FP7-REGPOT-2012-2013-1, Grant Agreement: 316087

AComIn:
Advanced Computing for Innovation

FP7 Capacity Programme
Research Potential of Convergence Regions

WP6: Assessment of IICT by Independent International Reviewers

D6.2
Final Project Evaluation

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Due date of the deliverable: 31/03/2016

Actual submission date: 31/03/2016

Start date of the project: 01/10/2012 **Duration: 42 months**

Version 1.0

EXECUTIVE SUMMARY

This deliverable contains the Final Evaluation of the research potential of the Institute of Information and Communication Technologies (IICT) after performing the project AComIn. The Deliverable D6.2 is prepared on the basis of the set of criteria established in Deliverable D6.1 "Evaluation Criteria and Input Materials for the Final Evaluation". The assessment of the research capacity and potential of the institute IICT is based on, but not limited to, the results of the REGPOT-1 project AComIn.

The input material for evaluation includes all AComIn delivarables and the full content of the project Website; personal impressions of the Reviewers regarding the IICT achievements gathered during their visit to Sofia on 28-30 January 2016; additional materials prepared by IICT after the meeting.

The evaluation included assessment of the following axes: human resources, equipment, research results with focus on the AComIn achievements, project execution organisation and management as well as sustainability. The general conclusions are:

IICT managed to improve its human resources: overall, the number of permanent staff remains the same but the average age is now between 40 and 50 compared to 50-60 in 2011. Many female researchers obtained scientific degrees and habilitations; new young researchers were attracted.

Regarding the equipment, the acquisition of Smartlab and its integration in the existent infrastructure of IICT is the most significant achievement of the AComIn project. Significant improvement in quality of work has been observes in all research directions within the IICT.

All research teams produced internationally acknowledged results. Several research directions (not envisioned in the original proposal) emerged as result of new ideas brought by the new postdocs.

IICT in general had stable connections to top international partners. Via AComIn, the institute reinforced the cooperation with some of the countries in the region, but the collaboration with the regional stakeholders is somehow limited to partners being involved directly in the IICT projects. The level of connectivity with national industry is good, considering the starting situation.

The project management was very efficient, lean and pragmatic. In general the IICT organisation is able to ensure ordinary services of a national institute of excellence.

Sustainability in short term seems to be ensured from the human resources perspective and regarding the infrastructure. Collaboration with academic institutions and industry is good and can be maintained at the existing level after the end of the AComIn project. The plans for long term sustainability are strongly related to participation in the EC Horizon 2020 projects and in a Center of Excellence in the framework of the Bulgarian Operational Programme "Science and Education for Intelligent Growth" where IICT will submit a proposal with leading Bulgarian partners as a coordinator.

IICT within AComIn progressed towards development of innovation capacity and proper IPR management.

Delivarable D6.2 also reviews the weaknesses from the previous IICT SWOT analysis (2011) and shows that the project successfully addressed most of them; there is considerable improvement of the negative findings encountered at the AComIn submission phase.

Giving the detailed analysis of the AComIn outcomes, the reviewers conclude that the project has truly fulfilled all six key performance indicators**,** defined in Deliverable 6.1.

D6.2 contains also recommendations for future work. Visibility of AComIn in the social media should be improved in the coming months. Long-term strategic planning and support for innovation has to materialise better; IPR management has to be functionalised within the IICT. Cooperation with Universities should be stronger esp. in joint Master and PhD programs. The IICT should extend the activities in the digital culture heritage area and raise attention, at the national level, to this area. Regional funding should be exploited and more cooperation with countries in Central and Southern Eastern Europe should be sought. More interdisciplinary cooperation between the IICT teams (e.g., vision, 3D modelling, language, acoustic holography) could demonstrate even more importance of having all facilities concentrated in one point.

Document Information

Project number	316087	**Project Acronym**	AComIn
Project title	Advanced Computing for Innovation		
Project URL	http://www.iict.bas.bg/acomin		
Document URL	http://www.iict.bas.bg/acomin/deliverables.html		
EU Project officer	Dr. Olivier Brunet		

Deliverable	**Number**	D6.2	**Title**	Final Project Evaluation
Work package	**Number**	6	**Title**	Assessment of IICT by Independent International Reviewers

Date of delivery	**Contractual**	31/03/2016	**Actual**	31/03/2016
Status	Version 1.0		Final	
Dissemination Level	Public			

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Summary	Deliverable D6.2 contains the Final Evaluation of IICT research potential after performing the project “AComIn”. It is prepared on the basis of the set of criteria established in Deliverable D6.1 “Evaluation Criteria and Input Materials for the Final Evaluation” in order to accomplish the task “Final evaluation of the research capacity and potential of the institute IICT based on, but not limited to, the results of the REGPOT-1 project AComIn FP7 grant 316087”. Deliverable D6.2 is the second and final deliverable of the WP6 “Assessment of IICT by Independent International Reviewers”.
Keywords	Assessment, human resources, equipment, results, research capacity, management structure, connectivity, sustainability, recommendations

Version log/Date	**Document history, Changes**	**Authors**

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1. REVIEW TASK DESCRIPTION

Deliverable D6.2 is a part of Work Package WP6 “Assessment of IICT by Independent International Reviewers” of the REGPOT-1 project AComIn “Advanced Computing for Innovation”, FP7 grant 316087. It is the final delivery of this work package, and contains the overall assessment of the IICT research quality and capability, as well as suggestions provided by the international evaluators. Deliverable D6.2 has been prepared during the last two months before the AComIn project completion and thus contains a comprehensive assessment of the projects’ results. It is also the final Deliverable of the whole project.

This evaluation is prepared for the grant holder (coordinator’s) organisation, the Institute of Information and Communication Technologies (IICT), Bulgarian Academy of Sciences.

It should be stressed that, as postulated in the Deliverable D6.1 “Evaluation Criteria and Input Materials of the Final Evaluation”, the task of final evaluation of the research capacity and potential of the coordinator's organization is based on, but **not** limited in its scope to, the results of the AComIn project (as provided by the grant holder organization). It is also based on, among others, results of the on-site visit that took place on January 28-30, 2016.

2. INPUT MATERIAL

This section contains a list of documents and information sources that have been considered during the evaluation process. For each document group, its source has been specified. *It should be stressed that **all** documents requested by the evaluators have been delivered with due diligence*. In particular, documents requested during the on-site visit have been expeditiously delivered by the AComIn project leader. Furthermore, all follow-up questions that materialised after the visit, have been promptly addressed by the representatives of the IICT BAS.

2.1. AComIn Technical Annex - Description of Work (DoW), version 20 August 2012

2.2. Project documents as published on AComin website (including team area)

Public Deliverables

Month 36 (September 2015)

- D1.2 Strengthening the IICT Human Potential
- D2.4 Building User Communities
- D2.5 Final Exploitation Plan of SmartLab and the AComIn foreground
- D3.2 Networking
- D4.3 Final Report on Innovation Capacity Building Activities
- D5.2 Dissemination Activities
- D5.3 International Conference “Advanced Computing for Innovation”
- D5.4 AComIn Awareness Raising and Wider Societal Impact
- D7.7 Input for EC Review
- D7.8 Steering Committee Conclusions Regarding Year 3

Month 24 (September 2014)

- D7.6 Strategy for Sustainable Development of the Institute of Information and Communication Technologies

Month 18 (March 2014):

- D1.1 Strengthening the IICT Human Potential
- D2.2 Infrastructure Upgrade and Integration
- D2.3 Building User Communities
- D3.1 Networking
- D4.2 Innovation Capacity Building Activities
- D5.1 Dissemination Activities
- D7.4 Input for EC Review in month 18

Further Materials:

- Movies about AComIn (*People*, *Smart Lab*, *Users*)
- Newsletters
- Awards, media reflections as shown at the project site

Deliverables with Restricted Dissemination

- D2.1 Smart Lab tender and delivery of devices (m12)
- D4.1 Suggestions for tuning the IICT Innovation Strategy and IP Policy to the best EU practices (m12)
- D7.1 Detailed Implementation Plan (m2)
- D7.2 Project Handbook (m3)
- D7.3 Steering Committee Conclusions regarding year 1 (m12)
- D7.5 Steering Committee Conclusions regarding AComIn Performance Year 2 (m24)
- D7.8 Steering Committee Conclusions Regarding AComIn Performance Year 3
- Year 1 Report (m12)
- First Periodic Report (Month 18)
- Project Progress Report Period 1 (Month 18)
- Year 2 Report (m24)
- Project Progress Report Period 2 (Month 36)
- Second Periodic Report (Month 36)
- Report national co-financing contract DO1-192 May 2015 (in Bulgarian)

Documents with Restricted Dissemination

- Regulations for ACOMIN mobility / Правила за реализиране на командировки по проект АКОМИН
- Monitoring of travels / Таблица за мониторинг на пътуванията
- PPT-presentation template / Шаблон на ppt-презентации по АКОМИН
- Event planning template / Заявка за планиране на мероприятие
- Event report template / Отчет за проведено мероприятие
- List of reporting documents / Списък документи за отчитане на пътувания
- AComIn Deliverable template / Шаблон за отчет по АКОМИН
- Periodic or Final WP Report / Междинен или заключителен отчет по Работен пакет

Reports with Restricted Dissemination

WP1: Presentations and Reports of Incoming experienced researchers

- Long-term employments of post-docs
- Short employments of experienced researchers

WP2: Building User Communities – list of participants in technology transfer events

WP3: Mobility reports

- Incoming short visits
- Outgoing short visits
- Secondments
- Participation in scientific events
- Participation in information events

WP4: Innovation potential development – event presentations, patents, certificates

WP5: Dissemination activities – list of participants, photos

WP6: Assessment of IICT by independent reviewers

- Presentations about AComIn and IICT, 28 January 2016

WP7: Public Procurement Procedures related to AComIn activities

Milestones and sample applications

- WT2: List of Deliverables
- WT4: List of Milestones
- Smart Lab Applications

2.3. Visit to the IICT

The experts, who perform the ex-post evaluation measures foreseen in the AComIn project (called, here, the Reviewers), were identified in the Commission Expert Database by the EC Project Officer Dr. Olivier Brunet. Keywords, related to the AComIn topics, were used for the search in the database*: large scale scientific computing, FEM simulations, Monte Carlo simulations, computational mechanics, computational electronics, language and speech processing, digital humanities, signal and image processing, digitization, 3D experimentation, 3D prototyping,* and *ICT-driven innovation*.

The following experts have been selected for the Reviewing team: (1) Prof. Virginio Cantoni from the University of Pavia, who is a project partner and thus knows the AComIn team from the very beginning; (2) D.Sc. Marcin Paprzycki from the Polish Academy of Sciences and (3) Dr. Cristina Vertan (Romanian national, currently working at the University of Hamburg) who are both experienced researchers in fields related to the AComIn key areas and with good knowledge about the situation in the Eastern Europe; (4) Dr. Dirk Philips who brings in the “commercial” vision of Western Europe.

The initial Meeting of Reviewers and the AComIn team was held on 28-30 January, 2016 in Sofia. It consisted of sessions devoted to:

- Presentation of the AComIn project and the IICT,
- Presentation of the currently employed AComIn researchers,
- Demonstrations of the equipment available at the IICT (purchased from the AComIn project funds as well as other funding sources),
- Presentation of the project results,
- Meeting with members of the AComIn Steering Committee,
- Discussions with all stakeholders of the AComIn project (including the management of the IICT and leaders of all teams involved in the project),
- Definition of the performance indicators to be used by the Reviewers (further specified in Deliverable 6.1 of the AComIn project).

2.4. Additional documents delivered by the IICT

Upon completion of the initial visit to the Institute, the following list of additional documents, to be prepared and delivered to the team of Reviewers, has been formulated. These documents have been delivered immediately upon request, or as soon as they became available:

- Schematic presentation of the evolution of the number of IICT research staff
- Organisational structure of the IICT
- Information about the administrative capacity of the IICT
- Scenarios for the future
- Overview of IICT projects with external funding for 2011-2015
- Update of AComIn results and publications by 31.01.2016 (given WP1-WP5 extension)
- Summary of changes in the AComIn thematic foci as selected in 2011
- Information about the IICT Technology Transfer Office in Energy Efficiency: Goals, Achievements

3. SHORT DESCRIPTION OF the IICT-BAS

The Institute of Information and Communication Technologies (IICT), Bulgarian Academy of Sciences (BAS) (http://www.iict.bas.bg) is an independent legal entity established on July 1, 2010. It arose after the Academy has been reorganised, as recommended in its International Evaluation performed by the European Science Foundation/ALLEA (November 2009). As a part of the reorganisation, involving extensive personal attestation and structural optimisation, the IICT was founded with the aim to integrate the research teams from the former Institute for Parallel Processing (IPP), Institute for Information Technologies (IIT) and Institute for Computer and Communication Systems (ICCS).

The IICT is a self-governing permanent research unit of BAS. The institute has the following major tasks:

(i) To carry out basic and applied scientific research;
(ii) To train students, on a contractual basis with the higher schools, granting them a possibility to participate in the scientific research process;
(iii) To provide postgraduate tutorship to the PhD students and professional researchers.

The governing bodies of IICT are:

- The Assembly of Research Scientists,
- The Scientific Council,
- The Director.

The legal basis of the IICT-BAS is legally grounded by:

(i) Law of Bulgarian Academy of Sciences http://bas.bg/about-us/legislative-acts
(ii) Statutes of the Bulgarian Academy of Sciences http://bas.bg/about-us/general-academic-acts

IICT-BAS carries out research in different areas. Nine of its 13 departments work in the four AComIn topics:

A) Advanced Computing research:
   - Department of Parallel Algorithms
   - Department of Scientific Computations
   - Department of Grid Technologies and Applications

B) Language and Semantic Technologies research:
- Department of Linguistic Modelling and Knowledge Processing

C) Image and Signal Processing research:
- Department of Mathematical Methods for Sensor Data Processing

D) Optimization and Intelligent Control research:
- Department of Embedded Intelligent Technologies
- Department of Intelligent Systems
- Department of Hierarchical Systems
- Department of Modelling and Optimization.

4. DETAILED EVALUATION

The following evaluation is based on the set of criteria established as a result of initial work of the Reviewers, and detailed in the deliverable D6.1 "Evaluation Criteria and Input materials for the Final Evaluation".

4.1. Human resources (Strategic Priority 1 of DoW Action Plan: Strengthening Human Potential)

Scientific competences

The acquisition of new technology (hardware and software) in-line with the state-of-the-art, and the engagement of new research personnel working with such technology would lead any academic institution to the development of new scientific competences. Thus, the question, which had to be addressed by the Reviewers was not "***if*** the AComIn project resulted in strengthening of human potential" but, rather "***to what extent*** such strengthening materialized". Answer to this question has to be further calibrated vis-à-vis the initial state of human resources when the AComIn project started (in 2012).

Based on personal experiences of one of the Reviewers, who is in regular contact with various units of the BAS (including almost annual visits) since 1996, the initial state of human resources in 2010-2011, when evaluated from the point of view of *potential for internationally recognized research*, varied considerably. Some of the units that currently constitute the IICT BAS (e.g. units originating from the IPP BAS, or the Linguistic Modelling Department), have been already working in a broad network of collaborations across Europe and reaching in their cooperations all the way to US and Canada. They also published research results in internationally recognized – Web of Science indexed – conference proceedings and journals. At the same time, other researchers had almost no international connections; they disseminated their work in Bulgarian, through publications in local (Bulgarian) journals and conferences. From this perspective, reorganization that took place around 2011-2012, combined with start of the AComIn project, provided a tremendous opportunity to excel across all units of the newly created IICT BAS.

The comparison of the situation before the start, and at the end of the AComIn project, based on the documentation presented to the evaluators, as well as presentations, conversations, and observations that originated from the on-site visit, grounds the reviewers to state clearly that:

> *The AComIn project had a definite, direct and clearly visible **positive impact** through **significant strengthening** of human potential **across all units** involved in it. This impact concerns not only personnel directly involved in the project, but all other researchers of the IICT BAS. The indirect effect comes, among others, from strengthening the international reputation of the IICT BAS as a prime research institution, and making it a key player at the regional level.*

Below we present few more detailed comments concerning strengthening of human potential (as a result of the AComIn project):

1. While this may seem contradictory, the smallest direct impact, as what concerns strengthening of human potential, could have been observed among those IICT units that were the most and the least "advanced" in 2011. Let us clarify this point.

1.a The most advanced units already had their existing and well-recognized scientific profile (collaborating, organizing top-level scientific conferences, and publishing on pan-European / global level) that only "standard" benefits from a project like AComIn could have been (and were) realized. Specifically, these units *were able to absorb all benefits* resulting from the AComIn project, to further maintain and strengthen their position in the scientific world. They were also acting as the "best practice" examples for the other (less advanced) units of the IICT. Examples of such (most advanced) beneficiaries are:

- The units formerly belonging to the Institute of Parallel Processing BAS and conducting research across various areas of the so called scientific computing,
- The Linguistic Modelling Department, which has been performing already 20 years of quality research in language / text processing, and being one of the more advanced centers in its discipline in the Eastern Europe.

These units were also able to perform interdisciplinary research or even develop, within the project, new research directions, not foreseen at the beginning (e.g. interdisciplinary research combining language and vision, digital humanities, computational quantum modelling, etc.).

1.b The least advanced units were able to absorb a reasonable amount of new expertise. However, they will require further strengthening.

2. The largest direct impact on the AComIn project was on the intermediately advanced units that were already ready to make the next step. Here, the project facilitated their rapid transition. Specifically, the impact of: hardware / software / incoming foreign personnel, allowed them to make a big step during the duration of the project. As examples of units where particularly clear transformation, due to the AComIn project, was observed are, among others: researchers utilizing 3D technologies, or speech processing.

Evolution of the number of people

In Figure 1, we present the evolution of number of researchers over time. On the basis of this data, as well as information gathered from the AComIn documents, interviews that took place during the on-site visit, and answers to questions posted after the visit, we can make the following detailed observations. Note that we discuss only data related to the number of permanent staff of the IICT. During the AComIn project, temporary and part-time staff was employed, which is not considered here.

Overall, we can observe a small reduction of the total number of personnel at the end of 2015, as compared with the 2011 (just before the start of the project). However, this is balanced by an improvement in the age structure of the current researchers of the IICT. Specifically, the decrease in the total number of personnel is mainly due to the reduction of the "aged members". Thus, the total number of professors has decreased slightly but, in the same time-frame, the number of PhDs and Assistant Professors has increased.

Furthermore, it is expected that:

(i) at least some of the PhD students, upon completion of their degrees, will remain in the IICT, and

(ii) the current Assistant Professors will obtain, in the near future, the necessary qualifications to become Associate Professors. In this way, an important problem, which is characteristic to most of New EU Member States ("reversed age pyramid" in academic and research institutions), has a chance to be addressed for the IICT.

In our opinion, the almost constant maintenance of the number of people, especially as what concerns the young researchers, is a big achievement directly related to the AComIn project. This should be seen also in the context of the well-known fact that, all over the world, but especially in the Central-Eastern Europe, in the sector of Information and Communication Technology, industry is absorbing more and more graduated students. ***The fact that IICT-BAS succeeded to have, over almost 5 years, the same number of researchers and, even more, to increase the number of young researchers is a notable result of the AComIn project.***

Figure 1 Age profile of IICT staff in 2011 and 2015

We observe also that, while the total number of female researchers remained more or less constant during the 5 years of the project, there is a significant increase of the number of degrees they obtained (see Figure 2). This is an important achievement of the project. In particular, it should be seen in the context of the fact that the increase of number of young female researchers, with higher qualification in ICT, is a constant effort among the EU policy-makers.

Figure 2 Degrees of female IICT researchers (PhDs and "Doctor of Sciences") in 2011 and 2015

Another observation is that the IICT plays a vital role in offering continued education to obtain a PhD via "*Correspondence*" or "*With independent preparation and paid PhD study*" (Table 1). This is an alternative way of illustrating the capacity building and the multiplicator effects of the IICT.
Moreover, these PhD students often come from industry. Hence, they should be seen as a "bridge" between the academia and the outside world. The number of this type of PhD students is relatively constant. Furthermore, it is worth noting that a first foreign PhD student was enrolled during the AComIn project. This might become an opportunity to attract even more foreigners, which would improve the visibility of the IICT around the world.

Number of PhD students in IICT	2012	2013	2014	2015
Regular	20	13	13	16
By correspondence	11	12	11	11
With independent preparation and paid PhD study	1	4	4	6
Total:	**32**	**29**	**28**	**33**
Defended doctoral theses	**5**	**7**	**7**	**4**
Defended theses as percentage of the total number of PhD students	16%	24%	25%	12%

Table 1: Number of PhD students in IICT in 2012-2015

At the beginning of 2016, there are four AComIn Post Doctoral Students, working as members of the research staff of the IICT. Three of them are younger than 35 years. Those 3 already applied for the BAS grants, in order to continue their activity within the IICT. One of them (Dr. Ivan Georgiev) became an Associate Professor of the IICT, another one (Dr. Stanislav Stoykov) is preparing the application materials to initiate the habilitation procedure, which will allow him to also become an Associate Professor. These are very important facts showing that the researchers, trained during the AComIn project, will remain active within the IICT-BAS and enable the supervision of new doctoral students in the near future. ***This also should be seen as an important achievement of the AComIn project.***

4.2. Equipment (Strategic Priority 2 of DoW Action Plan: Providing up-to-date Research Infrastructure)

Acquired during the AComIn project

The equipment acquired for the Smart Lab is the most visible and understandable asset of the IICT. Practical applications of this equipment can be understood easily through convincing demonstrator applications, as described in the document “SmartLabApps.pdf”. This document contains a detailed list of current valuable new research, performed together with the industry, and provides inspiration for further collaboration with companies.

The activities triggered by the acquisition of the Smart Lab equipment highlight that this is a perfect mechanism to attract additional interest and to generate industrial projects and collaborations. It reinforces the existing research with complementary activities.

Other related equipment

High performance computing equipment, available through the new supercomputer of the Bulgarian HPC infrastructure, is essential to completing research in the pertinent areas. Note that this infrastructure is planned to be “aligned to the plans of the European Technology Platform for High Performance Computing” (ETP4HPC). It should be stressed that, in the case of the IICT, this equipment is very-well utilized. This is important in the context of a well-known problem of

supercomputing centers (e.g. Texas High Performance Computing Center, Austin, TX or Supercomputing Center of the University of Oklahoma, Norman, OK), where large-scale machines are monopolized by few power-users, while under-utilized by other potential stakeholders. In the case of the IICT, such problem has not been observed, which shows that money spent now (and, possibly, in the future) on supercomputing equipment, which will be made available to the IICT researchers, is (and will be) money well-spent.

To our knowledge, such laboratory is not only unique in Bulgaria, but also for most of the neighboring countries. Thus, it is expected that the regional programmes, in the area of speech processing, could be led by the IICT in the future. Furthermore, the availability of this infrastructure makes the IICT competitive in any European research funding action, and opens a clear perspective for cooperation with the industry (dialogue systems for cars, speech-enabled robots, and automated advice systems). The encephalograph, which was also purchased through the AComIn funding, enables innovative research in the new emerging field of neuro-informatics.

4.3. Results

Research in AComIn areas

High-performance computing

In 2010, the area of high-performance scientific computing was one of the “most advanced” among units that constituted the IICT BAS. IICT had collaboration with academic organisations located, among others, in: US (Texas and California), Canada, Czech Republic, Netherlands, Germany, Russia, Poland, Denmark, etc. Since 1996 the institute organized a bi-annual international conference with proceedings published in Springer. IICT played a key role in purchase of the IBM Blue Gene (P-series) supercomputer and actively used its resources.

The result of the AComIn project was further strengthening of existing collaborations and development of new ones. Through arrival of new postdoctoral personnel, substantial scientific advancements have been achieved.

i) Wigner Monte Carlo algorithms for quantum transport in nano-electronics

In particular, the new discoveries in modeling of quantum transport in nano-electronics have to be mentioned. It is very likely that this is one of the key developments in computational methods applicable to modeling quantum process. It has to be stressed that this breakthrough discovery materialized thanks to the AComIn project.

ii) Robust finite element methods and algorithms for advanced computer simulations

The research on HPC can benefit significantly from the SmartLab infrastructure for verification of its computed results. One example of this is to compare the response of damaged structures recorded by the High Speed Camera with the calculated response of undamaged structure and to localize the damage.

(iii) Advanced computing in dynamical analysis of elastic structures

Solving complex dynamical behavior of elastic structures is very computing intensive. In order to solve large-scale dynamical systems, to obtain reliable and still get accurate results, computing time and numerical complexity increase drastically to a level where existing methods are not performing anymore. Clever discretization, parameter sensitivity studies, parallel implementation and especially

new original approaches are unavoidable to be able to solve these problems and to do it in a more efficient way.

Semantics, language and speech processing

In this area key activities were directed towards

- Automatic processing of image annotations in large-scale image databases;
- Application of Educational Data Mining for Analysis of the eLearning portal UCHA.SE;
- News Media Analysis and Creation of Language Resources;
- Language Technologies Applied for Generation of a Diabetes Register;
- Speech processing with focus on Bulgarian speech.

As stated above, the Linguistic Modelling Department of the IICT had already, by the beginning of the AComIn project, a world-wide recognized experience in text and knowledge processing. The team was a member of several European Projects and Networks, during which a number of important tools and resources for the Bulgarian language processing have been developed. Compared with other languages in the region, Bulgarian was better supported, even if it still lacked some resources, especially resources publicly available as open source. This made possible for the AComIn activities to target mainly novel research in the area of semantic processing, treatment of multimodal input (image and text), embedding state-of-the-art language technology in platforms for eLearning, media analysis, or health-care. Here, let us note, a double achievement results from the project:

- On the one hand, almost all applications were focusing on the Bulgarian language. This is a huge achievement, enabling the movement from strict research purposes (often done for English texts) to the cooperation with the industry and with the public administration;
- On the other hand, the results of the project are in many cases relevant for the entire linguistics research community, and could be disseminated at the international events.

In parallel, missing and indispensable resources like a publicly available Bulgarian WordNet were developed throughout the project. In the following we detail the results obtained in the area of text processing.

i) Automatic processing of image annotations in large-scale image databases

Annotations of images by keywords, called also tags, are introduced by humans or assigned automatically by a platform given some rudimentary image processing algorithms (contour recognition). Often, such tags are ambiguous and lead to inaccuracy and misunderstandings. Word-sense disambiguation is a research field focusing mostly on words situated in textual contexts (sentences, paragraphs); in AComIn these ideas were applied to isolated keywords (image tags) with the aim to process automatically image annotations in large-scale image databases. Quantitative evaluations indicate that the proposed approach can effectively disambiguate tags. The method can help to improve tag-based applications, among them machine translation and information retrieval.

ii) Application of Educational Data Mining for Analysis of the eLearning portal UCHA.SE

The research activities performed by the AComIn team are a success story of cooperation with the main eLearning Bulgarian portal UCHA.SE. Machine learning algorithms were applied to construct a rule-based model (quite accurate and understandable for the end-user) that predicts whether a user would renew her subscription to the site or not. The model was analyzed in order to find important factors which turn to be the length of the first subscription, the speed with which the user loses interest to the portal, the completion of the corresponding exercises after watching the videos etc. This kind of research is in line with current trends for mining massive open online courses portals.

iii) News Media Analysis and Creation of Language Resources

A publicly available Bulgarian WordNet (BTB WordNet) was created during the project. This is a basic language resource unavoidable for any disambiguation task. A system based on the natural language processing techniques aiming to enhance social news media in Bulgarian was developed based on the existent Bulgarian language resources. The system solved the task of multi-class, multi-label classification of documents. The algorithms were applied to a collection of media articles from the Svejo.net, a popular Bulgarian web resource comprising user-generated content. These results will be integrated in a Language Technology and Resources Centre for Linked Open Data.

(iv) Language Technologies Applied for Generation of a Diabetes Register

This is a particularly impressive result of applied research done within the AComIn Project. Within the Central and Eastern European countries there is certain difficulty to cooperate with public bodies. Usually the penetration of IT in the public sector is still at a low-medium level, and when it happens this is limited to standard database applications and IT-Technology (editing and presentation systems, statistics packages). This is why the cooperation between the IICT and the University Specialised Hospital for Active Treatment of Endocrinology, Medical University – Sofia, is of extraordinary importance. Both units joined efforts for automatic generation of national Diabetes Register for Bulgaria, using outpatient records of the Bulgarian National Health Insurance Fund. Extractors developed by IICT identify important patient-related entities in the free texts: e.g. values of blood sugar and blood pressure. This means that the IICT was convincing in demonstrating the potential of their text processing applications in real-life systems.

v) Speech processing with focus on Bulgarian speech

This was the only area within the field “Language technology” which, due to lack of adequate equipment, was not investigated before the AComIn project by the Linguistic Modelling Department. Speech Resources for Bulgarian were missing. Within the project a prototype speech recognizer for Bulgarian with very good accuracy and precision was produced; in addition, a novel method for improving the results of a speech recognizer was introduced. It provides the option to partially compile the word lattice into a deterministic finite-state automaton, making it suitable for the rescoring step in the speech recognition process. A Bulgarian speech corpus was also produced.

3D and video processing

i) Advanced methods, algorithms and innovations based on 3D digitization and prototyping

IICT research brings state-of-the-art CT image processing one step further by taking into account physical properties (conservation of mass) but also the connectivity within the material for 3D image reconstruction. Among the developed activities the one to protect images available on the public web portals in Internet can have a direct commercial impact. A Digital Watermarking service has been set up to provide a mechanism to secure and protect the published multimedia, by embedding metadata that remains invisible but readable. A complementary steganalysis service detects the watermarking data so preserving the right to obtain license fee for any commercial use.

A scientific result that can have a social impact is given by a new solution of the inverse problem, applied to the radiographic images such as these generated by computer tomography. The images obtained by counting particles are corrupted by the Poissonian noise. A blur operator (modeled as a Gaussian Kernel) and the intrinsic quoted noise degrade the recorded image. The quality of the 3D CT can be improved by the optimization of the de-noising process with the over smoothing of the original image.

Another activity that can have an important social impact has been developed to support the accessibility of visually impaired people. The development of an innovative graphical Braille screen allows the delivery of the graphical web content in tactile way. Note that this solution has been

patented both locally and through the WIPO. Nevertheless, in this connection, also some new SmartLab instruments, like the advanced handy scanner and the 3D printer, have been made available, respectively, for digitization and producing objects that can be inspected and interpreted by the "hands". This approach has been exploited for artifacts of cultural heritage as well as for tapestries.

ii) Biometric Authentication through Ear Biometrics

Ear is considered a valuable biometric feature because it is almost invariant with age, for its dissimilarity (even in twins) and acceptability (detected without requiring involvement). The common attention gained in this last period is due to the critical social problem of identification and overall to the performances of new 3D sensors. The acquisition of a high-resolution handy scanner opened these researches in the SmartLab. The activities soon gained a good visibility at international level, enriched also by a workshop that has involved many researchers of reference of the pattern recognition international community. Following this, as it has been illustrated in the AComIn conference, a new benchmark dataset has been conceived in SmartLab to exploit the precision of the handy scanner and with the support of international groups that have a high reputation in the biometry so guaranteeing extra visibility.

iii) Results in Video Stabilisation

Video stabilization is not a new subject. In particular, good solutions have been achieved for removing the egomotion of the acquisition sensor (camera carried by a man, car, plane, etc.). Nevertheless, still challenging is the case of multiple-movements in the scene. Within AComIn project, a young researcher of the IICT has developed an original and very effective solution that allows focalizing the attention and ignoring outliers.

iv) Applications to Digital Humanities

This is a newly emerged research direction which was not foreseen at the beginning of the project. 3D printing can be profitably exploited in the area of Cultural Heritage, with different targets: to reconstruct from fragments and pictures; to replicate for preservation of the originals; to interpret for understanding the past of an object through the analysis if its reconstruction; to investigate building various items to compares artworks from different sources; to share grouping 3D resources for extended integration of parts and models. The Smart Lab is one of the units of the IICT that has more experience in this field having applied it in at least two important contexts: in the quoted Pavia exhibition producing characters, scenes and architecture of the tapestry (1528-32 AC), and for the production of the well-known artifacts of the Thracian treasure (431-424 BC). It is more than justified to continue this important and prestigious activity.

The preservation of Cultural Heritage through the methods based on the, broadly understood, ICT is one of the key actions at the European level. Digital Humanities is a rapidly developing interdisciplinary field, involving actors from different fields of humanities, computer science, ethics and sociology. The activities within the AComIn project are of particular importance from two points of view:

- Even at the European level, most part of the research in Digital Humanities is focused either on textual material or on metadata classification of museum objects. Methods, which are used, come from language technology and text/data mining. Image processing is used also for handwriting recognition or detection of contours. The activities that took place within the AComIn project offer a complete new view on application of computer technologies to humanities;
- While, in the Western Europe, Digital Humanities is by now an established filed, introduced in almost all prestigious academic institutes, in Central-Eastern Europe it still lacks popularity,

mainly also due to the chronic lack of financing in the cultural sector. Thus, the work done in the AComIn project can be considered pioneer work in this part of Europe.

We hope that the acquired experience and knowledge could be used in the future for an enhanced representation of the rich Bulgarian cultural heritage.

IICT-BAS also took the initiative to present the advances of 3D printing on more "understandable" and appealing items such as clothes. AComIn project organized a technology transfer course on "Using advanced computer technologies in the fashion and textile industry". These lectures and demonstrations promoted the SmartLab, to reach the interest of a wider public and to connect to interesting partners outside academia. It gave the AComIn team an opportunity to increase its visibility and to disseminate the activities related to use of 3D equipment in a less conventional manner. Printing of 3D shapes was a new experience for most of the spectators so that follow-up demonstrations were arranged. In this way IICT demonstrated its pioneering role in new technologies.

Materials and testing

i) Enhancement of acoustic noise source localization and identification

IICT has acquired the not so common acoustic camera. First priority was to work with it in a correct manner and to explore its possibilities and its limitations. The research team discovered some areas where the method could be improved and this was elaborated in a second stage with the following targets:

- Automatic detection of distance to obtain more accurate results allowing more diverse applications.
- A better characterization of the acoustic equipment to detect range limitations and to enhance its performance by developing more advanced algorithms.
- Development and implementation of an intelligent (neuro-fuzzy) approach for visualization of muliti-dimensional measurements obtained by the acoustic camera.

Several examples were presented where acoustic camera has been applied successfully in real and sometimes aggressive environments. Because it is a contactless measurement it can be set up relatively easy making it more user friendly. Some interesting research on lubrication loss in ball bearings shows that it is a novel and non-destructive new way of testing a wide variety of existing cases. Exploitation plans for acoustic camera improvement are directed to aperture modification and implementation of different algorithms for resolution enhancement, enlargement of applicable frequency band, smart feature extraction, 3D visualization of the "observed" acoustic waves and so on. A future area to work on would be to detect "ageing" or "wear" in machines, e.g. make an acoustic picture today and again each year to detect anomalies. This could become part of a maintenance cycle.

ii) Target detection and parameter estimation

An advantageous method was proposed, using a Track-Before-Detect processing technique, which allows for the previously collected data to be used in the target detection process and parameter estimation.

iii) Development of a new type of chemical nickel coatings including nano elements

This research is dedicated to the production and detailed characterization of specialized powders to produce MMC composites. Both the constituent powders and composites are being characterized using various SmartLab apparatus. Grinding and production of nano-scale powders can be simulated with the EDEM software and the results can be verified experimentally with the laser particle sizer. Using CT scanning for analysing the particle morphology is an innovative approach in powder characterization. This research is only possible thanks to the complementary nature of the different

equipment in the SmartLab. This research is very much dedicated to practical applications and support for industry. It could directly be exploited with the local mining and minerals processing companies and help them to increase their competitiveness. These developments will directly contribute to an important sector of Bulgarian economy.

iv) Intelligent methods for technical diagnostics

The research work is much more focused on practical applications related to maintenance of transport systems and predictive techniques. Active user of large number of SmartLab's equipment with a long term interest in non-destructive testing and defect detection supporting companies in their goal to reduce costs. The equipment can provide high-quality real-time data about a broad range of industrial processes. In the document "SmartLabApps.pdf" several practical cases with real life applications have been presented.

As such, this research is a bridge between the academia and the industrial world, and will spread new technologies to practical applications in the field. Technology and experience could be easily shared with the industry and other research groups in different fields. This technology is also understandable for a wider public and will contribute to the visibility of the IICT.

Technical diagnostics is a classical interdisciplinary area where results from narrow scientific sciences and specific trends are applied. The possibility to predict eventual damage or wearing out without switching off the device turns out to be of great importance for providing faultless and reliable work of the plant.

v) Tribology

The tribology research is a very good example where the SmartLab equipment can show its added and complementary value. It clearly reinforces the research capability and contributes to a sustainable R&D environment because of wide applicability. It was shown that, by continuous measuring of the plain bearings contact temperature, it is possible to predict the value of friction in the plain bearing, an important parameter connected with the dissipation of energy in systems. As many companies struggle with these kinds of problems, it might become a spin-off activity for IICT BAS.

vi) Traffic Optimization in Communication Networks

Novel advantageous models of the incoming traffic in crossbar switch nodes are proposed including several families of input traffic patterns. Simulation studies and evaluations for the throughput of a switch node by the proposed family of patterns are performed using the grid-clusters of the IICT-BAS. A numerical procedure for computation of the upper bound of the throughput is suggested which enables to estimate the maximal throughput of the switch for different traffic scheduling algorithms.

Transport related

From the data gathered during the visit and cross-referenced with the materials provided by the AComIn team, it is clear that the AComIn project had definite positive effect on the team modeling transport phenomena. With incoming young researchers and purchased software the team was able to make an important step towards being able of perform state-of-the-art research in their area. The team has presented results concerning:

(i) Intelligent Transportation Systems;

(ii) Numerically Effective Kalman Estimator Algorithm for Urban Transportation Network.

These results are somewhat preliminary and focus of experiments with the new software (purchased from the AComIn project) and small-size explorations into the world of real-life transport modelling.

The main problem seems to be lack of access to the real data, which could be provided by the responsible authorities (e.g. the city of Sofia). Such data could help the team to advance quickly in

realistic applications. As a matter of fact, it can be postulated that, thanks to the AComIn project, the transport research team has reached the potential of actually explore and take advantage of the real-world transport data.

Publications

Let us now consider publication record of the researchers and research units involved in the AComIn project. In Table 2, we summarize the publication record of the project. It should be noted, however, that this data is not complete, as a number of contributions have been submitted during the last month of the project and the results of the review (and final publication) will be delayed by month (if not years) depending on the publication venue (and its backlog of papers awaiting publication). Therefore, what follows is based on standard global measures of publication quality evaluation. The key role is given to publications that involve IF-SJR-DOI.

Publications		AComin months 1-18				AComIn months 19-40			
		N	Total ∑	Average	Range	N	Total ∑	Average	Range
IF-SJR-DOI	IF	20	23,64	1.18	0.31-3.82	26	65.21	2.50	0.28-24.57
	SJR	20	13.36	0.68	0.17-2.18	26	35.98	1.38	0.21-9.73
SJR-DOI	SJR	26	8,632	0.332	0,332	43	11.96	0.278	0.15-0.34
Other Pubs		54				91			
Patents						4(+4)			

Table 2: Publication statistics

Publication data, presented in Table 2, is based on the information provided by the AComIn team and has been subdivided in two “half-periods” (the second including the extension of the activity). The upshot of the project is quite evident considering the journal papers (IF-SJR-DOI); in fact, more than doubled are: the extensive value (Total ∑ IF), the quality (Average IF), and also the feature related to the scientific domains (SJR SCImago Journal & Country Rank). In particular, it is worth to remark two points:

(i) the exploit of the activity in quantum mechanics (IF 24.57 and SJR 9.73);
(ii) the strong reduction of the number of publications on domestic journals (45% in the former half period, actually absent in the latter).

Remarkable is also the number of patents, two also extended to WIPO (plus one among the 4 in the near future).

Exploitation plans

The SmartLab extension enabled highly innovative scientific activities related to material sciences, energy, health, industrial control and optimisation to be developed. Several cases demonstrated the versatility and usefulness in industry but IICT should actively promote this research and diversify its customer portfolio.

The cited industrial interventions showed one of the strengths of the IICT. They were able to offer a very complete package of analysis tools to individual clients. In one of the interventions, in a mining

company, they applied acoustic holography to test bearings and laser particle measurements for air quality control. These two measurements were not related at all, but the client must be happy that in one go, he was able to reach various goals! In another intervention, SmartLab measurements were complemented with theoretical modelling. This really is a very clever and efficient approach by IICT.

SmartLab equipment has been used successfully but it is very much related to the sector of heavy industry, transportation and electronics. A list of other application areas could be drafted for future interventions.

Connectivity of the organisation (Strategic Priority 3 of DoW Action Plan: Strengthening IICT Innovation Capacity

The IICT has been creative promoting its Open Days via broadcasting on the national TV channels and the national radio (thanks to the PR Department of the Bulgarian Academy of Sciences).

At the same time, key relations with the AComIn User Communities are partially managed via traditional methods like mailing lists. This method was very successful before, but now there are more efficient ways of pushing information to the people. Mailing lists are very passive and they do not involve interactions (hence, they do not "engage" participants). In 2016, they should be complemented by social media related channels of communication. The IICT should develop the framework for doing this. Initially people should be encouraged to use social media for work but also companies should follow. Existing content could be recycled but maybe reformatted to attract a wider audience. So far, there seems to have been only limited Bulgarian interest in this. Nevertheless it is required to become more integrated in the rest of the world.

National connectivity

On a national level, BAS IICT is already very well connected. Collaborations with other divisions and universities increased interest from ministries and governmental institutions and participation in country wide sectorial organisations. Also the TTO ICTEE initiatives concerning knowledge transfer to Small and Medium-sized Enterprises should be seen as a further expansion inside Bulgaria. Part of this effort is channeled through the Bulgarian Technology Transfer Network (BTTN).

Regional connectivity and partnerships

Postdocs from Serbia / Macedonia / Ukraine give a chance for development of much stronger regional alliances and partnerships. They also illustrate that the IICT has existing links to these communities. Specifically, while they had problems recruiting postdocs from "the West", they were very successful in recruiting partners from the region.

International connectivity

International connectivity can be looked at from two perspectives: from the human / interpersonal dimension, and from the project collaboration dimension. Starting with the people, it should be observed that most researchers and visiting scientists of the AComIn project, came from Bulgaria or the surrounding non-EU countries. This leads us to formulate the following observations:

- The project was most successful recruiting expatriates to return to Bulgaria and attracting researchers from Serbia, Macedonia and Ukraine.

- The returning Bulgarians could be considered as a first wave of “foreign influence or collaboration”.
- The number of people coming from places outside Bulgaria or the neighboring region was limited. The main example of such work is research done with Jean Michel Sellier and with the Japanese researchers. The research with J.M. Sellier was very successful and placed the research of the IICT in an international spotlight.
- This research could be considered as a “second wave” of international collaboration and it should be expanded in the next years. Here, one should not forget that AComIn was a three year project. It takes some time to get started and to come to full speed. Moreover, the SmartLab became operational only in the second year of the project.
- The AComin project and the resulting SmartLab could become a real magnet that attracts very talented and motivated people from across the EU.

From a project collaboration point of view, technical expertise and industrial projects are more on a local / regional level but could be exported. For instance, Bulgaria has a long history in mining and metal processing. This is the sector where the SmartLab has shown its value and potential to engage industrial partners for close collaboration. The IICT is member of several sector organizations (e.g. the Mechatronics Cluster), which help them to promote this practical research.

On the level of international research collaboration, the activity is there but yet could be extended. More precisely, the level of international collaborations varies across the organizational units of the IICT. However, while appreciating the visible internationalization of some units (e.g. the Scientific Computing groups or the Linguistic Modelling team), there must be many more opportunities to closely work together cross-border, especially because the results from AComIn are there. It is worth noting that, while this should be an axis to work on in the near future, already initiatives such as the new conference series (the second edition of which is to happen this year in Hissaria and which is to be turned into a biannual event that will be organized interchangeably with the LSSC conference series), is a step in the right direction.

All this shows that research within AComin has reinforced the IICT strongly as a regional hub. The link between the regional hub and others in Europe is not yet strongly developed and should be a focus point for the next years.

Communication and Society (Strategic Priority 3 of DoW Action Plan: Endorsing the 'Science-in-Society' principles)

Communication of results of the AComin project is performed via the classical channels like journal papers, conferences and a very clear and to-the-point web page. Networking is done in a similar way: contacts are kept via personal relations, mailing lists, and participant lists. All this is done in a very consistent, clear and correct manner. This way of communicating to the “exterior” is relatively static and occasional. Somehow, it also limits the audience to the neighboring region and people who already know the research of the key players of the AComIn project. A different channel could help open up the audience.

Modern communication can be done in a much more interactive way, with room for meeting unknown but interesting new contacts all over the world, as well as people close by who do not know the research. It is worth noting that personal WWW sites, event when they are well kept and up to date, do not suffice in 2016. Social media became much better tools for establishing links and communicating research results. They are easy to use, free and have an audience of millions already.

For instance, for the professional communication, tools like LinkedIn could be used. For more popular occasions tools like Facebook could be used on the institutional level, while ResearchGate or Academia could be used for networking and dissemination of individual results. Let us make this point clearer:

AS IS situation:

- There is no Linkedin profile, nor Facebook / Google+ presence for the IICT. There is also no IICT on Twitter. The IICT should be a brand name and hence should be actively and officially promoted in the social media.
- Several researchers are not taking care of a profile in the Google Scholar / ResearchGate / Academia, and thus do not clearly show up in Google search and do not link within social media research portals.
- If personal profiles exist they are often very minimalistic and do not have a real content. This means that an opportunity to promote the researchers and the IICT has been missed.
- Not all researchers have up to date WWW sites optimized for search engines.
- Obviously, this is likely a more general conclusion of the situation concerning researchers in Bulgaria. As a matter of fact, it might be one of the reasons why cross border collaboration with the Western countries still remains limited even though many opportunities exist.

TO BE situation

Passive use: create yourself, tell the world that you exist, what your expertise is and what your capabilities are

- The BAS and the IICT should make official and recognizable profiles on the social media so that the researchers could connect to it.
- The BAS has a very beautiful logo. Somehow it is a “seal of quality”, which should be used whenever appropriate to visually promote the institute and make it more well known outside of Bulgaria.
- Researchers should be encouraged to: (i) create / update their WWW sites and (ii) create profiles in Google Scholar and Social Networks and refer to the IICT.

Active part: post news and interesting events; promote your activity to the outside world.

- The BAS and the IICT should make official and recognizable profile(s) within the social media to actively promote achievements.
- Researchers of the IICT should connect with their contacts and companies they work with.
- Researchers of the IICT should actively look for institutes and companies that do related research.
- Researchers of the IICT should post news: all news and information already exists e.g. in the AComIn website but should be reposted via social media (short and captivating), including services like the Twitter. Advantage is that the world would regularly get updates.

4.4. Project Execution Organisation

Management structure

The management structure of IICT BAS in general and for the AComIn project in particular, is classic, very robust and lean. The Scientific Council of IICT BAS, restructuring the original scientific units at the last year of the AComIn project, has established thirteen departments that functionally cover all the research lines. Three structural units did not participate in AComIn: the departments of Computer Networks and Architectures, Information Technologies for Security and Communication Systems and Services.

This IICT organisation, in addition to the scientific research and financial management issues, is appropriate to deal with the human resources, to take care about the publishing, to take care of the institute buildings, to support the equipment, and in general to ensure ordinary services of a national institute of excellence.

Project control and administration (Strategic Priority 5 of DoW Action Plan: Organising regular assessment of the IICT achievements)

The practical organisation of the project can probably very well be understood by looking at the project website:

- The website itself is very lean but complete. It is easy to find the correct information and the user does not get lost. All documents are clearly numbered and linked to the different milestones of the project or to administrative items.
- The documents themselves are well structured and formatted in a consistent way. All of them contain the correct information.

These two examples are based on the project web pages but the whole project has been organised in very much the same manner (lean in management, but effective).

In addition, travel arrangements for the Reviewers to Bulgaria were very fast and without any hassle. Even though the flights were arranged and directly paid for by the IICT, we were requested to provide the boarding passes for administrative traceability and justification. It really gave the impression that the administration is following very strict, consistent and formal procedures to be as transparent as possible.

The general conclusion is that project control is conducted in a very pragmatic manner with a clear traceability and full transparency.

Recruitment

Also here we can notice the very pragmatic approach to handle recruitment and the creativity of the IICT to overcome encountered difficulties in finding people to work in the project. In deliverable D1.1 on page 11 it was stated that: "*The analysis of the submitted applications shows that, via general sites like Euraxess, the announcement is visible to postdocs in Computer Science whose expertise might be relatively far from the topics of AComIn*"[1]. In the end, the project team was able to reach

1 Deliverable D1.1 page 11

appropriate candidates via the personal network of the IICT members and by reaching to the countries that were expected to deliver quality researchers, willing to come to work in Bulgaria. All this was done on a short notice and required managerial flexibility and adaptability.

It is worth noting that this situation demonstrates that the "classical channels", like the web portals, have become quite static and, maybe, they are not the best option anymore to reach the target audience. The personal network proved stronger. However, personal contacts are very dependent on the person and are also quite informal. It would be a good idea to follow them up in a more formal way, share them with colleagues and open the relatively closed circle of academia by linking with industry and looking more on the international horizon. Social media have become unbeatable in reaching this goal. The recruitment process itself was very straightforward and quick.

4.5. Sustainability

Short-medium term sustainability

Human resources – the following considerations are based on the indicators referring to the IICT staff capacity, including:

- the numbers of PhDs and Postdocs that remain at the IICT after the AComIn's end;
- the number of PhD candidates approved in 2015, who start their PhD studies;
- the number of PhD candidates who come from industrial settings or from abroad – who pay for their research training.

We remark that, in several IICT teams, covering all main directions of AComIn project, permanent staff members and new researchers will remain to work after the end of the project, namely:

(i) In the field of Advanced Computing:

a. In 3D imaging and numerical simulations: the group leader (Prof. S. Margenov) and three members of the team are the permanent staff within the AComIn, one PhD is ongoing. The team is involved in an EU-COST-Action MP1207: "Enhanced X-ray Tomographic Reconstruction: Experiment, Modeling, and Algorithms". Through this project it is supposed that the already existing international collaboration will be maintained and reinforced, and that new projects will be acquired.

b. In the Environmental problems area: the group leader (Prof. Georgiev) and the team members are permanent staff of IICT. The current ongoing project financed by the Bulgarian Science Fund will end in 2017.

c. In the efficient numerical methods and parallel algorithms for dynamic structures: the group leader (Prof. S. Margenov) and the 2 team members are the IICT permanent staff. They are involved in an EU-COST Action IC1305 "Network for Sustainable Ultrascale Computing (NESUS)" which will end in 2018.

d. In Monte Carlo methods in quantum electronics: the leader (Prof. Ivan Dimov) and 1 team member are permanent IICT staff. 2 ongoing PhDs are expected as outcome of follow-up activities within a project financed by the Bulgarian Science Fund (DFNI I02/20) which ends in 2017.

In June 2016 an international conference summing-up all above mentioned research directions will be organised by IICT. It is assumed that this may lead to new partnerships and fund raising. In this latter context, let us note that this is the beginning of the new conference series that will be biannual and interchange with the LSSC conference. Hence, the IICT will organise an

international scientific meeting every year, increasing visibility and providing opportunity to build new scientific relations.

(ii) Language and Semantic Technologies

The team leader (Prof. Galia Angelova) and 7 team members are permanent staff of the IICT. The group had a strong activity before the beginning of AComIn, thus there is no doubt that research will be continued and reinforced in the coming period. The group is already international established and has big potential in acquiring new PhD students. They are currently involved in 2 EU-COST Actions:

- PARSEME Cost Action IC 1207: Parsing and Multiword Expressions. Linguistic Precision and Computational Efficiency in Natural Language Processing, 2013-2017
- COST Action IC1307, iV&L Net: Integrating Vision and Language, 2014-2018

and one industrial cooperation with a Bulgarian company.

(iii) Signal and Image processing

a. In Biometrics: this is a new Group started within the AComIn project, but already with two permanent staff members from the IICT and a number of emerging PhDs. The group seem to have already attracted a significant number of international partnerships, which promise continuation of the activities.
b. In RTD activities, using the SmartLab acoustic camera, three members including the leader (Prof. Kiril Alexiev) are permanent staff members of IICT. The powerful SmartLab is supposed to attract new research projects, however no concrete actions are specified for the moment.

(iv) Optimisation and Intelligent Control, 3D Modelling, Material Sciences

a. In Traffic optimisation and control: the project leader (Prof. Todor Stoilov) and 2 team members are permanent staff. The team was member of the TUD COST Action TU1102 *"*Towards Autonomic Road Transport Support Systems" which helped them strengthen the connections to the international community in the field.
b. In 3D modelling using 2D sources and 3D printing for historic events: 2 permanent IICT staff members (team leader Prof. D. Karastoyanov) will ensure forthcoming research in this new emerging field.
c. In Tribological study of industrial coatings with nano-elements for heavy-duty applications: the team leader Prof. D. Karastoyanov is a permanent IICT staff member. The team has strong collaboration with the University of Belgrade and Technical University of Sofia. Seeking further international collaborations is strongly advised.
d. In Studies of materials and details made of metal and composite matrices: the group leader is a PhD student, so it is expected that the group will continue activity at least until the completion of the PhD.

Overall we observe very strong groups in Advanced Computing, Language and Semantic Modelling and Image and Signal processing. These are the groups that existed before the AComIn project with established cooperation networks and they were just reinforced by the AComIn.

It is a positive effect that at least 5 new research groups were created. Furthermore, it should be stressed that their research is in line with merging activities at an international level, so it can be assumed that, with proper guidance and support, they will grow and extend their cooperation. Problematic seem only the Studies of materials and details made of metal and composite matrices group, for which it is not sure what will happen after the completion of the PhD studies by the group leader.

Equipment – Institute's ability to support the SmartLab devices, to ensure their maintenance and relevant software updates

A first aspect of equipment sustainability is the availability of operators of the newly acquired equipment. In the short term, the main concern is that the people working with the Smart Lab equipment should remain employed to operate it. All practical knowledge built up during the first exploratory and operational period is in the hands and heads of these researchers. Since they have contracts limited in time, there is a risk of knowledge loss when these people leave.

During our visit in the labs, it was clear that each researcher has deep knowledge about his/her equipment combined with genuine interest in the other equipment. As such, they also became acquainted with some of the other equipment and know how to operate it. It is worth continuing this approach not only because people are very enthusiastic but also because it guarantees knowledge to remain present in the IICT. As what concerns the long-term perspective, if more routine work would be around, it is worth to hire a dedicated technical person to operate the machines, to support the researchers and to carry out studies for external parties such as the industry.

A second aspect is the maintenance of the equipment: as far as we understood, there was no dedicated budget for the maintenance of the Smart Lab equipment in the AComIn project. This might become a problem at a certain moment. Without proper maintenance, some equipment might not function properly anymore. The IICT should at least draw up maintenance plans and estimate the associated costs with particular attention to the issues that might render the equipment dysfunctional. This way, some contingency plans could already be anticipated and awareness on this subject raised. This item should be treated together with proper insurance. The equipment should also be assured properly.

A third aspect is the revenue that could be generated by more commercial and occasional activities. As long as this is limited, there is no issue. However, once industry services would be carried out on a larger scale, there should be a set of rules how the revenues will be used and shared within the department. At least a significant part of such revenue should be used to support and maintain the equipment. It is not clear how far this has been discussed formally and agreed upon within the IICT management. Without a clear framework (dedicated organisation and a set of rules of governance) it will be difficult to expand these activities to a higher level.

It would also be wise to set up some basic statistics/KPI on the use of the equipment. The most relevant factor will be how much time each device is standing still. These insights can then be used to determine the capacity to offer to industry. It will be an extra drive to look for more services for external parties.

Finally, a very important issue arises, which is related to upgrading, replacing, adding complementary equipment over time. It is obvious that the majority of the equipment available to the researchers of the IICT will become obsolete within next 2-3 years. Furthermore, the research that has been started due to the AComIn project will increase the need of further equipment to be able to reach new scientific goals. This is a simple process, where the beginning of research with new equipment introduces a slate of new questions, answering which will require additional machines to be purchased. As far as we are aware,

(i) there exists potential financial mechanisms that can results in procurement of new equipment;
(ii) researchers in most organisational units have ideas as to what equipment would supplement machines purchased using the AComIn funding;

(iii) there was no in-depth discussion concerning establishing a hierarchy of equipment purchases.

The latter may be particularly difficult due to the competing interests of organisational units. Therefore, such discussion, aimed at reaching consensus, should be initiated as soon as possible.

Collaboration with academic partners – keeping contacts with AComIn partners and researchers, especially with those incoming scientists who leave Bulgaria; number of internal thematic networks that are still running after AComIn's end; number of new contacts with leading international academic players that were created via the AComIn

At the end of the AComIn Project, each out of the 11 research teams has at least one cooperation partner, with which follow-up activities are planned. Three teams are involved in COST-Actions, some of them will continue 2 years after the end of the project. We should mention that the COST actions have a strong networking character so, apart from the principal cooperation partners, some other contacts are being, or will be, established. These COST Actions offer also possibilities for visiting researchers and young bursaries so it can be assumed that new PhD Students will be acquired.

In Figure 3 we show the geographical distribution of research partners of the AComIn research teams that will continue their activity beyond the project's end. We observe a relative good spreading across Europe: cooperation with 15 institutes from 10 countries. Among them 6 institutes from the Central and Eastern Europe which demonstrated that IICT will continue to play a major role in the region.

Figure 3 Geographical Distribution of project partners for AComIn research teams, beyond March 2016

We evaluate as positive the existence of cooperation with overseas universities in the USA as well as in the Middle-East (Qatar). We remarked also that each team cooperated with a different university. Some of the partners like the Penn State University in the USA, the Tübingen and LMU München Universities in Germany, or the Qatar Institute have definitely a broader coverage. It would be a good synergy for the promotion of the IICT Teams, if partnerships could be also used to raise attention about complementary research being available at the IICT.

We recommend that even more cooperation is started with institutes in the close neighborhood countries, such as Croatia, Romania, Hungary, Greece and Slovakia. All these countries can offer

competitive research partners. Also, a cooperation with Turkey, especially with the TUBITAK, should be considered as a beneficiary partnership.

Funding stability and collaboration with industry – how many immediate follow-up projects with industry and clients from the public sector are expected after AComIn; assessment whether the Institute's activity is funded through a variety of sources combining stable and flexible funding; membership of the Institute in clusters where industrial stakeholders are involved

In order to provide additional and stable revenues, more commercial activities should be developed. The SmartLab provides an excellent basis for this but it should be organised, promoted and exploited with this goal in mind. As such, the existing network with industry should be updated regularly about the technical capabilities of the IICT and its research activities. All these actions already exist to some extent but should be reinforced.

Funding representation depicted in Figure 4 indicates that in general half of IICT funding comes from the BAS and half from external sources. In the year 2012 external funding was higher because of the AComIn-based injection of funds.

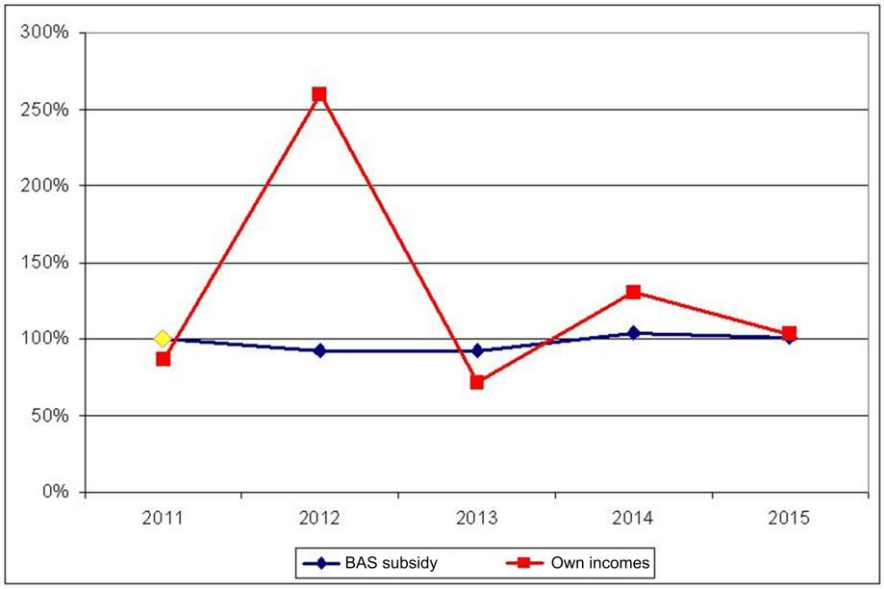

Figure 4 External IICT funding as percentage of IICT budget subsidy received from Bulgarian Academy of Sciences in 2011 (taken as 100%)

Figure 5 shows more details about IICT funding. Ministries and governmental sources became a new origin of income and should be further developed. The contracted work for Bulgarian companies and organisations is about 10% and more or less stable over time. There might be a great opportunity to double or triple this figure with appropriate marketing effort. Moreover, Bulgaria is a regional stronghold and hence there should be cross-border opportunities.

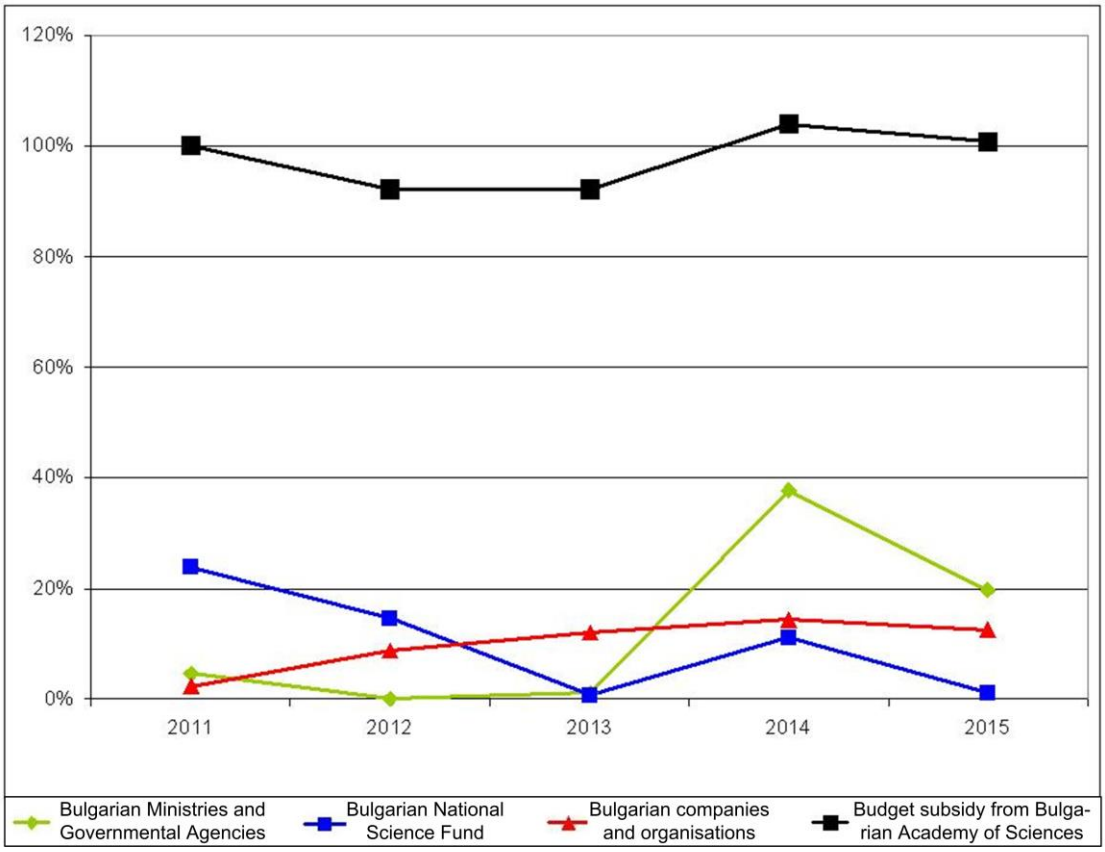

Figure 5 IICT funding from national sources

Long term sustainability

The plans for sustainable development are strongly related to participation in the EC Horizon 2020 projects. In this perspective two larger initiatives coordinated by IICT (in a team of inter-related Centers of Excellence - CoE) are very instrumental:

(i) a H2020 Teaming CoE "Mathematical Modelling and Advanced Computing in Science and Engineering" – the on-going first stage of the project is funded by the European Commission in 2016;

(ii) a CoE in the priority area of Informatics and ICT in the framework of the Operational Programme "Science and Education for Intelligent Growth" where IICT decided to submit a proposal as coordinator, in a consortium of leading Bulgarian partners.

These two initiatives could sustain the updating of current infrastructure and the purchasing of next generation tools for 3D digitisation, prototyping, and for 3D modelling; and in general support advances of all other growth successful activities.

Human resources – number of experienced AComIn researchers, who remain in IICT to maintain their research groups as strong leaders with ability to attract resources; ability of IICT seniors to adapt to new research areas

We considered here only the researchers being Associate or Full professors within the IICT, who are assumed to continue their activities on long term within the institute. Out of the 49 current professors, 28 are under 55 years of age, so they will continue their activity for at least 10 years. 14 Researchers are under 45 and therefore, with a perspective of 20 years activity within the IICT. Additionally there is a "pool" of 54 Assistant professors and PhDs, from which probably a significant number will continue to work within the IICT. In Figure 6 we summarise the qualification profile of permanent IICT Research Staff (i.e. with at least a PhD). We observe a significant improvement compared to the year 2011, just before the AComIn project started.

However the capacity of the IICT to maintain all these researchers is strongly related to the availability of new research funds. In the absence of these funds, there is a non-quantifiable danger of brain drain especially for the young staff, less than 35 years old.

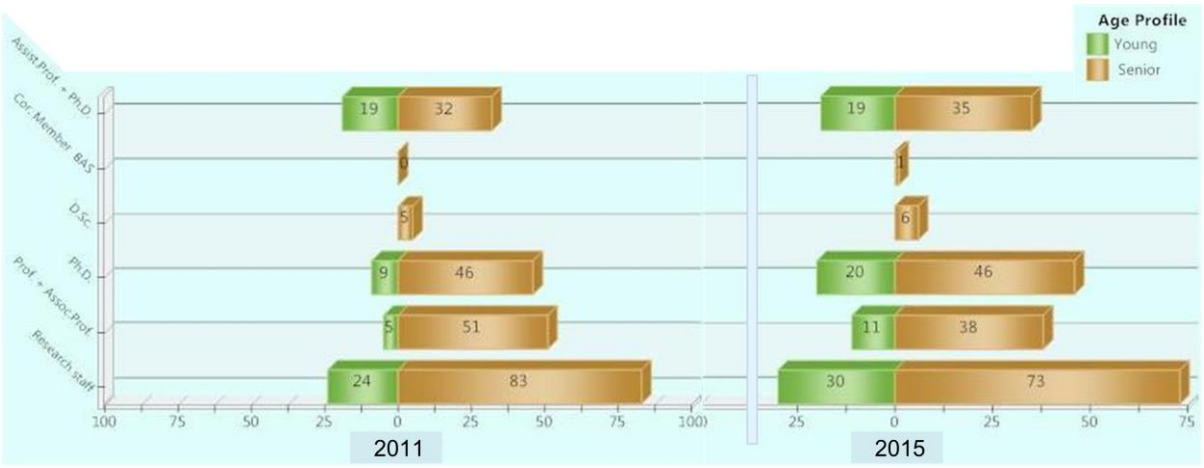

Figure 6 Age profile by staff categories: 22% of the IICT researchers were younger than 40 years in 2011, and 29% were younger than 40 years in 2015

Partnership – contacts of the Institute with strong international partners with ability to initiate joint projects and help building liaisons to international high-tech industry; involvement of Community leaders in collaborations with IICT; successful regional partnerships in the neighboring countries; close IICT cooperation with relevant national stakeholders

Projects like the running first phase of H2020 Teaming CoE "Mathematical Modelling and Advanced Computing in Science and Engineering", a joint initiative with the Technical University of Vienna, show that IICT has stable scientific collaborations with Community leaders who are able to initiate research activities that lead to breaking innovations. Apparently these top partners have good connections to the international high-tech industry in the respective field, but as we said earlier, further activities are necessary to establish liaisons to industry in e.g. material sciences and 3D modelling. We also recommend establishment of stronger liaisons with regional key players, especially industrial ones. On a national level, BAS IICT is already very well connected including links to IT industry which is positioned at the top3 - top5 places (for instance, Ontotext). Membership in relevant national clusters is a good opportunity for IICT to support its contacts.

Anyway we notice the positive fact that AComIn helped a lot for the appearance of new research directions in IICT and supported development of certain new liaisons in these emerging fields; now the challenge for IICT is to develop the partnerships further.

Strategic planning and support of innovation – the Institute has relevant regulatory documents, sustainability plan, business plan; IICT has the capacity to organise self-evaluations; IICT encourages IP protection and long-term collaborations with industry

The Technology Transfer Office "ICTEE" is the dedicated Institute's office for all technical requests from the outside, e.g. industry, other institutions, etc. This office handles the requests from external partners to the right person to answer technically, to propose a date for testing and to make a commercial offer. There should be standard contracts and a list of standard prices for common tests.

The IICT management adopted a "*Regulation for the organisation of the activities and use of specialised equipment within project AComIn*", see D2.2 "Infrastructure Upgrade and Integration" (month 18). AComIn also developed and proposed to the IICT governing bodies the following documents:

- Deliverable D4.1 "Suggestions for Tuning the IICT Innovation Strategy to the Best EU Practices" (month 12), including a draft of the IICT innovation strategy;
- Deliverable D4.2 "Innovation Capacity Building Activities" (month 18), including drafts of intellectual property policy of IICT and IICT Exploitation and Dissemination Plan, with structural descriptions of exploitable results and risk assessment tables for the exploitable results;
- Deliverable D7.6 "Strategy for Sustainable Development of the Institute of Information and Communication Technologies" (month 24) with measures for implementing the IICT Sustainable Development Strategy as well as indicators for successful implementation of IICT's Sustainable Development Strategy.

All these documents, taken as a whole, provide a consistent normative framework for the development of IICT Innovation potential. These regulations are currently under discussion for adoption in the Institute which will happen with a decision of the IICT Scientific Council.

Within AComIn, two patent applications were submitted to WIPO and other six – to the Bulgarian Patent Office. This means that the Institute encourages IP protection despite the fact that there is no dedicated structural unit to deal with these matters.

Visibility – the Institute leadership efficiently articulates to external partners the vision of IICT as an innovation driver; IICT's results are marketed in a way that generates interest; the Institute demonstrates its value to the public and increases the society awareness about the ICT key role

Information on IICT and BAS is available and presented well on the internet via a dedicated portal but you have to look for it. It is passive information and it will hence only reach a very limited audience. It is absolutely necessary that updates get published on the internet regularly via social media. The IICT should get connected to the outside to a much wider extent. All information is already available but could be reposted. Only part of it should be reformatted in a more popular style to reach a wider audience. An active strategy should be developed on this and people motivated to get out of their comfort zone.

This remark is probably valid for Bulgaria as a whole. Professionals, institutes and companies should understand the importance of being connected to the outside world. This approach will only be successful if a critical mass of people use it.

5. REVIEW OF AComIn DoW SWOT ANALYSIS[2]

5.1. Goal

- Determine which axes have been improved
- Remaining weak points to be tackled in near future – Action plan

5.2. Review the weaknesses from previous SWOT analysis

(i) Insufficient modern equipment in key fields, like the 3D microstructure input/output, sounds, speech, dynamics, which makes the IICT dependent on international partners' data, and prevents:

- setting of long-term research agenda for advances in "hot" ICT areas,
- exploitation of the full potential of the available core computing infrastructure,
- cooperation with leading EU partners in the respective ICT topics,
- know-how transfer to Bulgarian User Communities and society in general as well as
- Development of attractive training programs for young researchers in the respective areas.

Current status:

The SmartLab equipment has been a giant leap forward to diversify the research activities and attract new researchers. More complementary equipment should be added in the future when the need occurs.

(+) The new SmartLab equipment as well has set the path for future research and reinforces the existing infrastructure. Combination of both provides a unique eco system for more varied activities. For example, the creation of the Speech Laboratory was required for performing research in the area of Speech Processing. While speech recognition and synthesis is quite developed for major European languages, there is a lack of such results / systems / platforms for the so called "less-resourced languages", among them the Bulgarian. It should be stressed that any speech recognition system is based on a large corpus of recording, done in an adequate environment, namely a sound-proof room. Note that acquisitions for the speech laboratory goes beyond the basic equipment for simple speech recognition. It was done with a clear recognition of current trends that involve combination between speech, gesture, and also measurements of brain activity. This new laboratory will, therefore, enable cutting-edge research to be performed in the coming years, based on the resources already developed thanks to the AComIn project.

(+) The core computing infrastructure can now be used in combination with verification via the SmartLab experiments and measurements. This has provided a significant boost to the research.

(-+) Cooperation with leading EU partners is still more or less at the same level as before. However, the Bulgarian partner can now perform experiments on its own, or even conduct experiments, which cannot be done in the laboratories of the partners (one example is the Exhibition on the battle of Pavia in the field of 3D reconstruction of cultural heritage). Some cooperation was started at the regional level (Ukraine, Serbia, Macedonia), which did not exist at the same level before.
The absence of a significant increase of cooperation can be, in part, motivated by the relative late installation of the SmartLab equipment, which was satisfactorily justified by the IICT.

[2] *Reference § p45 in DOW AComIn (316087) 2012-08-20*

(+) Know-how transfer to Bulgarian User Communities and society has been successfully initiated. Within the IICT, a new functional unit dedicated to the technology transfer, an office “Information and Communication Technologies for Energy Efficiency” (TTO ICTEE) has been created, in order to support the successful interaction between researchers and the industry. After the acquisition of the SmartLab equipment, a series of projects in collaboration with the industry were started and some of them have been already successfully completed. We believe that these projects have the potential to become good showcases for attracting follow-up activities. It has to be mentioned that the Technology Transfer Office "ICTEE" has taken part in the establishment of a network of innovation centers, technology transfer offices and innovative companies, entitled "Bulgarian Technology Transfer Network (BTTN)".
For each of the areas “Intelligent Management of Digital Content”, “Advances in 3D Technologies”, “Advances in 3D Technologies”, “Advances in Material Analysis”, “Mechatronics and Industrial Applications”, the IICT organised at least 3 Technology Transfer Seminars for the respective User Community.

(-/+) For the moment the training was related to the PhD students working within various areas of the AcomIn project. The projects implemented to the industry rely more on solving a certain problem and delivering the results, than developing a software for which training of end-user is necessary.
The activities within the AComIn enabled researchers from the IICT to attend training events at partner institutions (up to 3-4 participations in international training events oriented to industrial ICT RTD and take-ups in areas related to applications of the SmartLab Devices). No structured training programme within the IICT has been implemented. This is an aspect, which could definitely be improved (see recommendations).

(ii) Weaker international orientation in some areas of the IICT research; focus on locally important topics in some papers published in local journals and proceedings of local forums.

Current status:

(+) The IICT has been very successful to attract people from the region (Bulgaria and neighboring countries). As such it has become a strong regional hub.

(+) The number of significant publications increased in all research fields covered by the AComIn (see section “Publications”).

(-+) For some of the new emerged research directions, however, it was difficult, in a relatively short time, to manage crossing the barrier to the Western European countries. One good example of break-through research, which was internationally acknowledged, is in the field of 3D-Reconsturction of cultural heritage.

(iii) Relatively low-flow of incoming researchers from EU and third countries.

Current status:

(+) BAS IICT was successful to attract many post-docs from neighboring countries.

(-) Given the level of development in some of the research unit before the start of the AComIn project, it was practically impossible to attract Western European researchers, which would perform long time research at the IICT. The acquisition of the Smartlab and the advertising of the new research facilities and knowledge will make definitely the IICT more attractive.

(iv) Insufficient dissemination activity for promoting IICT as a key actor in the 2020-agenda.

Current status:

(+) Scientific output is at a high and qualitative level.

(+) Very intensive dissemination through traditional academic channels (publications, participation to international conferences). Also 4 international renowned conferences were organised in Bulgaria by the IICT, two of them had two editions within the duration of AComIn due to their biennual scheme. Three Information Days and three Open Door days were organised. Given the

fact that time was needed to acquire the Smarlab and perform research that could be presented, these are already very good actions.
(+) The IICT was present in two TV programmes.
(+) Newsletters are published in Bulgarian and in English.
(-) The IICT should promote itself more via social media and researchers should be encourage to network with foreign groups.

(v) Insufficient IICT visibility as innovation driver.
Current status:
(+) Compared with the first SWOT analysis the visibility increased. 20 Technology Transfer seminars with more than 500 participants were organised.
(+) The most impressive participation of the AComIn in an event implying wide social impact is the project poster and the 3D printed models in the Exhibition “The Battle of Pavia” held in Visconti Castle in Pavia, Italy, in June-November 2015 as an associated event of EXPO-2015 in Milan.
(-) The institute should promote itself more actively via social media.

(vi) Lack of expertise how to approach the technology transfer and the IPR issues. Only first steps towards development of an IPR protection strategy for the IICT have been completed. No applications for patents to the European Patent Office.
Current status:
(+) Some progress has been made on IPR matters and strategies.
(+) IICT organised training events including two with an international lecturer, dedicated to Innovation Policy and IPR Issues.
(+) Eight patent applications were submitted within AComIn; 2 to the WIPO and 6 to the Bulgarian patent office BPO. Another application is in preparation for the WIPO.

(vii) Lack of strategy for building industrial User Communities and attracting PhD students from the innovation-absorbing companies.
Current status (as delivered by month 36):
(+) 4 contacts were established with Business Representatives, 2 of them are subsidiaries of large international companies, who are potential collaborators in future joint activities.
(+) 14 projects for joint developments were started, where the AComIn team contributed pilot studies and/or prototypes, 3 of them with companies.
(+) 6 projects were completed in the Competitiveness Operational Programme, coordinated by Bulgarian SMEs, which collaborate with the IICT as a research partner providing innovation.
(-) The institute should promote itself more via social media and researchers should be encourage to network with foreign groups.

6. STRATEGIC RECOMMENDATIONS AND ACTION PLAN FOR FUTURE RESEARCH

6.1. General conclusions

Giving the outcomes of the project, described in detail in previous sections, we can conclude that:

the AComIn project has truly fulfilled all six key performance indicators,

defined in Deliverable 6.1, as the reference measurement for the final evaluation of the project. Below we present a concise evaluation for each indicator.

Human resources

The IICT-BAS did increase significantly the number of young permanent staff. Overall, the number of employed persons remains the same but the average age is now between 40 and 50 compared with 50-60 before 2011.

These (young) people have the potential to successfully continue research activities that they have begun within the AComIn project, and to attract new funds and PhD students.

The international research personnel could not be involved at the expected scale, due to:

- the relative late launch of the SmartLab (which has been fully justified),
- lack of a global "IICT brand" that would attract such personnel (it is only the AComIn project that is an important step towards creation of such global brand).

Equipment

The acquisition of Smartlab and its integration in the existent infrastructure of IICT, is the most significant achievement of the AComIn project. As a result, significant improvement in quality of work has been observes in all research directions within the IICT.

- As mentioned in the SWOT analysis, some of the research groups were performing research at an international level even before the AComIn project, but either at a theoretical level, or they were dependent on partner's equipment. In addition, no cooperation with the industry was possible under these circumstances.
- The equipment was carefully chosen and aligned with the needs and the current technical state-of-the-art.
- Permanent staff was trained to use the equipment. Although acquired relatively late for some items (e.g. the Speech Lab), all acquired components have already been used in pilot projects, some of them with international impact, like the 3D-Modelling of Cultural Heritage.
- All equipment was also used in projects involving cooperation with the industry. The equipment corresponds to the current technological advances and covers a broad spectrum of technologies. Combined with the available scientific staff it makes the IICT one of the stronger research centres in the Central and South European region.

One thing that was not particularly addressed is the degree of exploitation of each equipment, i.e. which amount of time it was really in use for experiments and how much time it was unused. This kind of analysis may lead to new strategies for acquiring new funds.

Currently, all components of the equipment have guaranteed maintenance service. It is not clear how the maintenance will be financed when the warranty of the products is over.

It is also unclear what policies and funding mechanisms will be applied to replace equipment that becomes obsolete and augment the equipment portfolio when new research questions / direction materialise on the basis of results obtained when using the current equipment.

Scientific results

All research teams produced internationally acknowledged results, as described in detail in section 4.3. They are illustrated by a large number of publications with high impact score and by presentations at important conferences.

Several research directions (not envisioned in the original proposal) emerged during the project as result of new ideas brought by the new postdocs and PhD students.

Connectivity

The IICT reinforced the cooperation with some of the countries in the region, especially Macedonia, Serbia and Ukraine. Postdocs and PhD students from these countries are expected to continue, when returned home, the cooperation with the IICT.

Research group were recenty involved in five EU-funded COST projects. This EU funding scheme is focused on networking, so it is expected that the teams being involved in these actions will have more visibility and reinforce their scientific networks. There are still a number of teams (especially the newly created) which lack connections, especially with the “Western” partners.

In addition, cooperation with the regional stakeholders is somehow limited to the countries being involved directly in the project (Greece, as an AComIn partner was member of the Steering Committee, and Macedonia, Serbia and Ukraine, as countries from where scientific personnel was recruited). Additional cooperation with other near-by countries (e.g. Romania, Hungary, Croatia) would be of benefit. Three projects were addressing directly Science in Society principles (one environmental, one for impaired people, and one in relation with public health sector). This is remarkable given the particularities of the region, and should be advertised more.

The level of connectivity with industry is good, considering also the starting situation, which was characterised by practically no-existent cooperation in certain fields. The pilot projects, conducted during AComIn, as well as the Technology transfer workshops and the Open Door days, may ensure replicability of such projects.

There is a lack of visibility of the project in social media, which should be corrected in the coming months.

Project organisation

The project management was very efficient. The website is well structured and one can find all needed information. During the on-site visit in January 2016, we could observe that the teams were

cooperating with each other and the project coordinator interacted very efficient with the team leaders.

Almost all materials are available on the web site in Bulgarian and English.

Sustainability

From the point of view of human resources, the sustainability seems to be ensured. There is a critical mass of permanent staff that is very likely to remain with the IICT for the coming 20 years.

Equipment short-term sustainability is relatively secure. Consumables needed for the functioning of the equipment were acquired during the AComIn project and later will be provided via contracts. Most of the equipment has maintenance contracts. Depreciation for the next 5 years, given the quality of the equipment is not problematic. On long-term, we see some possible issues on exploitation, maintenance and renewal.

Collaboration with academic institutions and industry is good and can be maintained at the level existing after the end of the AComIn project, on short-term. On the long-term, the collaboration is directly influenced mainly by the sustainability of the equipment. However it should be assured if we assume that the research teams will not succumb to brain drain, will add new energetic members, and be equally active in acquiring new funds.

Visibility, especially in social media, has to be improved.

Strategic planning and support for innovation has to materialise.

IPR management has to be functionalised within the IICT.

6.2. Recommendations

While we acknowledge the big achievements realised by the AComIn project, there are some axes, which may be improved in the activity of the IICT in the future, so that the IICT becomes a real research leader in the region and a high level recognised international partner.

a) Cooperation with Universities should be stronger. Universities are involved in exchange programmes like the ERASMUS, and bilateral agreements. Joint Master and PhD program involving the IICT and other universities may ensure that young researchers from western countries may come and use the infrastructure facilities. On the other hand, personnel from the IICT could visit partner institutions, deliver lectures and advertise the IICT.

b) The grant programme available through the EU COST-Programme should be exploited entirely in the upcoming 2-3 years.

c) For research directions that are innovative and at the international level, summer schools could be organised. They could be combined with some of the “conferencing activities” of the IICT. Such activities would enhance also the international profile of the unit.

d) Regional funding should be exploited and more cooperation with countries in Central and southern Eastern Europe should be sought. One could investigate also complimentary capacities. For instance, in Romania, the Extreme Light Infrastructure (ELI) is being build, which will be the only European and International Centre for high-level research on ultra-high intensity lasers. This could be a good interaction point for the team working on materials and testing, but not only.

e) The IICT should extend the activities in the digital culture heritage area and raise attention, at the national level, to this area. In contrast with the Western Europe and the USA, where digital preservation of cultural heritage is on the national agenda, there are still few activities in this area in Central and Eastern Europe. The achievements of the AComIn could be used for realising similar projects on Bulgarian history and cultural heritage.

f) More interdisciplinary cooperation between the teams (e.g., vision, 3D modelling, language, acoustic holography) could demonstrate even more importance of having all facilities concentrated in one point, as it is the case with the AComIn infrastructure. Such collaboration projects could possibly ensure a more efficient distribution of funds for maintenance.

g) A long-term plan for renewal of the equipment, due to its failure, or depreciation is necessary.

h) A plan for exploitation of the equipment at its full capacity may ensure additional funds.

i) Plan for securing funding to augment the SmartLab equipment with new machines should be put in place.

j) For the moment, the coordination of all teams was ensured by the project coordinator. It is not clear what will happen in the future, how the management of the IICT will take over. Some action plan is required.

k) We remarked that the network clusters for most part of the research directions within the IICT are disjoint. However, big universities, like MU Munich, University of Tübingen, or Penn State University cover for sure other research areas of IICT BAS. It would be a good idea that research groups are promoting actively the other colleagues in the IICT.