

MAJOR THEMES:  
Information Systems, Technologies and Applications  
Applications of Informatics and Cybernetics in Science and Engineering Systemics

eScience in Moldova

The creation of a global information society is a task of great importance in this millennium. But in the Republic of Moldova, only 19 out of 1000 people use the Internet and Moldova ranks 112th in the world in the level of development of information and communication technologies (ICT). Statistics on the development of ICT in 2001 published by DEPRAOOH & ASPA in “*Benchmarking E-government: A Global Perspective*” presents a median index in the level of 1.62, but in Moldova the volume of this index is of 1.29. According to this, Moldova occupies last place among the European nations [1].

Major problems of science in Moldova:

- Number of scientists reduced from 30 000 to 5 000;
- About 90 % of funds were given to research (especially for salaries). State support for development and stimulation of innovations is little (in 2005 first time was write in budget volume of money send on innovations – 193,8 millions MDL ~\$15.4 millions USD);
- About 65-70 % of funding went to basic research, about 30-35 % to applied research (in EU countries this proportion is opposite);
- About 60 % of researchers are over 50 (middle 57 age);
- Expenditures of state on research and development are low – in 2004 about 0.18 % of Gross Domestic Product (GDP, in EU countries – about 2.3 %) [2].

The Government of Moldova allocated 56.1 millions MDL for science in 2003. Including for:

- Basic and applied research - 47.4 millions MDL
- Preparation of specialists in science - 4.2 millions MDL
- Scientific research foundations - 4.2 millions MDL
- Administrative departments - 1.1 millions MDL

Support of science in Moldova by the U.S. Civilian Research & Development Foundation for the Independent States of the Former Soviet Union (CRDF) and Moldovan Research and Development Association (MRDA) in 2003:

- CRDF - 22.1 millions MDL
- MRDA - 27.3 millions MDL.

The budget of Moldova in 2004 constituted 128 millions MDL (~\$10 millions USD) on transportation, road, information and communication technologies, but only 4.8 millions MDL from it were directed on information infrastructure.

The budget of Moldova in 2005 constituted 408 millions MDL (~\$32 millions USD). On innovations is send 47% of all money.

Today ICT provides many opportunities for full realization of all people's rights with regards to equal access to information. This access is one of the essential factors for the steady development of mankind. Information, to which everyone should have access, is one of the basic resources for balanced development of the individual today. Streams of information freely pass through international borders and internal obstacles. New technologies overcome the existing obstacles that occur on their way to reception and use of the information. ICT plays a key role in the Europe's forthcoming year of "civilization through education" which is to be organized in 2005.

Carrying out the first phase of the World Summit in Geneva on the problems facing an information society, the leaders of 125 countries and of the European Community have met. Still, 45 countries, including Moldova, delegated the powers to representatives to other countries. Five countries participating at the Summit have not presented any information at all on their representatives who participated at the Summit. The first phase was held on December 10 - 12 2003 at which the Declaration of Principles on construction of an information society was accepted. Representatives of Moldova can be present on the second phase WSIS, which will take place in Tunis hosted by the Government of Tunisia, from 16 to 18 November 2005 and where criteria of information, principles of an information society and a way of transition to a similar society will be discussed.

Part A of the Declaration of Principles, entitled «Our Common Vision of the Information Society», says:

**«1. We, the representatives of the peoples of the world, assembled in Geneva from 10-12 December 2003 for the first phase of the World Summit on the Information Society, declare our common desire and commitment to build a people-centred, inclusive and development-oriented Information Society, where everyone can create, access, utilize and share information and knowledge, enabling individuals, communities and peoples to achieve their full potential in promoting their sustainable development and improving their quality of life.**

**2. Our challenge** is to harness the potential of information and communication technology to promote the development goals of the Millennium Declaration.

**7. We recognize** that science has a central role in the development of the Information Society. Many of the building blocks of the Information Society are the result of scientific and technical advances made possible by the sharing of research results» [3].

The basis for electronic access to the scientific information in Moldova is the Mediateca Intended for Researchers (MIR), created on the initiative of the Academy of Sciences of Moldova and with financial support of grant N. MX2-3027 from CRDF. Our Internet address is **<http://www.mir.acad.md>**. In the framework of MIR we have utilized information technology for the preparation, storage, review, searching and updating of the metadata and full-text of scientific publications of the Moldavian scientists in non-relational text databases [4-11].

Our Mediateca is registered in Open Archives Forum, UNESCO's collection of scientific digital library services (from this link our site was visited more than 710 times – more than any Moldova and Romania Internet resources registered on UNESCO) and in UNESCO program of Electronic Theses and Dissertations (ETD) [8].

Open access to scientific research has been gaining momentum and was in the news quite often two years ago:

- Scientists (v. 17, Issue 24, 15, Dec. 15, 2003) included second the rise of Open Access among 5 major science stories of 2003,
- Nature (v. 426, Dec. 18-25, 2003, p. 755) included fifth the rise of Open Access among 5 major science stories of 2003,
- Science Magazine (v. 302, Dec. 19, 2003, p. 2040) listed fourth the Open Access among 7 "breakthroughs" of 2003.

Our information is of proven interest to scientists worldwide and such numbers testify:

- The English page of MIR was visited more than 9880 times by scientists from Moldova, Romania (14.81%), USA, Germany, France, Spain, Ireland, Italy, Great Britain, Russia, Norway, Hungary, Poland, Portugal, Greece, Switzerland, India, United Arab Emirates (UAE), Malaysia, Thailand, South Korea, Iran, Former Yugoslav Republic of Macedonia, Australia, Canada, Latvia, South African Republic, Algeria, Croatia, Belgium, Sweden, Saudi Arabia, Pakistan, Bulgaria, Tunis, Azerbaijan, Israel and Brazil.
- The Russian page of Mediateca was visited more than 9870 times by scientists from Moldova, Romania (13.86%), USA, Germany, Russia, Hungary, Latvia, Great Britain, France, Turkey, Bulgaria, Ukraine, Czech Republic, Kyrgyzstan, China, Canada, Belgium, Italy, Switzerland, Sweden, Holland, Uzbekistan, Azerbaijan, Australia, Tunis and Israel.
- The Romanian page of Mediateca was visited more than 9750 times by scientists from Moldova, Romania (15.07%), USA, Germany, France, Russia, Spain, Belgium, Sweden, Italy, Switzerland, Netherlands, Canada, Australia and Great Britain.

Operative access to the scientific information and, most of all, to new publications, is a necessary practicality for all scientists and experts irrespective of the fields in which they work. Scientific institutes have access to the electronic information and use it, as demonstrated by how positively it is reflected in the quality and results scientific research process and its financial support.

Proposed system provides development of technology of preparation, accommodation, access granting and updating of the information on scientific publications issued in Moldova in form of bibliographic and textual databases. It is supposed to use CDS/ISIS DB as a software toolkit via Z39.50 data transfer protocol. This format is recommended by the ISO-2709 standard, intended for the exchange of bibliographic information. The information system project realization will result in development of software for both data storage and manipulation within a database and representation of items of information about scientific journals and articles, published in Moldova. The system will have comprehensive open interface that will allow flexible access for local and external networking users.

For further development of the information system is supposed to improve the mechanism of dialogue with a database, to continue accumulation of the information and, in the long term, to capture all basic scientific editions of Moldova.

The creation of such system represents a doubtless step forward in the development of both information technologies and information infrastructure of the Academy of Sciences and will offer new bibliographical services for all scholars of Moldova.

Content of our Mediateca based on CDS/ISIS DB. CDS/ISIS in its basis has free-ASCII format most adequately representing structured non-numerical data in the form variable length records. Such a format represents in the best way bibliographic information and it is recommended by the international ISO-2709 standard, intended for exchange of bibliographic information on magnetic carriers. Among its characteristics is high efficiency of data processing, low hardware requirements and computing resources. The system is a noncommercial product and there is some experience of work with it in ASM. WWWISIS is a system developed and distributed by BIREME/PAHO/WHO, specially designed to act as a server for ISIS data bases in a WWW client/server environment. It provides functions for searching and data entry operations over ISIS data bases. WWWISIS operates as a server through the WWW Common Gateway Interface (CGI). The development and application of WWWISIS interfaces allow data exchange through the INTERNET. This DB has four parts:

1. old publications in Moldavian scientific journals, books, manuals, collections and on conferences was in Moldova
2. new publications in mir.acad.md journal ISSN 1681 – 7672
3. ETD of Moldavian scientists (structure of this table you can see in [9])
4. software created in Moldova.

Services of our Mediateca based on MySQL DB. This DB contents from:

1. our visitors
2. our subscribers
3. our links
4. our news

On MySQL DB will be base web-site of the first international conference of Balkan and Black Sea countries on digital library and electronic publications. This conference will be in Chisinau in august 2005.

In addition, several new initiatives for future work in this direction not only in Moldova, but also in the world, developed from this project:

1. To include in our scientific information portal the electronic theses and dissertations produced by students of the Moldavian Academy of Sciences. This data added value to the information on research activity in Moldova and information in support of scientific research around the world already in the database. Our proposal submission was received by CRDF for the 2005 Cooperative Grants (CGP) Competition. Proposal title: Applications of technologies of Mediateca Intended for Researchers in eJournal, software and Electronic Theses & Dissertations and development of its technologies. Confirmation Number: 102825.
2. To create a "*Thermometer*" for science in support of the Sixth Framework Program (2002-2006) of the European Community. This initiative includes partners from Germany, Italy, Spain, Greece, Slovakia, Great Britain, Australia, and USA. The idea for the *Thermometer* is a data visualization tool based on a set of electronic library resources, including e-journals and electronic theses & dissertations. Data will be accumulated based on the use (accesses) to the set of collections and analyzed by the intensity of use of the publications and conferences, quantity of scientific dissertations. This activity could then be visually displayed using a map of the world or Europe denoting areas of increased usage of the data. The next opportunity would be to define the activity by the subject areas of science. The activity could be displayed as a color map or as various sorts of graphic diagrams. In sectors where there is little or no measured activity (by e-library, e-journals and Electronic Theses & Dissertations) would have a white color or 0 values in the diagrams. Areas of intense usage will be objectively displayed and easily identified.

For the governments the "*thermometer*" will enable officials to analyze and to see:

- ⇒ the activity or productivity of scientific research institutes in various fields of study and to identify potential candidates to different posts,
- ⇒ identify centers of scientific research that are most dynamic and provide an objective justification further financing and support.

For sponsors the *thermometer* will enable them to define the priority areas for support.

For managers of administrative bodies the *thermometer* will enable them to analyze:

- ⇒ activity of the staff of scientific research centers or candidates to different posts,

- ⇒ what centers of scientific research are most active and productive for further funding and other support,
- ⇒ to easily identify people that encompass the necessary qualifications and to recruit them in decision making processes.

For researchers the *thermometer* would give the prospect to analyze and to see:

- ⇒ the most dynamic scientific research institutes in subject areas interesting to him or her,
- ⇒ what centers of scientific research are most active and prospective for professional training for developing professional skills,
- ⇒ where new trends in scientific research are born and where there is an opportunity to apply his or her knowledge and ideas.

For students the *thermometer* will enable them to analyze and to see:

- ⇒ where the scientific/research institutes with the best activity in areas attractive for him or her,
- ⇒ what scientific research centers are most dynamic and considered as prospective for graduate and postgraduate studies or doctoral studies,
- ⇒ where new scientific research trends are born and where there is an opportunity to submit the application of knowledge and ideas.

For schoolchildren and their parents, the *thermometer* will give the opportunity to analyze and to see:

- ⇒ where high schools with the best activity on scientific researches in an area interesting for him or her may be located,
- ⇒ what areas of scientific researches are most dynamic,
- ⇒ where new scientific research directions are born.

The first step for creation of the *thermometer* would be the development of a consortium by participants with the objective of standardized subject and institutional classification for the fields of studies. Then, create and populate a database with data that contains the values of these classifications.

- Filling of this field,
- Creation of mirror sites for accommodation of collections of partners in a consortium,
- Development and coordination of criteria for definition of research activity,
- Develop programs for reporting that analyze the research activity,
- Testing and debugging of these programs,

- Experimental operation of the *thermometer*, expansion of its opportunities and scope.
3. To create a *Network of Excellence* based on certification centers and/or the private industry of country-partners. The need for the Network of Excellence is based on a growing number of counterfeit and low-quality medicines and food products. It is in the best interests of government, business and the public to get reliable information about medicinal products, including their manufacturers and distributors. Truthful, objective analyses of medicines and food products are needed in varying degrees: for production firms, in-depth test results; for drug-stores, less detailed information; and for consumers, only the summary results. The business firms will get total and reliable (first hand) information about distribution of medicines and/or food products and results of local examinations. Agent-firms will get information of quality of the medicines and/or food they produce and information about medicines of their competitors. The pharmacies and public will have reliable and firsthand information on medicine and/or food that will help them make better purchasing decisions for medicine and/or food. Regulatory organizations will get operative information on the goods of sale; reveal counterfeits and identify low-quality medicines and/or food and also irresponsible distributors. A result of the activity from the proposed Network of Excellence will provide truthful, accurate information to firms and producers interested in honest competition and customers who care about their health. On February 24, 2005 in the Academy of Science of Moldova was organized an International Conference “Science and Technology Linkages with Local Industry: Pharmaceuticals and Medical Devices” with the scope of initiating new contacts, collaboration and partnership relations between Moldovan R&D scientists and local businesses in the field of pharmaceutical and medical products.
4. The commercialization of our work. Members of our team participated in:
- March 25-27, 2001 - Commercialization Seminar for the program "*Technological Development and Marketing*", State University, 46 participants
- June 10-12, 2003 - Industry Programs Workshop: «*Introduction to Commercial Opportunities for Applied Research Scientists*». The seminar was held at the State Agency for the Protection of the Industrial Property (AGEPI) and was organized by CRDF and MRDA representatives.
- At the seminar the following topics were discussed:
- Travel Grants Programs,
  - First Steps to Market Programs,
  - Next Steps to Market Programs,
  - Understanding the Market,

- How to find a U.S. Partner,
- Foreign Business in Moldova,
- Basic Business Skills,
- Intellectual Property.

The seminar was attended by 89 scientists from 45 scientific institutions, enterprises and factories including Balti, as well as some individual inventors. Of these, 10 seminar participants had individual meetings with the seminar's presenters with the purpose of evaluating the proposed technologies from the Moldovan side.

March 26–27, 2004 – *International Scientific Cooperation in Moldova: Results and Strategies for the Future*, Chisinau, Moldova. MRDA, jointly with the CRDF is sponsoring a two-day conference to highlight the results of the scientific projects sponsored by the MRDA's bilateral research grants program. The event was also provided an opportunity for participants to discuss the issues faced by Moldovan scientists today, as well as the future of international cooperation and the CRDF/MRDA grants programs.

October 13–15, 2004 – International Collaboration Opportunities For Research and Technology Development in Moldova, Chisinau, Moldova. The conference was conducted the Office of Naval Research Global (ONRG) in collaboration with the Academy of Sciences of Moldova and the Moldovan Research and Development Association (MRDA). The purpose of the conference was to facilitate discussion on S&T collaboration between researchers and S&T managers in Moldova and S&T managers from the US in the hopes of furthering collaborations between researchers in the two countries.

5. To create the Moldavian IST cEntRe (MISTER) for education and science in response to the Tempus program's Call for Proposals for a new generation of Regional Innovation Strategies (RIS), primarily for regions in Central and Eastern European countries or Regional Experimental Support Centers Program (RESC) of CRDF.

Utilizing the materials, information technology, financial and human resources, and expertise of the institutions of the consortium members, and with financial support of EU, the *Moldavian IST centre for education and science*, will offer the possibility of creating opportunities by collaborators and university students for:

- The study, analysis, and generalization of the advanced experience of studying information use in universities from partner countries for application in universities from Moldova;
- Achievement of Intranets and Web resources typical for universities, universities Extranet, university Web portal;



- The achievement of educational software projects, and for management process of study; some public courses, distance education e-learning, placed on the university Extranet server;
- Preparing pedagogical materials for utilization of modern education technologies;
- The elaboration of some methodical indications for acquisition/adaptation, application and development educational informatics system, the modern technology training, and of associated services for universities.

MISTER can be constituted as a juridical entity with commercial activity, in the form of a joint-stock company, or limited trust company, having founding universities which are members of a consortium, or as public organization of universities (and possibly colleges), representing interests of its members. The activity would be financed from dues and allocations for some projects of associated members.

MISTER can be at the same time an effective basis for teaching the practice of production for an important segment of students. The future specialists in information technologies, teaching, management, book-keeping, etc with prospects of engagement Post University of temporal collectives of work with members in respective universities, and/or the foundation of some smaller enterprises.

National and international solidarity represents one of the most important reasons to avoid double expenditure (work, resources, time), promote efficiency and the acceleration communication in universities in Moldova. The development of enterprise, eventually mixed with participation of foreign capital, could be the solution of the problems with reform of university studies and enlightening of IS in Moldova.

The main beneficiaries of the projects results will be Educational Ministry and universities from Moldova, but most of all the students, teachers and other training personnel, and their financial administration.

The general objective of the MISTER project is to align the university study, including state and particular training, to EU standards. This will make it possible for universities, including those smaller and middle ones, to have access to modern information technologies of studies, training, controlling and verifying of their knowledge and qualities, to a standardized system of academic credits.

In the same time the achievement of this objective will make it possible to employ young specialists, and eventually transform the temporal collectives of work in smaller enterprises.

MISTER will provide assistance to the universities in information technology, preparing personnel for using modern methods of study, training, and verifying the knowledge and its perfection in the process of enlightening.

The project will have short and long term effects. The short term goals will be to accelerate the use of NIT in all universities of Moldova, to enlarge the effective number of investments in the information infrastructure, and to improve the quality of initial formation and recycling using NIT.

Some typical solutions for the university Intranet include, the development of web sites and an Inter-University Extranet and the approval of the use of IT for management and technological processes. There will also be launched, tested, and applied, some pilot projects for SUM and AESM utilizing personnel, including educators, for project activities. The results of the pilot project can be used in the most of the universities if not in all of them.

Long term effects will be expressed in the MISTER activity, after funding from Tempus program, using the enterprises the students will elaborate new information systems such as: automated courses, recycling, the development of new forms and fields of study, the offer of other contractual services, the public training for adequate information culture for enlightening IS in Moldova.

The result of the objectives achievement mentioned above is:

- To raise the quality of university education in Moldova to the EU standards with coordination, communication and efficient informing of all participants;
  - To improve cooperation and coordination between universities from Moldova and EU to promote educational reforms, which will introduce the college credit system, encourage continuous, life-long learning using electronic resources;
  - To increase the access of citizens and universities from Moldova to services of educational process, study, the training and automated training for all life long based on consulting with MISTER, electronic courses, Web – books; eJournal, digital libraries, etc;
  - To raise the quality of the university studies by using advanced technologies;
  - To attract young people to research activities and for the solution of problems in the enlightening of IS in Moldova.
6. To organize First International Conference of Black Sea and Balkan countries on Digital Libraries & Electronic Publications. This Conference will be held in Kishinev. The struggle between control and dissemination of information has persisted since the Middle Ages. Especially blatant has been its manifestation in the Black Sea and Balkan area, which for

centuries has been at the crossroads of different powers and regimes. The electronic age, through the development of information and communication technologies, provides new opportunities for improved access to information; it has also given rise to new forms of censorship. The following questions, significant in the European and global context, will be discussed:

- Digital Libraries, electronic theses and dissertations and eJournals in XXI century;
- cooperation between Digital Libraries, electronic theses and dissertations and eJournals;
- new technologies and ideas for Digital Libraries, electronic theses and dissertations and eJournals;
- new technologies basis on Digital Libraries, electronic theses and dissertations and eJournals;
- experience of Digital Libraries, electronic theses and dissertations and eJournals;
- how Digital Libraries, electronic theses and dissertations and eJournals support science and education.

Dear Sirs, we would like to ask you whether it is possible that you would support us in finding some funds or in the organization of our project, or to include us into a program which deals with similar matters. Thank you in advance.

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#### References:

1. DEPRAOOH & ASPA in «Benchmarking E-government: A Global Perspective»
2. Banishing Moldova's Demons. Science. Vol. 304. 21 May 2004, pp.1098-1100, Richard Stone
3. Document WSIS-03/GENEVA/DOC/4-E.  
[http://www.itu.int/wsis/documents/doc\\_multi.asp?lang=en&id=11611160](http://www.itu.int/wsis/documents/doc_multi.asp?lang=en&id=11611160)
4. Virtual open access to the scientific information in Moldova. The International Scientific Conference "Integral Equations and Application in Physics, Mechanics and Medicine" (IEAPMM-2004) 1st-3rd of December, 2004, Tamara C. Sibirsky, Victor C. Sibirsky, Vladislav N. Seiciuc, will be publish
5. Efforts of the Moldavian scientists in construction of technologies of information society (in Romanian). The International Conference on "Tendencies of the Information Society Development", December 9-10, 2004, pp.155-157. Tamara C. Sibirsky, Victor C. Sibirsky, Gregory K. Youngen

6. Information support for Moldova science and educations. The Second Conference of the Mathematical Society of the Republic of Moldova dedicated to the 40 anniversary of the foundation of the Institute of Mathematics and Computer Science of ASM. Chisinau, August 17-19, 2004, pp. 295-297, Victor C. Sibirsky, Tamara C. Sibirsky, Gregory K. Youngen
7. Virtual scientific information in Moldova. The Second Conference of the Mathematical Society of the Republic of Moldova dedicated to the 40 anniversary of the foundation of the Institute of Mathematics and Computer Science of ASM. Chisinau, August 17-19, 2004, pp. 297-299, Victor C. Sibirsky, Tamara C. Sibirsky, Gregory K. Youngen
8. Site of scientific publications from Moldova (Russian). Conferința Internațională „Știința, Businessul, Societatea: evoluții și intercorelări în condițiile integrării în spațiul economic european” (12 – 14 February 2004). Volume 1. ASE, Kishinev. 2004, pp. 51-54. Tamara C. Sibirsky, Victor C. Sibirsky, Gregory K. Youngen
9. Mediateca for the scientists of Moldova: results and prospects. Buletinul Academiei de Științe a Republicii Moldova, Matematica, N 2(42), 2003, pp. 123-134. Tamara C. Sibirschi, Victor C. Sibirschi, Gregory K. Youngen
10. Revolutionary steps in Moldova in the field of ETD. International 6th Conference ETD, 2003, Berlin, Constantin V. Gaidric, Tamara C. Sibirschi, Victor C. Sibirschi, Gregory K. Youngen
11. First proposal from Moldova in the field of IST in the FP6 (Russian). III International Conference “Information technologies – 2003”, Kishinev, 7-11 April, 2003, pp. 240-243. Tamara C. Sibirschi, Victor C. Sibirschi

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