AComIn Newsletter №5

Advanced Computing for Innovation

March 2015

AComIn Mission: to strengthen the research and innovation capacity of the Institute of Information and Communication Technologies – Bulgarian Academy of Sciences (IICT-BAS) by increasing the knowledge and skills of its researchers in emerging areas as well as by purchasing modern research infrastructure. AComIn should help the institute to successfully accomplish its strategic mission: by 2016, i.e. 5 years after its creation, IICT-BAS has to become a leading RTD Centre in Eastern Europe, providing facilities and working conditions comparable to the average standards of the EU Centres of Excellence in ICT. The institute will support the sustainable regional and national growth and employment by providing RTD results to advanced industrial organisations; it will be a focal point of high-quality research and training in advanced ICT topics.

Progress Report (October 2014 – March 2015)

WP1: Strengthening the IICT-BAS Human Potential

Employed Incoming Post-docs

Dr. Iurii Chyrka is appointed to a post-doc position in AComIn in January 2015. He came to the Institute from the National Aviation University, Kyiv, Ukraine, where he worked on measurement theory, radiolocation and digital signal processing. During his appointment in AComIn he will conduct research on estimating the technical characteristics of the SmartLab Brüel & Kjaer acoustic camera and on enhancing them by aperture modification and algorithmic improvements. His supervisor is Assoc. Prof. Kiril Alexiev.

Dr. Aleksey Balabanov is appointed to a post-doc position in AComIn in February 2015. He comes from the Sevastopol National Technical University in Crimea, Department of Technical Cybernetics. His research interests include solving optimisation problems based on matrix algebraic Riccati equation and making expert decisions using fuzzy logic. In AComIn Aleksey is going to conduct research on design, modeling, testing and simulation of control algorithms in large scale and complex systems in the transport domain. Dr. Balabanov uses the integrating server environment from the SmartLab equipment. His supervisor is Prof. Todor Stoilov.

Dr. Kristina Jakimovska is appointed to a post-doc position in AComIn in January 2015. She came to the Institute from the Faculty of Mechanical Engineering of Ss. Cyril and Methodius University, Skopje, the Former Yugoslav Republic of Macedonia. Her currents research interests are focused on predictive maintenance, technical diagnostics, lifecycle management, safety and security in industry. In her research she is actively using the 3D laser scanner and the 3D printer from the SmartLab equipment. Her supervisor is Prof. Dimitar Karastoyanov.

Dr. Stanislav Harizanov is post-doc in AComIn since November 2014. He arrives to the Institute from the Image Processing Group of Kaiserslautern University, Germany, where he had been working on solving constrained convex optimisation problems based on epigraphical projections, which he later used for image (Poisson) denoising and deblurring. Within AComIn he is going to improve the quality of the reconstruction of 3D images, derived by the SmartLab Computed Tomograph. In order to do this he is developing new mathematical models and algorithms that should be then efficiently implemented. His supervisor is Prof. Svetozar Margenov.

Dr. Olga Kanishcheva was appointed to a post-doc position in AComIn in January 2015. She is Associate Professor in the Department of Intellectual Computer Systems at the National Technical University "Kharkiv Polytechnic Institute", Kharkiv, Ukraine. Her current research interests are in the field of analysing multimedia collections that integrate electronic text, graphics, images, sound, and video. Within AComIn she is going to develop algorithms for semantic analysis of text information contained in multimedia collections. Her AComIn hosting senior is Prof. Galia Angelova.
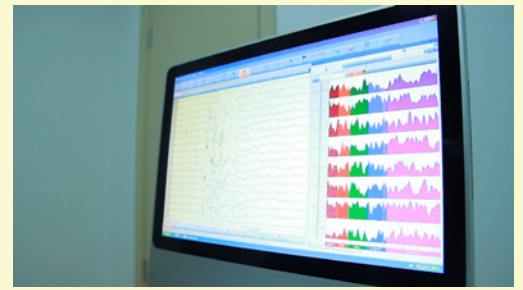
Dr. Emilia Abadjieva is appointed to a post-doc position in December 2014. She came to AComIn from Kawasaki & Mouri Laboratory at Gifu University, Japan, where she worked as a post-doctoral researcher. Her current scientific interests and activities are related to mathematical modelling of the processes of spatial motion transformation, oriented towards the synthesis of spatial mechanical transmissions, as well as to mathematical modelling of vehicle crashes, dedicated to reconstructing the origin of the processes and intended for the needs of the juridicial authorities. In AComIn Dr. Abadjieva creates a pilot strategy for 3D technological realisation of miniature micro-module hyperboloid gears. The models are printed using the SmartLab 3D printer. Her AComIn hosting senior is Prof. Dimitar Karastoyanov.

Dr. Mladen Savov was appointed to a post-doc position in January 2015. He came to IICT from the University of Reading, UK and the University of Oxford, UK. During his research career Dr. Savov has predominantly been working in the area of probability theory with emphasis on Levy processes, Markov processes and Random walks. Within AComIn he joined the group of Prof. Dimov with the aim to help the team theoretically understand some outstanding problems with respect to the Wigner Monte Carlo method which was developed and implemented by the same group. So far Dr. Savov has managed to formalise the Wigner Monte Carlo method in the language of modern probability and to consider it from several directions.

WP2: Purchasing Smart Lab Equipment and Building User Communities

In October 2014 the AComIn SmartLab was completed by a new set of devices – **Speech Lab**. Its equipment includes:
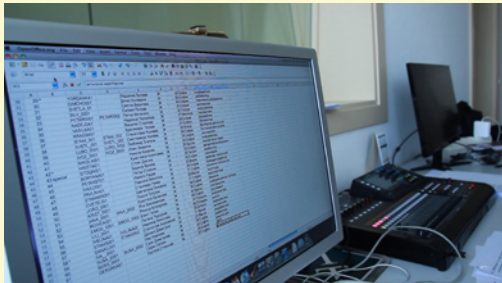
• Soundproof room

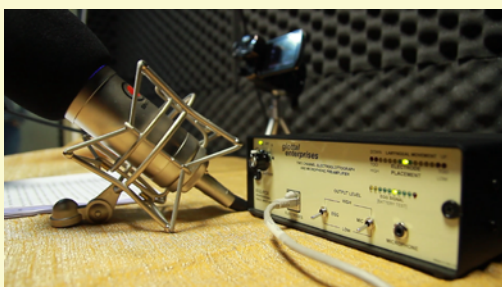Sound insulation – ISOVER FDPL 50 mm. + ISOVER Akusto 50 mm

Sound absorption – Echoabsorb PT 600 x 600 L

Showcase for visual monitoring

• Digital multi-track recorder and mixer TASCAM DP-32 – 32 channel - 8 input channels, 48 KHz, 24 bit

• Omnidirectional and unidirectional high quality microphones

SENNHEISER Pro Audio MK 4, SM pro audio MC03, BEHRINGER ECM8000

• Electropalatograph (EPG) ARTICULATE INSTRUMENTS WinEPG – 62 cont. pts

• Electroglottograph (EGG) GLOTTAL ENTERPRISES EG2-PCX2 – 2 channels EGG

• Combined Electromyogram Electroencephalograph NEURON-SPECTRUM - 4/EPM: 4 channels EMG и 23 channels EEG

• Digital stereo camera for gesture recording OTEK DVX-5F9 3D – Full HD 1080p, 5 Mpx

The equipment is currently used to investigate and develop novel approaches for building human machine interfaces, which will be based on a multimodal stream of audio, video, electric and other signals.

Pilot Applications of SmartLab Equipment

In order to demonstrate the potential of the SmartLab Equipment to different User Communities, several Pilot Applications have been developed during the reporting period.

A joint team from IICT-BAS, the Technical University of Sofia, and the Ethnography-Archaeological Museum of Elhovo carried out a multidisciplinary study of a silver coin (tetradrahm) minted in Thasos in the first half of I century BC. The coin was found during an archaeological excavation of a Thracian ruler's residence near the village of Brodilovo, in Southwest Bulgaria. The team discovered that the coin was an ancient fake consisting of a cupper kernel covered by a silver sheet. The study was conducted using the SmartLab industrial computer tomograph Nikon (XTH 225) and a scanning electronic microscope Zeiss (EVO 10MA) equipped with a Bruker roentgen analyser.

An interesting application of the 3D technologies has emerged in collaboration between IICT-BAS and Pavia University, Italy. The team creates 3D models of historical persons, objects and scenes extracted from 2D photos of tapestries presenting the Battle of Pavia. The models then are 3D printed and the created figures will be used in a 3D resto-

ration of the historical event (the Battle of Pavia in 1525) that will be demonstrated in an Exhibition in Visconti Castle, Pavia – a satellite event of EXPO 2015.

A joint team from IICT-BAS, the Institute of Maths and Informatics (BAS) and the National Archaeological Museum conducted a 3D scanning of a sculpture of a stone lion dated to II-III century AD that had been discovered during an archaeological excavation of the ancient city of Raciaria, located near the village of Archar, Northwest Bulgaria. The scanning was conducted at the exhibition hall of the museum using the SmartLab mobile 3D scanner Creaform ViUScan; the post-processing of the obtained 3D model was performed by the software package VXElements 2.1. The final 3D model will be applied to the museum passport of the exponent and will be used for long-term digital preservation of this object of Bulgarian cultural heritage.

A pilot application of 3D Digitising Technologies in Paleoanthropology was implemented by a joint team from IICT-BAS and the Institute of Experimental Morphology, Pathology and Anthropology with Museum – BAS. Two 3D digital models were created: one of a medieval skull of an adult male individual with an intentional artificial cranial deformation and one of a thigh bone of an adult individual with an oblique fracture of the shaft healed with displacement of the fragments. The fracture was concomitant with damages of the overlying muscles and post-traumatic myositis ossificans and osteomyelitis. The SmartLab computer tomography was also used for scanning the thigh bone with an excessive amount of callus formation around the fracture site.
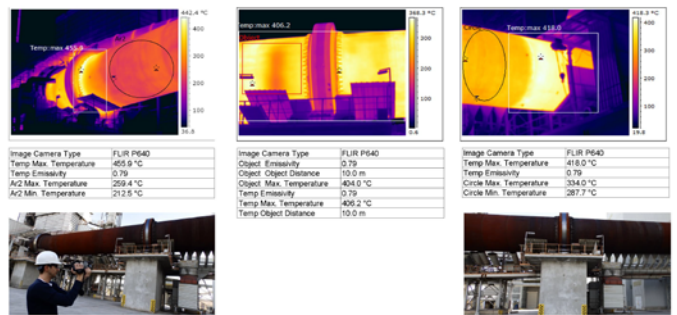
A pilot application of advanced methods for structure testing of fiber-reinforced silicate composites was implemented by a joint team of scientists from IICT-BAS and the Institute of Mechanics-BAS. The microstructure data was obtained by industrial computed tomography followed by segmentation and image analysis performed by VGStudio MAX software.

Two pilot applications of SmartLab thermo camera FLIR P640 were conducted by a joint team from IICT-BAS and the Technical University of Sofia. The first one was a thermographic study of a furnace for a ball mill in HOLCIM Ltd., Vratza, located in Northwest Bulgaria. The temperature distribution in the furnace for cement material depending on the rotation speed and the cement brand was analysed. The analysis showed that the blowing devices, cooling the mill, were not located optimally under the mill. As a result, one of three roller bearings of the mill began to heat up, which would cause damage of the mill. Based on these results the company decided to rearrange the blowing devices. The second application was a thermographic study of bandage rolls from a Gondola Lift located in the mountains near the Borovets resort. The study included creating and analysing the temperature distribution in bandage rolls according to the speed of the gondola lift and the carrying load. The study concluded that one of the rolls did not operate properly and had to be changed.

AComIn: Advanced Computing for Innovation
Съвременните пресмятания в полза на иновацията

Institute of Information and Communication Technologies, Bulgarian Academy of Sciences
Институт по информационни и комуникационни технологии, Българска академия на науките

Thermographic Study of furnace for ball mill in HOLCIM - Vratza
Термографско изследване на пещ за топкова мелница в ХОЛСИМ - Враца

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Thermographic Study of Bandage Rolls from Gondola Lift
Термографско изследване на бандажи на ролки от кабинков лифт

WP3: Networking with Leading EU Partners

Incoming Short Visits

In the period 18-21 February 2015 IICT-BAS was visited by **Prof. Virginio Canton**i from the University of Pavia, Italy. The main goal of the visit was to discuss a collaboration between the AComIn team and the University of Pavia. The planned joint work is in the field of cultural heritage restoration, in particular the restoration of the Battle of Pavia in 1525. Prof. Cantoni is working on a cultural heritage restoration project and one of the tasks includes the creation of a 3D model of the battle. This is the reason why he proposes a collaborative activity involving the 3D printer, purchased in the frame of project AComIn, for the creation of models of main characters. Prof. Cantoni had several meetings with the project participants and presented his first ideas and drafts of 3D-historical images. The project participants will assist in processing these 3D-images, modify them and make them suitable for the 3D-printer software (part of the SmartLab equipment). Some problems connected with the processing were discussed and some test models were 3D printed. It was a very fruitful visit and the main plan about the future collaboration was set.

In the period 2-15 February 2015 IICT-BAS was visited by **Prof. Raytcho Lazarov** from Texas A&M University, College Station, USA. The main goal of his visit was to do joint research with Prof. Svetozar Margenov in the area of development, study, analysis and implementation of preconditioners for systems arising in FEM approximation of second order elliptic problems, describing processes in highly heterogeneous media. Regular working discussions were held with the researchers of the Scientific Computing Department, including the AComIn Postdocs Dr. Ivan Georgiev, Dr. Stanislav Harizanov and Dr. Stanislav Stoykov. Prof. Lazarov also discussed the organisation of a Special Session on "Numerical Methods for Multiphysics Problems" at the 10-th Conference on Large Scale Scientific Compu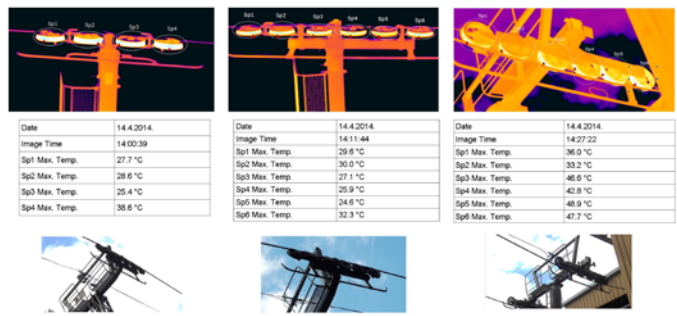ting (LSSC'15), Sozopol, 8 – 12 June 2015. The aim of this Special Session will be to bring together researchers working in the area of large scale simulation and computations of coupled processes of different physics and different scales in space and in time.

In the period 20-24 February 2015 IICT-BAS was visited by **Prof. Otto Spaniol** from the University of Aachen, Germany. Prof. Spaniol had meetings with the AComIn project participants and made a presentation on Security in Communication Networks: Technical and Nontechnical Issues, which aroused big interest in the audience. After the discussions Prof. Spaniol took part in a meeting with scientists from the Department of Computer Networks and Architectures.
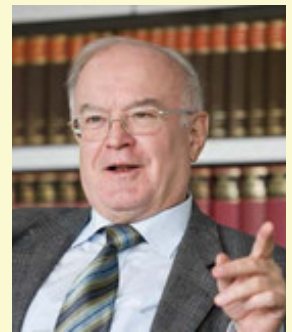
Secondments to Project Partners

In the period 13 October – 12 November 2014 **Assoc. Prof. Kiril Alexiev** visited the Computer Vision and Multimedia Lab in Pavia University, Italy. During his stay he worked on several topics of joint interest, among them 3D scene reconstruction (based on multi-view geometry or using only one image), eye tracking (based on statistics - detect and analyse - of randomly generated trajectories in each moment of time and on measuring the correlation between this statistics and answers of the examined person), acoustic analysis and modelling as well as development of interactive multimedia applications for the Violin Museum in Cremona. Dr. Alexiev gave two presentations on 21 October and 6 November 2014 for PhD students and the Lab staff. Along with Prof. Virginio Cantoni, Dr. Alexiev prepared a proposal for collaboration and joint research in the field of 3D scene and object restoration between the Mathematical Methods for Sensor Data Processing Department of IICT-BAS and the Computer Vision and Multimedia Lab in Pavia University.

From 17 September to 17 October 2014 **Prof. Todor Stoilov and Prof. Krasimira Stoilova** visited the Dynamic Systems and Simulation Laboratory (DSSL) of the Technical University of Crete, Greece. The main goal of the visit was to perform joint research on problems of control in transportation systems. During their stay Prof. Stoilov and Prof. Stoilova evaluated the METANET model for ramp metering control on highways. They had been acquainted with the experience of the Greek partners about their work with the Transport Department of the Municipality

of Chania. The Greek colleagues expressed their concerns about the difficulties of implementing new control strategies in freeway transport control. Because of the specific city infrastructure and the enormous number of tourists the practical results of the control policies were not always satisfactory. On 1 October 2014, at a DSSL seminar, Prof. Stoilova presented the main research fields of IICT-BAS, the AComIn project, the SmartLab equipment, and the networking scheme within AComIn. Prof. Stoilov gave the lecture "Trough multilevel optimisation to self-optimisation control" which presented ideas how to improve the urban traffic management based on changing the duration of the traffic lights cycles and the relative duration of the green light of some of the streets with the most intensive traffic in Sofia. Prof. Stoilov and Prof. Stoilova plan to prepare a joint paper with Prof. M. Papageorgiou and Dr. I. Papamichail on integration of optimisation problems in the traffic control domain.

WP4: Development of IP and KT Plan and Innovation Capacity Building

On 24-26 November 2014 the AComIn innovation consultant **Dr. Frank Heemskerk** visited IICT in order to discuss further project developments concerning strengthening the Institute's innovation potential and to give lectures at IICT.

On 24 November Dr. Heemskerk met Prof. Galia Angelova, AComIn coordinator, and Prof. Svetozar Margenov, the director of IICT. They discussed the IICT Innovation strategy and the draft of the IICT Sustainability strategy, produced within AComIn and offered to the IICT governing bodies for implementation. On 25 November a full-day Innovation Workshop was held at the IICT premises. In the morning two lectures were delivered by AComIn seniors - Prof. Galia Angelova and Prof. Dimitar Karastoynov. In the afternoon, Dr. Heemskerk presented two lectures: "Research, Innovation and Society Impact: Stimulating Innovation in an International/global context" and "Innovation for Value creation in practice". Demonstrations of innovative applications, created using the AComIn Smart Lab equipment, followed the lectures. The event was attended by more than 25 participants.

On 26 November Dr. Heemskerk met members of the Sofia Municipality Innovation Expert Council (Prof. Ivan Dimov, Prof. Kostadin Kostadinov, and representatives of Sofia Municipality) and discussed with them the initiative to develop an Innovation Strategy of Sofia.

WP5: Dissemination

Scientific Events Supported by AComIn

The Technology Transfer Workshop on Biomedical Simulation (BIO 2014) was held on 4 December 2014 in Sofia. This interdisciplinary event brought together 31 specialists in the fields of scientific computing, fluid dynamics, biomechanics, computer linguistics, physicians and medical equipment producers. The scientific program started with the presentation of the topics and activities at IICT-BAS by the vice-director Assoc. Prof. Krassimir Georgiev. Afterwards the program continued with a plenary lecture given by Dr. Wolfgang Fenz from Johannes Kepler University Linz. Then Dr. Vanya Georgieva from Sofiamed hospital presented typical cases from the medical practice, where biomedical simulations could improve significantly the treatment of the patients. Prof. Galia Angelova presented some of the recent AComIn activities related to the analysis of large repositories of patient records. Another biomedical application developed in the IICT, based on computer simulation of radio frequency ablation, was presented by Yavor Vutov. The workshop was closed with a hands-on demonstration of real-time virtual clipping simulations.

Upcoming Events Supported by AComIn

The Technology Transfer Seminar on Advanced Computing for Innovation - Industrial Applications will be held on 14-15 May 2015 in Bankya. The event aims at presenting the ongoing research results related to the use of AComIn SmartLab devices to industrial participants. The seminar is organised as an associated event to the 23th International Symposium on Control of Power Plants, Industrial and Ecological Systems.

The Intensive Course on Digitalisation and Creating 3D Replicas of Cultural Heritage Objects will be held on 19-21 and 25-27 May 2015 in Sofia. The course aims at familiarising the IICT young researchers and museum experts with some of the newest technologies for digitalisation, 3D scanning and 3D printing of replicas of cultural heritage objects. The event is organised by the AComIn project in collaboration with the innovative Bulgarian companies Smart Fab Lab, Digital Spaces Living Lab, and B2N.

The 10th International Conference on Large-Scale Scientific Computations (LSSC'15) will be held on 8-12 June 2015 in Sozopol. The conference is expected to bring together scientists working on hierarchical, adaptive, domain decomposition and local refinement methods; robust preconditioning algorithms; Monte Carlo methods and algorithms; numerical linear algebra; control systems; parallel algorithms and performance analysis; large-scale computations of environmental, biomedical and engineering problems, etc. The Conference Proceeding will be published by Springer in the series Lecture Notes in Computer Science.

The Technology Transfer Workshop on Advanced Techniques in Non-Destructive Testing will take place on 18-19 June 2015 in Sozopol. The topics of interest include digital radiography, industrial CT scanning, 3D laser scanning, acoustic holography, thermography, nanoindentation, assessment of the mechanical properties of materials etc. The event is partially supported by AComIn; it is organised by IICT-BAS in association with the Bulgarian Society for Non-Destructive Testing.

The International Workshop on Big Data in Natural Language Processing, Education and Digital Collections

The International Workshop on Big Data in Natural Language Processing, Education and Digital Collections will be held on 29 June 2015 in Sofia. The event will be a meeting venue of data scientists and experts in computational linguistics and text mining, intelligent management of digital content, eLearning and digitisation of cultural heritage. Recent AComIn achievements will be presented there among them first experiments of educational data mining in Bulgaria, using data from a popular eLearning portal.

The 10th International Conference Recent Advances in Natural Language Processing (RANLP 2015) will be held on 5-11 September 2015 in Hissar. RANLP has established itself over the years as one of the most influential and competitive NLP conferences. The event will feature six invited keynote speakers plus 95 presentations of peer-reviewed individual papers. There will also be an exhibition area for poster and demo sessions. The conference will be preceded by two days of tutorials (5-6 September 2015). Five post-conference Workshops will be held on 10-11 September 2015. A Student Research Workshop will run in parallel to the main conference.
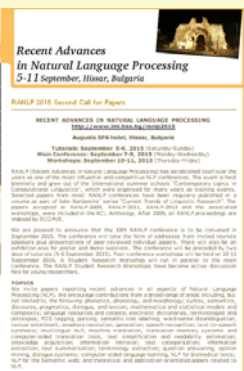
The International Workshop on Information Fusion will be held on 25 September 2015 in Sofia. The event is a forum for interchange of the latest research on information fusion and discussion of its impacts on society. It is organised by the Department of Mathematical Methods for Sensor Data Processing, IICT, as a dissemination activity within AComIn project in order to spread out the project results by bringing together researchers from the academia and industry who will also report on the latest scientific and technical advances in the field.

The International Workshop on Advanced Industrial Control Applications will take place on 8 October 2015 in Sofia. The aim of the Workshop is to gather scientists and specialists for presentation, discussion and dissemination of advanced results in the fields of control and optimisation, intelligent systems, multiagent systems, process control, robotic and mechatronic systems, as well as to report about important practical applications.

The International Conference Advanced Computing for Innovation - 2015 is the final scientific event of the project. It will take place on 10-11 November 2015 in Sofia. The conference aims at providing a forum for international scientific exchange in several fundamental topics for the computational intelligence but is also viewed as a forum for dissemination of project results. Selected papers will appear in a special volume of Springer series Studies in Computational Intelligence.

WP7: Project Management

The Steering Committee meeting after year 2 was held in Panagyurishte on 23 October 2014. It took place after 12 presentations of IICT experienced researchers who overviewed the project achievements in year 2. Two AComIn post-docs presented their results - Dr. Jean Michel Sellier and Dr. Ivan Georgiev. The Progress report for year 2 was presented too, including a summary of the project progress towards the objectives, explanation of deviations and related contingency plan, as well as the use of resources. After the presentations of the IICT seniors, AComIn post-docs and the project manager, the Steering Committee members met at a special session to discuss findings, make suggestions and plan further tasks in year 3.

On 1 November 2014 the AComIn Deliverable **D7.6 Strategy for Sustainable Development of the Institute of Information and Communication Technologies** was published. It contains the draft of a Sustainable Development Strategy (SDS) for IICT-BAS which is proposed to the IICT governing bodies (Scientific Council and Director) for consideration and adoption. The SDS is a regulatory document proposed by AComIn in order to enable the innovation capacity development of the Institute. Together with all other regulatory documents, proposed by AComIn, SDS provides a consistent normative framework for the development of IICT's Innovation potential.

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