outcomes, evaluation guides). Are these publicly available?

- What are the existing programme regulations and who is responsible for ensuring that they are followed?
- How are the programme structure and content monitored, reviewed, enhanced and implemented?
- How is staff workload calculated and monitored? How is the norm for allocation of hours (academic staff related) for various types of activities (teaching, supervision, evaluation) calculated (ECTS, formula, or historical)?
- How is student workload calculated and monitored and how does this help to shape curriculum planning and development?
- What are the expected learning outcomes? How are the learning outcomes reflected in the assessments? How are the learning outcomes communicated to the students and how are they assessed?
- How is the student evaluation/assessment conducted? What forms of evaluation are practiced? (Written exams/open questions, multiple choice tests, oral exams, project presentations. Are there innovative forms of assessment e.g. peer assessment, IT based?)
- What are the progression requirements?
- What measures are taken to avoid and sanction 'cheating' and plagiarism? How are these recorded and evaluated?
- What are provisions for student appeals?
- What is the existing system of grading? What are the arrangements for credit transfer and accreditation of prior learning?
- What is the role of the external examiner?
- How is student-mobility embedded in the programme structure and how it is facilitated?
- How is the stuff evaluation/feedback conducted by the students? How are the outcomes of feedback managed?
- What are the academic requirements for students to enter the programme?
- How do students contribute to the curriculum development?
- How are the programmes supported by administrators and what responsibilities do administrators have in directly supporting students? (e.g., answering enquiries; administration of assessments; managing academics' diaries etc.).
- Is the employment of graduates monitored? If so how and over what period?
- Which software, e-learning (e.g. Moodle, MOOC's, Knowledge Apps, moderated forums), how it is used, what checks there are for plagiarism

Annex 2. TUM study programmes

FULL-TIME STUDIES	PART-TIME STUDIES
Faculty of Energetics and Electrical Engineering	
523.1 Electroenergetics	523.1 Electroenergetics
524.1 Electromechanics	524.1 Electromechanics
529.1 Engineering and Quality Management	529.1 Engineering and Quality Management
521.8 Engineering and Management in Energetics	
523.2 Thermoenergetics	
Faculty of Engineering and Management in Electronics and Telecommunications	
525.1 Electronics	525.1 Electronics
521.8 Engineering and Management in Telecommunications	521.8 Engineering and Management in Telecommunications
525.2 Optoelectronic Systems	525.2 Optoelectronic Systems
525.3 Radio and telecommunications	525.3 Radio and telecommunications
Faculty of Computers, Informatics and Microelectronics	
526.1 Computers	526.1 Computers
444.3 Applied Informatics	526.2 Information Technology
526.4 Biomedical Systems Engineering	
525.4 Microelectronics and Nanotechnologies	
444.2 Informational Management	
526.5 Informational Security	
526.2 Information Technology	
Faculty of Mechanical and Industrial Engineering and Transport	
527.1 Engineering and technology of motor transport	521.8.4 Transport Engineering and Management
527.2 Engineering and technology of railway transport	527.1 Engineering and technology of motor transport
522.2 Machinery and equipment for the Food Industry	522.2 Machinery and equipment for the Food Industry
522.1 Machinery and equipment for the Light Industry	522.3 Refrigerating equipment and air-condition systems
522.3 Refrigerating equipment and air-condition systems	
841.1 Transport technology (auto, plane, railway, ship)	
522.6 Equipment and technology for the packing industry	

Faculty of Mechanical and Industrial Engineering and Transport	
521.2 Equipment and Agricultural Machinery Construction	521.9 Innovative Engineering and Technology Transfer
521.7 Industrial Design	521.8.1 Machine Construction Engineering and Management
521.9 Innovative Engineering and Technology Transfer	521.1 Manufacturing Engineering
521.8.1 Machine Construction Engineering and Management	
521.3 Machinery and Production Systems	
521.1 Manufacturing Engineering	
Faculty of Food Technology	
552.2 Industrial Biotechnology	521.8 Engineering and Management in Food Industry
521.8 Engineering and Management in Food Industry	541.1 Technology and Management of Catering
541.1 Technology and Management of Catering	541.2 Technology of Food Production
541.2 Technology of Food Production	541.3 Technology of Wine and Fermented Products
541.3 Technology of Wine and Fermented Products	
Faculty of Textile and Polygraphy	
215.1 Decorative arts	543.4 Polygraph Design and Technologies
543.4 Polygraph Design and Technologies	521.8 Engineering and Management in Light Industry
542.2 Industrial Clothes Design	542.1 Textile and leather production engineering
521.8 Engineering and Management in Light Industry	
542.1 Textile and leather production engineering	
Faculty of Architecture and Urban Planning	
582.7 Engineering of gas supply and heating systems, ventilation	582.7 Engineering of gas supply and heating systems, ventilation
581.1 Architecture	582.4 Railways, Roads and Bridges
582.4 Railways, Roads and Bridges	582.2 Engineering of construction materials and fittings
581.4 Interior Design	522.4 Mechanical Engineering in Construction
582.6 Engineering and Water Protection	582.6 Engineering and Water Protection
522.4 Mechanical Engineering in Construction	543.2 Technology of pottery and glass
211.3 Sculpture	581.2 Urban planning and landscape management
543.2 Technology of pottery and glass	

581.2 Urban planning and landscape management	
Faculty of Cadastre, Geodesy and Constructions	
582.1 Construction and Civil Engineering	584.3 Assessment of Real Estate
381.1 Law	521.8.1 Engineering and Management in Construction
584.3 Assessment of Real Estate	543.1 Wood Processing Technology
584.2 Geodesy, Topography and Mapping	
582.5 Fire Engineering and Civil Protection	
521.8.1 Engineering and Management in Construction	
521.5 Deposits Engineering and management, Mining	
543.1 Wood Processing Technology	
Faculty of Economic Engineering and Business	
363.1 Business and Administration	
361.1 Accounting	
362.1 Marketing and Logistics	

Annex 3: Educational plan for the study programme "Software Engineering"

Year I										
Semester I	***Learning based on problems of science, technology and society***									
Code	**Name of the course unit / module**	***Total hours***			***Number of hours by type of activity***				***Evaluation form***	***No. of credits***
		Total	***Direct contact***	***Individual study***	***C***	***S/P***	***Pr***	***per week***		
G.01.O.013	Conceptual design of an IT application	300	150	150			150		PA	10
F.01.O.001	Mathematics	150	75	75	45	30			E	5
F.01.O.002	Computer programming	150	75	75	30	15	30		E	5
F.01.O.003	Special Mathematics 1	150	75	75	30	45			E	5
U.01.A.021 *U.01.A.022*	Computer history *Computer science and society*	150	75	75	30	30	15		E	5
G.01.O.014	*Foreign language 1***	*90*	*45*	*45*		*45*			*E**	*3*
G.01.O.015	*Romanian language (alolingual) 1**	*60*	*30*	*30*		*30*			*T**	*2*
G.01.O.016	*Physical Education 1**	*60*	*30*	*30*		*30*			*T**	
	Total semester I:	**900**	**450**	**450**	**135**	**120**	**195**	**0**	**5E**	**30**
					450					
Semester II	***The engineering and scientific basis of the calculation***									
Code	**Name of the course unit / module**	***Total hours***			***Number of hours by type of activity***				***Evaluation form***	***No. of credits***
		Total	***Direct contact***	***Individual study***	***C***	***S/P***	***Pr***	***per week***		
F.02.O.004	Equivalent models	300	150	150			150		PA	10
F.02.O.005	Applied Sciences	150	75	75	30	15	30		E	5
F.02.O.006	Special Mathematics 2	150	75	75	30	15	30		E	5
F.02.O.007	Computer architecture	150	75	75	30	45			E	5
F.02.O.008	Data structures and algorithms	150	75	75	30	30	15		E	5
G.02.O.017	*Foreign language 2**	*90*	*45*	*45*		*45*			*E**	*3*
G.02.O.018	*Romanian language (alolingual) 2**	*60*	*30*	*30*		*30*			*T**	*2*
G.02.O.019	*Physical Education 2**	*60*	*30*	*30*		*30*			*T**	
	Total semester I:	**900**	**450**	**450**	**120**	**105**	**225**	**0**	**5E**	**30**
					450					
	Total I year of studies:	**1800**	**900**	**900**	**255**	**225**	**420**	**0**	**10E**	**60**

**- It is not calculated in the total amount of the evaluation forms (the course units are carried out under extracurricular arrangements and they are allocated credits in addition to the 240 credits per program, and the course unit "Physical education" is not quantified with credits).*

T - Test, rated "accepted / rejected"*

Year II											
Semester III	***The bases of application development***										
Code	**Name of the course unit / module**	***Total hours***			***Number of hours by type of activity***				***Evaluation form***	***No. of credits***
		Total	***Direct contact***	***Individual study***	***C***	***S/P***	***Pr***	***per week***		
S.03.O.027	The bases of application development	300	150	150			150		PA	10
S.03.O.028	Object oriented programming	150	75	75	30	15	30		E	5
S.03.O.029	Computer Networks	150	75	75	30	45			E	5
S.03.O.030	Databases	150	75	75	30	15	30		E	5
S.03.A.039 *S.03.A.040*	Data analysis and visualization *Computer graphics*	150	75	75	30	30	15		E	5
	Total semester III:	**900**	**450**	**450**	**120**	**105**	**225**	**0**	**5E**	**30**
					450					
Semester IV	***Formal languages and compilers***									
Code	**Name of the course unit / module**	***Total hours***			***Number of hours by type of activity***				***Evaluation form***	***No. of credits***
		Total	***Direct contact***	***Individual study***	***C***	***S/P***	***Pr***	***per week***		
F.04.O.009	Development of domain-specific languages	300	150	150			150		PA	10
F.04.O.010	Formal languages and compiler design	150	75	75	30	15	30		E	5
F.04.O.011	Calculability and complexity	150	75	75	30	15	30		E	5
S.04.O.031	Operating systems: internal mechanisms and design principles	150	75	75	30	45			E	5
S.04.A.041 *S.04.A.042*	Multimedia technologies *Modeling and simulation techniques*	150	75	75	30	30	15		E	5
	Total semester IV:	**900**	**450**	**450**	**120**	**105**	**225**	**0**	**5E**	**30**
					450					
Internship in production (It is done at the student's choice based on the modules *Bases of Application Development* and *Development of domain-specific languages*)										
	Total II year of studies:	**1800**	**900**	**900**	**240**	**210**	**450**	**0**	**10E**	**60**

Year III											
Semester V	***Networks and security***										
Code	**Name of the course unit / module**	***Total hours***			***Number of hours by type of activity***				***Evaluation form***	***No. of credits***
		Total	***Direct contact***	***Individual study***	***C***	***S/P***	***Pr***	***per week***		
S.05.O.032	Developing secured applications	300	150	150			150		PA	10
S.05.O.033	Network programming	150	75	75	30	15	30		E	5
S.05.O.034	Cryptography and security	150	75	75	30	15	30		E	5
G.05.O.020	Ethics, communication and law	150	75	75	45	30			E	5
S.05.A.043 *S.05.A.044*	Techniques and mechanisms for software design *Verification and validation of program products*	150	75	75	30	30	15		E	5
	Total semester V:	**900**	**450**	**450**	**135**	**90**	**225**	**0**	**5E**	**30**
					450					
Semester VI	***The Internet of things (IoT)***									
Code	**Name of the course unit / module**	***Total hours***			***Number of hours by type of activity***				***Evaluation form***	***No. of credits***
		Total	***Direct contact***	***Individual study***	***C***	***S/P***	***Pr***	***per week***		
S.06.O.035	IoT projects	300	150	150			150		PA	10
S.06.O.036	Embedded systems	150	75	75	30	15	30		E	5
F.06.O.012	Signal processing	150	75	75	30	30	15		E	5
S.06.A.045 *S.06.A.046*	Human - computer interaction *Real time programming*	150	75	75	30	15	30		E	5
S.06.A.047 *S.06.A.048*	Mobile applications programming *Web programming*	150	75	75	30	15	30		E	5
	Total semester VI:	**900**	**450**	**450**	**120**	**75**	**255**	**0**	**5E**	**30**
					450					
Technological internship (It is done at the student's choice based on the modules *Developing secured applications* and *IoT projects*)										
	Total III year of studies:	**1800**	**900**	**900**	**255**	**165**	**480**	**0**	**10E**	**60**

Year IV											
Semester VII										***Information systems***	
Code	**Name of the course unit / module**	***Total hours***			***Number of hours by type of activity***				***Evaluation form***	***No. of credits***
		Total	***Direct contact***	***Individual study***	***C***	***S/P***	***Pr***	***per week***		
S.07.O.037	Designing information systems	300	150	150			150		PA	10
S.07.O.038	Programming distributed applications	150	75	75	30	15	30		E	5
U.07.A.023 *U.07.A.024*	Software Project Management *Company Management*	150	75	75	30	30	15		E	5
U.07.A.025 *U.07.A.026*	Electronic marketing *Digital entrepreneurship*	150	75	75	30	30	15		E	5
S.07.A.049 *S.07.A.050*	Software quality *Analyzing and specifying software requirements*	150	75	75	30	30	15		E	5
	Total semester VII:	**900**	**450**	**450**	**120**	**105**	**225**	**0**	**5E**	**30**
					450					
Semester VIII										***Bachelor's degree project***	
Code	**Name of the course unit / module**	***Total hours***			***Number of hours by type of activity***				***Evaluation form***	***No. of credits***
		Total	***Direct contact***	***Individual study***	***C***	***S/P***	***Pr***	***per week***		
S.08.A.051 *S.08.A.052*	Fundamentals of artificial intelligence *Non relational databases*	150	75	75	30	45			E	5
S.08.A.053 *S.08.A.054*	Fundamentals of game developing *Mixed reality technologies*	150	75	75	30	45			E	5
S.08.A.055	Bachelor's degree project	450		450					E	15
S.08.A.056	Theoretical synthesis test: *Algorithms, programming and databases*	120		120					E	4
S.08.A.057	Defence of the Bachelor's degree project	30		30					E	1
	Total semester VIII:	**900**	**150**	**750**	**60**	**90**	**0**	**0**	**5E**	**30**
	Total IV year of studies:	**1800**	**600**	**1200**	**180**	**195**	**225**	**0**	**10E**	**60**
	Total for the study programme:	**7200**	**3300**	**3900**	**930**	**795**	**1575**	**0**	**40E**	**240**