Higher SCT Education: EU and PC Approach

Chapter: **P8: Mongolian University of Science and Technology** /MUST/

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8.1. Background

8.1.1. Vision 2050 aims to develop a people-centered and smart city

As a correlation of past, present and future is preserved in the ideal linkage of mind, speed and essence, the long-term vision – 2050 will be a development model of Mongolia that is founded upon the exceptional features of the nation aligned with global progressive ideas.
The "Vision-2050"[1] is a policy document, according to the Prime Minister's order No:52 dated April 30, 2019, the working group analyzed development stages of the past 30 years of Mongolia and formulated the policy document that will define long and mid-term development policy until 2050. The long-term development policy of Mongolia has 9 fundamental goals and 50 development targets, which are carefully divided into three groups of actions of 10 years for 2020-2030, 2031-2040, and 2041-2050. Following missions are identified to be achieved, focusing on the vision of "Mongolia becoming a leader with its economic growth and social development and a country that achieved sustainable preservation of its nature, language, territorial integrity, and culture". Objectives are: Shared values of the nation, Human development, Life quality and middle class, Economy, Good governance, Green growth, Peaceful and safe society, Regional development, Ulaanbaatar city and satellite cities
Although the capital city Ulaanbaatar takes up 0.3 percent of the territory of Mongolia, 45 percent of the total population is residing here. Due to the over-centralization of the population, a number of issues including air pollution, environmental pollution, traffic jam, and inaccessibility of engineering infrastructure have been arising. Therefore, there is a necessity to plan its development policy issues in the short-, mid-and long-terms, based on the current

[1] "Vision-2050" Mongolia's long-term Policy document, according to the Prime Minister's order No:52 dated April 30, 2019

condition of urban development, social and economic growth, scientific and technological advancements, possible changes as well as the future trends of urbanization.

"Vision-2050", Mongolia's long-term policy document targets to take the following biggest measures in aims of developing Ulaanbaatar city and satellite cities and solving encountering problems. It includes:

- To implement people-centered development policy, ensure equal participation of every citizen and increase jobs through encouraging businesses with state policy
- To have an integrated standard of the city and create a safe and favorable living, working, learning, and traveling conditions for the citizens
- To eliminate air, soil, and environmental pollution by introducing eco-friendly advanced technologies
- To develop and carry out proper science-based policies on urban planning that reflect modern solutions and the right budget estimate
- To decentralize population in Ulaanbaatar city in ways of diversifying and developing satellite and neighboring cities and villages in directions of trade, service, culture, education, agriculture, food and light industry, transport and logistics and tourism, and increasing workplaces
- To create various and smart public transport networks and make Ulaanbaatar city free of the traffic jam by introducing passenger transport that connects Ulaanbaatar city with satellite cities and high-speed transport that links the city with regions
- To establish new city centers, sub-centers, diversified centers, and public centers that are provided with cultural, educational, and trade services, apartments, and social infrastructure and create a multi-centered urban system

On the basis of the implementation of the aforementioned measures, Ulaanbaatar city will be developed as an environmentally friendly, people-centered, and smart city that is comfortable to live, by 2050.

8.1.2. Smart university is a key indicator of the development of smart and innovative cities

Founded in 1969, the Mongolian University of science and technology /MUST/ has been very successful as a university specializing in science and technology, producing a great number of leading engineers and professionals in the field of science and technology. The

University is dedicated to continuing to build on our solid records of achievements of moving the institution from being one that has earned national recognition to one that is achieving to be education and research center of excellence in North-East Asia. MUST experience has been published by the UNESCO Institute for International Education as a book entitled Higher Education Reform: Asia[2].

MUST be an initiator in restructuring measures and reforms among Mongolian higher education institutions. A number of universities, institutes, and colleges of our country have followed these reforms and renovation practices started at MUST. The reforms and renovation are the following: Credit-Based System, Professorship System, University's Management Information System, e-Learning Management System, Accreditation, Joint, Transnational programs and last one is a Double Degree Master Program. As a result of this Erasmus +Capacity Building in Higher Education, SMARTCITY: Innovative Approach Towards a Master Program on Smart Cities Technologies Project, we have successfully organized a double master's degree program that fully meets the quality assurance requirements of the European Union's universities (Riga Technical University), and for the first time in Mongolia, we have produced engineers with a Double Master's Degree in Electronics Engineering with specialization in Smart City Technologies.

Credit-Based System

One of the largest parts of the main activities in a university is academic activities. At the beginning of the '90s, there was a lack of information and perceptions regarding the organization of training processes of foreign universities and colleges. Therefore, it should be noted that there was hesitation in making any reforms and restructurings based on the second information. On the other hand, in terms of easy mobility of students in the era of globalization, a Credit-Based System[3] has been widely introduced. There were briefly mentioned only some essential preparation activities for successful and complete implementation of Credit-Based Systems in university's activities. MUST is the first university in Mongolia that is dedicated to the full-pledged implementation of a key in restructuring processes - a Credit-Based System in all own activities. However, it is essential to note here that MUST community has made

[2] http://www.iiep.unesco.org/en/publication/higher-education-reforms-institutional-restructuring-asia

[3] Yadmaa Narantsetseg, Vision for the development of higher education in Mongolia, Higher education reforms Institutional restructuring in Asia, New trends in higher education, International Institute for Educational Planning, UNESCO, 2009

substantial efforts for introducing a Credit-Based System in its activities by the following phases:

- Phase I. 1992/93 Academic year: Restructuring curriculum
- Phase II. 1996/97 Academic year: Students' knowledge evaluation system
- Phase III.1997/98 Academic year: Academic staff as an essential element of the university
- Phase IV. 1997/98 Academic year: Institutional and Program Accreditation
- Phase V. 1998/99 Academic year: Methodology of assessment of academic staff performance by Credit Unit
- Phase VI. 1999/2000 Academic year: Pilot implementation of Credit-Based System of MUST

A Credit-Based System has been implemented in MUST in scale. With a purpose to assist students in self-planning of the learning process in Credit-Based System e.g., selection of subjects and selection of semesters to study a particular subject, selection of lecturers, individual scheduling of time-sheet from general time-schedule of MUST. The Department of Academic Policy and Coordination of MUST is responsible for the organization and arrangements of MUST academic activities in terms of general academic calendar and training plan in Credit-Based System implementation.

The main distinctiveness of the current era is related to the fast dissemination and application of information in every field of human activities, thus, creating a new information infrastructure.

It should be noted that the complete implementation of a Credit-Based System by MUST administration was a foundation of the creation of current management information systems at the university and was the grounds of all preparation works carried in very fields of the university's activities. It is clear that in the era of the knowledge century information systems serve as catalysts in the training of high-qualified human resources, and assist and appropriate management of fast-pacing information flows and rapid adaptation in the ever-changing business environment right in time. Moreover, the introduction of a university's Management Information Systems tolerates delivery of valid information to managers and staff, supply of necessary information for optimal decision-making and problem solving, and provides excellent opportunities for application of modern and advanced training technology based on the Internet. Thus, the MUST community strongly was believed that the establishment and implementation of Management Information Systems suited for higher education institutions

as a basis of the foundation of future Open Universities will significantly contribute to restructuring and reforms of higher education.

Cloud University System "Cloud UNIMIS"

The Mongolian University of Science and Technology /MUST/ is the first university in Mongolia that is committed to the establishment and maintenance of the foundation of future Open Universities for the higher education system of Mongolia with the effects of Cloud Computing. The Cloud University System MUST (*Figure 1. The Sub-Systems and Web portals of Cloud University System at the MUST)* was developed on the "UNIMIS" system, which is a management information system of our university that has been used by the Mongolian University of Science and Technology for 18 years. Developing integrated systems to use as a reliable instrument for policy creation, monitoring, and evaluation, standards-setting, regulatory frameworks, coordination, and maximization of resources is paramount.[4]

[4] Yadmaa Narantsetseg, **"The Cloud University System at the Mongolian University of Science and Technology",** Вестник Бурятского Государственного Униьерситета Образование. Личность. Общество 2019. Вып. 4 УДК 378:004.9 http://journals.bsu.ru/content/articles/2104.pdf

The credits and marks collected by the Double degree master's program students of the Erasmus+ Capacity Building in Higher Education project, in SMART CITY: Innovative Approach towards a Master Program on Smart Cities Technologies have been transferred to the European Credit Transfer and Accumulation System (ECTS). It is gratifying to note that this transferring of credit units, knowledge assessment was performed using this "Cloud UNIMIS" University's Management Information System.

The MUST has implemented dozens of programs in its history, including the development of E-learning programs in the 2007/08-2010/11 academic years, and inside this program, we developed and implemented the "UNILMS" E-Learning Management System. In this way, we started to build today's Open MUST. The fact that the E-learning management system of MUST meets the requirements of the International Hybrid Learning Space (IHLS) of the project with open and online educational resource teaching materials posted on UNILMS and virtual laboratories is consistent with innovative teaching methods using modern information and communication technologies. Dissemination of part of teaching materials which are massive, open, and online educational resources to Mongolian students through the European Union and partner universities' e-learning portals and virtual laboratories is a that guarantees the satisfaction of modern students. In addition, conditions will be created to fully meet the important criteria for quality assurance in higher education.

Figure 1. ***The Sub-Systems and Web portals of Cloud University System*** *at the MUST*

Quality Management Sub-System

Quality work supports the MUST in achieving its vision defined in the Strategic Plan. Every member of the academic community shall contribute to the common goal of achieving the University's objectives and shall be responsible for his or her performance and outcomes. The purpose of the University's quality system is to aid the academic community and its members in developing a framework for quality management. The University maintains and enhances the quality of activities through jointly determined procedures, processes, or systems.

The objectives set in the strategic plan, target programs, and action plans are the foundation for all operations. Quality management system aims to continuously improve University operations and make development an inherent part of all activities and units as well as the work of individuals. It affects all members of the academic community: lecturers, researchers, and other staff as well as students.

The Quality Management Sub-System of Cloud University System MUST (*Figure 2. Quality Management Sub-System of Cloud University System)* rests on an appropriate organizational structure as well as good management and decision-making. The University's quality system provides the necessary structures and defines the procedures and responsibilities for well-functioning quality management. The Quality Management Sub-System supports the

University’s strategic objectives and helps both the University and its units to achieve them. The operations management process, which involves setting objectives and monitoring their achievement, is at the core of quality management. The University has defined indicators and quantitative follow-up targets to monitor whether it is moving in the direction defined by its objectives. Every member of the academic community shall contribute to the common goal of achieving the University’s objectives and shall be responsible for his or her performance and outcomes. The purpose of the University’s quality system is to aid the academic community and its members in developing a framework for quality management. Another purpose of the quality system is to assure that the quality management procedures are set up to ensure the quality of operations is present in all operations. Quality Management Sub-System aims to continuously improve University operations and make development an inherent part of all activities and units as well as the work of individuals. It affects all members of the academic community: faculty, researchers, and other staff as well as students.

Experts from international higher education accreditation organizations such as ASIIN, ACBSP, ABET, BAC, Asia-Pacific Accreditation and Certification Commission praised University's “Cloud UNiMIS” management information system.

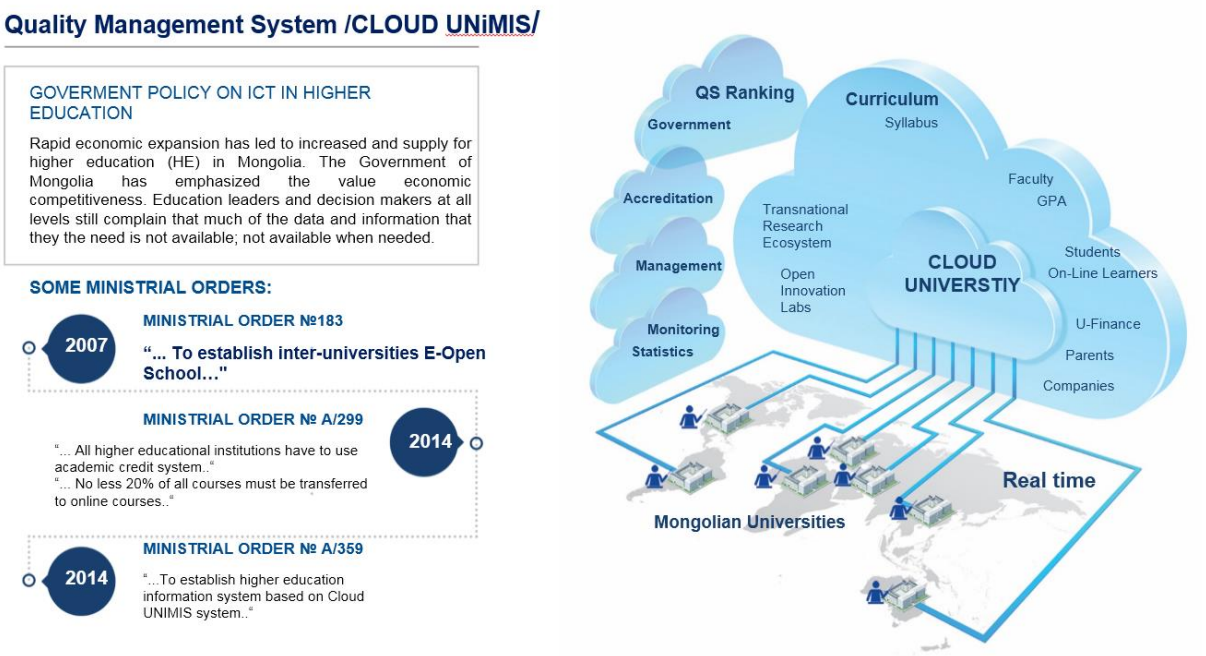

Figure 2. ***Quality Management Sub-System of Cloud University System***

Inside the Background Report of the Global High-Level Policy Forum -Online, Open and Flexible Higher Education for the Future We Want: Policy challenges‖ in Paris, France, 9-11 June 2015 marked the following: Example of Good Practice in Accreditation[5]

"…In Mongolia, work in progress on a Cloud University project which will integrate Academic Credit Systems with Online and distance learning, create Online collaboration among all Mongolia universities, and set up social networking of university, students, professors, graduates, parents, and employers."

8.2. Objectives

We are confident that Bologna's participation in the process and its deep penetration into the principles of the European Union will pave the way for the recognition of Mongolian engineering higher education at a quality assurance level.

The development and implementation of dual degree programs with the European Union and neighboring countries provide an opportunity to increase the number of internationally open-minded young people who are resilient to modern social change.

Double Degree Master Program in Smart City (DDMP) will allow also give the possibility for the Mongolian students to get innovative technological knowledge which can help to build future smart cities for comfortable living and will lead to modernization in Mongolian engineering higher education.

DDMP is a multidisciplinary program combining technological knowledge in the computer science, Internet of things field, digital humanities with the urban ecology principles, energy effective technologies for energy saving, transport logistics, critical infrastructures control fundamentals, innovation urban management, and entrepreneurship with information communication technologies and allows to create a new breed of multidisciplinary ICT engineers.

[5] The Background Report of the Global High Level Policy Forum ―Online, Open and Flexible Higher Education for the Future We Want: Policy challenges‖ in Paris, France, 9-11 June 2015

8.3. Implementation

WP:	Outcomes/ Outputs	Implementation Documentations *(By appendix, Downloads)*	
D 1.1. Business community needs and expectations analyzed,			
WP.1: 1.2	Business analysis of the demands for knowledge & skills in SCT	**Business analyses,** December, 2019 http://www.smartcity.edu.mn/Documents Download: Business of the demands for knowledge and skills in SCT	
D 2.1. New curricula developed,			
WP.2: 2.2.	Curriculum of Master program in SCT	**Cooperation agreement** concerning a Double Diploma Master Programs between Riga Technical University and Mongolian University of Science and Technology *Appendix D.2.1.1*	
D 2.2. New syllabi developed,			
U.SC705	Fundamental of Smart city	Download: Fundamental of Smart City	
F.EE714	Microprocessors - based Automation Systems	Download: Microprocessor based automation system	
F.EE715	Control Technique with Microprocessor Controllers	Download: Control Technique with Microprocessor Controllers	
J.EE703	Digital Signal Processing	Download: Digital Signal Processing	
J.EE702	Semiconductor IC technology	Download: Semiconductor Integrated Circuit Technology	
F.CN725	Basics of Occupational Safety	Download: Introduction to Occupational Safety	
D 2.3. Partners' network established legally,			
WP.2.1	Training session for the senior academic administrators 4-10 of March, 2019 at the University of Applied Science of Salzburg (Austria)	Download Cascade Training: CT1-2.1 CascadeTraining-MUST-Riga.docx The date of the cascade training: 2019.03.18 The speakers: Narantsetseg Yadmaa, Batdorj Davaagombo / The target group: MUST administrators level The number of the participants: 10 Location: Ulaanbaatar, MUST, Conference Hall -203	
WP.2.4	Riga Technical University, Riga, Latvia	**General agreement for academic cooperation** between Riga Technical University, Riga, Latvia & Mongolian University of Science and Technology, Ulaanbaatar, Mongolia http://www.smartcity.edu.mn/Documents Download: Agreements	
WP.2.4	Yuri Gagarin State Technical University of Saratov, Saratov, Russian Federation	**Agreement on Cooperation between** Mongolian University of Science and Technology, Ulaanbaatar, Mongolia & Yuri Gagarin State Technical University of Saratov, Russian Federation http://www.smartcity.edu.mn/Documents Download: Agreements	

WP.2.5	Training session for the senior academic administrators 11-18 March, ATEI, Thessaloniki, Greece	Download Cascade Training: CT2-2.5 Cascade Training.docx The date of the cascade training: 2019.04.17 The speakers: NARANTSETSEG Yadmaa The target group: MUST level training. /Graduate and Undergraduate Schools/ The number of the participants: 26	
D 3.1. Skills upgraded and methodological support of the teaching process is ensured,			
WP.3.2	Teachers from Mongolia has visited ATEI, Thessaloniki and TUS, Bulgaria for intensive training in double-degree master program development, content & methodology	**Download Cascade Training:** CT1-3.2-CascadeTrainingReport-MUST.Teachers The date of the cascade training: 2019.10.18 The speakers: Alimaa Jargalsaikhan Chair and Speaker: Khishigjargal Gonchigsumlaa The target group: MUST level training. /Teacher, Graduate Schools student/ The number of the participants: 20	
WP.3.2	Teachers from Mongolia has visited ATEI, Thessaloniki and TUS, Bulgaria for intensive training in double-degree master program development, content & methodology	Download Cascade Training: CT2-3.2 Cascade training teacher's-2 The date of the cascade training: 2020.01.17 The speakers: Dr.Alimaa Jargalsaikhan, Dr. Khishigjargal Gonchigsumlaa The target group: MUST level training /Teacher, Graduate Schools student/ The number of the participants: 65 Location: Room 102, School of Information and Communication Technology, MUST	
WP.3.2	International Teachers Training Event Within the Frames of ERASMUS+ Project, November 11-15, 2019, Riga, Latvia	Download Cascade Training: CT-3.2 Cascade training teacher's The date of the cascade training: 2019.12.19 The speakers: Narantsetseg Yadmaa Tuvshintugs Tsoodol The target group: MUST level training Program developers and teachers The number of the participants: 10	
WP.3.4	Summer School "Smart City Today and Tomorrow" at Novosibirsk State Technical University, Novosibirsk, Russian Federation, July 1-5, 2019	Download Cascade Training: CT-3.4 Cascade Training Report- W.P3.4-MUST-Novosibirsk The date of the cascade training: 2019.09.16 The speakers: Narantsetseg Yadmaa The target group: MUST level training administration staff and teachers. The number of the participants: 10	
WP.3.4	Summer School – 26-30 April, 2021 “Smart University is the foundation for a Smart City” Al-Farabi Kazakh National University, Almaty, Kazakhstan	Download Cascade Training: CT-3.4 Cascade Training Report - W.P 3.4-MUST-Almaty The date of the cascade training: 2021.06.08 The speakers: Narantsetseg Yadmaa The target group: MUST level lecturers The number of the participants: 62	

WP.3.4	Summer School: 25-29 October, 2021 Mongolian University of Science and Technology & National University of Mongolia, Ulaanbaatar, Mongolia	Download Summer School: http://smartcity.edu.mn/event/show/19 The speakers: Narantsetseg Yadmaa The speakers: Oyun-Erdene Namsrai The target group: MUST, NUM The number of the participants: 72	
D 3.2. Teaching materials and training guide developed,			
U.SC705	Fundamental of Smart city	http://www.smartcity.edu.mn/Documents Download: Fundamentals of Smart city	
F.EE715	Control Technique with Microprocessor Controllers	http://www.smartcity.edu.mn/Documents Download: Control Technique with Microcontrollers	
F.CN725	Basics of Occupational Safety	http://www.smartcity.edu.mn/Documents Download: Basics of Occupational Safety	
D 4.1. PC universities staff upgraded in quality assurance,			
WP.4.1	Seminar on quality assurance system at Sofia Technical University 06-10 May, 2019 Sofia, Bulgaria	Download Cascade Training: CT-4.1 Cascade Training Report The date of the cascade training: 2019.05.30 The speakers: Narantsetseg Yadmaa, Zorig Gunjee Chair : Dulmaa Dagvadash The target group: MUST level training /Administration staff, Graduate and Undergraduate Schools/ The number of the participants: 54	
D 4.2. QAS and user guide developed,			
WP.4.3	ECTS and quality assurance: • Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG) • Accreditation with ASIIN - Degree Programs, Institutions and Systems Introduction to the procedural principles	The Procedure of Education Accreditation Process MNCEA: Mongolian National Council for Education Accreditation http://www.smartcity.edu.mn/Documents Download: Development_QAS_MUST	

4.3.QAS in operation,			
ECTS	Credit transfer list	Confirmation of credit transfer list	
ECTS	Academic transcript /GPA/	Confirmation of academic transcript	
	International research conference Ulaanbaatar, Mongolia 07 May 2021	"Best paper awards-2021" Conference of Master and PhD students	
	Master defense Ulaanbaatar, Mongolia Riga, Latvia 17 June 2021	MUST Database, Main library of MUST Master Thesis: Tenuun.D, "Charging and discharging electrochemical battery in residential energy storage" Batmunkh.E, "Development of robot test-bench with different control systems" Bilguun.G, "Automated trash bin development for Intelligent Waste Management System in Smart Cities"	
D 5.1. PC universities staff upgraded in e-learning and new technologies,			
WP.5.1	18-22 of November 2019 E-learning training at Chemnitz Technical University	Download Cascade Training: CT- 5.1. Cascade Training Report - MUST-Chemnitz The date of the cascade training: 2020.01.15 The speakers: Narantsetseg Yadmaa, Batdorj Davaagombo The target group: MUST level training lecturers and program developers The number of the participants: 67	
D 5.2. IHLS in operation, equipped (an innovative approach to teaching includes web-portal, remote/virtual labs, e-learning, access to the EU databases),			
WP.5.2	E-Learning Management System	**https://lms.must.edu.mn/**	
	University entrance exam simulation and evaluation system	www.esh.edu.mn	
	MOOC: Mongolian Open Online Courses	www.mooc.edu.mn	
WP.5.3	Open Research Laboratory: "Smart city technologies"	Open Research Laboratory: Smart city technologies Professor's team: Smart engineering system design Location: Room 701, Research and Innovation Center building, Graduate School of Engineering, MUST	
D 6.1. Students' training implemented;			
J.EE18E021	Tenuun Dovdon	Master thesis: Charging and discharging electrochemical battery in residential energy storage	
J.EE19E003	Batmunkh Erkhbayar	Master thesis: Development of robot test-bench with different control systems	
J.EE19E006	Bilguun Ganbaatar	Master thesis: Automated trash bin development for Intelligent Waste Management System in Smart Cities	

Appendix

Appendix D.2.1.1	Cooperation agreement concerning a Double Diploma Master Programs between Riga Technical University and Mongolian University of Science and Technology
Final Book. Pictures	*Att.file*: FinalBook.P8.MUST.Pictures
Video. MUST	https://youtu.be/MHTRnJRv0zQ