Collaboration opportunities for EU ICT R&D organisations in

BELARUS

October 2009

SCUBE ICT
GATEWAY TO UKRAINIAN & BELARUSIAN ICT RESEARCH

-eeca
Member of the
Eastern Europe and Central Asia cluster
www.eeca-ict.eu

Funded by the European Commission
under the Information and
Communication Technologies (ICT) theme

This report has been developed under the **FP7-ICT SCUBE-ICT** project (www.scube-ict.eu) by the following group of specialists:

- **Kostas BOUGIOUKLIS**, Q-PLAN North Greece Ltd (bougiouklis@qplan.gr)
- **Iakovos DELIOGLANIS**, Q-PLAN North Greece Ltd (delioglanis@qplan.gr)
- **Christos PAPANEOPHYTOU**, Q-PLAN North Greece Ltd (papaneophytou@qplan.gr)
- **Giles BRANDON**, Intelligentsia Consultants (gilesbrandon@intelligentsia-consultants.com)
- **Tatyana LYADNOVA**, Belarusian Institute Of System Analisys And Information Support Of Scientific And Technical Sphere (tlyadnova@fp7-nip.org.by)

*Supported by the European Commission under the 7th Framework Programme
for Research in the Information and Communication Technologies area (ICT)*

Page - i -

S*upported by the European Commission under the 7th Framework Programme for Research in the Information and Communication Technologies area (ICT)*

Page - ii -

Preface

The present document has been elaborated under the joint efforts of the SCUBE-ICT project consortium.

SCUBE-ICT is an innovative EU funded initiative aiming to upgrade the cooperation in the field of Information and Communication Technologies (ICT) between EU, Belarus and Ukraine in key areas of mutual interest in order to create substantial socio-economic benefits in all three regions. A wide range of diversified activities will be implemented at two levels:

Research / industrial level

  ✓ Analyse the Belarusian and Ukrainian research and industrial ICT domain,

  ✓ Create a 'pool' of key ICT players from Belarus and Ukraine to promote collaboration with their EU counterparts.

  ✓ Advise and consult highly motivated ICT actors from the three regions and support their collaboration under FP7-ICT research activities.

Policy level

  ✓ Identify and analyse existing and future commonalities and differences in ICT R&D policies between EU and the targeted countries.

  ✓ Support and facilitate policy dialogue towards future cooperation directions in the ICT Research and Development field.

SCUBE-ICT identity

Title:	*"**Strategic Cooperation in Ukraine, Belarus and EU in Information and Communication Technologies**" (Contract No 231148)*
Duration:	*January 1, 2009 – December 31, 2010 (24 months)*
Website:	*http://www.scube-ict.eu*
Coordinator:	*International Environment and Quality Services North Greece Ltd* *(Q-PLAN N.G., Greece, www.qplanng.gr) -*
Contact Person:	*Mr. Kostas BOUGIOUKLIS – info@scube-ict.eu*
Consortium	

The project will be implemented by a multidisciplinary and multicultural consortium of 10 partners from 5 European countries:

▪ **International Environment and Quality Services North Greece Ltd**
  Q-PLAN N.G., Greece, www.qplanng.gr

▪ **Intelligentsia Consultants Ltd**
  Intelligentsia, UK, www.intelligentsia-consultants.com

▪ **ALTEC SA Information and Communication Systems**
  ALTEC, Greece, www.altec.gr

▪ **Technical University of Catalonia**
  UPC, Spain, www.upc.edu

▪ **Belarusian Institute of Systems Analysis and Information Support of Scientific and Technical Sphere**
  BELISA, Belarus, www.belisa.org.by

▪ **United Institute of Informatics Problems of the National Academy of Sciences of Belarus**
  UIIP-NASB, Belarus, www.uiip.bas-net.by

▪ **Belarusian State University of Informatics and Radioelectronics**
  BSUIR, Belarus, www.bsuir.by

▪ **Lviv Centre of Scientific, Technical and Economic Information**
  LvCSTEI, Ukraine, www.cstei.lviv.ua

▪ **V.M. Glushkov Institute of Cybernetics of National Academy of Sciences of Ukraine**
  GIC, Ukraine, www.icyb.kiev.ua

▪ **Institute of Artificial Intelligence Problems**
  IAIP, Ukraine, www.iai.gov.ua

Supported by the European Commission under the 7th Framework Programme for Research in the Information and Communication Technologies area (ICT)

Page - iii -

Table of Contents

Supported by the European Commission under the 7th Framework Programme
for Research in the Information and Communication Technologies area (ICT)

Page - vi -

Introduction

The present document aims to highlight the collaboration potential between Belarusian and EU ICT research and industrial actors. It summarizes the current status and trends of Belarusian ICT sector, describes the regional policies/priorities and identifies the strengths of ICT sector of Belarus both in RTD and in business level by focusing on the advantages for outsourcing in Belarus. A number of existing collaborations between Belarusian and EU ICT actors are presented as 'case studies'. The document concludes to the prominent collaboration areas between Belarusian and EU ICT actors both at RTD and business level.

The document is structured into the following chapters:

- **Chapter 1** summarises the structure and status of the National ICT sector;
- **Chapter 2** describes the strengths of Belarusian organisations and institutes at both RTD and business level, while it outlines existing collaborations between Belarusian and EU ICT actors. It concludes to the prominent collaboration areas at both levels.
- **Chapter 3** outlines the collaboration potentials between Belarusian and EU ICT actors.

*Supported by the European Commission under the 7th Framework Programme
for Research in the Information and Communication Technologies area (ICT)*

Page - 1 -

Executive Summary

Information and communication technologies (ICT) gradually turn to an important tool for the improvement of the Economy of Belarus:

- The **key research**, education and training in ICT in Belarus are provided from several universities and related institutions. For example, the Belarusian State University of Informatics and Radio Electronics (BSUIR) trains experts in a wide range of ICT specialist: design and construction of radio-electronic equipment, software development, telecommunications, information protection, and micro- and nano-electronics.

- Belarus also has a number of **public and private organisations** that play essential role in the ICT sector, such as the National Academy of Science of Belarus (NASB) which has several departments involved in academic ICT research. In particular, this includes the United Institute of Informatics Problems (UIIP-NASB) as one of the institutions of the Departments of Physics, Mathematics and Informatics.

- Additionally, in Belarus there are several **specialized enterprises** that develop applied software systems for different economic sectors based in Minsk and regional cities.

Even though there have been major improvements in the ICT sector performance in Belarus between 2000 and 2007, the penetration rates are still low compared to other countries. The numbers of telephone lines and mobile subscribers have increase of over 37% and 140% respectively. While in 2000 the internet was almost unknown in Belarus, in 2007 the number of internet subscribers was the 4.2% of the population. In contrast the number of personal computers in 2007 was still very limited.

The Belarusian ICT market counted about 650 private companies and organisations in 2008. Approximately, 70% of them are engaged in software development in Belarus and 63 of them are members of the science and technology association "Infopark". About 15,000 IT experts work in Belarusian software development companies - approximately 6500 on projects on the domestic market and 8500 for international markets. In 2003, 20% of all Belarusian software development companies had an annual turnover in excess of US$0.5 million. By 2008, the percentage had increased to 55%. Similarly, the percentage of companies with turnovers in excess of US$2 million increased from 13.5 to 24% during 2003 and 2008.

In order to improve the ICT sector, Belarus has designed and implemented a broad range of ICT related **policy measures** to establish and develop its information society. The most important of them is the National ICT programme of the Republic of Belarus from 2003-2010 "e-Belarus", which has aimed to create a unified ICT environment that will provide conditions to improve the economy; enhance state and regional management; and provide citizens with the right to freely search and distribute information on the economic and social status of society.

Referring to RTD level

Belarus has a long tradition in the information and communication technologies and always has been in the centre of attention for foreign researches, universities and companies. Historically, the country was one of the most technologically advanced republics of the former Soviet Union. Belarusian R&D organisations have also developed technical infrastructures such as supercomputers and computer systems for different medical applications, as well as for space technologies, nanotechnologies, photonics etc.

Even though there is a continuous increase in the scientific cooperation of Belarusian universities with foreign partners only 5% of Belarusian universities are involved in ICT research with EU partners. Unfortunately, looking back over the European Commission's fifth and sixth framework programmes, besides several accompanying measures/support actions, there has only been a small number of IST/ICT research projects involving Belarusian higher education and research institutions. However, there are many potential collaboration ICT areas between Belarusian and the EU, amongst them the most prominent are:

- Supercomputing;
- Grid technologies and Infrastructure;
- Electronic Health (e-health);
- Micro/nano-electronics and photonics;
- Space/space related technologies.

Supported by the European Commission under the 7th Framework Programme for Research in the Information and Communication Technologies area (ICT)

Page - 3 -

Referring to business level

Belarus is an attractive destination for ICT **outsourcing /near-shoring**. Belarus benefits from geographical proximity to the EU market, it is culturally close to Europe, and there is a small time difference with Europe. Additionally, the Belarusian ICT-key specialists have a high level of English knowledge as well as great experience and reliability in intensive projects with western companies. The activities of the majority of the Belarusian IT companies are focused on:

- Bank Office applications;
- Electronic Commerce Applications;
- Front Office Application Software;
- Internet and Electronic Workplace Software,
- Networking and Communication Software;
- Software Infrastructure and
- Enterprise Application Integration.

Thus, a lot of the global leaders in telecommunication and computer technology sphere have already recognised the advantages of outsourcing in Belarus. Amongst the customers of Belarus' software development companies are: Alcatel, IBM, British Telecom, Microsoft, SAP, Siemens, Sun Microsystems and Xerox. The establishments of the Hi-Tech Park and changes to legislation have been welcomed by the heads of Belarus' software development companies. These developments have been also noticed by various organisations abroad. In 2008, many foreign investors expressed interest to co-operate with Belarus in various technology fields and to invest considerable sums in the country's economy.

1.   National ICT sector

1.1   Overview

Information and communication technologies (ICT) gradually turn to an important tool for the improvement of the Economy of Belarus. The country has real prerequisites for setting up a modern information society and becoming a part of the global information community. An effective educational system has been preserved. Moreover, the scientific, technical and production potential in the field of informatics, as well as intellectual potential of the nation remain relatively high[1].

At policy level, a large number of measurements have been implemented in Belarus aiming at the development of ICT in different spheres of activity (state and regional governance, industrial production, healthcare, culture, sciences, social attitudes etc). A network of governmental bodies has been created to provide a unified national information resource and to connect to international communication networks. At the same time, scientific research to develop advance information technologies, including programming and information security facilities, is carried out in the framework of state scientific-technological programmes.

The key research, education and training in ICT in Belarus are provided from several universities and related institutions. For example, the **Belarusian State University of Informatics and Radio Electronics** (BSUIR) trains experts in a wide range of ICT specialist: design and construction of radio-electronic equipment, software development, telecommunications, information protection, and micro- and nano-electronics. These universities has specialised laboratories in all these fields. Moreover, various programmers and IT specialists are trained at the ***Belarusian State University*** in Applied Mathematics, Radio Physics, Mechanics and Mathematics. Active research is conducted in the area of cryptography and information protection. Nearly, all technical universities in the regional cities and Minsk (e.g. Belarusian National Technical University, Belarusian State Technological University, etc) have faculties dedicated to prepare experts in the field of IT[2].

Belarus also has a number of public and private organisations that play essential role in the ICT sector, such as the **National Academy of Science of Belarus** (NASB) which has several departments involved in academic ICT research. In particular, this includes the **United Institute of Informatics Problems** (UIIP-NASB) as well as the **Institute of Mathematics** and **Institute of Physics** as the member institutions of the Departments of Physics, Mathematics and Informatics.

Private enterprises are thriving in the ICT sector in Belarus. Generally, private ICT enterprises can be divided in to the following clusters:

1. Services in the development of custom-oriented software (e.g. Epam systems, Belhard group, Sam solutions, Softclub, System technologies, BelSoft, Joint-Stock Company IBA)
2. Telecommunication services (e.g. GSM operators – "MTS" ltd, Joint-Stock Company "Best", Foreign Enterprise "Velcom", CDMA operator – "Belcel" ltd)
3. Manufacturing of the telecommunication equipment (e.g. Belrossviaz', Sviaz'informservice)
4. System integration (e.g. IBA, Sviaz'informservice)

Professional unions and associations also start to play a significant role in the development of the ICT sector in Belarus. The public association NGO "Information Society" was created in 1999 aiming to facilitate the application of information and communication technologies in all spheres of Belarusian society. More than 500 members are experts in the field of information technologies from industry, scientific-educational sector and government.

The scientific and technological association "**Infopark**" was created in 2001 following the Decree of the President of Belarus. It aims to support the development of export-oriented software and unite information technology developers working in various types of companies and activities. In April 2009, about 60 enterprises, organizations and establishments were members of the association. Some special tax privileges are granted to members of the association. Also, "Infopark" carries out ICT market research in the Republic of Belarus, conducts scientific conferences (in particular in the banking and financial IT sector), and supports educational projects.

In 2005, the Belarus' **High Technology Park** (Hi-Tech Park) was created following the Decree of the President of Belarus to stimulate high technology production development in the country. Today, most Hi-Tech Park residents are involved in information technology development. Special and exclusive economic conditions are granted to residents of the park. One of the important roles of the park is the maintenance of the IT education system. Currently, there are about 67 enterprises - with various

---

[1]   Karolina   Datlikovich   and   Igor   Tavgen.   Promoting   ICT   for   Development   in   Belarus; http://europeandcis.undp.org/governance/show/67F101C0-F203-1EE9-B6260AA10E7BF8DB.

[2] National ICT Sector and Policy Appraisal Report. Belarus" (October 2009), Prepared under the SCUBE-ICT project.

ownership structures - in the Hi-Tech Park and their export of software development services exceeded $100m during 2008. Due to its success, there are plans to expand the park's activities and create a business incubator for IT companies.

The Park provides the following benefits for its residents and investors:

- **Residents** of High Technologies Park are exempt from the following dues and taxes: Dues and taxes to the state budget and non-budgetary funds; Income tax; Value added tax; Customs dues and VAT when the residents import hardware, firmware necessary for their activities in the High Technologies Park; For foreign legal entities without a permanent Belarusian representative office the rate of income tax on the dividends, debts, royalty and licenses paid by the residents of High Technologies Park is 5% in case no other, more beneficial privileges are stipulated by international agreements of the Republic of Belarus; Individual income tax for High Technologies Park residents' employees has a fixed rate of 9% from the salary received.

- **Non-residents** of High Technologies Park can also take advantage of the benefits adopted for High Technologies Park residents. For this non- residents need to register their business project in High Technologies Park. In case the goals of the business project comply with the park priority activities, the non-resident can benefit from the above-mentioned preferences while the business project is implemented.

Finally in Belarus, there are several specialized enterprises that develop applied software systems for different economic sectors based in Minsk and regional cities. For instance, the State Unitary Enterprise "Institute of Applied Software Systems" within the Ministry of Communications and Informatization, is the leader of several projects under the programme "e-Belarus". The Institute Hyprocommunication is engaged in problems of communication networks design, standardization and certification of telecommunication equipment. The Institute is also under the responsibility of the Ministry of Communications and Informatization. The Republican Centre of Technologies Transfer is a specialized institution, within the State Committee on Science and Technologies, responsible for marketing of ICT research and development. Finally, the Interuniversity Centre of Marketing and Techno Park "Metolit" were created within the Ministry of Education for a similar purpose.

Belarus was listed amongst the ten most reformed countries in the World Bank's "Doing Business Report for 2010"[3]. In terms of conditions for doing business, Belarus has gained 24 positions and now occupies the 58th place.

This improvement is in part due to a number of actions to liberalise economic activities that have been successfully implemented:

- Procedure for opening a private business has been simplified;
- Taxation system has been simplified;
- Various administrative and technical procedures have been improved;
- Price and anti-monopoly regulation has been improved;
- More favourable conditions for investment activity have been provided.

Additionally, a number of activities to improve the investment climate in Belarus are being implemented: the procedure for permission to realise licensed kinds of activity has been simplified; the number of various administrative procedures has been reduced; and customs registration process for commercial organisations has been simplified, etc[4].

---

[3] "Doing Business Report:2010" http://www.doingbusiness.org/features/Reformers2010.aspx

[4] "Review of Economic Development: Belarus 2008", www.mfa.gov.by/upload/economic_review.pdf

1.2   Current Status and trends of Belarusian ICT sector

According to the World Bank's "ICT at a Glance"[5] there have been major improvements in the ICT sector performance in Belarus between 2000 and 2007. The country's ICT penetration rates are illustrated in the table below[6]:

	2000	2007
Access (per 100 people)		
Telephone lines	27.5	37.8
Mobile cellular subscriptions	0.5	71.7
Internet subscribers	0.05	4.2
Personal Computers	-	7.78
Usage		
International voice traffic (minutes/person/month)	3.3	5.3
Mobile telephone usage (minutes/person/month)	-	500
Internet Users (per 100 people)	1.9	29
Quality		
Population covered by mobile cellular network (%)	62	93
Fixed broadband subscribers (% total internet subscribers)	0.0	2.8
International Internet bandwidth (bits/sec/person)	2	264

Table 1: ICT penetration rates in Belarus

The improvements of Telecommunication sector, personal computer usage and Internet usage are then examined.

- **Telecommunications**

    The telecommunication sector in Belarus recorded a significant growth rate between 2000 and 2007. Fixed telephony lines were increased approximately 30 per cent, from 27.5 to 37.8 per 100 people. International telephone usage has increased over 1.5 times from 3.3 to 5.3 minutes/user/month. A significant increase, almost 150 fold, of in the mobile phone subscribers was observed, from 0.5 to 71.7 per 100 inhabitants. Moreover, mobile telephone usage was reached at 500 minutes/user/month from in 2007 and. The population covered by mobile telephone network was increased from 62 to 93 per cent between 2000 and 2007.

- **Personal Computers**

    As illustrated in Table 1, personal computers' (PC) usage in Belarus is still limited. It is estimated than in 2007 there were 775,000 PCs operated in the county meaning approximately 7.88 PCs per 100 people. According to the National Statistics Committee[7] data on 2008, while 32 % of households in Belarus possess a computer that is 6% more than in 2007 (26%).

- **Internet services**

    Internet users in Belarus were increased from 1.9 to 29 (per 100 people) between 2000 and 2007. According to the Ministry of statistics in 2009 there are 3.1 million Internet users in Belarus while more than 470,000 of them have broadband access to the Internet[8] Moreover between 2000 and 2007, the bandwidth went up from 2 to 264 bits/sec/user.

Regarding the Belarusian ICT market, in 2008 there were around 650 ICT private companies and organisations operated in the country. Approximately, 400-450 companies are engaged in software

---

[5] World's Banks "ICT at a Glance", 2009, http://devdata.worldbank.org/ict/blr_ict.pdf

[6] World's Banks "ICT at a Glance", 2009, http://devdata.worldbank.org/ict/blr_ict.pdf

[7] http://it.tut.by/news/95458.html)

[8] http://it.tut.by/news/94161.html

development in Belarus and 63 of them are based at the science and technology association "Infopark". About 15,000 IT experts work in Belarusian software development companies - approximately 6500 on projects on the domestic market and 8500 for international markets. In 2003, 20% of all Belarusian software development companies had an annual turnover in excess of US$0.5 million. By 2008, the percentage had increased to 55%. Similarly, the percentage of companies with turnovers in excess of US$2 million increased from 13.5 to 24% during 2003 and 2008.

Belarus has shown steady economic growth over many years and during the past ten years the country's gross domestic product (GDP) has almost doubled. In 2008, the GDP of Belarus reached 128,8 trillion Belarusian roubles (approximately €32 billion) and increased by 10 percent in comparison with 2007. Average annual GDP in Belarus increase about 8 percent.

According to the Words Bank's "ICT at a Glance"[9] data, the relative amount of ICT services exported (% of services exported) has increased almost 26% from 5.4 to 6.8 between 2000 and 2007. The size of the export market for Belarus' software development services is several times greater than that for the domestic market. Total export income for Belarusian companies is about $360m. However, part of this income is received from the foreign development centers of Belarusian companies. If one excludes the contribution of these centers, then pure software development export amounts to about $300m. In other words, software and IT services export is almost three times larger than the domestic market.

Based on the "National ICT Sector and Policy Appraisal Report-Belarus"[10] ICT gradually turn to an important tool for the improvement of the economy of Belarus. Automated system for design and manufacturing such as Computed Aid Design (CAD), Computer Aid Manufacturing (CAM) and Computer Aid Engineering (CAE) are widely used in the industry. Integrated resource management systems ERP (Enterprise resource systems) are being currently introduced at large enterprises. Moreover, more than 1,000 Internet shops and 4 full-fledged retail information and trading systems that use two domestic systems of electronic payments have been registered and operated in Belarus.

According to the Ministry of Communications, during the period January - June 2008, the net profit of the telecommunication enterprises grew 1.5 times and reached 462 billion Belarusian roubles (approximately 160 million euros). Taking into account the profitability of branch enterprises (about 40 %), it is estimated that their cumulative annual turnover is about 800 million euros. Therefore, it is estimated that the size of the IT market in Belarus is approximately $600m with the software development market about $100m.

---

[9] World's Bank "ICT at a Glance", 2009, http://devdata.worldbank.org/ict/ukr_ict.pdf

[10] "National ICT Sector and Policy Appraisal Report- Belarus" (October 2009). Prepared under the SCUBE-ICT project.

1.3   National ICT policies

There is a growing understanding of the role the ICT industry could play in Belarusian economy. Thus the Belarusian ICT sector governance system first started to form in the early 1990s with the establishment of the special Fund of Informatization for financing and managing ICT projects by the Belarusian Government resolution on the formation of the Fund for Financial and Technical Support of the Development and Fostering of Informatization Processes in Belarus. The Fund promoted scientific and technical activities aimed at the development of the republic through financial assistance to legal entities. In 2005, the Fund was liquidated due to the transfer of its activities to the newly formed Department of Informatization of the Ministry of Communications and Informatization.

In December 2001, the Scientific and Technological Association "Infopark" was set up by the decree of the President of Belarus on the State support of Development and Export of Information Technology (#234, May 4, 2001). Later in September 2005, the degree #12 "On High Tech Park" was adopted to increase competitive capacity of the national economy and its IT industry. As a next stage the Belarusian government considers adding medical & biotechnologies, nanotechnologies, integrated green technologies as well as other future-oriented activities to the high priority areas of the Hi-Tech Park activities. Hi-Tech Park is keenly interested in R&D projects in various science-intensive areas.

Moreover, according to the "National ICT Sector and Policy Appraisal Report-Belarus"[11], the main objective of the national policy in Belarus is to form the single information space as one the main stages of the transition to the information society, to provide favourable conditions for effective economic performance, state and local management, to secure the right for free research, transfer and distribution of the information.

The main objective of the information society development in Belarus is to improve the quality of living of the Belarusian people and maintain the ample opportunities to satisfy needs and free development of an individual and the society. For these reason considerable emphasis is put on the development of the innovative and competitive economy together with transparent and effective system of governance (Draft of the "Strategy of Information Society Development in Belarus for the period til 2015", it has already went through preliminary readings in the Parliament committee).

The objective of the information society development corresponds to the strategic aim of sustainable development of the Republic of Belarus. This strategic aim is defined by the National Strategy for Sustainable Development of the Republic of Belarus «as dynamic increase of the well-being standard, cultural enrichment, maintain morals of people on the basis of intellectual and innovative development of the economic, social and spiritual spheres, preservation of environment for present and future generations».

Additionally, during the past years, Belarus has designed and implemented a broad range of ICT related policy measures to establish and develop its information society. Some examples of these policies are listed below:

The **National ICT programme of the Republic of Belarus from 2003-2010 "e-Belarus"** has aimed to create a unified ICT environment that will provide conditions to improve the economy; enhance state and regional management; and provide citizens with the right to freely search and distribute information on the economic and social status of society.

The "**State Programme of Innovation Development of Republic of Belarus for 2007 – 2010**". Strategic goal of the Programme is to develop the Belarusian economy to be knowledge-based, competitive in the world market, science-intensive, resource-saving and eco-friendly as well as oriented towards sustainable socio-economic development and improving the quality of life of the Belarusian nation. The major targets of the programme include: building up the national innovation system; cultivating the economic, legal and socio-cultural environment conducive to innovation activities; upgrading manufacturing and social facilities on the basis of new and high technologies; achieving a brand new technological level in the economic sectors; increasing the share of high-technology exports, import-substitution, economy and energy security; developing intellectual potential and creative activities of people.

The "**Electronic and Optics Programme for 2006-2010**" with a budget of approximately 25 m euros aiming to develop the physical and technological basis of new material production, new micro- opto- nano- radioelectronic devices and control systems development for the next generation of information and telecommunication systems.

The "**INFOTECH Programme for 2006-2010**" aiming to support the creation of new intelligent information technologies and systems, the development of models, mathematical methods and

---

[11] "National ICT Sector and Policy Appraisal Report- Belarus" (October 2009). Prepared under the SCUBE-ICT project.

Supported by the European Commission under the 7th Framework Programme
for Research in the Information and Communication Technologies area (ICT)

Page - 9 -

hardware/ software facilities to increase the product competitive abilities and improve social sphere of the country.

On October 2006, the Belarusian Ministry of Communications adopted the "**Telecommunications Development programme for 2006-2010**". The Programme's objectives are the development of all categories of telecommunications services and the creation of national Informatization networks in order to provide access to information for all citizens of the country.

The **State Programme for the Introduction of Digital Television and Radio Broadcasting in the Republic of Belarus until 2015** has begun in 2005 and it has a budget of approximately 41 m euros. The main objectives of the programme are: the development of electronic media, the expansion of the information space of the Republic of Belarus, the production of new types of receiving equipment of satellite television broadcasting and the increase of the competitiveness of domestic products of international markets.

A more detailed analysis of the Belarusian ICT policies and programmes is performed in the report "National ICT Sector and Policy Appraisal Report- Belarus"[12].

---

[12] "National ICT Sector and Policy Appraisal Report- Belarus" (October 2009). Prepared under the SCUBE-ICT project.

Supported by the European Commission under the 7th Framework Programme for Research in the Information and Communication Technologies area (ICT)

Page - 10 -

2. Collaboration opportunities in Belarus

2.1   Collaboration Potential at RTD level

2.1.1   Strengths of Belarusian RTD organisations

Historically, Belarus was one of the most technologically advance republics of the former Soviet Union[13]. A major key advantage of Belarusian ICT organisations is the highly educated labour force. According to the "UN 2007/2008 Human Development Report"[14], Belarus ranks 67th among 179 countries of the world with regard to the human development and its human development index (HDI) being 0.817. Belarusian R&D organisations have also developed considerable infrastructures such as supercomputer and computer systems for medical applications. The main advantages of Belarusian RTD organisations are presented below:

- **Human Capital and Educational System**

   Belarus has an excellent education system inherited from the Soviet times. Approximately 3,500 IT–related specialists graduate annually from numerous Belarusian universities and technical schools such as: the Belarusian State University of Radio Electronics and Informatics; the Belarusian State University; the Belarusian National Technical University; and the Minsk Radio Technological College.

   After the collapse of the USSR the majority of skilled IT specialists were involved in Belarusian open-market IT businesses. A lot of IT specialists in Belarus have participated in scientific R&D projects for the military, energy and other industries of the former Soviet Union. It is worth to mention that Belarus is among the few countries in the world whose specialists have been involved in construction of space stations, global communication systems, and nuclear development projects[15].

- **Infrastructure**

   Many Belarusian research institutions and universities have developed individual IT infrastructures which are used in many research applications. A main achievement of Belarus in supercomputers is the "SKIF" clusters which were developed as a joint effort of Russia and Belarus. In 2004 the Supercomputer **SKIF K-1000** was installed in Minsk (Belarus). This cluster based on 567 AMD Operton processors was designed by the **United Institute of Informatics Problems of the National Academy of Science of Belarus**. Other participant of the project is Programme Network Institute of the Russian Academy of Science and the AMD Corporation. The cluster has a peak performance of 2.5 teraflops and Linpack tested performance of 2,032 teraflops. SKIF K-1000 supercomputer was the fastest computing system in the Eastern Europe and one of the fastest in the world. In 2004 SKIF was ranked 98th among the world's 500 TOP Supercomputers. Moreover, SKIF-1000 had one of the best price/quality rations in the industry[16].

   SKIF has allowed reaching a new research level in fundamental and applied areas, such as nuclear energy and its safety problems, aero and hydrodynamics, climate research and forecast, bio-informatics and cryption, information security, etc[17].

   In the frame of the projects **SKIF-GRID** and **BalticGrid-II** Belarus is becoming the part of E*uropean e-Infrastructure.* The cluster resources of Belarusian computers will be included in shared computer capabilities of European computer networks.

   Additionally, several Belarusian R&D organizations have developed computer systems which are used in medical applications. Some of the most interesting of them are the system of the histology image analysis. The most remarkable of the Belarusian histological image analysis systems are: the "Bioscan", the "Autoscan", the "Contour" and "Cytron". A more detailed analysis of these systems is performed in chapter 3.

---

[13] http://www.park.by/en/belarus/

[14] "UN 2007/2008 Human Development Report", http://hdr.undp.org/en/media/HDI_2008_EN_Tables.pdf

[15] http://www.park.by/en/belarus/

[16] http://skif.pereslavl.ru/psi-info/rcms/rcms-leaflets.eng/skif-k1000-leaflet-engl.pdf

[17] http://www.t-platforms.ru/en/super.html

2.1.2 Current collaborations

According to "National ICT Sector and Policy Appraisal Report-Belarus"[18], over 50% of international projects involving Belarusian organisations are performed by Belarusian higher education institutions. There is a continuous increase in the scientific-industrial cooperation of Belarusian universities with foreign partners. In total, Belarusian universities have partnerships with universities from 57 countries. However, only 5% of Belarusian universities are involved in ICT research with EU partners. The three strongest organisations in the field of ICT research are the Belarusian State University of Informatics and Radioelectronics (BSUIR), the Belarusian State University (BSU) and the National Academy of Science of Belarus (NASB).

- **Belarusian State University of Informatics and Radioelectronics** trains experts in a wide range of ICT specialists: design and construction of radio-electronic equipment, software development, telecommunication, information protection and micro- and nano-electronics. Students and academic staff take part in international programmes such as INTAS, Europractice, NATO, Tempus, Copernicus, Erasmus Mundus. In addition, students win scholarships from the German Academic Exchange Service (DAAD) and the institution wins grants from the French Society for Research support, German Research Foundation and (DFG) and the International Science and Technology Centre (ISTC). It has also participated in some FPs projects.

- **Belarusian State University (BSU)** is a prominent educational and research establishment with over 8500 staff including 2500 lecturers. The university trains more than 25,000 students including 1500 foreign nationals. Student programmers and IT specialists are trained in the Faculties of Applied Mathematics and Computer Science, Radio Physics and Electronics, and Mathematics and Mechanics. BSU has the largest number of international cooperation amongst all the Belarusian higher education institutions. It has partnership relations with more than 180 foreign educational and scientific organizations. Traditionally, it has close connections with European countries and CIS member states. Each year, on average, BSU is involved in over 80 on-going international projects with the support of the different foreign programmes and funds such as TEMPUS, ERASMUS MUNDUS, INTAS, PHARE, ISTC, NATO, and CERN. BSU has also some experience of participation in FPs projects.

- **National Academy of Sciences of Belarus (NASB)** carries out its activities through 90 different scientific institutions distributed across seven departments. The biggest of them is Department of Physics, Mathematics and Informatics. In this department, there are 3 main scientific institutions dealing with ICT research: United Institute of Informatics Problems, Institute of Mathematics and Institute of Physics.

- The *United Institute of Informatics Problems of the National Academy of Sciences of Belarus (UIIP-NASB)* is involved in fundamental and applied research in information technology, computer science, applied mathematics, computer aided design and some other related fields. It cooperates with industrial research centres and enterprises in solving applied problems in the field of computer aided design, computer aided engineering, new products testing, software and hardware development.

  UIIP-NASB has the following comprehensive range of departments: modeling of intelligent processes; modeling of image synthesis and recognition processes; information technologies and systems; laboratories of mathematical cybernetics; operation research; logical design; modeling technological processes; technical systems synthesis; self-organizing systems modeling; computer networks; computer aided design; image processing and recognition; speech recognition and synthesis; cartographic systems and technology; system identification; system engineering; high performance systems; information protection; bio-information systems; computer graphics automation of video information input, information analysis systems; divisions of automation systems; joint space information technologies; and joint programmes of supercomputer systems.

- The *Institute of Mathematics of the National Academy of Sciences of Belarus (IM-NASB)* is involved in fundamental research in algebra, geometry and theory of numbers, differential equations, optimization methods and systems of control, functional analysis, computational mathematics, discrete models and algorithms, probabilistic and statistic analysis and theory of random processes. Development of mathematical models and methods for solving actual applied

---

[18] "National ICT sector and Policy Appraisal Report-Belarus" (July 2009). Prepared under the SCUBE-ICT project.

Supported by the European Commission under the 7th Framework Programme for Research in the Information and Communication Technologies area (ICT)

Page - 12 -

problems arising in cryptology, physics, mechanics, microelectronics, engineering, economics, ecology, medicine, oil-refining industry, metallurgy, building, force majeure safety, logistics and theory of transport network and others.

IM-NASB has the following departments: mathematical theory of systems; differential equations; nonlinear and stochastic analysis; control process theory; mathematical physics; algebra; computational mathematics and mathematical modeling; combinatoric models and algorithms; parallel computational processes; laboratory of finite group theory and applications; and production-and-technical division.

- The ***Institute of Physics of the National Academy of Sciences of Belarus (IP-NASB)*** is involved in laser physics, development and fabrication of new laser sources and systems for various applications; nonlinear and quantum optics, laser spectroscopy; nonlinear dynamics of complex systems; physics of quantum-dimensional structures; transfer of optical radiation and optics of scattering media, optical methods of investigation and diagnostics of natural objects and biological media; physics of elementary particles and nuclear reactions; physics and technology of novel nanostructures for applications in opto-electronics and information technologies, incl., e.g. optical interconnects, optical and electro-optical switching and modulation, luminescent materials incl. those for white LED development and biomedical applications (in medical diagnostics), plasmonic structures for ultrasensitive molecular analysis as well as for solar cells improvements.

Unfortunately, looking back over the European Commission's fifth and sixth framework programmes, besides several accompanying measures/support actions, there has only been a small number of IST/ICT research projects involving Belarusian higher education and research institutions.

The FP5 IST project "Research and training action for System on Chip design" (REASON, IST-2000-30193) ran from 2002 – 2005 and involved BSUIR and BSU. The aim of the project was to integrate academic and research institutions of Central and Eastern Europe working in the field of microelectronics into the mainstream R&D activities going on in EU countries. To achieve this aim, the project organised training courses and workshops together with academic and research institutions from EU countries. Together with subcontractors the project involved about 50 institutions. The total number of public training events was 291 involving 7600 participants.

The FP6 IST project "Nanophotonics to realise molecular-scale technologies" (PHOREMOST, 511616) was a network of excellence dedicated to nanophotonics and molecular photonics in order to address the near- and long term needs of photonic functional components. The project ran from 2004 – 2008 and involved the Institute of Molecular and Atomic Physics of the National Academy of Sciences of Belarus.

Meanwhile, the FP6 IST project "Engineered Quantum Information in Nanostructured Diamond" (EQUIND, 034368) is funded under the Future Emerging Technologies domain and runs from 2007 – 2009. The Belarusian partner is the Institute of Physics of the National Academy of Sciences (IP-NASB). As its title suggests, the project is examining the application of diamond to quantum information.

On the other hand, there have been many ICT focused collaborative research projects involving Belarusian partners that have been funded by the intergovernmental organisation International Science and Technology Center (ISTC). ISTC was established in Moscow by international agreement in November 1992 as a nonproliferation programme. ISTC coordinates the efforts of numerous governments, international organizations, and private sector industries, providing former weapons scientists from Russia and CIS countries with new opportunities for sustainable, peaceful employment. The Parties to ISTC are Canada, the United States, the European Union, Japan, Norway and South Korea (funding parties), as well as Russia, Armenia, Belarus, Georgia, Kazakhstan, the Kyrgyz Republic and Tajikistan (recipient parties).

A relatively recent example of a successful ISTC funded projects involving Belarusian and European partners was ISTC project B-276.2 "Mesoscopic Lights Emitters, Switches and Transformers", which involved the Institute of Molecular and Atomic Physics of the National Academy of Sciences of Belarus, BSUIR, Centro Ricerche FIAT (Italy), EVOTEC BioSystems AG (Germany) and the University of Dortmund (Germany). The objective of the project was to exploit mesoscopic optical phenomena for the development of novel efficient light emitters, switches, and transformers. During the project, mesoscopic effects were used for developing experimental grade samples of: visible light emitting plates with enhanced efficiency. Afterwards, the samples were evaluated through optical and laser experiments and theoretical simulations.

Although now discontinued, the International Association for the promotion of co-operation with scientists from the New Independent States of the former Soviet Union (INTAS) was also a very valuable body for funding collaborative research projects involving Belarusian organisations. It was

established in 1993 by the European Community and like-minded countries, in order to promote scientific research activities in the New Independent States (former Soviet States) and scientific co-operation between scientists in these countries and the international scientific community.

Between 1993 and 2006, INTAS funded numerous ICT related research projects involving Belarusian partners. One such example was "Quantum information technologies: quantum cryptography and simulation of quantum many-body systems" (INTAS 2004-77-7289), which ran from 2005 – 2007 and involved the Institute of Physics of the National Academy of Sciences of Belarus (IP-NASB) and the University of Stuttgart amongst other partners. Interestingly, these two partners have gone on to collaborate together in the FP6 EQUIND project.

2.1.3   Prominent collaboration areas

Belarus software and IT sector is based on a 50 year-old tradition on IT skills development and IT education. Belarus has well–established higher educational institutions performing advance research and able to train qualified programmers. Belarusian R&D institutes and organization are specialised in many ICT/ICT related fields and thus they provide many collaboration potentials with EU ICT actors. A set of prominent areas of collaboration are illustrated in the table below and are subsequently examined.

No	*Prominent Collaboration Areas*
I	Supercomputing
II	GRID-technologies and infrastructure
III	Electronic-health (e-health)
IV	Micro/Nano- electronics and Photonics
V	Space and geo-information technologies

Table 2. Prominent collaboration areas between Belarus and the EU

I.   Supercomputing (High-Performance Parallel-Architecture Computers)

The past ten years Belarus has become an important player in **supercomputing**. Belarusian and Russian scientist and engineers have developed the supercomputers "SKIF". Sixteen (16) supercomputers samples were created in the years 2000 and 2004 during implementation of the skiff project and over 60 installations were produced between 2005 and 2007.

The **SKIF K-1000** supercomputer, with the 2.5 Tflops peak performance was ranked as the second fastest among the 50 most powerful computer installations in the territory of the former Soviet Union and Eastern Europe. The main specifications of the SKIF K-1000 are summarized in the table below.

Number of computing knots/ processors	288/576
Type of processor	AMD Opteron TM 248 (2200 MHz)
Peak-performance	2,5 T Flops (2534 GFlops)
Linpack-performance	2,0 T Flops (2032 GFlops)
Specification of Linpack	Efficiency = 80% N = 274000; N 1/2 = 24950
RAM	288 x (8 x 0.5 Gb) = 1152 Gb
HDD	288 x 80 Gb = 23040 Gb
System network	InfiniBand, IB 4x (MPI: ~ 830MB/s, ~ 5µs)
Disk capacity of file-server	2 000 Gb
Controlling (auxiliary) network	Gigabit Ethernet

Table 3. Main specifications of SKIF K-1000 supercomputer

Following a successful evaluation of the supercomputer development in Belarus, a new scientific programme "Development and implementation of intensive computer technologies-TRIADA" was approved and started in 2005. The main directions of the project are:

- Investigation, verification and adaptation of advance foreign computer technologies on the basis of Russian and Belarusian high-performance multi-processors computer systems;
- Development and implementation of new science intensive technologies on the basis of high-performance multi –processor computer systems;
- Development of the system software and hardware on the basis of high-performance multi-processors computers produced in Russia and Belarus complying science intensive computer technologies.

Thus, there is a considerable collaboration potential with the EU in high performance parallel architecture computing as well as in the related problems addressed by them (i.e. several problems in mathematics and physics or in other application areas).

II. GRID-technologies and infrastructure

The **Computer Network of the National Academy of Sciences of Belarus** (BASNET) is one of the first networks created in the Republic of Belarus to exchange data between various research organisations and scientific groups. Since 1997 BASNET together with the Belarusian State University networks "BSUNet" and "NIKS" and Ministry of Education network UNIBEL have formed the Unified Research and Informational Computer Network (URICON) of the Republic of Belarus.

Until now BASNET is the most advanced and dynamically developing research computer network in the Republic of Belarus. BASNET provides international connectivity to others Belarusian NRENs and proposes various Internet services in all regional cities of Belarus - Brest, Gomel, Grodno, Mogilev, Vitebsk and capital – Minsk. Since May, 2007 BASNET is administrated by the UIIP NASB, who is recognized as Belarus NREN provider to unite research, cultural, educational and high-tech IT institutions and IT-research laboratories in Belarus.

Belarus, since 2007 has joined several projects in order to be a part of the **European Grid Structure**. The **United Institute of Informatics Problems (UIIP) of NASB** has joined most of these projects. Currently two projects, the "SKIF-GRID" and the "BalticGrid-II", are in progress.

The **SKIF-GRID** (http://www.skif.bas-net.by) is a joint Belarusian-Russian project (2007-2010) which mainly aims at:

- The development, study and introduction of High-Parallel-Computing (HPC) tools based on Grid-technologies with supporting the heterogeneous territorially-distributed computer complexes.
- The creation of cluster supercomputers, focused on using in Grid – environment.
- The maintenance of Information Security of the Created Distributed Grid-computing environment with communication via public networks.
- R&D works for perspective applications of created Grid – environment, including development of pilot samples of various purpose systems.

The United institute of Informatics Problems is the leading organization from Belarusian side. In total, about 20 Russian and Belarusian scientific centers participate in the project. High performance computing resources of National Academy of Sciences of Belarus and Russia are provided for the users of the **grid networks**. The users in Belarus are the universities, research institutes, industrial and social organization and enterprises.

The **BalticGrid-II** project (http://www.balticgrid.org) started in 2008 and is funded by the EU under the seventh framework programme. The project is under cooperation with European projects **EU EGEE-II** and **GEANT-II**. The main goal of the project is to enhance the dissemination of electronic infrastructure of Baltic countries and Belarus and also to increase the support for the users of this infrastructure. The goal will be reached by expansion infrastructure of BalticGrid to Belarus to improve the interoperability of the region on the basis of gLite, UNICORE and ARC infrastructures.

BalticGrid-II is a part of the FP7 infrastructure projects "INFRA-2007-1-2-3 Grid-infrastructure of e-Science". The **United institute of Informatics Problems and** *the* **Research Division of**

Supported by the European Commission under the 7th Framework Programme for Research in the Information and Communication Technologies area (ICT)

Page - 15 -

Belarusian National Technical University are the Belarusian partners of FP7 BalticGrid project consortium. Three departments, responsible for Belarusian scientific networks BASNET are engaged in the project:

- Department of Scientific Networks Development;
- Department of the National Academy of Sciences Network Supply;
- Department of Telecommunications;

Moreover, the Department of Data Ware of Scientific Research is responsible for **scientific and educational librarian networks in Belarus**.

Participation of the United Institute of Informatics Problems in **BalticGrid-II** let the institute becoming the national member of trans-European association of research and educational networks TERENA. In 2008 the National Grid-Center was organized and equipped with computers and network resources at the United Institute of Informatics Problems.

Finally, the GRID infrastructure has been connected with the European GRID structure enhancing the collaboration potential between Belarus and the EU.

III. Electronic –health applications

The creation and development of **electronic health** (e-health) applications is a common ICT RTD priority for Belarus, according to the "e-Belarus" programme, and for the EU, according to the FP7 Work programme (Challenge 5: Towards sustainable and personal health care; Challenge 7: ICT for Independent living, Inclusion and Participatory governance).

Additionally the potential for collaboration in this area is highly significant since Belarus has a long history in e-health. Starting from 1999 bio and medical information systems were under development in several institutes of the National Academy of Sciences of Belarus, Belarusian State University and the universities and medical research institutions of the Ministry of Healthcare of Belarus.

The **soft-hardware and administrative system of the hospital** for collecting and processing the information for diagnostic and treatment was developed and implemented. The system covers all departments of a hospital allowing the creation of comprehensive information diagnostic environment for high-quality medical care for patients and day-to-day management of medical subdivisions, to solve the problems of remote control, observation, diagnostics and on-line exchange of medical information.

In the frame of cooperation with European institutions, the methods and infrastructure of **telemedicine** started to be realized in Belarusian healthcare. Telemedicine system of digital fluorography provides the services on tele-interpretation and tele-consultation of images of radiation diagnostics, the consultations about radiation diagnostics for medical recreation centres, the radiation diagnostics images interpretation and submission to avoid the trip of specialists to the place of examination. The system covers more than 25 medical institutions of Belarus, including:

- The State Hospital of the Ministry of Defence.
- The State Scientific-Practical Center "Cardiology".
- The Minsk Hospitals #6, #9, #10.
- The Minsk Emergency Hospital.

Several **biomedical** projects were developed under the funding of national and European foundations:

- "Information technology of childhood cancer diagnosis and treatment support" (ISTC).
- "Disclosing intrinsic relations between ultrasonic and histological images for improving thyroid cancer diagnosis after the Chernobyl Reactor Accident" (INTAS).
- "Global and Local Protein Matching" (INTAS).
- "Media content conversion for colour-blind user" (Central European Initiative).
- "Detecting Invisible Borders of Lungs Cancer Tumors" (Empire London College).

Starting from 1999 the Gomel Specialised Health Dispensary in cooperation with other scientific centres are involved into the developing a sophisticated system for tele-consultation and an improved pathological review system for thyroid cancer[19].

These systems (some of the most interesting among the Belarusian medical systems) deal with **histological images** to carry out an analysis of histological and cell structures of different tissues. The computer system for morphological diagnostics improves accuracy of diagnostics and compensates deficit of morphologist-specialist. The most interesting systems among the Belarusian histological image applications are the **"Bioscan-IW"**, **"Autoscan"**, **"Contour"** and **"Cytron"**. The main features of these systems are presented in the table overleaf[20]:

Feature / System	Bioscan-IW	AutoScan	Contour	Cytron
Number of measure parameters	111	40	20	80
Advance measure statistic	Excel-like	Special Report	Special report	Special Report
Specialized scripts	yes	no	no	no
Expert analysis	no	no	Thyroid carcinoma	Basic oncology properties
Advance image processing	yes	no	no	Lite
Video input	VFW, Twain, Matrox.IEEE-1394, BitFlow	VFW, Twain	Twain	VFW, Twain

Table 4. Main functional properties of the computer systems of histology image analysis

Several Belarusian research Teams are working in the field of histology automation. The main players in this area are: the United Institute of Informatics and Problems of the National Academy of Science of Belarus (UIIP-NASB), the Belarusian State Medical University and the Belarusian State University (BSU). These organisations have not only developed computer systems for histology investigation but they also have many achievements in the fields of cell extraction, tissue separation, morphomery automation, histology expert system and teleconsultation.

Moreover, along with the institutions of **the National Academy of Sciences of Belarus** many clinics and hospitals of Belarus took part in the development of medical information systems. The projects with foreign investments are being developed by the **Belarusian State Research Center for Pediatric Oncology and Hematology** and other research centers of the Ministry of Healthcare of Belarus.

IV. *Micro/Nano- electronics and Photonics*

"Micro/ Nano-electronics" is an emerging technology that plays a vital role in the development of the new generations of the information and telecommunication systems. Government of Belarus is paying a strong attention to the micro/nano- development and it has approved the state competitive programme of scientific research "Electronics" and "Photonics" for 2006-2010[21]. The program mainly aims in the development of opto-, micro-, nanoelectronics, electronics of microwave range, micro-sensors, new generation information-measuring systems, competitive radio electronic devices and inspection technology.

The collaboration opportunities at this area are significant high since the development of **micro/nano- electronics** is a common priority for both Belarus and the EU. Nanotechnology and Microelectronics is a priority on "e-Belarus" programme and the "National strategy for sustainable development for the period to 2010". The same field is an EU RTD priority according to the FP7 ICT work programme (Challenge 3: components system engineering).

V. *Space and geo-information technologies*

---

[19] Final Report: Monitoring of Russia and Ukraine (priority 1) and Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan and Moldova (priority 2):Telecommunications and the Information Society http://www.internews.fr/IMG/pdf/political-intelligence_final_published_report.pdf

[20] Nedzved A, Belotserkovsky A, Ablameyko S (2005) Computer systems of histology image analysis in Belarus; http://www.advms.pl/roczniki_2005_supl_2/volumes/09_Nedzved.pdf

[21] http://www.government.by/en/eng_solution201.html

Belarus has a long tradition in Space/Space related technologies and is one of the few countries whose specialists have been involved in the construction of space stations.

The space programs in Belarus started in 1999 when the first Belarusian-Russian program **"Cosmos-BR"** was initiated. Five years later, in 2004, the second program **"COSMOS-SG"** - "The development and implementation of perspective Space facilities and technologies in the best interests of Belarusian-Russian Union State economy and technology" was started. The elements for integrated system to provide the consumers of the Union State with the space information were created. New technological and instrument bases with extended operation resource for new generation of remote sensing data micro-satellites were developed. The elements of land segments for navigation-information systems with advanced accuracy were created.

Another goal of the program was the creation of the **Center of Space Information Reception**. The Center is connected through the fiber optic network with the stations of Ministry of Forestry, Hydro-meteo offices and other consumers. Distributed archive of space data was created, the technology of space pictures deciphering was developed for monitoring the gas and oil pipelines and diagnosis of agriculture areas. The results of the Program provide: on-line observation of terrain to control ecology, forest fires, rivers flooding, extreme situations of natural and industrial genesis, and also to create the cadastre of natural resources.

Additionally the space program "**COSMOS-NT**" "The development of basic elements and technologies for the creation and implementation of onboard and land based facilities of multi-functional Space system" for 2008-2011 has been approved. The main idea of the program is the development of advanced Space technologies and creation of pilot samples of onboard and land-based Space facilities. Moreover, some other tasks of the Program are the development of advanced technologies of remote sensing of Earth information processing; the creation of new pilot samples of land based devices for reception, processing and distribution of Space information; the creation of pilot sample of micro-satellite platform and pilot sample of micro-satellite, the development of design documentation, creation and debugging the technologies and experimental facilities of processing and situation display of information received from Space equipment and land based facilities taking into account coordinate and time binding.

The state customers of the programs are Russian Federal Space-Aero Agency and National Academy of Sciences of Belarus. The leading organization for execution of the Program from Russian side is the State Space Scientific-Production Centre name after M.Hrounichev.

The National Space Program in Belarus was approved by the Government for the period 2008-2012. In the frame of this program, the **Belarusian Space System of High Resolution Remote Sensing of Earth** will be created along with the development of advanced geospatial technologies. The results will be used in the interests of Belarusian economy, government, enterprises and citizens of Belarus. The main tasks of the Program are:

- Scientific research for creation of basic elements and prospective technologies of space-system engineering;
- Creation of space apparatus for different application;
- Creation of land-based infrastructure for space information reception, processing, dissemination and also for space satellites control;
- Development of geospatial information technologies to be used in many social and economy spheres like agriculture, forest industry, water resources, city and land cadastre, navigation.

Finally, the satellite **flight control center** is under development in Belarus to control the flight **of Belarusian satellite** to be launched in 2010. The Center will be located in the building of United Institute of Informatics Problems and connected through the fiber optic network with the stations of Ministry of Forestry, Hydro-meteo offices and other consumers

Thus, Belarus is a prospective partner for those EU RTD organisations and institutions which are interested in space/space related technologies.

A detailed analysis of the profiles of the Belarusian key actors specialized in the above ICT sectors is performed in Annex 1.

Supported by the European Commission under the 7th Framework Programme for Research in the Information and Communication Technologies area (ICT)

Page - 18 -

2.2 Collaboration potential at business level

Belarus' competitive strength in software and IT services is based on a tradition of multi-generational IT skills. According to official data in 2008 there were approximately 650 private companies providing software development as one of their main activities. Most of these companies are mainly specialised in:

- *Bank Office Applications*: applications for corporate Finance and Enterprise Resource Planning
- *Electronic Commerce*: applications of Web Services Development software, Internet security and Electronic Marketplaces
- *Front Office Applications*: Customer Relation Ship Management (CRM) and Supply Management solutions
- *Internet and Electronic Workplaces*: Document system applications. Developments for customers in the spheres of knowledge Management and Office systems.
- *Networking and Communications*: Applications for Wireless technologies, WAN and LAN Technologies
- *Software infrastructure*: Development of Database Management systems applications.

Belarusian IT companies are committed to providing high quality services and solutions and seek to comply with the latest international standards. For example in October 2003, the two largest Belarusian enterprises, IBA Group and EPAM systems, were the first in Europe achieve the SEI CMMI (Software Engineering Institute's Capability Maturity Model Integration) Level 4 Rating. Later in December 2008, IBA became the first IT company in Belarus to certify its labour safety management system for the production of IBA PCs, servers and information and payment terminals as well as for maintenance and support of hardware and banking systems to the international standards OHSAS 18001[22]. According to Gartner estimations, Belarus enters in 13 of "the Fast-growing countries" for IT Outsourcing and in the near future has great chance to pass in group of "Leaders and competitors".

2.2.1 ICT outsourcing market

According to the "Central and Eastern Europe IT outsourcing review (2008)"[23] The Belarus state promotes IT outsourcing services with a variety of incentives to IT and IT outsourcing industries. The market consolidation is very strong relative to other Eastern European countries.

Graduates from IT institutes are employed either in private companies or in 93 scientific-industrial centres, as well as research and design institutes of the radio and electronic industries such as: the Research Institute of Electronic Computers (development of computer systems and networks); the Minsk Industrial Amalgamation of Electronic Computers (production of personal computers, servers, communication means); and the Scientific Industrial Amalgamation "INTEGRAL" (producing about 60% of world demand in integrated circuits for timepieces). It is estimated that more than **100,000** qualified specialists are working in the ICT domain[24].

Belarus has very stable positions in hardware design. A tradition of Engineering (Belarus was the innovation, technology and engineering hub of the former Soviet Union) and high-level, technology oriented educational provisions are other advantages of outsourcing to Belarus. The advantages of outsourcing in Belarus are summarized in the table below[25].

Technical Excellence and Profound Education	More than forty years of scientific research in high-tech sphere created a strong basis for excessive ICT human capital and a well-established system of education and training in this field. Belarus was the high-tech zone of the Soviet Union, where technology was used to design products for both civil and military application. Local software engineers are greatly appreciated in the world, demonstrating highly qualification and experience levels incomparably.

---

[22] http://www.development.by/it

[23] Central and Eastern Europe IT outsourcing review 2008. Available at http://itonews.eu/en/central-eastern-europe-it-outsourcing-review/review-2008/cee-it-outsourcing-review-2008/index.html

[24] "Towards a Knowledge-based Economy - Belarus. Country Readiness Assessment Report (2002)" http://www.unece.org/operact/enterp/documents/coverpagbelarus.pdf

[25] http://www.eleganceit.com/en/company/belarus

Supported by the European Commission under the 7th Framework Programme for Research in the Information and Communication Technologies area (ICT)

Page - 19 -

Competitive Rates	One of the main advantages of outsourcing to Belarus is reasonable project costs.
Convenient Location	Belarus is located in the geographical centre of Europe and it takes only about 2 hours by air to reach Minsk from many EU cities.
Cultural Proximity	Belarus is culturally close to European civilization. Belarusian companies adhere to the same standards and business ethics.
Time Difference	Time difference with Europe is only 1-2 hours.
Governmental Support	The Belarusian government supports the companies, operating in the sphere of IT. One of the first steps was the practical implementation of "Electronic Belarus 2001-2010" program, which is intended to speed up the development of infrastructure and IT-sector in governmental organizations. One of the main goals of nowadays is future development of national "High Tech Park", integrating developed infrastructure, tax and customs exemptions and benefits. Thus, "High Tech Park" is aimed to become a business-incubator for the IT companies, stimulating further development on this sphere, but also already to spread the areas to other complementary activities.

Table 5. Advantages of outsourcing in Belarus

Additionally, Belarus is a favourable ICT outsourcing destination since local companies posses strong expertise in vertical market solutions. Moreover, the key specialists have a high level of English knowledge as well as great experience and reliability in intensive projects with western companies. These aspects promote fruitful cooperation with western customers, and help Belarus' service providers to build good levels of business trust with their clients. Thus, Belarusian IT companies are often selected as the general contractors in complex migration projects, including not only software development, implementation and support, but also various IT consulting services and system re-engineering[26].

2.2.2   Previous collaboration

Based on "National ICT Sector and Policy Appraisal Report- Belarus"[27], amongst the customers of Belarus' software development companies are global leaders in telecommunication and computer technology sphere: Alcatel, IBM, British Telecom, Microsoft, SAP, Siemens, Sun Microsystems and Xerox. There are also other international corporations and institutions that order IT support and development services from Belarusian companies: Coca-Cola, Ford, Goodyear, Honda, Johnson & Johnson, London Stock Exchange, Procter & Gamble and World Health Organization. In particular, Belarus is proud to be provide software development services to the Russian giants: "Gazprom", the manufacturer of the telecommunication equipment "IskraUralTel", oil company "Rosneft", metallurgical industrial complex "Severstal", aircraft association "Tupolev", telecommunication company "Vympelcom" and other companies well-known in Russia and worldwide.

The establishments of the Hi-Tech Park and changes to legislation have been welcomed by the heads of Belarus' software development companies. These developments have been also noticed by various organisations abroad. In 2008, many foreign investors expressed interest to co-operate with Belarus in various technology fields and to invest considerable sums in the country's economy. The most serious interest has come from the Russian Open Joint-Stock Society AFK "System" owned by the Russian billionaire Vladimir Yevtushenkov. In May 2008, this corporation declared its intent to invest between $300m to $1bn in various projects in Belarus such as microelectronics production and telecommunications system development. Futhermore, Telekom Austria Company has already entered the Belarus market and France Telecom has shown interest in following suit.

Examples of Belarus' ICT companies with business activities and partners in Europe are provides below:

- **EPAM Systems** is a leading software engineering outsourcing services provider in Central and Eastern Europe. EPAM maintains North American headquarters in Newtown, PA, and European headquarters in Budapest, Hungary, as well as support and delivery operations in UK, Sweden,

---

[26] "Belarus. IT-outsourcing Marketplace and leading companies", http://www.scnsoft.com/docs/IT_outsourcing-Belarus_marketplace_20051005.pdf

[27] "National ICT Sector and Policy Appraisal Report- Belarus" (October 2009). Prepared under the SCUBE-ICT project.

SCUBE●ICT   *Supported by the European Commission under the 7th Framework Programme for Research in the Information and Communication Technologies area (ICT)*

Page - 20 -

and Germany. EPAM software development centres are located in Russia, Hungary, Belarus, and Ukraine.

- **ScienceSoft Inc** is one of the most mature IT outsourcing service providers in Eastern Europe. During 20 years its custom software development centre has successfully completed more than 200 large projects (with some of them taking more than 100 man-years). Today 40% of Fortune 500 companies use software developed by ScienceSoft Inc.

- **Itransition** is a software development company that creates cost-effective custom solutions based on technical expertise of about 600 software developers in staff. Itransition provides offshore software development, custom software design and outsourcing application development, as well as software solution customization and support. It has representative offices in USA (Texas), UK, and Netherlands.

- **EffectiveSoft** is a custom software development firm located in Minsk, Belarus. It offers full cycle custom software programming services, from product idea, offshore software development to outsourcing support and enhancement.

- **BelHard Group** is one of the leading IT holdings in Belarus, and BelHard Outsourcing is its software development division. Started in 1994, it has successfully completed more than 500 projects and has a substantial number of corporate customers.

- **IBA Group** is the largest IT service provider in Eastern Europe performing onshore, near-shore and offshore projects with 2500 professionals. Headquartered in Prague, Czech Republic, IBA Group has offices in US, Germany, Bulgaria, Cyprus and Russia, and software development centres in Belarus and Czech Republic.

- **NTLab** is a system-on-chip design and fabless microelectronic company. NTLab's is able to design digital, analogue, mixed-signal and RF microelectronic circuits. The company works in many fields of radioelectronics: GPS/GLONASS/Galileo satellite navigation, digital TV, and RF ID systems.

- **Generation P Consulting Ltd** develops custom software solutions for the travel and hospitality businesses: travel technology companies, service providers, consolidators, tour operators, travel agencies and other industry players. It maintains a development centre in Minsk, Belarus, and a sales office in Munich, Germany serving clients throughout the EU, CIS and North America.

2.2.3   Prominent collaboration areas

Along with state ICT organizations numerous private ICT companies actively work in the area as developers of software applications mainly for foreign customers. Their efforts are based on the highly equipped IT workforce that is available in the country.

According to official data, in 2008, there were around 650 Belarusian private companies specifying software development as one of their business activities. The majority of Belarus' IT service providers (96.6%) utilize the model for software development on a customer's request while only a few companies are working on ready-made products. More than 75% of the companies provide services for application development and installation ordered by the customers. Solution developments are the business of more than 72 % of service providers.

The activities of the majority of the Belarusian IT companies are focused on: Bank Office applications; Electronic Commerce Applications; Front Office Application Software; Internet and Electronic Workplace Software, Networking and Communication Software; Software Infrastructure and Enterprise Application Integration.

Some examples of ICT outsourcing companies in Belarus are given in Annex A.

Supported by the European Commission under the 7th Framework Programme for Research in the Information and Communication Technologies area (ICT)

Page - 21 -

3.   Conclusions

Belarus is going through a phase of development and economy transformation where IT sector becomes one of the fastest growing sectors of the economy. Belarus now gives attention to: the enhancement of the national information and telecommunications infrastructure; the improvement of ICT and Internet uptake in the education system; increasing opportunities for distance learning; and strengthening of the supporting legislative foundation. The state objective is to ensure economic policy which promotes development across the scientific, innovation, educational, investment and social spheres. Moreover, in 2003 Belarus has adopted a national strategy (e-Belarus) for the development of the information society and e-government.

The country's strength in ICT sector is rooted in its mature technical infrastructure and reputable educational system inherited from Soviet times when Belarus used to manufacture over 50 percent of the computers and computer components in the former USSR. Belarus has well established higher educational institutions sufficient to train qualified IT scientists.

Additionally, the ICT sector in Belarus is strongly supported through the High Technologies Park, which was created in order to boost the competitive power of the national new and high technology-based sectors, developing modern technologies and expanding their exports, as well as attracting to the sector both Belarusian and foreign technologies. It was intended to become a Belarusian "Silicon valley" starting from strengthening the position of the IT sphere, boosting exports of software and advance the e-society development in Belarus. Recently, the Park's activity is planned to be extended to other perspective modern industries: biotechnologies, nanotechnologies, green integrated technologies, etc.

At **RTD level**, Belarus provides many collaboration potentials with EU ICT actors mainly due its well established educational system, the availability of a large pool of highly qualified human resource and the existence of considerable technical ICT infrastructures which are established in many Universities. Additionally there are many common ICT priorities between Belarus and the EU. A potential channel of co-operation between Belarusian and the EU at RTD level is the EU funded programmes such as the ICT Programme of the Seventh Framework Programme. The most prominent ICT areas of collaboration between Belarusian and EU actors are:

- **Supercomputing**: During the past 10 years Belarus has became a major player in supercomputers. For example the "SKIF" clusters are the key elements in several Russian-Belarusian Union State Programme such as "SKIF", "COSMOS-SG", "TRIADA" and "SKIF-GRID".

- **Grid technologies and Infrastructure**: The long tradition of Belarusian universities in High Performance Parallel Architecture Computers has boosted the creation of **GRID-infrastructures**, which have been connected the European GRID structure, enhancing the collaboration opportunities between the Belarusian and EU RTD organisations and institutions.

- **e-health applications**: Belarus has a long history in electronic health and the most remarkable ICT medical systems developed by the Belarusian ICT organisations are those for histological images analysis. These systems meet the international specifications and are already used in medical organisations in Belarus. Moreover, several Belarusian Hospitals are established with electronic systems for collecting, monitoring and processing all the necessary information about the patients.

- **Micro/nano- electronics**: Belarus is consider to be a strong player in micro/nanoelectronics. Moreover, the Belarusian government is paying a strong attention to the micro/nano-development and it has approved the state competitive programme of scientific research "Electronics" and "Photonics" for 2006-2010.

- **Space/Space related technologies**: Belarus is one of the few countries whose specialists have been involved in the construction of space stations. The development of space and geo-information systems are strongly supported form the Belarusian government through the adoption of various programmes such as the **National Space Programme** (2008-2012).

At **business level**, Belarus possesses a significant potential in the information technologies export, especially in the field of software development and ICT **outsourcing**. Outsourcing in Belarus has major advantages since, more than forty years of scientific research and tradition in high-tech sphere has created a strong basis for excessive ICT human capital as well as a well-established system of education and training in this field. Belarusian IT companies are committed to providing high qualified services and solutions and seek to comply with the latest international standards.

Belarus used to be the high tech zone of the Soviet Union, where technology was used to design products for both civil and military applications. The country's reputation for scientific and IT excellence is currently complemented by the competitive labour market that has attracted the interest of numerous IT-intensive companies. Consequently, outsourcing in Belarus has the advantages of

Supported by the European Commission under the 7th Framework Programme for Research in the Information and Communication Technologies area (ICT)

Page - 22 -

reasonable project costs. Moreover, Belarus is located in the centre of Europe, within 2 hour flights from the main European cities and a small time difference with the Western Europe. Additionally the Belarusian government is interested in growing IT exports and thus some radical regulatory measures have already been taken that create a highly favourable climate for IT businesses in the country.

The main activities of the majority of the Belarusian IT companies are focused on:

- Bank Office applications;
- Electronic Commerce Applications;
- Front Office Application Software;
- Internet and Electronic Workplace Software, Networking and Communication Software;
- Software Infrastructure and Enterprise Application Integration.

The additional competitive advantages of Belarus' ICT outsourcing companies are their strong expertise in vertical markets solutions as well as their experience and reliability in intensive projects with western companies. These features positively influence fruitful collaboration with western customers and helps Belarusian service providers to build good level of business trust. Thus Belarus' companies are often selected as the general contractors in several projects including not only software development, implementation and support, but also various IT consulting services and system re-engineering.

Annex A: Mapping of Belarusian ICT actors

A.1 ICT RTD organisations

The high level of expertise as well as the ICT R&D infrastructure of Belarusian organisations is highlighted below. The list of organisations is indicative, based on a preliminary analysis performed under SCUBE-ICT partners.

A.1.1 Supercomputing (High-Performance Parallel-Architecture Computers)

United Institute of Informatics Problems of the National Academy of Sciences of Belarus (UIIP- NASB)

http://uiip.bas-net.by

The **United Institute of Informatics Problems of the National Academy of Sciences of Belarus-UIIP NASB** is the leading Belarusian institution for carrying out fundamental and applied research in the fields of information technology, computer science, applied mathematics, computer aided design and some other attached fields in Belarus. The UIIP NASB is a coordinator and principal executor of three Russian-Belarusian joint **supercomputer programs**:

- SKIF (Development and creation of supercomputer family SKIF, 2000-2004);
- TRIADA (Development of applications based on SKIF supercomputers, 2005-2008) and
- SKIF-Grid (Development of Grid technologies and new generation SKIF supercomputers, 2007-2010). The program SKIF result is clusters with performance from hundred GFlops till several Tflops. The clusters were used both for software debugging and for the computations in the projects for Russian and Belarusian scientific centres and enterprises.

The main scientific and technical directions of institute activity are:

- Supercomputer systems architecture analysis;
- Supercomputer systems configuration and performance range analysis;
- Supercomputer systems network hardware and topology analysis;
- Technical requirements for supercomputer components creation development;
- Concept of supercomputer configurations creation and application development.

The UIIP NASB has commercial version of LS-DYNA for high speed non-linear dynamic processes modelling, commercial version of STAR-CD for hydro and gas- dynamic processes modelling, academic license of Fluent 6.2 for hydro and gas- dynamic processes modelling and the licensed packages Pro/E, SolidEdge, Inventor 9 for creation of computer 3D models of the objects and systems.

The institute supports scientific and technical cooperation with about 20 enterprises, universities and institutes of Academy of Sciences from Belarus and Russia to form the virtual pool of developers of supercomputer systems.

Computer Research Institute "NIIEVM"

http://www.niievm.by

The **Computer Research Institute** (CRI) "NIIEVM" (is the leading hardware and software developer in Belarus. It is also a central Internet administrator for Ministry of Industry of Belarus. CRI "NIIEVM" is engaged in computer research activities more than 40 years.

The main activity directions of the Institute are:

- supercomputers;
- personal computers, including PC for operation in severe environment, secure, portable; mainframe computers of special and general purpose, including mobile computers with IBM S/390 architecture;
- local computer networks of various types, program-technical means and teleprocessing systems;

Supported by the European Commission under the 7th Framework Programme
for Research in the Information and Communication Technologies area (ICT)

Page - 24 -

computer software;

- task-level system on the basis of computer engineering;
- job-dedicated machinery;
- automated checkpoints for underground, assisted tokens, magnetic cards and noncontact cards;
- hybrid integrated circuit and MCM;
- power supply systems, including uninterruptible;
- systems and devices providing information security;
- Internet technologies; equipment testing (climatic, mechanical, computer security).

Moreover "NIIEVM" offers computers and supercomputers of any architecture (compatible with Intel, IBM, AS/400, RS6000, S/390) and various customized computer equipment, software systems and services for any application area.

"NIIEVM" is involved in the SKIF K-500 and SKIF K-1000 clusters for the government supercomputer SKIF Program of Russia and Belarus. "NIIEVM" developed specialized racks and assembled SKIF K-500 and SKIF K-1000 clusters on customer site in Minsk.

A.1.2 GRID-technologies and infrastructure

United Institute of Informatics Problems of the National Academy of Sciences of Belarus (UIIP- NASB)

http://uiip.bas-net.by

The **United Institute of Informatics Problems of the National Academy of Sciences of Belarus** (**UIIP- NASB**) is the leading Belarusian institution for carrying out fundamental and applied research in the fields of information technology, computer science, applied mathematics, computer aided design and some other attached fields. The UIIP employs over 400 persons including 264 research workers: 2 Corresponding member of Belarusian Academy of Sciences, 17 scientists with DSc degree and 69 - with PhD degree. The UIIP priority research directions are: Computer aided design (CAD/CAM/CAE); Processing and recognition of signals, images and speech; Operation research and discrete optimization; Decision making in extreme situation; Bio and medical informatics, ergonomics; Geoinformation systems; Computer networks and telematics; Input-output of video information; Information security; Supercomputers, **Grid and applications**.

In 2003 the UIIP NASB) on behalf of URICON started to report to Trans-European Association of Scientific Educational Networks (TERENA) as a National Research Educational Network (NREN) of the Republic of Belarus.

A.1.3 Electronic –health applications

The Laboratory of Image Processing and Recognition-United Institute of Informatics Problems of the National Academy of Sciences of Belarus

http://uiip.bas-net.by/eng/lab_ipr.html

The **Laboratory of Image Processing and Recognition - LIPR** is a basic laboratory of the UIIP in the field of image processing and pattern recognition. The LIPR main scientific direction is the development of methods and systems for image processing and pattern recognition. The main achievements of LIPR in histology image analysis are the systems **"Contour"** and **"Cytron"**.

- The system **"Contour"** is an expert system for thyroid carcinoma diagnosis based on a set of karyometric parameters of follicular cells and developed computer analyzed of color images. Main tasks of automated color images processing and binarization by applying of several developed

Supported by the European Commission under the 7th Framework Programme for Research in the Information and Communication Technologies area (ICT)

Page - 25 -

segmentation algorithms, automatic raster-to-vector transformation and biological objects formation, morphometric assessment of biological objects by quantitative parameters characterizing the changes of cell nuclei and diagnostic rules formulating with further diagnosis of thyroid cancer were done. "Contour" was developed in collaboration with the Clinical Institute of Radiation Medicine and Endocrinology.

- The system "**Cytron**" is a morphological application of diseases diagnostic of human organs morphometrical investigations of tissue, cells and cell's accumulation in human organs. On the base of form, size, color and morphologic structure of tissue and cells, the algorithms of cell segmentation and cell morphology structure extraction from histological images identify histology patterns. The system consist of software packages of image processing including filtering, binarization, segmentation, contouring, extraction and morphometric estimation of objects based on geometrical and densitometry features. The software of diagnostic approaches allow to detect indication of pathology in human organs and lesion degree or to confirm the absence of diseases automatically based on analysis of some sets of morphometric features through a database. Unique algorithms of tissue analysis allow to define more exactly diagnose by morphometry investigation on different optical magnification. The software package could be used for estimation of changes of cell morphological structures of different extent of lesion.

Laboratory of Bioinformatics - United Institute of Informatics Problems of the National Academy of Sciences of Belarus

http://uiip.bas-net.by/eng/lab_b.html

The **Laboratory of Bioinformatics** of the **United Institute of Informatics Problems** specializes on the development of medical information systems. Some of the main achievements of the laboratory regarding e-health applications are:

1. Hybrid neuro-genetic fuzzy model for classification of patients according to risk groups, which provides the generation of several subsets of compact and interpretable classification rules. Distinctive model features are the number of methods and algorithms: clustering method for initial rule set construction; method of model structure initialization using the procedure of rule base expansion in response to each new data objects entry; method of adaptive learning of membership functions parameters of hybrid model; method of rule length optimization. Model is implemented as software "HYBRID", which is applied in Belarusian Research Center for Pediatric Oncology & Hematology, Ministry of Health of Belarus.

2. Method of genetic clustering for classification rule extraction from neural network structure, which provides the improvements of classification results in case of overlapping clusters. Software implementation for the method is integrated in medical-oriented software «ProAPF» for use in childhood leucosology.

3. Complex of special methods and algorithms: data preprocessing as a result of discretization of continuous features and selection most informative prognostic factors on the basis of entropy and chi-square criteria; neural network training algorithm on the basis of Gauss-Zeidel method; interactive decision tree algorithm, etc. These methods and algorithms along with other known statistical and neural network methods (in all 16 methods and algorithms) constitute the basis of four-step information technology for oncohaematology data analysis and intend for data preprocessing, patient classification and prediction of inductive therapy of acute leucosis outcome. Developed methods and algorithms are embedded into software «ProAPF» and applied in Belarusian Research Center for Pediatric Oncology & Hematology, Ministry of Health of Belarus.

The **United Institute of Informatics Problems** also has the Laboratory of Information Analysis System specializing on the creation **of medical information systems**. The medical systems, applications and complexes which are developed in the laboratory have already installed in the majority of Minsk hospitals. Currently the laboratory installs the equipment and software in Minsk clinics after the financial support of Switzerland Entrydell S.A. Joint-Stock Company.

Supported by the European Commission under the 7th Framework Programme for Research in the Information and Communication Technologies area (ICT)

Page - 26 -

The Faculty of Applied Mathematics and Computer Science - Belarusian State University

http://www.fpmi.bsu.by - *http://www.bsu.by*

Belarusian State University (BSU) is the major Belarusian University. It has 15 Schools (Faculties) with 148 Departments, 5 R&D institutes, 24 Research Centres, 114 R&D laboratories. The University employs over 2,400 academic staff and 1,100 research associates; about 2,000 of these hold Ph.D. or Sc.D. degrees.

The main achievement of the university in histology images analysis is the system "**Autoscan**". The system consists of visual and threshold allocation of objects in a picture, qualifying editing of objects, splitting of objects into arbitrarily adjusted classes, 40 measured characteristics of objects, arbitrarily formed reports (tables, histograms). The systems have specialized part of calculation of statistical information over the all characteristics, report generation (tables, histograms). This features permit to solve some task of histology such as geometric cells measurement, cells counting.

Laboratory of Information and Computer Technologies- Belarusian State Medical University

http://www.bsmu.by

The **Belarusian State Medical University-BSMU** () is a leading higher medical education provider in the Republic of Belarus. The University has a strong international reputation across a wide range of disciplines.

The "**Bioscan**" image analysis system has been developed in the **Laboratory of Information and Computer Technologies** of the University. The system "**Bioscan-IW**" (http://itbal.anitex.by/bioscan) has powerful software for image processing and measuring. The system is successfully used for diagnosis in clinical oncology and pathology anatomy, for analysis of cell evolution, for investigation to influence of new pharmacology medication, for fixation to control points in neurosurgery.

"Bioscan-IW" incorporates graphic editing tools and functions that work with a wide variety of image types including 16-bit, 32-bit and 64-bit (complex) images. A multiple window interface allows for simultaneous display of static and live images, charts, and measurements for the rapid creation of custom applications and development of new imaging techniques. Automatic and interactive measurement functions support more than 100 built-in and user-defined geometrical, optical and topological parameters.

The Faculty of Radio Physics & Electronics - Belarusian State University

http://www.rfe.bsu.by - *http://www.bsu.by*

The Faculty of Radio Physics and Electronics of BSU, develops electronic applications for medical purposes such as the "**Mobile E-health Sensor for Non-invasive Multi Parameter Diagnostics of Blood Biochemistry**". This method, for non-invasive monitoring of human blood biochemistry, is based on spatially localized optical diffuse scattering spectroscopy and metabolic heat measurements has been developed. Several versions of compact apparatus integrated spatially localized fiber optical sensors complemented by thermal sensors for different applications have been developed. At the moment these equipments are used to develop a mobile e-health sensor of blood biochemistry.

The Faculty also develops non invasive multi parameter sensor which is used as a prototype of point-of-care diagnostic devices for cardiologic, tumour and diabetic patients. Integrated platform for data acquisition, data processing and communication to remote networks is being developed on pocket PC. Clinical testing of developed sensors is now in progress. Calibration functions generated for different patient groups (healthy, cardiologic, pathological, diabetic patients, new born childes, elder peoples etc) classified into clusters for both individual variables and their composites and generated for each group. By comparing the values from the noninvasive measurement with the standard invasive reference methods from the same patient, the analytical functions for each patient are obtained. Clinical changes in patient's metabolism are also affect the values used to classify patients into clusters.

Big part of these investigations/developments is going in cooperation with several German research institutions.

Supported by the European Commission under the 7th Framework Programme for Research in the Information and Communication Technologies area (ICT)

Page - 27 -

A.1.4 Micro/Nano- electronics and Photonics

Research & Design Centre "Belmicrosystems"

http://www.bms.by

"**Belmicrosystems**" Reseach & Design Center is a subsidary of the "Integral" Research & Production Corporation. Almost all ICs produced by the Corporation as well as semiconductor devices and technologies for their manufacturing have been designed at the Belmicrosystems possessing both advanced design methods and up-to-date technological processes.

It's one of the biggest design centers in Eastern Europe with over 30 year experience in designing integrated microcircuits and semiconductor devices. It uses a broad spectrum of technological processes based on CMOS, Bipolar, BiCMOS, DMOS, BCDMOS and IGBT technique. The staff consists of 600 specialists, including 12 doctors on science, 290 design engineers and process design engineers. Highly qualified personnel, up-to-date equipment and software allow the creation of the most complicated products within a short period of time. The availability of the modern design center equipped with powerful work stations with software by the Mentor Graphics and Cadence companies for IC designing, and that by the Silvaco company for technological designing, as well as program packages of own design allow to perform designing of custom integrated circuits within short time. Development capacity: 80-90 new IC's projects of various applications are designed and put into production yearly.

Laboratory of "Physics of micro- and nano-electronic devices" of the Belarusian State University of Informatics and Radioelectronics

http://nanodev.bsuir.by/about.html

The laboratory of Physics of micro- and nano-electronic devices, NANODEV is located at the Microelectronics Department of the Belarusian State University of Informatics and Radioelectronics. The main research area of the Lab concerned theoretical investigations and simulation of various modern nanoelectronic devices such as resonant-tunneling structures, single- electron transistors, devices based on quantum interference and their combinations. Practically cooperative work of the laboratory is being implemented in nanoelectronic device simulator "NANODEV" .

The Simulation system "NANODEV" contains three interdependent subsystems, which are oriented for simulation three types of promising nanoelectronic devices, namely: simulator for single-electron devices "SET-NANODEV" (subsystem 1), simulation subsystem for resonant-tunneling structures "RTS-NANODEV" (subsystem 2) and quantum interference, quantum wires based devices "QW-NANODEV" (subsystem3).

Laboratory for Nano-Optics, B. I. Stepanov Institute of Physics of the National Academy of Sciences of Belarus

http://ifanbel.bas-net.by

Laboratory for Nano-Optics deals with physics and technology of novel **nanostructures** for applications in **opto-electronics and information technologies**, incl., e.g. optical interconnects, optical and electro-optical switching and modulation, luminescent materials incl. those for white LED development and biomedical applications (in medical diagnostics), plasmonic structures for ultrasensitive molecular analysis as well as for solar cells improvements.

The laboratory's staff has strong background in the following fields:

- Ultrafast semiconductor optical switches for 1.5 micrometer range
- White luminophores compatible with LEDs to improve performance of currently existing white LEDs
- Plasmonic nanostructures structures for ultrasensitive analysis (e.g. in medical diagnostics)
- Plasmonic nanostructures and anti-reflecting coatings for thin film solar cells
- Novel photonic components based on nanostructures, e.g. metal-semiconductor-dielectric filters for CCD matrices.

The laboratory has also participated in the FP6 IST project "Nanophotonics to realise molecular-scale technologies" (PHOREMOST).

Supported by the European Commission under the 7th Framework Programme for Research in the Information and Communication Technologies area (ICT)

Page - 28 -

Laboratory of Quantum Optics, *B. I. Stepanov Institute of Physics of the National Academy of Sciences of Belarus*
http://master.basnet.by/lqo

The laboratory of Quantum Optics was in 1994 and currently employs 12 researchers. The staff of the laboratory specialized in experimental and theoretical investigations on

- Optical fiber systems for quantum key distribution;
- Physical random number generators;
- Nano-diamond devices and protocols for quantum information processing;
- Protocols and security proofs for quantum cryptography systems;
- Random number production and testing;
- Photonic band-gap structures with single emitting centers;
- Entanglement-based quantum information processing.

At the moment the laboratory takes part in a number of local state scientific projects concerning:

- detection of noise signals and operation of stochastic processes in bistable lasers;
- optical methods of controlling spin states of single impurity colour centres;
- creation of hybrid daylight system using solar tubes and LED;
- investigation of colour centres properties located nearby nanostructured diamond surfaces for solid state quantum computers and single photon sources;
- quantum correlation complex system of various dimension;
- methods and algorithms of generation of random number sequence in space-separated points using quantum cryptography technology.

It is worth mentioning that **Quantum Information technologies** are considered as an area of Future and Emerging Technologies (FET) within FP6 and FP7, and this laboratory is actively working within this area with very high level results. They are participating in the IST FP6 FET project EQUIND - "Engineered Quantum Information in Nanostructured Diamond".

A.1.5 Space and geo-information technologies

Overall, ***the United Institute of Informatics Problems of National Academy of Sciences of Belarus*** is the general managing organization of all Space programs from Belarusian side and it contains the following departments involved in the decision of space problems:

- The enterprise "Geoinformation systems"
- The Department of Space Information Technologies
- The Laboratory of Cartographical systems and Technologies

Besides them the UIIP is also the Belarusian NCP for space in FP7. Finally, starting from 2008 UIIP participates in the launched negotiations with the ESA regarding Belarus membership in this organization.

Last but not least, the ***State Enterprise "Peleng"***, ***Belarusian State University***, ***Institute of Physics of NASB***, ***Institute of Heat and Mass Transfer of NASB***, ***State Enterprise "CAMERTON"***, have also participated in the space programme of Belarus.

Supported by the European Commission under the 7th Framework Programme for Research in the Information and Communication Technologies area (ICT)

Page - 29 -

A.2 Outsourcing in Belarus and ICT private companies

Among the ICT companies working in Belarus' information technologies market, there are about 20 acting as the main market players, 6 of which are considered to be the leading companies[28]:

- International Business Alliance (IBA)
- EPAM Systems
- BelHard Group
- SaM Solutions
- ScienceSoft
- Belsoft

IBA and EPAM occupy the first two positions of the "Top 5 to Watch in Central and Eastern Europe" section of the "Offshore 100", a list of the world's leading IT and Business Processes Outsourcing (BPO) by consulting firm neoIT and monthly newsletter CMP's Managing Offshore.

The profiles of the ICT leading companies in Belarus are presented below.

International Business Alliance (IBA)

http://iba.by/index.html - *http://www.iba-it-group.com*

IBA Minsk is a part of IBA Group, one of the largest IT service providers in Central and Eastern Europe which employs about 1350 IT specialists. IBA Group has special expertise in mainframe software development, both system and applied, and in legacy systems migration. IBA Group activity covers all major directions in the field of information technologies:

- Development and implementation of integrated projects on end-to-end information technologies and system integration
- Development, production and supply of computer hardware and banking equipment
- Warranty and post-warranty support of information systems based on agreements with world IT leaders
- Full-cycle software development and support
- Training and consulting of customer personnel

Amongstthe customers of the company are IBM, SAP CIS, Chordiant, T-systems.

EPAM Systems

http://www.epam.com

EPAM systems is one of the leading software engineering and IT consulting providers with delivery centers throughout Central and Eastern Europe (CEE). In EPAM systems' office in Belarus are employed approximately 3700 IT specialists. The major products/solutions of the company are:

- EPAM INSURE™:
- Provider Information and Credentialing,
- Broker Portal,
- Self-Service Individual Portal,
- Individual Sales CRM;
- EPAM Content Management System;
- EPAM Project Management Center

Selected clients: SAP, BEA Systems, Microsoft, Oracle, Thomson Reuters, London Stock Exchange, Colgate-Palmolive, British Telecom, CareFirst BlueCross BlueShield, Lufthansa Systems, Renaissance Capital, Philips, Schlumberger.

---

[28] "Belarus IT-Outsourcing Marketplace and Leading Companies", http://www.scnsoft.com/docs/IT_outsourcing-Belarus_marketplace_20051005.pdf

Supported by the European Commission under the 7th Framework Programme for Research in the Information and Communication Technologies area (ICT)

Page - 30 -

BelHardGroup

http://soft.belhard.com

BelHard Group focuses on development and implementation of innovative information technologies and is a partner of over 20 companies abroad and 5,000 companies within its home country. Its main area of activity is development and delivery of software products, including MIS, PCS, CAD, web-site design, search optimization, information security products, training in use of hardware and software, English for IT, as well as business in the IT sector, IT consulting and business consulting, and other activities related to the IT sector.

The Major Products/Solutions of the company are: AIPSIN package, an IT tool against organised crime; Expert, an electronic inquiry system for legal acts of the Republic of Belarus; information security products.

The major partners of BelHard Group are HP (software, hardware); Kyriba (finance management software developer); Gerber Technology (light industry computer automation); InterSystems (DBMS, integration software), SolidWorks (Competence Center for CAD), Tadiran Telecom (telecommunications hardware).

SaM Solutions

http://www.sam-solutions.net

SaM Solutions has its offices in the USA, Eastern and Western Europe. The main development centre is located in Minsk. The SaM Solutions brand brings in a highly qualified team of over than 500 IT specialists. The company's specialists gained large experience in development and use of the up-to-date platforms and development tools; they have also acquired knowledge in various business domains, such as eCommerce, Banking & Finance, Insurance, Intellectual Property, Production & Transportation, Logistics, and Tourism.

SaM Solutions provides a full spectrum of software services, enabling its customers to view concepts on the strategic level and think about IT solutions/software applications in terms of business objectives:

- Business analysis, software requirements co-development
- Architecture and design of software applications
- Custom software application development
- Technology/data migration, porting of software
- Re-engineering of legacy software applications
- Support and maintenance of software applications
- Customization/localization services
- Software testing and quality assurance

The main partners of the company are Microsoft, IBM and SUN.

ScienceSoft

http://www.scnsoft.com

ScienceSoft Inc. is an outsourcing software development company. ScienceSoft provides solutions for a range of industries: Telecommunications, Financial Service and Banking, Healthcare, E-Commerce, Security, Engineering, Transportation and Retail. One of our unique services is developing science-intensive solutions, such as pattern recognition and analysis, decision support systems, real-time data processing, data base distribution and knowledge bases.

Belsoft

http://www.belsoft.com.au

BelSoft is a software company that provides expert information technology services to the corporate sector. Belsoft specialises in customised computer systems focusing on traditional and emerging software technologies. BelSoft-Borlas Group possesses expertise in developing effective solutions and software products for a wide array of industries, including the state owned sector.

Supported by the European Commission under the 7th Framework Programme for Research in the Information and Communication Technologies area (ICT)

Page - 31 -

Annex B: Websites of key ICT organisations

Name of organisation (in English)	Website
Private sector organisations and entrepreneurship promotion	
Associations	
Belarusian association of the industrial enterprises	www.belapp.by
Republican Public Association "Belarusian scientific industrial association"	www.bnpa.info
Union of legal bodies "Republican Confederation of Entrepreneurship"	http://belarusbusiness.by
Belarusian Banks Association	www.abbanks.by/
Belarusian Union of Entrepreneurs	http://bae.iatp.by/
Minsk Capital Association of Entrepreneurs and Employers	http://allminsk.biz/
Association "Belarusian branch telecommunication union"	http://tos-by.com
Republican public association "Information society"	http://info.minsk.by
ICT enterprises association "Belinfocom"	www.belinfocom.by
IT Enterprises Association	www.akit.niks.by
Scientific and Technological Association "Infopark"	www.infopark.by
Telecommunication and content service	
Velcom, FE	www.velcom.by
Mobile TeleSystems, jLtd	http://mts.by
Life:)	http://life.com.by
Diallog (BelCel)	http://diallog.by
BelPost (Public Enterprise)	www.belpost.by/
Beltelecom (Public Enterprise)	http://beltelecom.by
Belinfonet, Ltd	http://adsl.by
Alternative Digital Network (Atlant-Telecom), FE	http://telecom.by
Business Network, JE	http://sml.by , http://bn.by
Solo	http://solo.by
Network Systems, CJSC	http://nsys.by/
IP TelCom, Ltd	www.iptel.by/
Aichyna Plus, ALC	www.aplus.by
ISP Anitex	http://anitex.by/
Open Contact, Ltd	http://ok.by
Cosmos TV, jLtd	http://cosmostv.by
Minsk Television Information Networks (Public Interprise)	http://mtis.by
Mobilcom	http://mobilcom.by
SPN Media	http://spn.by
Streamline	http://streamline.333.by
Publishing House "Glyanets"	www.gl.by
Nikita Mobile, jLtd	www.nikita.by
Belarusian Television and Radio Company (Public Enterprise)	www.tvr.by
ONT [Nationwide Television] (Second National TV Channel, CJSC)	www.ont.by
CTV (Capital Television, CJSC)	www.ctv.by
8 Channel, CJSC	http://8channel.tv
Hardware and software, system integrators	
Altoros Development	www.altoros.com
Applied Systems	www.appsys.net
Avest	www.avest.by/
Belhard Group, CJSC	www.belhard.com
Belitsoft	http://belitsoft.com/

Name of organisation (in English)	Website
BelRosSvyaz'	www.telemiks.by
Belsoft, CJSC	http://belsoft.by/go
Belsoft-Borlas Group	www.belsoft-borlas.com/
BLRSoft	www.abaxia.com/
CLabs Ltd.	www.clabs.eu
Dana Networks	www.dananetworks.net
EffectiveSoft	www.effectivesoft.com/
Epam systems	www.epam.by
Erpbel	www.erpbel.by/
Exadel	www.exadel.com
Exigen Services	www.exigenservices.com
Exon IT	www.exonit.by/
FE Godel Technologies Europe	www.godeltech.com/
Foranks	www.foranx.by/
Game-Stream, CJSC	http://game-stream.org
Generation P	www.generation-p.com/
Horizont, JSC	http://horizont.by/
IBA, CJSC	http://iba.by
Intellectual Systems, CJSC	http://is.by/
IntexSoft (Intellectual Export Software)	www.intexsoft.by
Invention Machine	www.invention-machine.com/
Issoft Solution	http://issoft.by/
IT Park IBA	www.iba-it-group.com/
ITlect	http://itlect.com/
Itransition	www.itransition.com/
Lakshmi	www.autokroy.com
LeverX International	www.leverx.com/
Marco	www.marco.by/
Mikst	www.mikst.by/
Mobiletag	www.mobiletag.com
Nival Network	www.nival.com
Novacom Group	www.nvcm.net/
NTLab Systems	www.ntlab.com/
Numerical Methods	www.chisltech.com/
OnCleverSoft	www.oncleversoft.com/
Ozone Consulting	www.ozone-oo.com/
Pi-consult.by	www.pi-consult.by/
PM&S Software	www.pms-software.com/
Qulix Systems	www.qulix.com/
Real Soft	www.realsoft.com/
RelSoft	www.relsoft.by/
Republican Unitary Production Enterprise "Vityaz"	http://vityaz.by/
Sakrament	www.sakrament.com
Sam solutions	www.sam-solutions.by
Science and Technical Center "Atlas"	www.atlas.by
ScienceSoft	www.scnsoft.com/
Soft Perspectiva	http://soft.edu.by/
Softclub	http://softclub.by
Softeq Development	www.softeq.com/
Softline, Ltd	www.slbel.com

Name of organisation (in English)	Website
Steel Monkeys, FE	http://steelmonkeys.com/ru
Stylesoft	http://dev.by/companies/stylesoft
Svyaz'InformService	www.sis-group.com
Synesis	www.synesis.by/
System Technologies	http://www.st.by
Telesoftservise	www.telesoftservice.com
TietoEnator Ltd.	www.tieto.com/
TKP-Soft	www.tkp.by/en/
Top Soft	www.galaktika.by/
Viaden Media	www.viaden.com/
Vimix	www.wimix.by/
VironIT	http://ru2.vironit.com/
VirusBlokAda Ltd.	http://anti-virus.by
VPI Development Center	www.vpisystems.by/
Knowledge institutes (R&D and education bodies)	
Research institutes	
National Academy of Sciences of the Republic of Belarus	http://nasb.gov.by
Belarusian Institute for System Analysis	www.belisa.org.by
United Institute for Informatics Problems of National Academy of Sciences	http://uiip.bas-net.by
Scientific Research Institute for Electronic Computers	www.niievm.by
Institute of Applied Software Systems	http://infores.mpt.gov.by
Identification Systems Centre	www.ids.by
"Giprosviaz" Institute, JSC	www.giprosvjaz.by
Central Research Institute for Management Technology	www.cniitu.by
System Analysis and Strategic Researches Center of the National Academy of Sciences	http://center.basnet.by
Instrument Engineering Innovation Center	www.ieic.biz
Research Institute for Technical Information Protection	www.niitzi.by
"SKIF" Super Computer Research Programme	http://skif.bas-net.by/
Institute of Solid State Physics and Semiconductors	http://ifttp.bas-net.by/
Institute of Physics	http://ifanbel.bas-net.by
Institute of Mathematics	http://im.bas-net.by/
Industrial ICT research centres	
Research and Production Corporation "Integral"	www.integral.by
State Scientific and Production Association "Planar"	www.planar.by/ru/
Belarusian Optical and Mechanical Association	www.belomo.by
Scientific and Production Association "Agat", Research Institute for Automation Means	www.agat.by
Republican Unitary Enterprise of Computer Technics and Informatics	http://belvti.com
Universities	
Belarusian State University	www.bsu.by
Institute for Informatization and Management Technology of the Belarusian State University	www.itiubsu.by/
Belarusian State University of Computer Science and Radio electronics	www.bsuir.by
Belarusian State Economic University	http://bseu.by/
Belarusian National Technical University	www.bntu.by/
Belarusian State Technological University	www.bstu.unibel.by

Supported by the European Commission under the 7th Framework Programme for Research in the Information and Communication Technologies area (ICT)

Page - 34 -

Name of organisation (in English)	Website
Polotsk State University	www.psu.by/
Belarusian-Russian University	www.bru.mogilev.by/
Gomel State Technical University	www.gstu.gomel.by
Minsk State Higher Radio engineering College	www.mgvrk.by
Brest State University	www.brsu.brest.by
State Higher Communication College	http://vks.belpak.by/
Baranovichi State University	www.barsu.by
Belarusian State Pedagogical University	http://bspu.unibel.by
Belarusian State Agrarian Technical University	www.batu.edu.by/
Brest State Technical University	www.bstu.by/
Vitebsk State Technological University	www.vstu.vitebsk.by/
Vitebsk State University	http://vsu.by/
Gomel State University	www.gsu.unibel.by/
Grodno State University	http://grsu.by/
Minsk State Polytechnic College	www.mgpk.unibel.by
ICT intermediaries	
Republican Centre for Technology Transfer	http://ictt.by
Belarusian Innovation Fund	www.bif.ac.by
Belarusian Republican Fundamental Researches Fund	http://fond.bas-net.by/
National Fund of Technical Legislative Acts of the Republic of Belarus	www.tnpa.by/
Department on Entrepreneurship Development and Support of the Ministry of Economics	http://svoedelo.by/
Belarusian Hi-Tech Park	www.park.by
Information Resources for Education System Center	http://iso.minsk.edu.by/
Mogilev Technological Park	www.technopark.by/
Annual International Exhibition "PTS - Prospective Technologies and Systems: Informatics, Telecommunications, Safety"	www.pts.by/
Technics and Communication, CJSC – Exhibition Company; Annual Exhibition on Telecommunication, Information and Banking Technologies "TIBO"	www.tc.by, www.tc.by/exhibitions/tibo/
Belarusian Search Index System	http://all.by
Business Support Center "XXI Century Center"	www.bc.by
Scientific and Technological Park "Metolit"	www.metolit.by
Small Entrepreneurship Incubator	http://mapzao.by/
Small Entrepreneurship Incubator "Beltrustinfo"	www.beltrustinfo.by
Brest Business Incubator	www.partnerplus.by/
"Apsel" Entrepreneurship Support Centre	www.ei.by/ooo-apsel
Belarusian Business Portal	http://bel.biz/
Electronic Business Center TUT.BY	www.tutby.com - www.tut.by
Banking Technologies Center	www.cbt.by
Bank Processing Center	www.npc.by/
Bank Financial TeleNetwork	www.bfn.by/

*Supported by the European Commission under the 7th Framework Programme
for Research in the Information and Communication Technologies area (ICT)*

Page - 35 -