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MONGOLIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY
SCHOOL OF INFORMATION AND COMMUNICATION TECHNOLOGY

The Korean Government Grant Project:

CAPACITY BUILDING PROJECT FOR SCHOOL OF ICT MONGOLIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

2019 - 2024

MONGOLIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY
SCHOOL OF INFORMATION AND COMMUNICATION TECHNOLOGY

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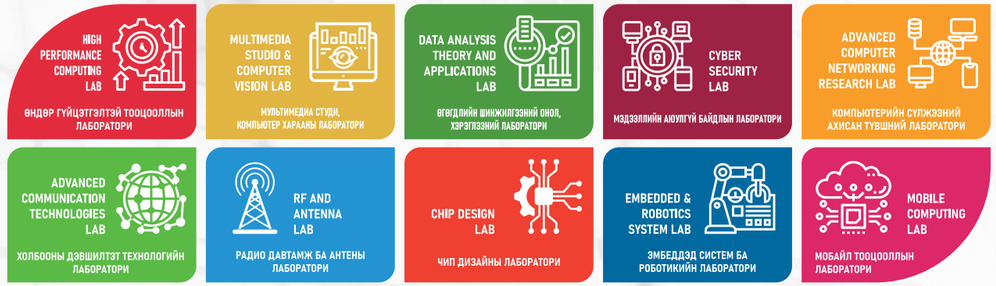
MUST



CAPACITY BUILDIING PROJECT FOR SCHOOL OF ICT

MONGOLIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY • 2019-2024

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Project overview

The idea of the project "Development of higher education institutions in the field of ICT in Mongolia" with the help of Korea, one of the leading country in ICT area, first appeared in 2015 at the level of Mongolian and Korean leaders. The School of ICT, MUST drafted the project concept paper and submitted it to the Government of the Republic of Korea through the Korea International Cooperation Agency (KOICA). In accordance with this, KOICA organized several preliminary study teams at the school from 2016 to 2018, and as a result, in January 2019 Country director of KOICA and State secretaries of the Ministry of Education, Culture, and Science of Mongolia and the Ministry of Finance of Mongolia have signed the Record of Discussions to implement "The capacity building project for SICT at MUST" for 4 years with a grant from the Korean government.

The concept of the project formulated as “The capacity building for SICT leads to ICT industry development and its development will speed up the development of other sectors, thus laying the foundation for the sustainable development of Mongolia” based on Mongolia's ICT and Education sector development policy, Mongolia-Korea cooperation development policy, and the Master plan of the MUST for research-oriented university development (Figure 1).

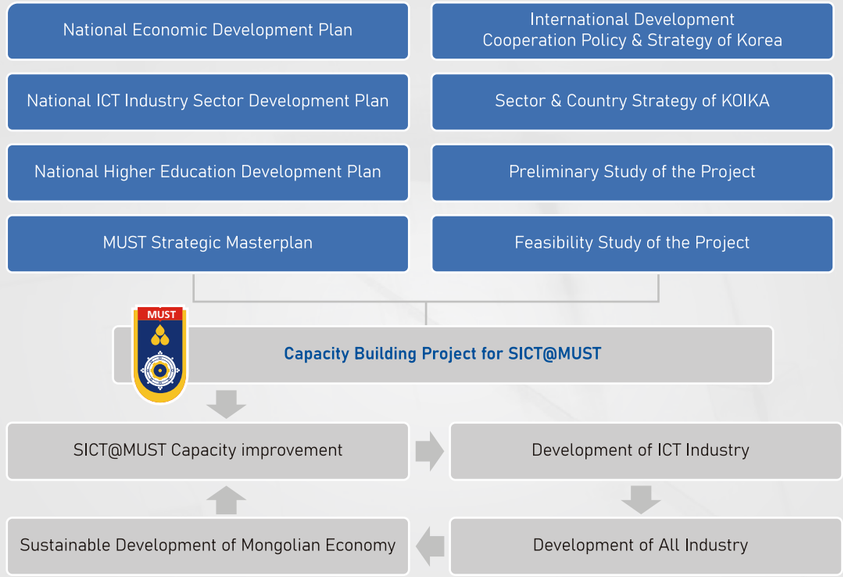

Figure 1. Project concept

“The SICT capacity building project” will improve the capacity of the school in 4 main directions (Figure 2).

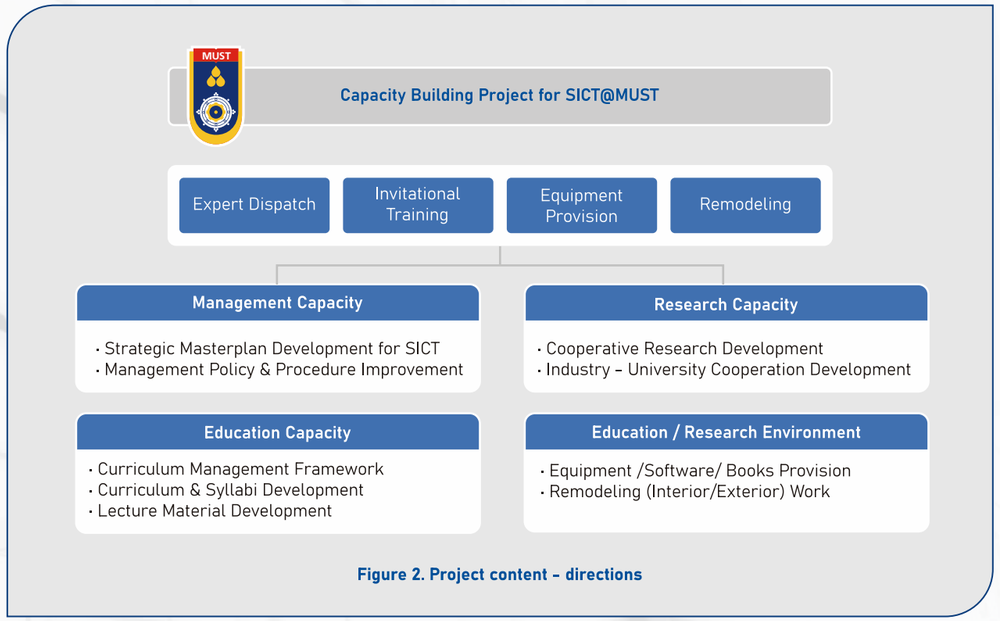

Figure 2. Project content – directions

The human, technical, and technological capabilities that will be created as a result of the project will be "the core of cooperation and attracting talents of any organization that is doing research and academic work in the field of ICT".

Korea's Sangmyung University (https://www.smu.ac.kr)
was selected as the main implementing organization of the project, and professor Paek SeonUck of the Department of Computer Science working as the project leader/coordinator.

Prof. Ph.D Chuluunbandi.N
Project manager from SICT, MUST

Prof. Ph.D Erdenebaatar.A,
Project coordinator from SICT, MUST

Management capacity building

Since SICT is one of the schools of the MUST, its development policy should be a part of the university policy and aimed at ensuring its implementation. In 2019, MUST developed the policy document – "MUST 2030 Strategic Plan" reflected in the government's policy goal on higher education for "developing research-oriented universities and increasing their competitiveness".
The main principle in the development of the SICT Master Plan is the role and leadership of the schools within the university in the implementation of the "MUST 2030 - Strategic Plan" to transform the university into a research-oriented university.

2. SICT-2030 Planning Procedure

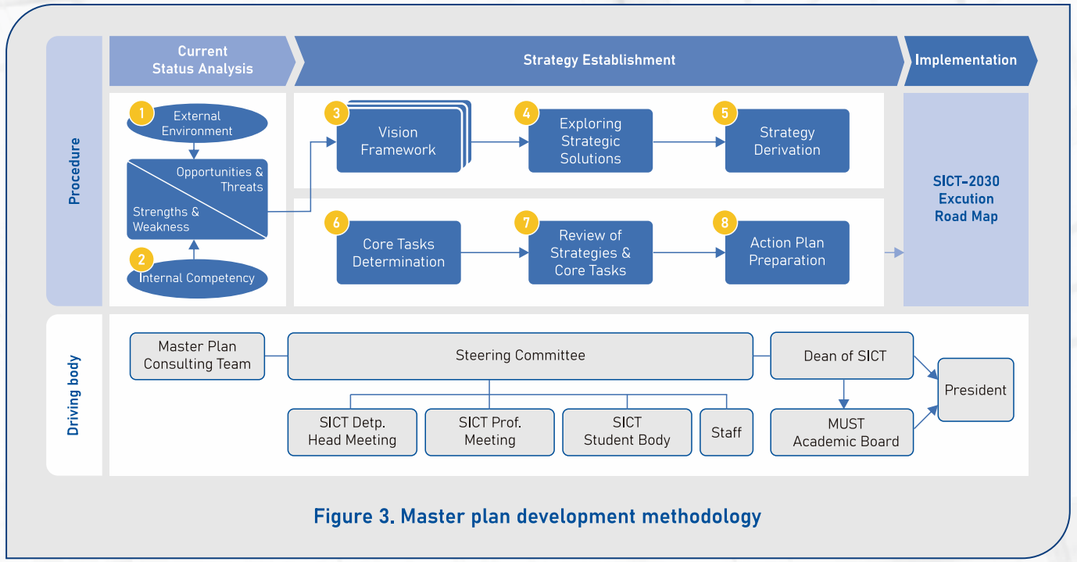

Figure 3. Master plan development methodology

As part of the project's management capacity building, the MUST management team spent 2 weeks in Korea to study the experience of Korean higher education, including the graduate levels. Prof. Kh.Tamir, head of the Higher Education Department of the Ministry of Education and Culture, and Prof. T.Namnan, President of the MUST are joined in this team, and it was important for further changes and reforms in the school's management and administration.

Figure 4. Managerial team in Korea

Education capacity building

Project's educational capacity building includes 3 sets of works as following:
A. Academic program development. The project will develop in total 20 new and revised undergraduate and graduate programs at the SICT.

Table 2. New and revised academic programs

Name of department	ISCED 6 level /Bachelor/	ISCED 7 level /Master/	ISCED 8 level /Doctor/	Remarks
Information network and system security	Computer network	Computer network		To be revised
	Cyber Security	Cyber Security		To be revised
Information technology	Information system	Information system		To be revised
	Data Science	Data Science		To be developed
Computer Science	Computer Science		Computer Science	To be revised
	Artificial Intelligence	Artificial Intelligence		To be developed
Communication Engineering Technology		Information and Communication Network Technology		To be revised
		Wireless Communications Network Technology		To be revised
		Mobile and IoT Technology		To be developed
Electronics		Electronics		To be revised
	Robotics and Artificial Intelligence	Robotics and Artificial Intelligence		To be developed
Interdisciplinary		Applied Information and Communication Technology	Applied Information and Communication Technology	To be developed
Total	**7**	**11**	**2**	**20**

The update of the programs is being developed by professors of Sangmyung University and our school in collaboration online and on SICT campus. During the work, it was concluded that the bachelor's programs of SICT were developed in accordance with the requirements of national and international accreditation organizations, and thus the content structure is qualified, so the course selection and logical prerequisites in the program are being improved. However, the content and organization of the graduate level programs in SICT are far behind the common international practice, it has been concluded that direct localization of the good practices of Korean universities is an appropriate solution.
Б. Faculty training. Through the project, 15 faculties/teachers attended a 6-week training in Korea in June-July 2022.

Table 3. The list of faculties

No	Name	Position/Title	Department
1	KHURELBAATAR Tseveenjav	Assoc.Prof, PhD	Electronics
2	AMARTUVSHIN Togooch	Senior lecturer	Electronics
3	SUGIR Tsagaanchuluun	Senior lecturer	Electronics
4	BAYAR Gombosuren	Senior lecturer	Information Network and Security
5	MANLAIBAATAR Tserenkhuu	Lecturer	Information Network and Security
6	BUJMAA Byambadorj	Lecturer	Information Network and Security
7	BATSHAGAI Baatar	Lecturer	Communication Engineering
8	GANCHIMEG Ganbold	Senior lecturer	Computer Science
9	GUNDSAMBUU Bold	Lecturer	Computer Science
10	BATDALAI Sukh	Assoc.Prof, PhD	Communication Engineering
11	ERDENEBAYAR Lamjav	Assoc.Prof, PhD	Communication Engineering
12	MUNKHBAYAR Adiya	Senior lecturer	Communication Engineering
13	BAT-ENKH Oyunbileg	Professor, PhD	Information Technology
14	SARANGEREL Dorjgochoo	Assoc.Prof, PhD	Information Technology
15	DOLGORSUREN Batjargal	Assoc.Prof, PhD	Information Technology

Figure 5. Faculties in Korea

B. e-Course development. According to the project, each department of the SICT will develop the content of one course for future delivery in electronic form. The newly established multimedia studio and computer vision laboratory techniques and equipment will be used to produce the content.

Research capacity building

The main concept of the project is to develop advanced research and education in the SICT and to create a research-oriented framework in the school. In this context, research capacity building is the largest and most weighty part of the project, accounting for more than 50% of the total cost. This part consists of 2 main tasks:
A. Establish 10 research/education labs. These laboratories cover all areas of research and education at the SICT, the core of which is the High performance computing laboratory based on cloud computing.

1 Advanced Communication Technologies Laboratory

Main Activity

- To do research and develop technologies related to the transmission of information through optical fibers. This includes designing and testing components such as lasers, modulators, detectors, and optical amplifiers, as well as developing techniques for signal processing and system optimization

Research topics

- Advanced optical modulation format conversion
- Orbital Angular momentum
- Resource allocation algorithm for PON
- Energy harvester for IoT node

Courses

- Photonics
- Optical Communication Network
- Internet of Things
- Signal and System

Main equipment

- Real time oscilloscope
- Tunable Laser source
- 40G intensity modulator
- Arbitrary Waveform Generator
- Optical Spectrum Analyzer
- Spatial Light Modulator
- EDFA
- Semiconductor Optical Amplifier
- Infrared camera
- IQ modulator
- U3814A IoT System Training Kit
- Field strength meter
- Wavecontrol MonitEM Hybrid

Software

- OptiSystem

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Room
324
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2 Advanced Computer Networking Research Laboratory

Main Activity

- Network Traffic Modeling and Attack Detection

Research topics

- Wireless Network Traffic modelling and Simulation
- Network attack detection
- Embedded Wireless Access Point
- Modelling and Analysis of TCP protocol

Courses

- Wireless Network and Security
- Analyzing Internet protocols
- Computer Networking-I, II
- Advanced Routing and Switching

Main equipment

- Wireless Embedded modules
- Access Point
- Attack detection
- Switch & Router
- Server
- Nuand BladeRF 2.0 micro xA9
- MpSoC Evaluation Kit
- LIDAR SparkFun SEN-14032
- Flir Leton 2.5
- MpSoC Evaluation Kit Xilinx ZCU106
- MTSN Kit

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Room
313
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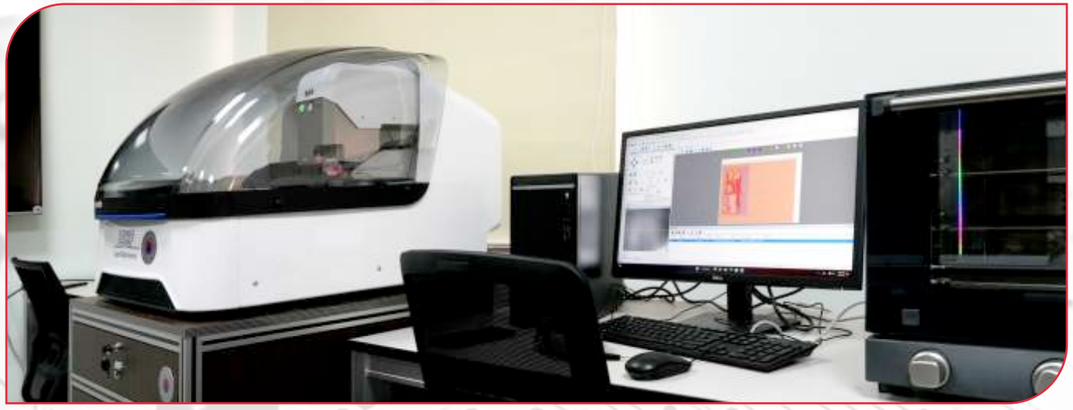

3 Chip Design Lab

Main Activity

- Research, innovation and academic excellence in cyber security

Software

- LabVIEW Education AVL
- Proteus PCB Design Starter Kit

Research topics

- Logic design, FPGA
- Quantum computer
- Semiconductor Device
- Automation
- Robotic technology
- IoT system design
- Artificial Intelligence

Courses

- Logic design, FPGA
- Semiconductor IC technology
- Driver Programming
- CMOS design
- VLSI

Main equipment

- PCB Prototyping Machine, LPKF ProtoMat S64
- Lambda labs Workstation for AI training
- FPGA Digital Circuit Design Trainer HBE-Combo II-DLD
- Xilinx Digilent ZedBoard Zynq-7000
- Digilent Pmod GPS
- Digilent Pmod MTDS

lambda labs

SEM EM-30

PCB prototyping line

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320
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4 Cyber Security Laboratory

Main Activity

- Research, innovation and academic excellence in cyber security

Research topics

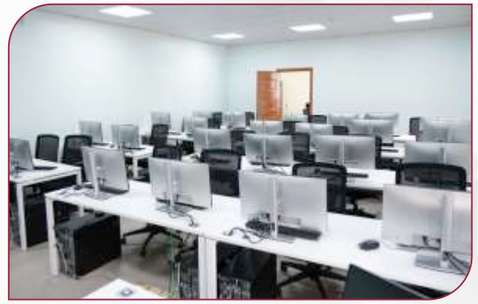
- Malware Analysis and Detection
- Cryptography
- Anomaly Detection
- Deep Learning
- Network Intrusion Detection
- Grayscale Image

Courses

- Digital Forensics
- Cryptography
- Ethical Hacking
- Firewall and Intrusion Detection System
- Computer Network

Main equipment

- Dell, Precision 7920 Workstations
- USB-WiFi-Premium Keygrabber
- IDA Pro Disassembler
- Raspberry Pi 400 Personal Computer Kit
- Hak5, USB Rubber Ducky Keystroke injection device
- Hak5, Screen Grabber
- Dualcomm, Dual-Link GbE Copper and Fiber Network Tap



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317
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5 Data Analysis Theory and Applications Laboratory

Main Activity

- The research focus of our lab is on modern machine learning models, in particular deep learning, which is at the core of many recent successes in data science and artificial intelligence. The key technologies we currently focus on are data analytics, data mining, computer vision, machine learning, deep learning, optimization and process mining. These technologies are leveraged to solve problems originating from a range of application domains such as demand forecasting, mobility pattern mining, credit risk modelling, fraud detection, preference learning in vehicle routing, data-driven logistics, inverse design of complex systems, and healthcare.

Research topics

- Statistics
- Data visualization
- Image processing
- Computer vision
- Artificial Intelligence
- Social media
- NLP

Courses

- Foundation of Data science
- Machine Learning
- Deep learning
- Data mining
- Neural Networks
- Natural language processing
- Big data analytics
- Optimization techniques in machine learning
- R/Python programing

Main equipment

- iMac 24 inch
- MacBook Pro13
- Macbook Pro 16 inches
- LaserJet Pro MFP M428

Software

- Microsoft Power BI Pro

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Room
316
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6 Embedded and Robotics System Laboratory

Main Activity

- Embedded system design and Reinforcement learning

Research topics

- Self-driving car
- Embedded system
- Reinforcement learning
- Image Process
- Digital signal process

Courses

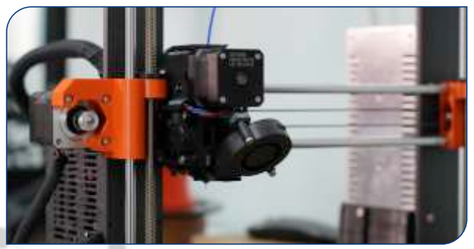
- Fundamentals of image process
- Robot training and Modeling
- Smart robot modelling

Main equipment

- High-speed data logger
- Asus Xtion 2 depth image
- WeGO –ERP 42MINI – RC car
- AIoT Serbot Series Medium size robot
- Hanback DSP – II trainer
- Holybro X500 Pixhawk 4 Drone
- Robotis OP3 Humanoid Robot
- PowerDebug Module TRACE32 - JTAG for I.MX8
- Raspberry Pi 3 Application Kit for IoT
- EPOC Flex Gel sensor

Software

- LabView NXG professional edition
- 8085 Simulator IDE
- Proteus



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Room
222
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7 High Performance Computing (HPC)

Main Activity

- To support the provision of an efficient network architecture for high-performance systems. It allows high speed network and adjustable computational environment for high-capacity, super-computational research and simulations by researchers, students and off-campus researchers.

Research topics

- Artificial Intelligence
- Machine learning
- Deep learning
- Knowledge Management
- Social media
- Bioinformatics
- Big data
- Urban computing
- Multiagent systems
- Graph Neural Networks
- Computer Vision
- Natural Language processing
- Big data analytics

Courses

- Foundation of Artificial Intelligence
- Machine Learning
- Deep learning
- Multiagent Systems
- Neural Networks
- Natural language processing
- Data mining and processing

Main equipment

CPU (6 nodes)
Power Edge R6525
2 x Intel Xeon gold 6230R 2.1G, 26C/52T,
RAM: 12 x 16GB, SDD: 2 x 1.92TB SSD
RAM: 24 x 32GB DDR4 3200MHz
GPU node
Power Edge R740
GPU: 3 x NVidia Ampere A100, CPU: 2 x Intel Xeon Gold 6230R 2.1G 26C/52T
CPU: 2 x Intel Xeon Gold 6230R 2.1G 26C/52T
RAM: 24 x 16GB RDIMM
Admin node
Power Edge R640
CPU: 2 x Intel Xeon gold 6230R 2.1G, 26C/52T
RAM: 12 x 16GB
Storage (3 nodes)
Power Edge R740XD
CPU: Intel Xeon Gold 6230R 2.1G 26C/52T
SSD: 24 x 1.92TB STAT
RAM: 4 x 32GB RDIMM
Controller (3 nodes)
Power Edge R640
CPU: 2 x Intel Xeon gold 6230R 2.1G, 26C/52T
RAM: 12 x 16GB

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115
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8 Multimedia Studio and Computer Vision Lab

Main Activity

- To develop tools, visualization environments and applications based on VR, AR and MR, tracking and natural interaction, computer vision techniques and visual analytics of large amount of data for the resolution of problems and technological challenges. At lab, the participants mastered the basic tools for creating augmented reality products as well as learn designing the 2D/3D motion.

Research topics

- Artificial Intelligence Image processing
- Content production
- Multimedia programming
- VR & AR development
- Multimedia streaming
- Multimedia Privacy Protection
- Computer vision
- Game Development
- Motion Sensor

Software

- Adobe Creative Cloud
- Visual Paradigm Professional
- Unreal Engine
- Maya
- SolidWorks
- Raise 3D
- KAT-VR
- Insta361
- Control App
- Apple Educational Pro App Bundle

Courses

- Multimedia Studio Technology
- VR and AR Technology
- 3D production
- 3D simulation
- Video Production
- Game Development
- Film and Television
- Multimedia Content
- Motion Capture

Main equipment

- Insta360 Pro II
- KAT-VR Walk Mini
- Optitrack
- Boxx Apexx P4i
- Sony PXW-Z90
- Blackmagic Design ATEM 2 M/E Production Studio 4K
- Shining3D EinScan Pro 2X
- Raise3D Pro2
- Brexel VStation-Lightboard
- Apple Mac Studio
- Synology DiskStation DS 1821+
- Brexel VStation-Lightboard
- Dell OptiPlex 7090 Tower

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211-217
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9 Mobile Computing Laboratory

Main Activity

- Mobile computing laboratory conducts research and teaching in the mobile computing and cloud computing domains. Our research topics include cloud computing, mobile application development, mobile cloud, mobile web services, Internet of Things and migrating scientific computing and enterprise applications to the cloud.

Research topics

- Mobile computing
- IoT
- Image processing
- Computer vision
- Artificial Intelligence
- Cloud computing
- Mobile Networks and Its Applications

Courses

- Cloud computing
- Advanced networking
- Virtualization with VMware
- Mobile app development
- Cyber security
- IoT
- Data security in cloud computing

Main equipment

- iMac 24 inch
- MacBook Pro13
- Macbook Pro 16 inches
- Insta360 ONE X2
- Livescribe Sympony
- Samsung Galaxy S22 Ultra 5G
- Samsung SMART TV 85 inch

Contact

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315
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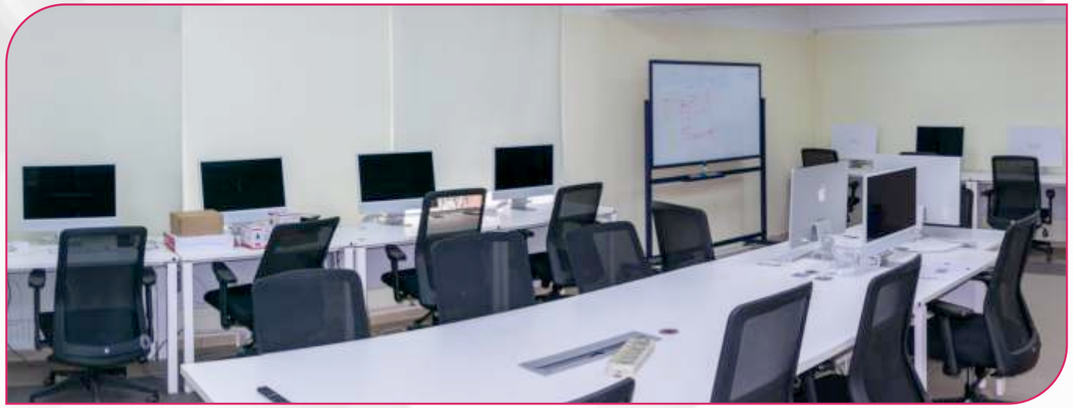

10 RF and Antenna Laboratory

Main Activity

- RF and Microwave Components design and experiments

Research topics

- Low-profile circularly polarized antennas
- Broadband dual and circularly polarized antennas
- Sensor antennas, high efficient rectennas
- Antenna decoupling techniques
- OAM, MIMO techniques in antenna
- EMC, EM propagation
- Microwave circuits

Courses

- Antenna and Wave Propagation
- Microwave Engineering
- Antenna Design and Application
- RF Network Planning
- RF Transceiver
- Analog and Digital Communication Systems

Main equipment

- Vector network analyzer
- Spectrum analyzer
- VNA network analyzer (Keysight E5063A (10 MHz to 6 GHz)
- RF signal generator
- Selective radiation meter
- RF calibration & test kits
- Anechoic chamber SNF-RAZ-0.7 (0.5-20GHz)
  - SNF-RAZ-0.7 (0.5-20GHz)
  - Near-field measurement)
  - Far-field calculation

Software

- CST Studio Suite
- PathWave Advanced Design System (ADS)

Contact

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Room
319
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SICT Staff Room

A technical team or lab managers use this room and take a responsible for the operation and maintains of research/training 10 laboratories.

Items

- Laser Printer (A3)
- Epson document Camera
- AIO PC OptiPlex 7400 All-in-One
- Glass Board

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KOICA Capstone Lounge

The newly renovated KOICA capstone lounge is designed to give students a space for relaxation and study. The KOICA lounge located on the 3th floor of the SICT. The capstone course allows students to demonstrate expertise in their major or area of study.

Items

- SMART TV 85"
- 8-AIO PC
- Document Camera
- Printer (A4)
- Glass Board
- Whiteboard with Stand

SICT

Student Rest Area

The area separated by glass walls is located on 1-3 floors, designed to give students a place for socializing, studying, talking with friends, or simply relaxing while waiting for their next class. The student rest area is open to all currently enrolled students.

SICT

Books

Through the project, the library of SICT received 250 books and textbooks that are essential for students, and students are using them for their studies.

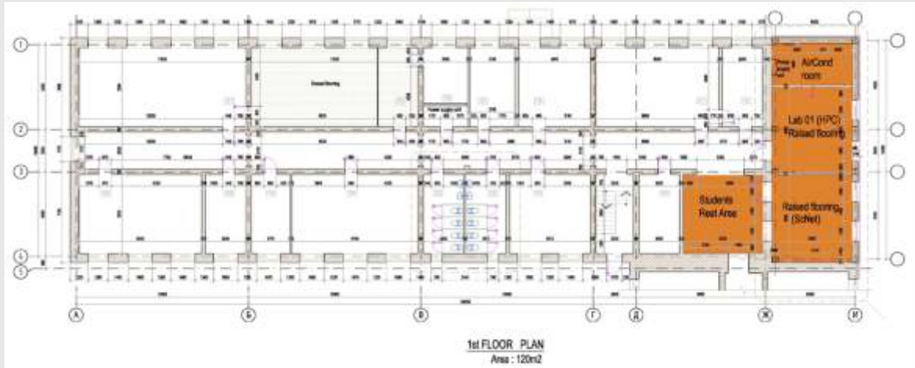
B. Joint research projects. Using the newly established laboratories under the project, professors and researchers of SICT will implement a total of 22 research projects together with the professors of Sangmyeon University. The results of the projects will be research articles published in internationally recognized SCI-registered professional journals.

Table 4. The list of research projects

No	Research project title	Team leader
1	Beam Scanning Leaky Wave Antenna for underground communication	CHULUUNBANDI Naimannaran
2	Sensor antenna project for non-destructive analysis of the underground mine	CHULUUNBANDI Naimannaran
3	Malware Detection Using Deep Learning	NYAMSUREN Vaanchig
4	A Study of Applying Data Analytics in the Energy Sector	MUNKHNASAN Choinzon
5	The Study of Developing Virtual Laboratory Utilization Approach	ERDENEBAYAR Lhamjav
6	QoS-based Dynamic Wavelength Channel and Bandwidth Allocation Method in Next-Generation Optical Access Network	GANBOLD Shagdar
7	Model Development for Optimizing KPIs to Reflect the Development Indicators of Higher Education Institutions (HEIs)	NYAMSUREN Purevsuren
8	Development of A Public Transport Mobility Analysis Model Using Deep Learning	ZOLZAYA Dashdorj
9	Design of Health Care Analysis Model Based on The Relationship Between Disease and Symptoms Using AI	ZOLZAYA Dorj
10	Blast Fragmentation Analysis Using Image Processing	ERDENETUYA Dorj
11A	Study to Determine the Mongolian People's Age, Sex, and Ethnicity Through Their Faces and Voices	BAT-ENKH Oyunbileg
12	Energy Harvester for IoT Node on The Freight Train	BATDALAI Sukh
13	The Study on 5G Mobile Network Based on D2D Communication Resource Allocation	OTGONBAYAR Bataa
14	The Project on Measurement and Modeling of the RF Electric Field Strength Levels in the Vicinity of Schools and Hospitals	ERDENEKHUU Norinpel
15	Machine Learning-Based Drug Target Predictions for Mongolian Medicinal-Plant-Based Metabolisms	DOLGORSUREN Batjargal
16	Prediction and Optimization of Sales & Delivery using Data mining and Artificial Intelligence	SARANGEREL Dorjgochoo
17	A Study of a Human Location System Based on An Inertial Sensor in A GPS- Free Environment in An Underground Mine.	TENGIS Tserendondog
18	Embedded Real-Time Wide Area Vehicle Detection and Tracking System for Traffic Safety and Monitoring Using Deep Learning	DORJ Byambaa
19	AI-Based Virus Spectrum Analysis and Detection System Development (AI-Virus)	TSEREN-ONOLT Ishdorj
20	Network-Based Drug Repurposing Analysis	TSEREN-ONOLT Ishdorj
21	Attack Detection Method Development in IoT Based on SDN	DASHDORJ Yamkhin
22	Opto-Electric Characterization of Gallium Oxide Schottky Barrier Diode	ZAGARZUSEM Khurelbaatar

Education/Research environment improvement

This part of the project involves renovation of the exterior and interior of the SICT building (mainly on the right wing of the building). The following floor plan shows the renovation area by color.



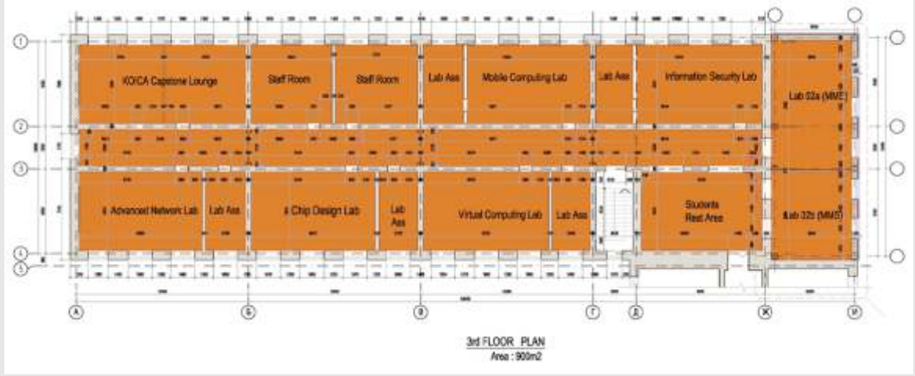


Figure 6. School building renovation area map

Due to the fact that the usable area of the school building was insufficient for the establishing a large number of new laboratories through the proj ect implementation, in 2018-2019, SICT carried out expansion of the building with its own funds to increase the useable area to 270 sq. meters.

Due to the global pandemic, at the request of KOICA, an additional project contract was signed, and MUST was responsible for the management and organization of renovation work. The work was well organized by the Investment and supply department of MUST (headed by G. Javhlan), and the following 4 local companies were employed through tender selection. As a result of the good organization of this work, MUST completed a number of additional renovations, such as the complete siding of external walls, toilets, corridors and entrance expansion, which exceeded the project's required tasks.

Table 5. The list of local contractors

No	Contractors	Tasks
1	Davkhar Urgoo company	Exterior works
2	Tsagaan Zuun company	Interior works
3	ASS company	Network and security
4	New Telecom company	Cooling system, Power generator, and UPS