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Toward a New Policy for Scientific and Technical Communication: the Case of Kyrgyz Republic

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Content

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List of Abbreviations

CIS	Commonwealth of Independent States
GOST -	All-Union State Standard
GSNTI	State System of Scientific and Technical Information
STI	Scientific and Technical information
TEI	Technical and Economical Information
VINITI	All-Russia Institute of Scientific and Technical Information
USSR	Union of Soviet Socialist Republic

Abstract

This paper is a backgrounder for a policy paper which formulates a new policy in the field of scientific and technical communication in Kyrgyzstan. The paper examines new vistas of scientific communication opened up by the advancement of Internet technologies globally and makes an analysis of the current state of national scientific information system of the Republic. Applicability of new models of scientific communication is discussed as well. Stakeholder analysis is first applied for scientific and technical information system.

1 Introduction

Revolutionary development of information and communication technologies has resulted in such a great leap forward in scientific and technical communication that it is considered to be comparable in significance with Gutenberg's invention of the movable type printing press in 15th century. The arrival of new information technologies affords breathtaking opportunities with respect to the rapidity of scientific information exchange, information retrieval, and multimedia presentation, but also brings up serious issues concerning data archiving, intellectual property aspects, and peer review.

This paper is a background study for a policy paper (Djenchuraev 2004), which addresses a number of vital issues for the Kyrgyz Republic: what should be the new scientific and technical communication policy provided new electronic communication opportunities? which new models should be introduced and supported by the government in order to shape an effective and efficient communication system in science? who are the policy stakeholders in scientific communication system and what is their significance? what is the mission of the scientific communication system? and so on.

Chapter 2 opens with a definition of scientific communication and co-terms. This is followed by a discussion of the mission and goals of STI system. The chapter concludes with a discussion of forms and functions of scientific communication.

Chapter 3 considers global tendencies in science communication systems. It discusses models of paper and electronic communications, collaboratories and other issues.

Chapter 4 traverses the history and current state of the scientific and technical system in The Kyrgyz Republic. It describes the legislative basis, country preparedness for electronic communications, and features of major actors: scientists, libraries and publishers. The chapter concludes with an original study of science communication in The Kyrgyz Republic.

Chapter 5 provides a conclusion.

2 Backgrounds

2.1 Definitions

A definition of scientific and technical information and co-terms can be found in many sources. International Encyclopedia of the Social Sciences (1968) defines scholarly communication as “the exchange of information and ideas among scientists in their roles as scientists.” Borgman (2000) provides a more comprehensive definition: “scholarly communication is the study of how scholars in any field (e.g. physical, biological, social, and behavioral sciences, humanities, technology) use and disseminate information through formal and informal channels. The study of scholarly communication includes the growth of scholarly information, the relationships among research areas and disciplines, the information needs and uses of individual user groups, and the relationships among formal and informal methods of communication.” An expanded definition of scientific and technical information is given by (A-130 Implementation Guidelines Group for Scientific and Technical Information 1995):

Scientific and Technical Information (STI) derives primarily from research, development, and monitoring activities of scientists and engineers and individuals supporting their work. ST1 includes new theory and data obtained from experimentation, observation, or computation in the form of text, numeric data, images, charts, and graphs. It includes information derived from theory and data that may be further transformed, described, evaluated, synthesized, and recorded through stages of analysis. This includes information ranging from laboratory notebooks and preprints to formal publications and evaluated databases. It includes metadata that are needed to describe and identify data and data sources as well as data about methods and protocols used in the information gathering processes.

STI may be documented and communicated in print, micrographic, magnetic, optical, or other media to enhance its communication, usefulness, and value for a wide spectrum of users and uses, The knowledge that exists in experts and is exchanged through interpersonal communications is an important part of the STI system.

Model Law on Science and Technical Information adopted by Inter-Parliamentary Assembly of CIS and Law on Scientific and Technical Information of Belarusian Republic defines **scientific and technical information** as "information about documents and facts obtained as a result of scientific and technical, innovation and social activity". A definition of “**documented STI**” is provided: "the scientific and technical information fixed on material carrier with entries allowing its identification" and “**scientific and technical information system”** as "the rank ordered assemblage of scientific and technical information resources and the technological-organizational means of realizing processes of creation, collection, processing, systematization, search and supply of scientific and technical information to meet the needs of the state, juridical, physical and physical persons".

The 1999 Law on Scientific and Technical Information System of The Kyrgyz Republic provides quite a vague definition of STI, mentioning only that STI “includes information obtained as a result of research, development, design, administrative-organizational production and economic activities documented on any carriers ensuring its storage, accumulation, duplication, search, distribution and usage”.

The equivalency of the terms “scientific information system” and “scientific communication system” must be considered in order to avoid ambiguity. Both terms are widely used in the literature, but in Russian sources “scientific information” is definitely dominant. In his book "The General Theory of Social Communication" (Sokolov 2002) Sokolov provides his interpretation of this issue. He indicates that after the epochal publications of Shannon and Viner, "the information approach", the essence of which is the consideration of objects through the prism of informational category, has received general recognition in many science disciplines and many communication phenomena have risen into the light of "information glasses". As a result of the "painting" of the socio-communication system with "information colors", a number of terminological equivalents have appeared: social communication – social information, communication channel – information channel, recipient – information user, etc. Hence, the State System of Scientific and Technical Information (GSNTI) in the Soviet Union properly represented the scientific communication system. However, this system was referred to as "information" and never "communication". The reason apparently was either the dominancy of the information approach or communist ideologists decreeing communication science as "anti-Marxian".

At present, the term "scientific communication system" is not widely distributed in relevant literature, legislation and policy documents in The Kyrgyz Republic, while the scientific information system is in general use.

Taking into account the above-mentioned for the purpose of this paper these two terms will be considered as equivalent.

2.2 The Mission and Goals of Scientific Communication

The mission of the scientific and technical communication system can be defined by analogy with the one proposed in Russia (Yashukova 2003): "information support of innovative development of the national economy of the Kyrgyz Republic for the purpose imparting to it a new quality - knowledge-based economy"

The major goal of a scientific and technical communication system is the effective and efficient fulfillment of its functions, namely registration, certification, awareness and archiving which will be considered in detail in Chapter 2.4. The effectiveness and efficiency of scientific communication is determined by (Roosendaal and Geurts 1998) as "its combined ability to facilitate both the generation of relevant research problems (raise the right questions) and the solution of these problems (identification of appropriate solutions)". This also relates to the issue of use, availability and retrievability of information."

Effective and efficient scientific communication system should provide for:

- maximum visibility and accessibility of scientific knowledge produced both nationally and internationally to scientists and the general public in the Kyrgyz Republic;
- global visibility and accessibility of knowledge developed by scientists in the Kyrgyz Republic.

2.3 Forms of Scientific Communication

Social communication is the process of transferring meanings in social dimension and time. Three forms of social communication can be distinguished presently: oral (spoken), documentary (print, written) and electronic (Sokolov 2002). Scientific communication is a part of social communication. While oral communication is based on verbal and nonverbal natural channels which can not be replaced, documentary and electronic communication compete with each other. Should communication barriers for electronic communication be lower than barriers for documentary communication, the latter will be squeezed out to the periphery of social communications (Sokolov 2002).

These forms interact with each other resulting in hybrid communication forms as shown in the figure 3.1. A short description of the seven combinations obtained as a result of this interaction is as follows:

1. **Oral (spoken) communication** involves the personal contacts of scientists with colleagues at conferences, seminars and lectures, etc. Oral communication plays a substantial role in informal communication of academics. Spoken communication is localized in time and space, rich in information saturation, and quite expensive to organize.

2. **Documentary (written, print) communication** uses artificially created print documents to transfer meanings in time and space. Documentary communication is the basis of formal communication for scientists through publication in books and journals.

3. **Electronic communication** is based on transferring information through telecommunication networks including wireless communication. One of the most important electronic communication channels is the Internet. The emergence and development of the Internet has had a considerable impact on the advancement of scientific communication in recent years. Scientists are utilizing such forms of electronic communication as e-mail, e-groups, etc.

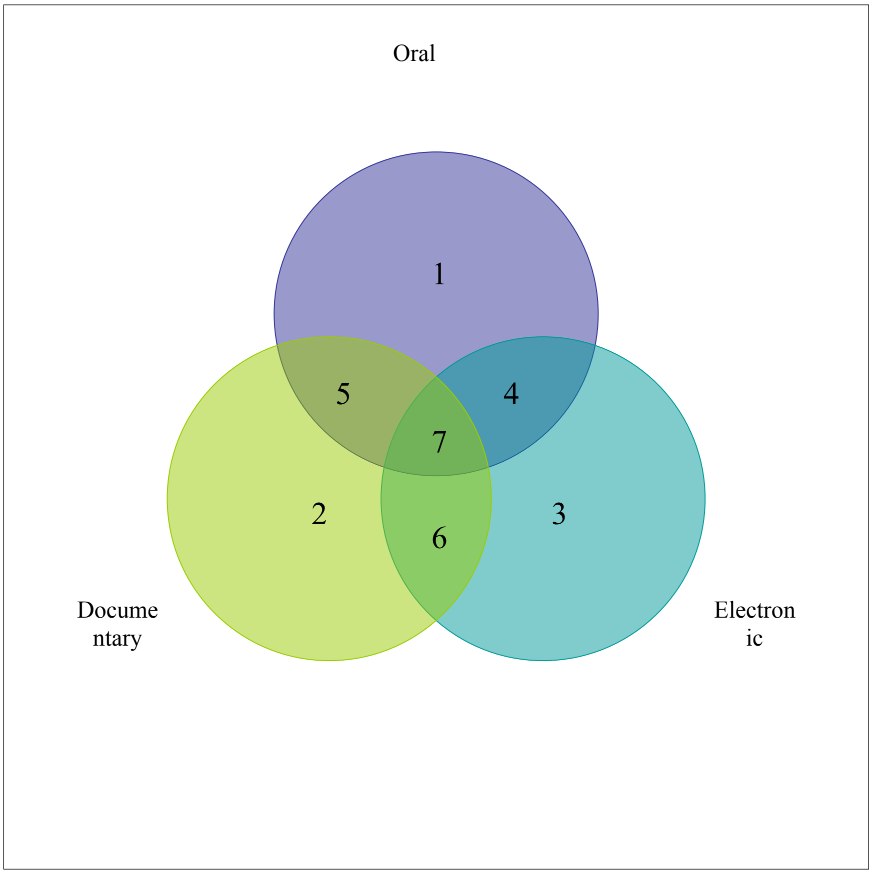


Figure 3.1 Relationship of forms of scientific communication

4. **Oral – Electronic.** This combination provides such communication tools as telephone, radio and TV. Relatively new communication channels which show the potential to win popularity in

academic societies include videoconferencing, electronic notebooks and IP-telephony. In the context of the globalization of science the combination of oral and electronic forms of communication will play a progressively more important role.

5. **Documentary – Oral**. This rather old combination includes video or audio recording.

6. **Documentary – Electronic**. This grouping gives birth to electronic journals, dissertations, books, and new formats such as e-prints. The potential for this combination to gradually displace documentary communication is sufficiently high.

7. **Documentary – Oral – Electronic**. This combination allows the creation of new forms of scientific organization such as collaboratories (virtual laboratories) which will be considered below in greater details.

Kaye (1995) distinguishes the following information sources in accordance with their status:

- Personal vs. Impersonal
- Formal vs. Informal
- Published open vs. Unpublished/ confidential/secret.

Whereas the meaning of personal/impersonal and published/unpublished pairs is understandable, there is a description of the widely-used pair formal/informal below. Formal scientific communication, or scientific publishing, is the process through which newly discovered knowledge is refined, certified, distributed to, and preserved for researchers, professors, students and the public and usually takes the form of published journal articles, conference proceedings or monographs (Shearer and Birdsall 2002). Informal sharing of data by scientists is an important tool of scientific communication distinguished in localization in time and space and rich information saturation. Only a decade ago virtually all informal exchanges of information between scientists took place as person-to-person interactions between scientists at conferences, seminars and other events or personal letters. Computer-mediated communications substantially minimized many barriers and drastically increased the frequency of contacts between scientists for a short period of time.

2.4 Functions of Scientific Communication

Roosendaal and Geurts (1998) identified four different services which contain a scientific communication system. These are:

- Registration – scientists must have the ability to claim they have made a new discovery or finding;
- Certification - it is necessary that a system of scientific communication allow these claims to be certified;
- Awareness – it is vital that information about work existence is ensured;
- Archiving – scientist’s heritage must also be preserved for future generations.

3 Global Trends in Scientific Communication

Global tendencies taking place in scientific communication lately can be illustrated by the example of Canada. Table 3.1 presents the impact of a number of external drivers (Shearer and Birdsall 2002) on the scientific communication system of Canada.

Table 3.1. External drivers and trends in scientific communication of Canada

Drivers	Trend
Technology	Electronic communication systems are increasingly becoming a principal means of scientific communication displacing traditional communication forms and creating a new hybrid of communication formats.
Globalization	Scientific communication is becoming more interdisciplinary and globally increasing the collaboration among scientists worldwide.
Economics	The spiraling costs of publication in scientific journals in developed countries and lack of funds for new journals and books in developing countries.
Changing pattern in research	New unique information needs and new forms of scientific organization such as collaboratories are emerging .
Public policy	The scientific communication policy in Canada is changing from year to year and from administration to administration. Especially this relates to research priority, intellectual property and applied vs. fundamental research issues.

3.1 Models of Scientific Communication System

The concept of a national scientific communication system can easily be derived from Figure 3.1 (Shearer and Birdsall 2002). As can be seen from this scheme the system involves four key groups of actors: scientists (as creators and users of knowledge), libraries and publishers. As was discussed above, it has a number of external drivers such as technology, globalization, economics, changing patterns in research and public policy. Knowledge is spread into society through knowledge translation, technology transfer and commercialization.

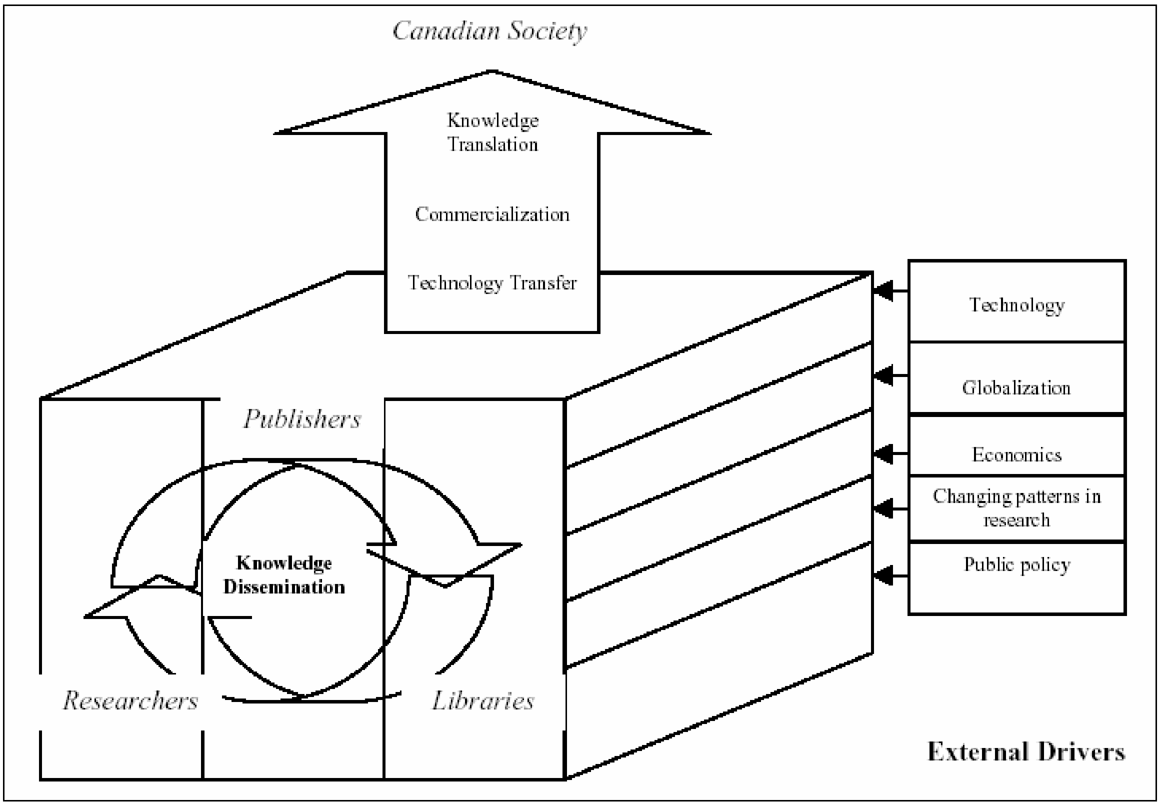


Figure 3.1. The concept of the scientific communication system of Canada (Source: (Shearer and Birdsall 2002))

With respect to scientific communication channels it would be useful to consider one of the classical paper-based models.

Hurd (1996) describes a model adapted from the works of Garvey and Griffith shown in Figure 3.2.

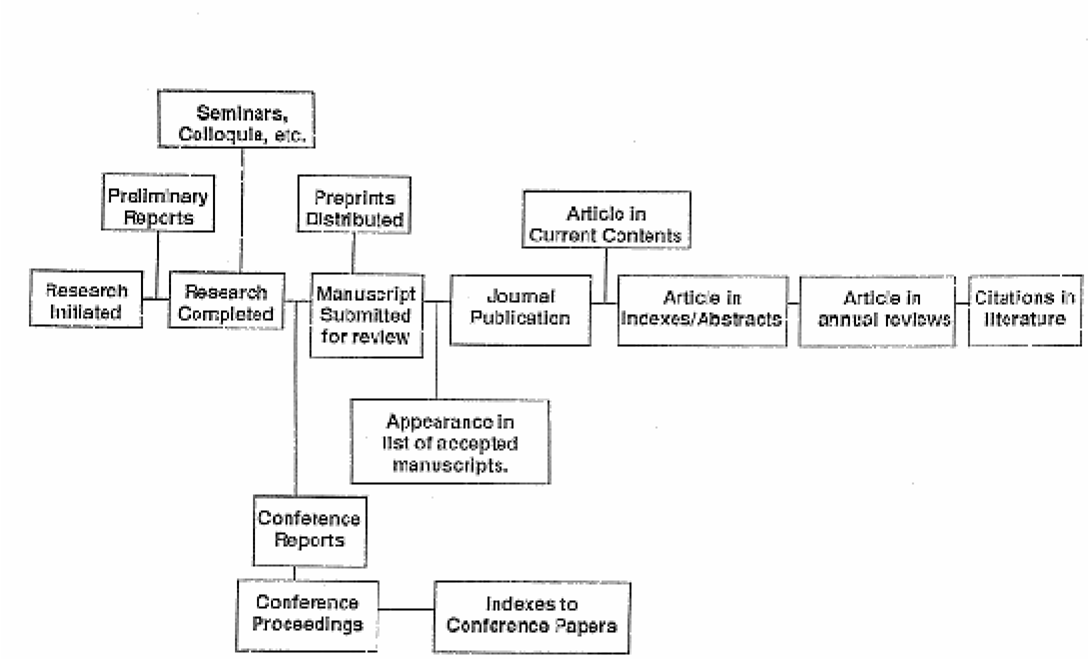


Figure 3.2. Garvey and Griffith Model of Scientific Communication

The process of research communication and different stages of the research starting from the beginning of research to archiving is sketched out in the model. The model takes into account both formal and informal communication of scientists which lead to a final goal – publication of the article in a peer-reviewed journal.

Sondergaard, Andersen, and Hjorland (2003) proposed Internet-based model of scientific and technical communication by revising and updating paper-based UNISIST model originally published in 1971 (see Figure 3.3).

As can be seen from Figure 3.3., similar to the Garvey and Griffith model, the revised UNISIST model comprises two channel of communication: formal and informal; the formal channel serves both e-journals and grey literature such as unpublished reports and dissertations as well as preprints.

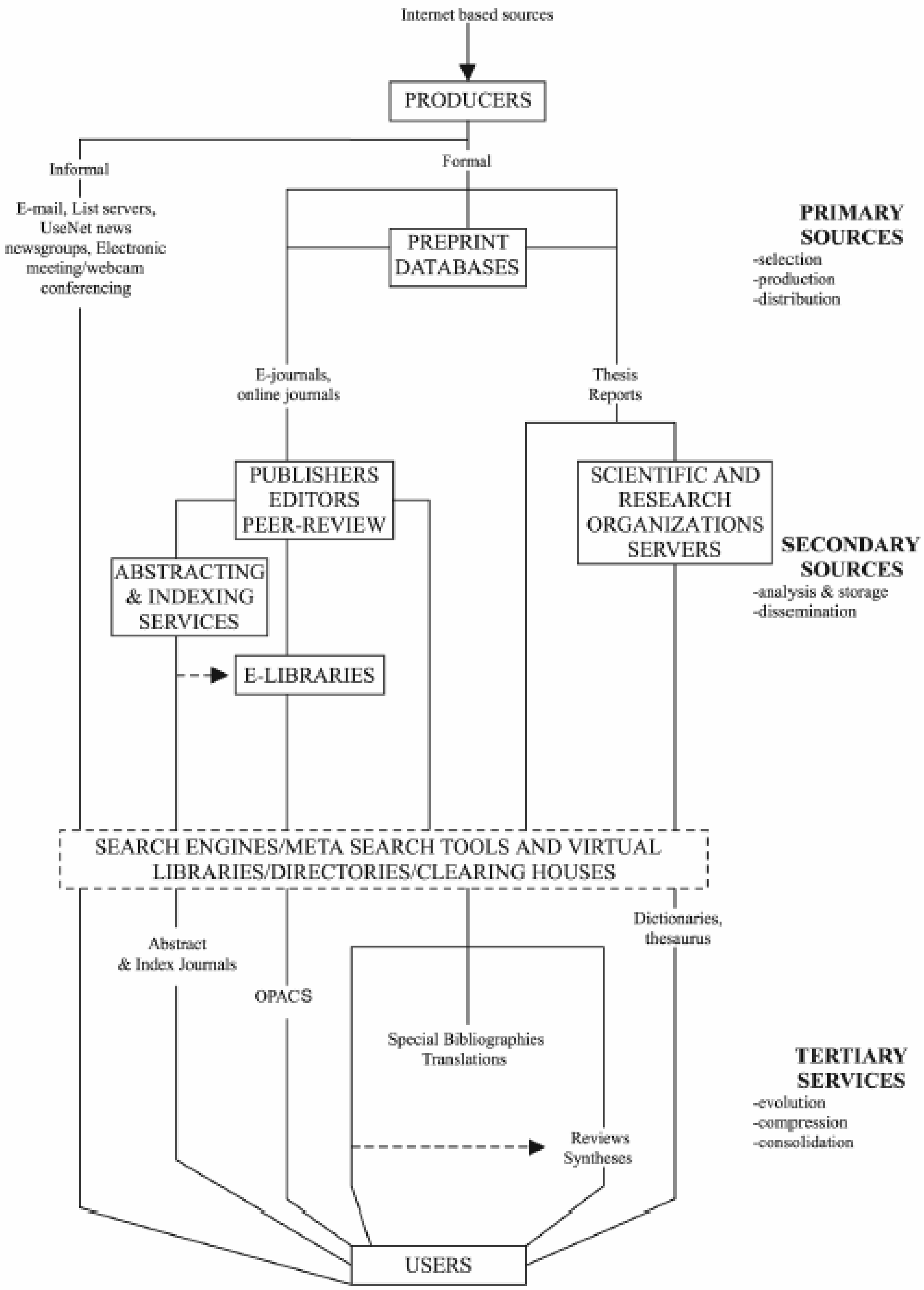


Figure 3.3. Communication of Internet-based scientific information

3.2 Electronic Publishing

Among all electronic editions such as e-journals, e-books, e-dissertations, etc electronic journals have received the highest recognition and will be considered in a detail below.

The history of electronic journals can be traced back to the 1970's when all the main components for an electronic-journal system emerged — authors could input digital text through magnetic tapes or cards; publishers used computerized photocomposition or computer-driven typesetting; libraries began to automate; bibliographical databases were searched online; scientists had computers and modems; and the foundations of the Internet were established (Tenopir and King 2001). Further development of these components led to the appearance of the first electronic journals by early 90-s. According to the Directory of Scholarly Electronic Journals and Academic Discussion Lists (http://db.arl.org/dsej/index.html) published by The Association of Research Libraries in January 1991 there existed 7 peer-reviewed on-line scientific journals, in December 1997 – 1049, and in November 2000 more than 3900. Currently, the number of electronic journals is increasing so rapidly that it is difficult to assess.

Lancaster (1995) distinguishes four evolution stages from print to electronic journals:

1. Use of computers in the preparation of printed publications;
2. Distribution of electronic equivalents of paper versions;
3. Distribution in electronic form with slightly extended features in comparison to print versions;
4. Completely new publications incorporating hypermedia possibilities.

What is understood by an electronic scientific journal and what are its functions? Though there is currently no universally accepted definition of an electronic scientific journal, a number of co-terms in literature offer a definition. Moreover a recent Interstate Standard on Technology of Electronic Publications enacted in the Kyrgyz Republic in 2002 provides the following meanings:

- **Electronic edition** is an electronic document (or group of electronic documents) which has passed through editing, intended for distribution in invariable form with publisher's imprint;
- **Electronic scientific edition** is an electronic edition including facts about theoretical and/or experimental studies. In addition it is scientifically prepared for publishing memorials and historic documents;
- **Periodical electronic edition** is an electronic edition appearing over definite periods of time, with a constant number of issues published yearly, non-repeatable content, uniform lay-out, numbered and/or dated issues with the same title.
- **Network electronic edition** is an electronic edition available to a potentially unlimited number of users through telecommunication networks.

Considering that a basic requirement for scientific journals is the scientific quality of publication implemented through peer-review system and accessibility through telecommunication networks (unlike journals on carriers) the following definition is proposed for electronic scientific journals: **Network peer-reviewed periodical electronic scientific edition.**

Informational electronic scientific journals can be text and multimedia (e-zines). Depending on the availability of print versions, they can be presented as electronic analogues to print editions or independent electronic editions which do not have a print version. Lastly, depending on the nature of interaction between a user and electronic edition the form of an electronic edition can be predetermined or interactive.

It is well known that the distribution of information is not the only important function of scientific journals. Quality control, canonical archiving and recognition of authors are among some of the functions worthy of mention (Rowland 1997). These four basic functions are valid both for print and electronic journals.

3.2.1 New Possibilities

The shift to electronic media has opened up new avenues for scientific editions including journals which will be summarized below:

- **New possibilities for representing and using information** (multimedia interactive journals). Unlike traditional journals, electronic journals possess substantial additional capabilities for representing information (Holoviak and Seitter 1997). The simplest case could involve a colored pictured. This is often not possible in paper journals for economical reasons. In other cases inclusion of sound and video files and modeling software offer the potential to considerably enhance text in many research fields, such as astronomy, organic chemistry, medicine, etc. There is virtually no limitation to the volume of main or additional material in comparison to print editions. Presently there is a considerable potential for the further processing of electronic texts. It is worth particular mention that electronic texts can be easily translated from one language into another by specialized software. Modern systems provide high quality translations with the capacity translate complex research papers in many fields.
- **Global distribution**. With the availability of an Internet-linked computer a scientist from any country in the world has the ability to access numerous on-line journals provided that there is no economical barrier such as payment for access. Unfortunately there are not many journals with open access on the Web. However, a scientist from a developing country utilitizing an electronic journal can make research available to a much wider audience through publication in low-circulation local journals.
- **Speed of publication**. Submitting an article to an e-journal on the Web can substantially reduce publication time. This is especially important in fast progressing disciplines where time is often a critical factor.
- **Searching capability**. This is one of the most important improvements of the e-journal. A full-text search can be carried out through a journal or archive. Greater flexibility in searching is attained by using a combination of logical operators.
- **Hyperlinks**. One more important option provided by electronic journals is the possibility to navigate through references by clicking on hyperlinks. Ideally, full-text access to all references mentioned in a paper can be obtained in a matter of seconds. This enables one to trace the history of the issue and various methods of tackling a problem.
- **Feedback**. Discussions of the paper are possible immediately following its publication on the Internet, presenting a powerful interactive tool.
- **Flexible circulation.** The circulation of e-journals is a function of the number of copies made from the original stored on a server. There are no problems with being “out-of-print” or overprinted.
- **Solving library problems.** E-journals make it easier for users to solve typical library problems such as a lack of free storage space, damage to items by readers, poor storage conditions and the possibility of a document being simultaneously used by several readers.

3.2.2 Problems

Along with new the opportunities offered by electronic publications there are several problems associated with the development of on-line journals in the Kyrgyz Republic, such as poor and expensive access to the Internet, lack of adequate training in Internet-technologies, the language barrier, the poor informational content, storage formats for electronic journals, copyright issues, etc.

Some scientists express concern that at the "scientific weight" of e-journals. They argue that the rapid development of desktop publishing systems and Internet has substantially simplified the publication of on-line scientific journals. Now anyone who has a computer and access to the Internet can potentially publish their own scientific papers whereas the traditional peer-review system presents a reliable quality control filter. Moreover, these scientists note that e-journals are virtual or "lightweight". They can not be held in one's hands and it is not possible to the flip through the pages of the journal.

Furthermore there is the issue of the perception of electronic information and psychological factors. Valauskas (1997) is skeptical of the scientist's perception of electronic information and sites a number of interesting facts: "a paper can hold up to 50 times more information than can a monitor." He also notes that "because of flicker and other factors, we lose up to 40 percent of the information presented on a computer screen… and we also read more slowly on a computer compared to paper, up to 25 percent to 30 percent more slowly".

It is worth noting that e-journals are still in the process of gaining recognition and all the above problems are solvable with time. For example, rapid progress in display technologies already makes it possible to enhance the perception of electronic information. There are also the permanently decreasing costs associated with the Internet and a better preparedness of younger scientists to ICT and language barriers.

3.3 Collaboratories (Virtual Laboratories)

Information and communication technologies have enabled the cooperation of geographically distributed scientists working in one field to a level never reached before. Data from the observation of scientific communication spanning several decades demonstrate a clear trend of closer collaboration among scientists due to a deep transformation of the nature of scientific research resulting in research tasks with greater size and complexity. This trend began long before the Internet (Odlyzko 2000; Finholt 2002a). Collaboratories or virtual laboratories have also emerged representing a new alternative for the organization of scientific activity.

The term collaboratory comes from combination of two words «collaboration» and «laboratory». The classical and most cited definition of collaboratory belongs to William A Wulf: a "…center without walls, in which the nation's researchers can perform their research without regard to geographical location - interacting with colleagues, accessing instrumentation, sharing data and computational resources, [and] accessing information in digital libraries". Another definition of collaboratory or virtual laboratory is "an electronic workspace for distance collaboration and experimentation in research or other creative activity, to generate and deliver results using distributed information and communication technologies (UNESCO 2000)."

Finholt (2002b) distinguishes between a laboratory and collaboratory: "the laboratory is principally disciplinary-oriented, concerned with problems of interest within a given lab, and place-based. The collaboratory produces an environment that is more problem-oriented than disciplinary-oriented, that is global rather than local, and where research and education occur independent of physical location".

A collaboratory is more than an elaborate collection of information and communication technologies; it is a new networked organizational form that also includes social processes, collaboration techniques, formal and informal communication, and agreement on norms, principles, values and rules within the network (Cogburn forthcoming).

Several attributes of the collaboratory are suggested (Lunsford and Bruce 2001):

- Shared inquiry – participants share not only common goals, but the common array of problems;

- International character – a collaboratory is recognized by its participants as a joint venture;
- Active participation and contribution – a collaboratory is heavily dependent on the input of its participant;
- Access to shared resources implies access to common information or computational resources or research equipment;
- Technologies – a collaboratory involves information and computer technologies or scientific instruments;
- Boundary crossings – collaboratories bridge geographic (international access), time (synchronous and asynchronous communication), institutional (group access to tools and materials), and disciplinary (interdisciplinary resources) gaps.

Collaboratories possess a leveling potential in relation to three aspects: people to facilities (remote access to scarce scientific resources), people-to-people (increasing visibility of remote scientists), and people-to-information (enhancing access to information resources) (Finholt and Olson 1997). Remote access to equipment is considered to be one of the new developments which can significantly change the way scientific work is performed (Glaser 2003).

The advantages of collaboratories can be summarized as follows:

- They enable substantial funds to be saved as they promote the sharing of expensive equipment performing or observing experiments.
- They may contribute to the prevention of “drain brain”.
- They are ideal for involving young scientists in the work of international teams and the training of new professionals.

Participation in the collaboratory requires telecommunication lines with adequate bandwidth. The availability of computers, computer literacy of scientists and adequate technical support of collaboratory technologies may also present serious barriers to the development of virtual laboratories (Canessa, Postogna, and Radicella 1999).

There are numerous examples of successful laboratories involving developing countries. One of the most successful laboratories involved Brazil in The Human Genome Project. A virtual institute represented by 35 laboratories dispersed across The Sao Paulo State published the first-ever sequence of the genome of a plant pathogen and later the composition of 279,000 human expressed-sequence tags. Thus, Brazilian scientists were recognized in cutting-edge science. Moreover, these projects attracted new investments and more than 200 young geneticists received training (Collins 2000).

In 1997 The Institute of Atomic Energy and The National Nuclear Centre of the Republic of Kazakhstan had a pilot project together with The Los Alamos National Laboratory (LANL), to establish a Virtual Laboratory addressing radio-ecological problems in Kazakhstan (UNESCO 2000).

Some other examples of research areas where collaboratories may be especially valuable are (UNESCO 2000):

- global and regional teamwork in data prospecting and mining,
- searches for new correlations in environmental or health data,
- new multi-disciplinary and multi-cultural approaches to problem solving,
- synergistic insights with added value from multi-national and multi-cultural collaborations,
- joint studies where scientific consensus is important for policy goals.

4 Scientific and Technical Communication in the Kyrgyz Republic

This chapter addresses the scientific and technical communication's historical and current state of art in The Kyrgyz Republic. STI resources are described in view of the three major groups involved: scientists, libraries and publishers. This chapter also analyzes the legislation framework and preparedness for electronic communications through an analysis of a recent survey of scientists in The Kyrgyz Republic.

4.1 The history

The history of the national STI system in The Kyrgyz Republic is rooted in the Soviet Union times when the Institute of Scientific Information and Academy of Science of USSR was established in 1952 (since 1955 it has been known as the Institute of Scientific and Technical Information (VINITI)). Presently VINITI is an agency directing the State Scientific and Technical Information System (GSNTI) of Russian Federation.

Basic principles of the structure and development of GSNTI USSR were (Nechiporenko 1999b):

- the management of scientific and information activity is the responsibility of the state;
- the structure of GSNTI USSR is correspondent to the management structure of the national economy;
- the state provides funding for virtually all works conducted by STI bodies which are involved in GSNTI USSR;
- GSNTI USSR processes all basic information sources in all fields of science and technology and all branches of the national economy;
- the processing of information in GSNTI USSR is the responsibility of information organizations with clearly distributed functions;
- the system provides for centralization of processing different types of documents in correspondent STI bodies and decentralization of information transfer to users;
- the system provides for compatibility of its components by using uniform classification systems and standards.

The organizational structure of GSNTI USSR included four levels: all-union STI bodies, central branch STI bodies, intersectorial republican STI bodies, and territorial STI centers, STI departments of organizations, enterprises, and associations.

By 1990, the last year of existence of the infobase of GSNTI USSR, 1893,3 million documents were accumulated and some 135.9 thousand people worked in the system providing services to about 29 million users. Furthermore, some 200 EC computers and 2000 personal computers were used in the system. Total electronic resources amounted to 16 million documents.

With its declaration of independence in 1991, The Kyrgyz Republic inherited separate elements of GSNTI system and after a time began to recreate a similar national system of scientific and technical information.

The national scientific and technical communication system in The Kyrgyz Republic is represented by a scientific and technical information (STI) system which includes as its basis the state STI system. The basic objectives of the STI system in The Kyrgyz Republic are:

- the provision of achievements of national and international science and engineering and industrial know-how for wide usage in the national economy;

- the establishment, on the basis of national and international sources, of library and reference funds, automatic state and commercial databases and databanks;
- The marketing of information, the provision of informational products, services, databases and databanks and their advertisement.

As was shown in Chapter 2.1, a national scientific and technical information system considers scientific and technical communication through "information glasses", with a focus mostly on documented information; scientific information is considered as an object. At the same time, using a communication approach could offer an advantage over an information approach given that the former represents a wider interpretation of the problem than the latter. For example, informal communication among scientists through "invisible colleges" may have a dramatic effect on research planned or being conducted.

4.2 Stakeholder Identification and Analysis

According to the Merriam-Webster Dictionary the word "stakeholder", which can be traced back to 1708, is defined as "a person entrusted with the stakes of bettors". Later, in the second part of 20th century, the word acquired several new meanings in connection with the development of the stakeholder concept mostly in the field of strategic management. Mitchel, Aglre, and Wood (1997) cite a chronology of definitions of "who is a stakeholder", encompassing the years 1963-1995 and containing as many as 27 definitions.

The common, classical definition (Freeman 1984) is:

> "A stakeholder in an organization is any group or individual who can affect or is affected by the achievement of the organization's objectives".

Policy stakeholders are defined as (Dunn 1994):

> "Individual or group who have a stake in a policy because they affect or are affected by government decisions."

Other than strategic management, stakeholder analysis has been recently applied in many other fields, such as electronic commerce (Papazafeiropoulou, Pouloudi, and Currie 2001), interorganizational systems (Gupta 1995), multi-sector innovations (Bunn, Savage, and Holloway 2002), project management (Alexander 2003) and others.

For the purposes of this chapter, an attempt is made to apply stakeholder analysis to scientific communication in the Kyrgyz Republic in order to guide government policy-makers to consider national and international stakeholders in the formulation, design, implementation, monitoring and evaluation of the scientific and technical information policy. Classification of the stakeholders is made to assist government policy-makers in developing management strategies for them.

No universally adopted approach for the identification and analysis of stakeholders is currently known (Glick, Hatcher, and Ashton 2002). However, based on critical examination of the literature (Ramirez 1999 and Bunn, Savage, and Holloway 2002) a number of steps for carrying out a policy stakeholder analysis of scholarly communication system in The Kyrgyz Republic may by proposed:

1) The identification of goals for policy stakeholder analysis;
2) The identification of stakeholders of scholarly communication system;
3) The description of the properties and interests of stakeholders;
4) The analysis and classification of stakeholders in accordance with stakeholder attributes.

4.2.1 Goals of the Policy Stakeholder Analysis

The major goal of stakeholder analysis is the comprehensiveness of the scientific and technical information system in a policy context by means of:

- an early identification of explicit and implicit policy actors involved in a scientific communication system,
- an assessment of the interests and needs of all stakeholders in the system in order to shape integrated policy to encompass the interests of not only the most powerful stakeholder groups but also marginal ones,
- an assessment relationships between stakeholders,
- an evaluation of stakeholders power, legitimacy and urgency to take part in policy cycle activities including policy formulation and implementation.

4.2.2 Policy Stakeholders of the STI System

Keeping in mind the above definitions of Freeman and Dunn, for our purposes science communication policy stakeholders can be defined as:

> "any group or individual who have a stake in a scientific and technical communication policy because they affect or are affected by government decisions"

As reported by Shearer and Birdsall (2002) the traditional system of scientific communication involves four major actors: scientists (as producers and users of scientific information), publishers, and libraries.

However, a more detailed consideration suggests a more complex pattern. Two levels of stakeholders can be distinguished while considering the scientific communication system in the Kyrgyz Republic: national and international ones, as is shown in Table 4.1.

Table 4.1. Groups of national and international stakeholders in the scientific communication system in Kyrgyz Republic

<table>
<tr><th>National stakeholders</th><th>International stakeholders</th></tr>
<tr><td>Group 1. Government
State Agency on Science and Intellectual Property
National Academy of Sciences of Kyrgyz Republic
Ministry of Transport and Communications
Ministry of Education and Culture
Council on ICT under the President of Kyrgyz Republic
Ministry of Justice
Ministry of National Security</td><td>Group 1. Governments of other countries</td></tr>
<tr><td>Group 2. Academic Community
Individual scientists, post-graduate students, associations of scientists.</td><td>Group 2. International Scientists
Individual scientists, post-graduate students, associations of scientists</td></tr>
<tr><td>Group 3. Research Libraries, University Libraries</td><td>Group 3. International research and university libraries</td></tr>
<tr><td rowspan="2">Group 4. Science Publishers
Science publishing houses, editors, referees</td><td>Group 4. International science publishers</td></tr>
<tr><td>Group 5. International Donor Organizations & Foundations
OSI, ICSU, IREX, UNESCO, OCED, UNDP, etc</td></tr>
</table>

It is also necessary to note that some international players can be represented at the local level: for example, many international and private foundations such as IREX, The UN and Soros Foundation have representative offices in The Kyrgyz Republic.

4.2.3 Description of Properties and Interests of Stakeholders

4.2.3.1 National Level

Government. The Government of The Kyrgyz Republic is an evident stakeholder in the scientific and technical communication system. Stakeholders within the government are represented by a number of ministries, agencies and other organizations as shown in Table 4.1. They currently act not as a single actor but rather pursue various purposes in scientific communication policy. For example, The Center on STI under The Agency on Intellectual Property is responsible for the implementation of STI policy, The Ministry of Transport and Communications deals with telecommunication infrastructure, and The Ministry of National Security is responsible for the security of information (including scientific information). The major task of the government is the implementation of integrated scientific communication policy to support the achievement of specific national goals. The government can affect policy authoritatively in horizontal and vertical dimensions.

Government - Center of STI. The Center of STI is one of the departments of Kyrgyzpatent which was established on the basis of The Kyrgyz Research Institute. The major goal of the center is to provide scientific information to scientists in the field of fundamental science, law, economics, agriculture, environment, human sciences and so on.

The functions of the Center are as follows:

- the development and implementation of the STI and TEI policy and programs;
- the acquisition, processing, storage, analysis and distribution of STI;
- the set-up and development of the national STI and TEI system;
- the provision of STI and NTI to organizations, scientists and all concerned;
- the organization and coordination of international cooperation and scientific information exchange;
- the management of research for improvement of the STI system and formulation of national and state resources;
- the development of legislation in the field of STI;
- the registration of R&D's and defended "kandidate" and doctoral dissertations;
- the establishment of databases on the state basis.

Academic Community. It may be said without exaggeration that scientists represent the major stakeholders in scientific communication. They stand as both creators and users of scientific knowledge. As creators of knowledge scientists are inherently interested in having open access to scientific information and as users are interested in the maximum visibility of the results of their research.

According to the State Program for Reform of Science in Kyrgyz Republic for 2003-2005:

a) The scientific potential of The Kyrgyz Republic is concentrated in 92 independent organizations, universities, science centers, industries, etc.
b) The share of scientific research in GDP is declining constantly: in 1990 it amounted 0.7%, in 1995 – 0.22%, and in 2001 only 0,1%.
c) The number of scientists is declining as well: in 1991 there were 17800 scientists, in 1995 – 6900, and in 2001 only 4600.

In fact, there is a dilemma in scientific communication associated with the aging of scientists and their perception of electronic communications. On the one hand older scientists, who feel uncomfortable with computers (according to the above survey, the use of computers is a barrier for only 16% of scientists 40 years old and younger and for 32.5% of scientists older than 40), draw information for their research mainly from traditional paper journals. They have considerable material for publication but are inclined to publish their findings in paper journals or law circulation booklets. On the other hand, younger scientists surf the Internet for information but rarely publish their work. Thus, those who have knowledge to share do it very inefficiently, contributing to the "lost science" phenomenon. Furthermore, reference materials are quite old and incomplete contributing to research backlog.

Older scientists who travel in policy-making circles are not interested in lobbying for electronic scientific communications, whereas younger scientists are less involved in government but ready to use electronic communications.

Findings from focus-group composed of scientists conducted in the scope of this research shows that there is a "publish or perish" alternative in the Kyrgyz Republic, although not as pronounced as in the West. In general, an academic community involving individual scientists or science associations can play the role of policy experts in a horizontal policy dimension.

Libraries. Research libraries are represented by a number of libraries including The State Patent and Technical Library, university libraries, academic community libraries and others. Research libraries are interested in providing open access to their resources to scientists and the general public. Similarly to academic community libraries are suitable for the horizontal policy dimension.

Present research library resources in The Kyrgyz Republic involve the following libraries (Rafikova 2003):

- The State Patent and Technical Library (SPTL) under the State Agency on Science and Intellectual Property (Kyrgyzpatent). The SPTL currently offers access to about 6 million library items including 200 thousand books, 220 thousand scientific journals and a large amount of patent documents. Financing for the library is provided by philanthropic foundations and the funds of Kyrgyzpatent;
- The Republican Science and Medical Library (RSML) with 15 branches under the Ministry of Health;
- The Central Scientific Library (CSL) under the National Academy of Sciences with 8 branches; the library provides access to about 1 million books and science journals including 190,000 items in foreign languages;
- science and technical libraries (STL) at 16 organizations;
- university libraries – The Library of Kyrgyz-Russian Slavic University maintains 103 thousand items including 22 thousand scientific journals, The Science Library of Naryn State University holds 92 thousand books, The Kyrgyz State Medical Academy maintains more than 600 thousand items and The Bishkek Humanitarian University maintains about 250 thousand books. Additions to university libraries are mainly to the result of contract education funds.

Science Publishers. Science publishers are represented by a small number of publishing houses interested in the publication of the results of scientists' research following editing and peer-review. Surprisingly, the interests of science publishers are practically unrepresented in any of the policy or legislative documents analyzed.

The publication of scientific literature in the Kyrgyz Republic is experiencing a period of distress. Publishers face numerous problems including a lack of skilled personnel, regional inequality in the geographical location of publishing houses (more than 80% of publishing houses are located in Bishkek), and a lack of coordination (The Association of Publishers and Booksellers 2001). Ilim, the oldest publishing house established in 1954, heads the list of science publishers. Other important organizations publishing science literature in the Kyrgyz Republic include the Publishing Center of the Soros-Kyrgyzstan Foundation, The Publishing House of Kyrgyz-Russian (Slavonic) University and The Center of State Language and Encyclopedia, etc.

4.2.3.2 International Level

Governments. The governments of many developed countries may be interested in providing access to scientific and technical information and in collaborating their research institutions and universities with scientists in The Kyrgyz Republic. An illustrative example is INTAS (International Association). It was formed by the European Community and provides funding for an e-library action dedicated to providing access to scientific literature for NIS researchers, based on electronic delivery (http://www.intas.be). Governments on the international level may be involved in the horizontal dimension of policy-making.

Scientists. Scientists worldwide have solidarity in each other through lending assistance by sending their works to as wide an audience as possible. (Roosendaal and Geurts 1998) state that “authors want to publish more and have their product widely available while readers want to read less, but want to be informed of all that is relevant for their research at hand, want this information available just in time, and want to be guaranteed that they can and will be informed of all that is relevant to them.”

Libraries. The mission of research libraries is to acquire information, organize it, make it available and preserve it (Graham 1995).

Science Publishers. International commercial science publishers are interested in profit. Some publishers, however, are ready to provide free access to their resources to scientists from developing countries. In doing so The National Academy Press provides open access to scientists from developing countries (http://www.nap.edu)

International Donor Agencies. (IREX, OSI, Soros Foundation, UNESCO, Eurasia, INASP, etc). International donor agencies are interested in extending economic assistance to developing countries to achieve long-term development of a recipient country. Similar to international governments, international donor agencies have a role in the horizontal dimension of policy-making.

4.2.4 Analysis and Classification of Stakeholders in Accordance with Stakeholder Attributes

The classification of stakeholders, representing the fourth step in the stakeholder analysis is based on a concept proposed by Mitchel, Aglre, and Wood (1997) who argued that a theory of stakeholder identification and salience must take into account three relationship attributes: power, legitimacy and urgency as shown in Figure 4.1.

According to Mitchel, Aglre, and Wood (1997) power can be defined as “a relationship among social actors in which one social actor, A, can get another social actor, B, to do something that B would not do otherwise”. Legitimacy is “a general perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs and definitions”. And finally urgency is “the degree to which stakeholder claims call for immediate attention”.

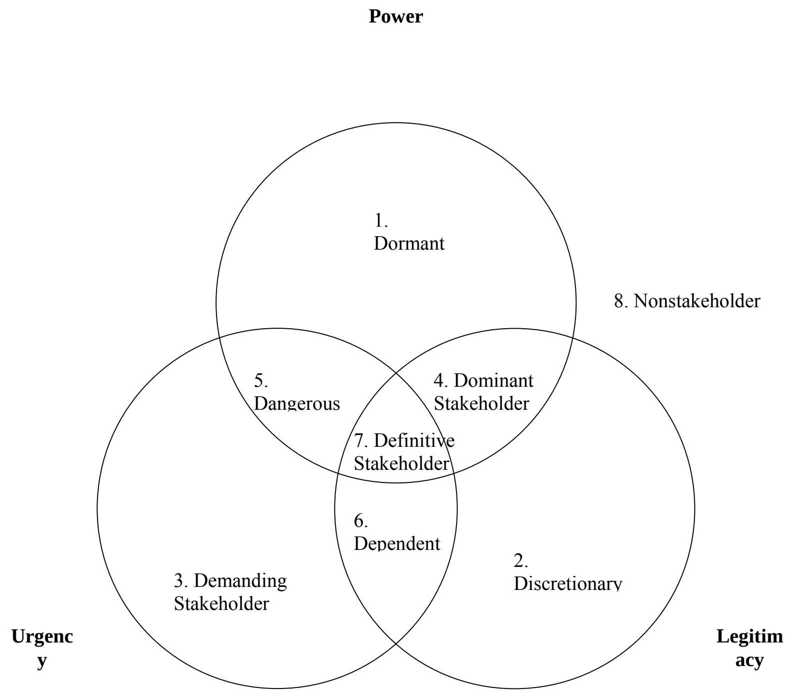


Figure 4.1. Stackeholder's Typology

Thus, all policy stakeholders may be categorized into seven classes as shown in the stakeholder classification in Table 4.2. It is necessary to note that this classification is valid only for the time of analysis and may change due to dynamic interaction between stakeholders. Moreover, the analysis is made from the national perspective, thus the attributes of the same groups of stakeholders at the national and international levels are different.

Table 4.2. Classification of scientific communication policy stakeholders in the Kyrgyz Republic

		Power	Legitimacy	Urgency	Stakeholder
National Level (Kyrgyzstan)					
1	Scientists		X	X	Dependent
2	Libraries		X	X	Dependent
3	Publishers		X	X	Dependent
4	Government	X	X	X	Definitive
International Level					
1	Scientists		X		Discretionary
2	Libraries		X		Discretionary
3	Publishers		X		Discretionary
4	Governments	X	X		Dominant
5	International donor organizations		X		Discretionary

4.3 Preparedness for Electronic Scientific Communications

4.3.1 National Telecommunication Infrastructure

A number of telecommunication projects have been completed in The Kyrgyz Republic lately. A description of these projects is summarized in a recent country report (UNECE 2002):

The First Telecommunication project was funded via a loan from the World Bank and EBRD to the Kyrgyz Government. The budget of the project was 27,400,000 USD. As a result of this project the telecommunications infrastructure of the country has been improved considerably:

- earth satellite stations of the standards A, F and B were installed;
- a network connecting regional centers was reconstructed;
- digital telephone stations were built in Bishkek and regional centers;
- digital telephone stations in Bishkek were linked by fiber optic cables, with the help of SDH technology.

The Chuy Telecommunication project was financed via a loan from the Korean Government of 12,000,000 USD. Digital telephone stations with a capacity of 43 784 lines were established in the Chuy valley. A fiber optic line Bishkek – Kant – Ivanovka – Tokmok – Kemin was built.

The Osh Telecommunication project was funded by the Kuwait Fund of Arabic Economic Development, for 8,700,000 USD. It was used to modernize telecommunications infrastructure in the south of the country, including Osh, Jalal – Abad and Batken provinces. Digital telephone stations with a capacity of 23 400 numbers were installed in Osh City and regional centers.

The Trans – Asia – Europe (TAE) Fiber Optic line, connecting Shanghai, China and Frankfurt-on-Main, Germany, goes through the territory of the Kyrgyz Republic. Right now, eight countries (China, Romania, Hungary, Austria, Iran, Poland, Germany, and the Kyrgyz Republic) have completed their segments, and the total length of the TAE is 27,000 km. In some places in The Kyrgyz Republic, access to the backbone will be done through radio-relay communication facilities by NERA Co. This backbone will provide access to many countries in Europe and Asia with a speed of 622 Mbps.

The National Research and Educational Network (NREN) was sponsored by the NATO Science Programme. Via this project, research and educational institutions have obtained satellite backbone communication lines with a capacity of 2,5 Mbps.

The latter project which has been called the “Virtual Silk Highway” or, in short, the “SILK Project” (http://www.silkproject.org/index.htm) is worthy of special notice. The aim of the SILK Project is to significantly increase the exchange of information with and between academic and educational institutions in Central Asia and Caucasus. In The Kyrgyz Republic, the connection to the NREN is provided for universities, academic hospitals, institutes for higher professional education, research institutes, scientific and public libraries. In fact, the NREN presents a basis for scientific electronic communications offering the prospect for development of the STI system.

4.3.2 Computer Availability and Literacy

The recent study conducted by The Expert Consulting Agency (2004), provides important background data for the analysis of computer availability and literacy in The Kyrgyz Republic though the study is not focused on the academic community,. According to this research the computer market in The Kyrgyz Republic is composed of 2 wholesale suppliers, 7 large trading companies, approximately 20 medium-size and 20 small-size companies. The amount of privately-owned computers in towns of the country is estimated at 30 thousand or about 6% of all urban households. The estimated amount of computer users in cities and towns makes up 300 thousand people (around 10% of adults). Users with a college degree compose 40%.

Computer availability and the readiness of scientists, librarians and publishers to use computers for networking is a serious problem. Discussion in the focus group with scientists (see Chapter 4.5) showed that many scientists (especially above middle-age) suffer from computer-phobia and prefer to use traditional sources of information such as libraries.

4.4 Legislative and Policy Framework

The major document defining a long term strategy, implementation of which will help in overcoming existing problems in a systematic way and provide for the dynamic development of the state and society in political, social and economic areas is **The Comprehensive Development Framework for the Kyrgyz Republic to 2010** (CDF). The strategy is based on the effective application of the nation's human and natural potential for development through the formation and participation of partnerships comprising the state, the private sector, civil society and the international community. The overarching goal of the CDF is to achieve political and social well being, economic prosperity of the people of the Kyrgyz Republic, together with freedom, human dignity and equal opportunities for all. The statement of the national vision identifies the overall development goal and its three basic constituent parts, as well as their components. The national vision focuses on the improvement of the material wellbeing of the people, provision of human rights, dignity and equal opportunities for all. The three basic parts of the overall goal are effective and transparent state governance, fair society providing human development and protection and sustainable economic growth and development.

The future development of the Republic's intellectual capabilities depends on overcoming the critical degradation of scientific and technical research and training in the country. Scientific and technical development is essential for meeting the needs of innovative activities required by the market system. To successfully resolve such problems, the efforts of the state should be to implement a number of specific policy measures including:

- the creation of a rational financing model for scientific research institutions;
- the improvement of the legal framework for development of science;
- the promotion of competitive, innovative activities and the development of privately-owned scientific research institutions;
- the broadening of scientific links and integration into the world's scientific community;
- the development of applied science and the commercial exploitation and application of scientific achievements to improve the ability of domestic producers to compete;
- the creation of real incentives to prevent the outflow of intellectual capital from the country;
- the enhancement of the appeal of scientific research work in the Kyrgyz Republic to private investors.

Objectives in science are to preserve scientific potential, to create conditions for development of the most promising directions of science and to strengthen interaction between science, production and society. Planned actions include the improvement of the regulatory framework of culture, the promotion of formation of state order for science on a competitive basis, the development of a transfer system of new technologies, the formation of scientific and educational entities integrating science, education and production, introducing a mechanism for crediting applied studies, the creation of conditions favorable for the development of small and medium innovative companies, the improvement of regulatory framework for the protection of intellectual property, norms, standards and systems for the certification of products, the creation of telecommunications infrastructure for science, and the promotion of international scientific and technical collaboration.

The National Strategy for Information and Communication Technology (ICT) for the Development of Kyrgyz Republic defines basic priorities, goals and tasks and state policy in the field of ICT. It is considered one of the most important directions for the development of The Kyrgyz Republic within the framework of the national strategy "The Comprehensive Development Framework of the Kyrgyz Republic to 2010". This strategy states that considerable progress has been achieved for the development of information infrastructure and informatization of state and private organizations. It also indicates that appropriate legislation is under development. Development concerns considering achievements in the ICT sphere demonstrate a need to transform from a policy for the development of separate sectors – communication and information technologies – to a policy for the formation of a global strategy of integration into the global information society. This policy should be designed to shape the national information sphere and develop local data and knowledge bases, information resources, and infrastructure. One of the strategy's goals is to increase the share of the ICT sector in GDP to 5% towards 2010.

The National Poverty Reduction Strategy for 2003-2005 in the frame of the "the Comprehensive Development Framework of the Kyrgyz Republic to 2010" considers the current state of science of the Kyrgyz Republic and provides recommendations for its improvement. It promotes the "creation of the telecommunication structure of science", the "enhancement of the legislative framework for science and intellectual property" and the development of international collaboration.

The current legislative framework in the field of scientific and technical information in The Kyrgyz Republic is encompassed by the following legislation:

The Law on Science and Basics of Scientific and Technical Policy (1994) was signed into law by the President of Kyrgyz Republic on April 15, 1994. This law outlines a national policy and regulates legal relationships in the field of science. The law establishes:

- The role of the state in the development of science and engineering, usage of science and technical results in transforming social production and satisfying the needs of the people.
- The basic goals, directions and principles of the state's scientific and technical policy.
- The forms and methods of the state regulation in scientific and technical field.
- The authority of state bodies in the implementation of scientific and technical policy.
- The economic and legal guarantees for the development of science and technical activities.
- The legal bases for the activity of researchers and scientific institutions.

According to this law the state should pursue a policy supporting and promoting the provision of information for decision-making in the scientific and technical sphere. One of the basic principles of the state scientific and technical policy is freedom of distribution of scientific and technical information and communication of scientific and technical achievements.

In order to establish a scientific and technical information system, the state secures the development of central and territorial networks for collecting and processing scientific and technical data and ensures the distribution of scientific information and quality improvement. The state provides funding for the inflow of information, literature, periodicals into state informational centers, research libraries and creates the necessary network for all of this. The state contributes to the freedom, accessibility and preservation of scientific and technical information.

The Law on the Scientific and Technical Information System (1999) lays down the organizational, legal and economic bases for the operation of The Scientific and Technical Information (STI) System in Kyrgyz Republic.

The Law defines the object – STI (including information obtained as a result of research, development, design, administrative-organizational and production and economic activities) – and subjects (state bodies, natural and juridical persons as well as international organizations), basic goals and directions of the state STI policy, organizational structure of national STI system, methods of forming and using of its resources and principles for operating products and services in the STI market.

The state STI policy, as a part of the science and technology policy, is aimed at providing usage of information for the achievements of the national and international science, engineering and industrial know-how in the national economy of Kyrgyz Republic for the sake of social and economic development of all the society.

The state therefore:

- establishes and develops the STI system, defines content and patterns of activity for its separate elements and administers them;
- creates necessary conditions for the accessibility of STI resources and improves the efficiency of their usage;
- supports the development of market relations in the field of STI, fosters competitiveness and stimulates business activity;
- develops international cooperation in the STI field and contributes to maintaining free and equitable relations with foreign and international organizations and structures.

The Concept for the Reformation of Science in Kyrgyz Republic for 1999-2005 defines basic principles for the reformation of the science and technical sphere and immediate measures necessary to adapt it to new economic relations. This concept states that "While implementing state scholarly information policy major attention should be paid to the set up of the telecommunication infrastructure for information exchange, support for existing information networks and provision of access to worldwide knowledge to scientists".

The State Program for the Reformation of Science in Kyrgyz Republic for 2003-2005 defines basic measures for the reformation of the science system and its adaptation to new conditions. It states that "state scientific information policy in Kyrgyz Republic is a component of science and technical policy. It is aimed at usage of facts about achievements of national and global science, techniques and advanced experience for the sake of development of all the society. The program provides for measures to improve efficiency of the scientific information support by:

- setting up academic information network by the National Academy of Sciences;
- setting up university information network by the Ministry of Education and Culture;
- setting up sectoral science information network by sectoral institutions;
- on the basis of the above three networks setting up state science information network by State Agency on Science and Intellectual Property.
- developing library network and transfer to digital libraries.

The information systems should include the following elements:

a) databases on R&D's implemented by institutions;
b) databases on publications, scientific editions, conferences and seminars planned;
c) databases on scientific personnel,
d) databases on participation in international projects, grants receives, international collaboration."

Other documents in scientific and technical communication enacted in CIS countries are as follows:

Standard (GOST 7.83-2001. Electronic editions. Basic types and imprints), adopted by a number of CIS countries, is effective from July 1, 2002. The standard defines requirements for basic types of electronic editions and is aimed at the producers of electronic editions.

Agreement on Free Access and Exchange Procedure for Open Scientific and Technical Information between CIS countries of September 11, 1998 states that users of information have equal rights for information access regardless of citizenship and country of residence. Provision of scientific and technical information may be realized on a non-profit or commercial basis. Lists of information services rendered from state information resources are defined by the owner.

4.5 A Study of the Scientific Communication in Kyrgyz Republic

This section presents findings from a comprehensive study of scientific and technical communication in The Kyrgyz Republic carried out in September – November 2003. Three focus groups comprised of scientists and one survey of 100 scientists in Bishkek, the capital of Kyrgyz Republic, Osh (South) and Kara-Kol (North) were conducted. The ultimate goal of the research was to examine the condition of the STI system in The Kyrgyz Republic through an analysis of the formal and informal scientific communication channels, barriers to scientific data exchange, scientific information distribution and sources of information acquisition.

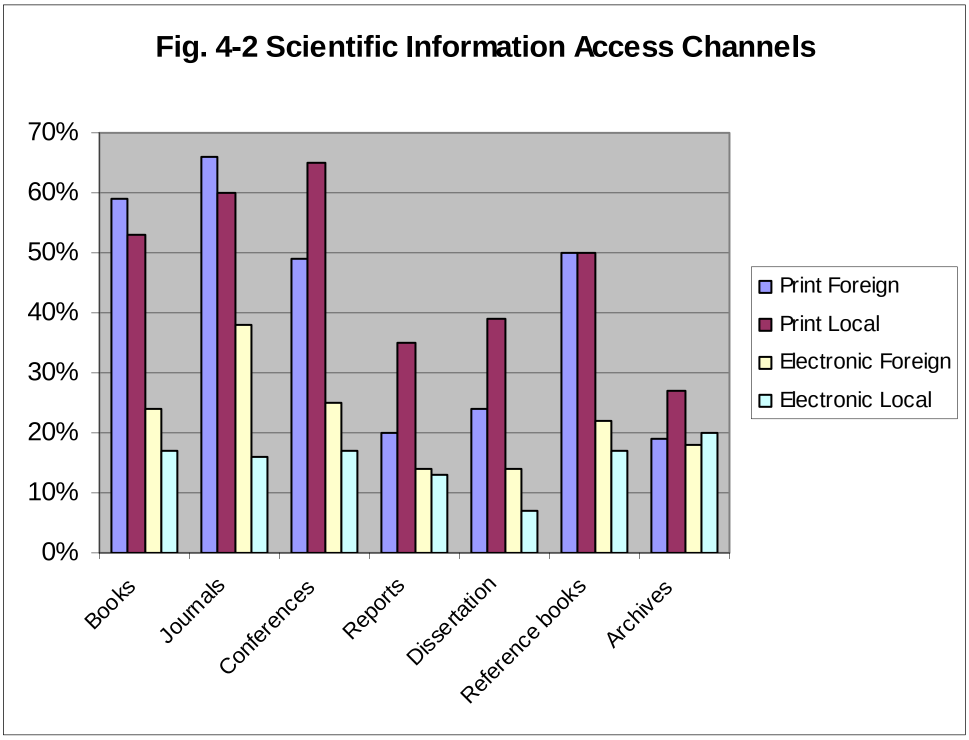
The methodology and description of target groups are presented in Appendix 1 and the results of the research are discussed below.

4.5.1 Formal Scientific Communication

Because scientists are both users and producers of scientific information two aspects of the problem will be discussed below: access to scientific information of scientists from The Kyrgyz Republic and the distribution of knowledge developed by Kyrgyz scientists.

Access to Scientific Information

The data represented in Fig 4-2 demonstrates that print communication dominates all sources of information. The five most popular types of information sources used by scientists in the country are: foreign print journals, local print conferences, local print journals and foreign and local print books. Among the most important electronic sources of information are foreign electronic journals, books and materials from conferences. Local electronic editions are poorly represented on the Web compared to foreign ones as demonstrated in Fig. 4-2.

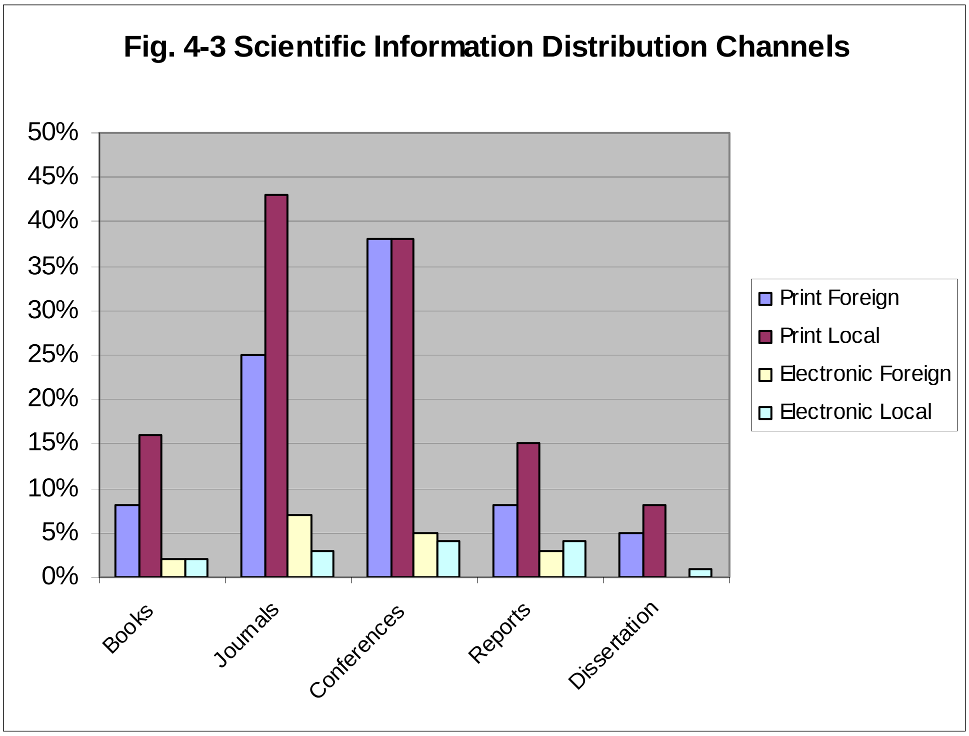


Information distribution channels

Fig 4-3 presents the results of the survey pertaining to Kyrgyz scientists' knowledge distribution channels. The most evident conclusion which can be made from an analysis of the data is that print publications clearly dominate electronic ones. This relates to both local and international editions.

It is also evident from Fig. 4-3 that, in general, scientists publish the results of their work in local print journals, to a lesser degree, in foreign and local conferences, books, reports and dissertations in print. Publication in local low-circulation journals and conferences leads to a situation when the results of the research conducted in the Kyrgyz Republic remain unknown to the academic society abroad.

A comparison of Fig. 4.2 and Fig. 4-3 suggests that a gap between paper and electronic channels is much less a case of access to scientific information as compared with publication of scientific information. In other words, while Kyrgyz scientists increasingly use electronic sources they are quite reluctant to publish in electronic media. Personal communication with scientists and opinions of participants in focus groups lead to the conclusion that for the time being the academic community in the Kyrgyz Republic perceives publishing in electronic media somewhat skeptically. While recognizing benefits of electronic publications such as wider distribution speed of publication, etc. scientists voice their concerns about issues of intellectual property and peer-review.



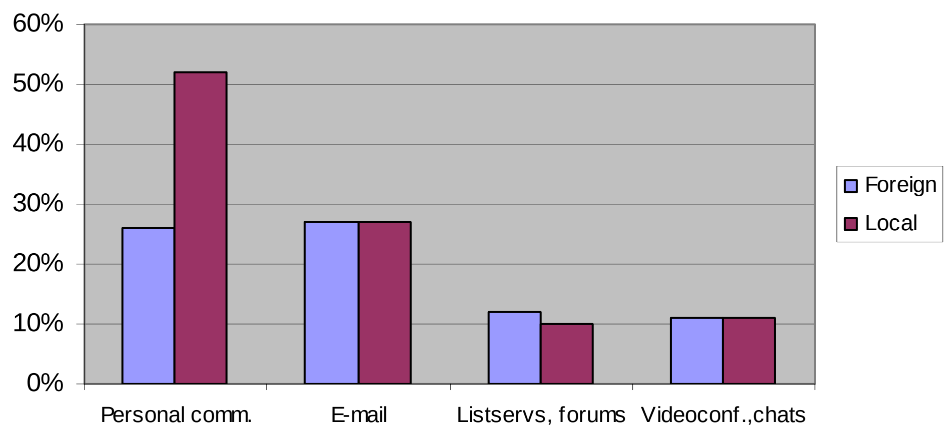
In general, it should be noted that there are virtually no electronic scientific journals in The Kyrgyz Republic at present. Moreover, materials from conferences and seminars, electronic books, reports and dissertations are rarely published in the Internet. Reports by international organizations on The Kyrgyz Republic are represented on the Web from case to case but many of them are not open for the general public.

4.5.2 Informal Scientific Communication

From the analysis of informal scientific information channels it seems reasonable to conclude that even by now intensity of scientist in The Kyrgyz Republic-to-scientist abroad contacts through e-mail is comparable with the level of traditional communications as shown in Fig. 4-4.

Organization of face-to-face contacts between scientists (conferences, seminars) is quite expensive including travel and accommodation costs, conference fees, etc. This can be readily seen from a relationship between the number of scientists communicating at the local (52%) and international (26%) levels as demonstrated in Fig. 4-4. Alternatively, electronic communications make it possible to balance this relationship, as in this case. Because there is no difference where communicating scientists are located costs are low. An increase in the number of scientists using e-mail and frequency of email usage while lowering the language barrier of informal communication through e-mail will be increasingly important.

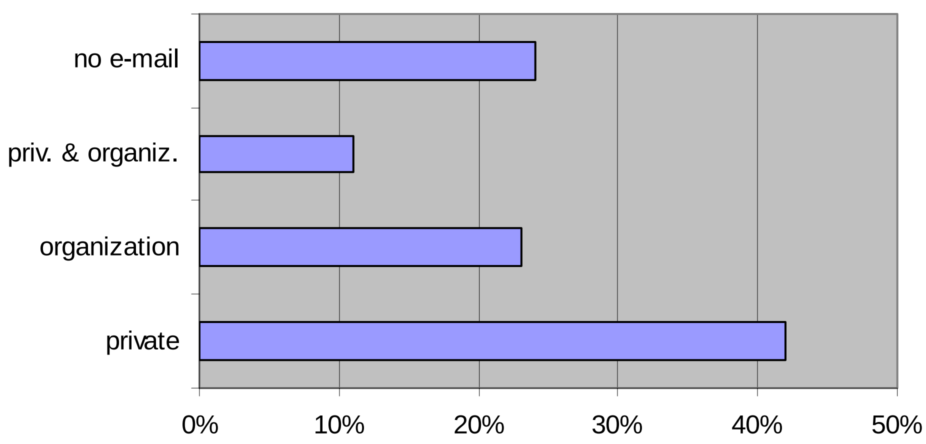
Fig. 4-4 Informal Scientific Communication Channels



Further inspection of Fig 4-4 discloses that communication through forums and listserves is presently less-accepted by scientists. This may be a function of their poor acquaintance with this form of interaction or difficulties they experience in searching forums, lists and chats, reflecting their interests. Videoconferences are practically unutilized due to low available bandwidth. The necessity of closer integration of scientists (with the emergence of collaboratories), increasing Internet connectivity and lowering Internet costs will contribute to wider variety of these communication forms in the Kyrgyz Republic.

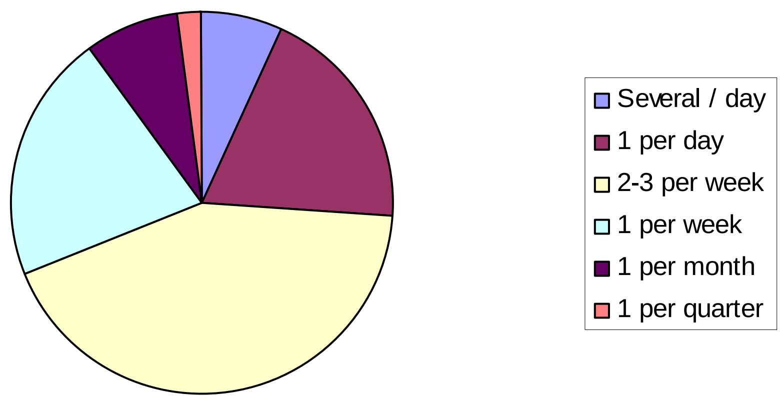
Figure 4-5 depicts the proportion of scientists in the Kyrgyz Republic possessing e-mail addresses. According to the survey only one fourth of all scientists in the country do not have e-mails. Some 42% of scientists have private e-mails and 23% use e-mail addresses of organizations. Around 11% use both private and organizational electronic mail.

Fig.4-5 E-mail Use by Scientists in Kyrgyzstan



The frequency of e-mail usage for those who have e-mail is shown in Fig 4-6. Three groups of users can be distinguished here. As may be inferred from the figure there is a group of advanced users making up one forth of all scientists who have e-mail; some 19% communicate through e-mail once a day and 7% even more frequently. Another group totaling almost two thirds of all e-mail users communicates through e-mail 2-3 times a week (43%) or once time per week (21%). A comparatively small group of scientists uses e-mail once a month (8%) or more rarely (2%). Thus, the first and second (to a degree) groups represent the “information elite” who have much better opportunities to integrate into the global scientific community in comparison to the third group or those scientists who have no access to e-mail (Russell 2001).

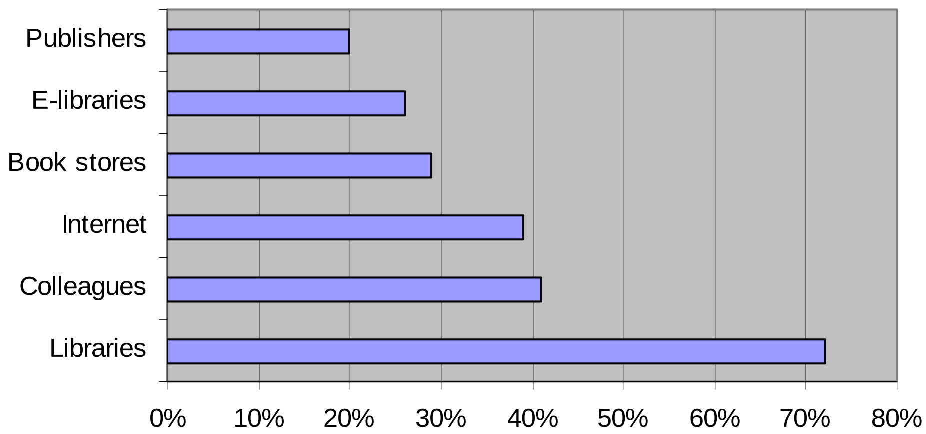
Fig. 4-6 Frequency of E-mail usage



4.5.3 Sources of Information

As is readily apparent from Fig. 4-7 the scientists surveyed prefer free or nearly free sources of information. This refers to, first of all, libraries (72%), colleagues (41%) and the Internet (39%). Fee sources such as book stores and publishing houses amount to 29% and 20% respectively. Electronic libraries gain increasingly wider acceptance (26%).

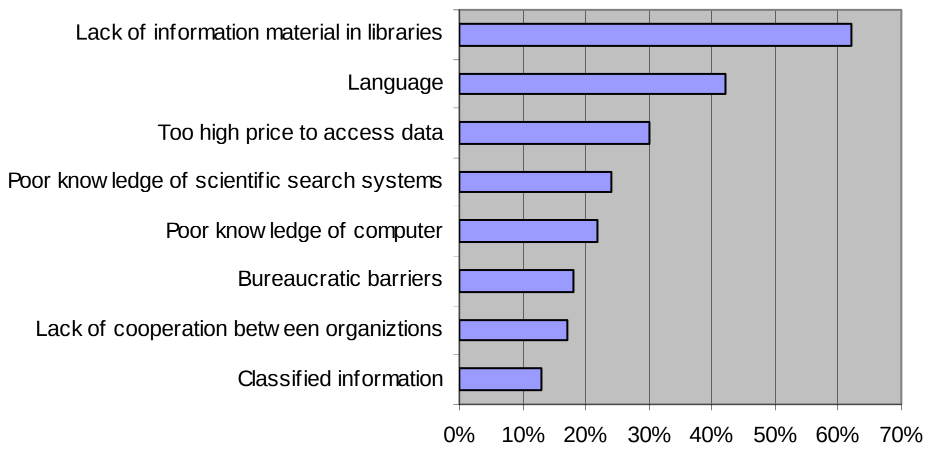
Fig. 4-7 Sources of information



4.5.4 Barriers to Scientific Communication

The results of the survey of academic society in respect of barriers to scientific communication are shown in figure 4-8.

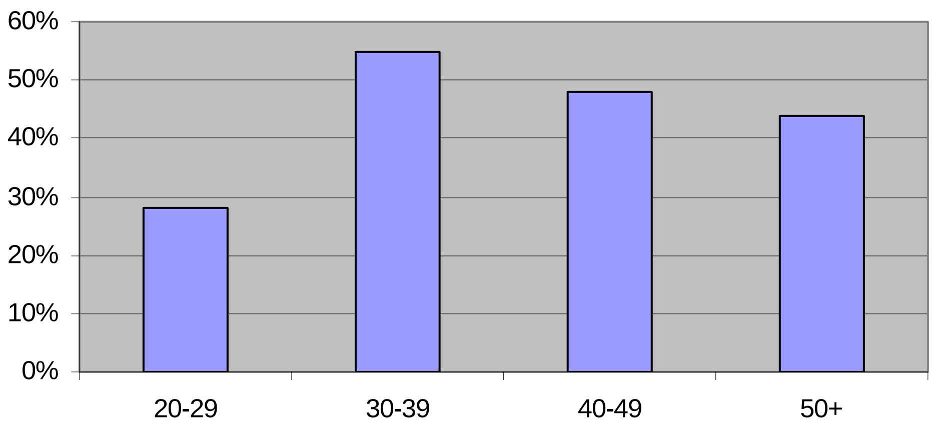
Fig. 4-8 Barriers to Scientific Communication in Kyrgyzstan



As can be seen from this figure the highest barrier (62%) is the lack of information in libraries. This is no surprise since libraries are the most important source of information (illustrated above).

Another impediment considered as serious by 42% of academic society is language. The language barrier here involves English. The results of the focus groups conducted with scientists demonstrate that a poor knowledge of English is not the only reason for this barrier, but rather the traditional orientation of academic society in The Kyrgyz Republic on a centralized system of information distribution inherited from USSR. In Soviet Union scientists were largely reliant on the resources of GSNTI USSR (see Chapter 4.1) which processed scientific information from many languages of the world into Russian. After the dissolution of this system and the emergence of mostly English Internet databases, the academic community in the country could not rapidly switch to a new source of information. As follows from the analysis of the survey the results of the “language barrier” are considered important by only 28% of young scientists (ages 20-29) as evident in Fig. 4-9.

Fig. 4-9 Language barrier: age distribution



An investigation into the statistics of EBSCO usage (Appendix 2) in the Kyrgyz Republic show that the American University of Central Asia, with English as a language of instruction, makes up a considerable portion of EBSCO users, although connectivity to Internet in this university is probably better in comparison with other universities.

The high price of accessing data is the third most important obstacle to scientific communication in the Kyrgyz Republic (30%).

Surprisingly, barriers related to computer and Internet turned out to be not so high: only 22% mention poor knowledge of computers and 24% have problems with searching for information in the Internet.

5 Conclusion

Today we are witnesses to revolutionary and epochal changes in scientific and technical communication associated with the emergence of ICT technologies, which are, as stated in The Okinawa Charter on Global Information Society "one of the most potent forces in shaping the twenty-first century". It is clear that under conditions of the rapid transformation of the STI system, industrialized countries with better access to new technologies and financial resources have considerably more opportunities for the advancement of information society thus leading to a widening digital gap. However, developing countries applying their energy appropriately have good chances to develop knowledge-based economies.

At present, discussions are still in progress concerning the degree of penetration of ICT technologies in the STI system and transformation speed. Evidently, extensive inertia in the academic society, not the inaccessible capabilities of modern technologies, is the limiting factor. Thus the co-existence of electronic and documentary communications can last for decades. Despite this, we eyewitness the birth of new, inconceivable possibilities for representing data, information and knowledge as well as new organized forms of research, such as on-line raw databases, virtual laboratories, e-print archives, etc.

An analysis of scientific communication in The Kyrgyz Republic demonstrates the dominance of global trends in the transformation of scientific communications, however the trends are expressed not so clearly in comparison with developed countries. Current research demonstrates that the involvement of the academic community in informal communications through the Internet is actively competing to be a substitute for direct scientist-to-scientist information exchange at conferences and seminars. Access to formal scientific information through electronic channels has also improved thanks to the considerable efforts of international donors and charitable foundations. However, the impact of research conducted in The Kyrgyz Republic for the advancement of science is still weak due to the predominance of publication in local low-circulation journals, reports and their consequently low "visibility". A survey of scientists demonstrates that preference rests with traditional paper journals. This can be explained to a large extent by the absence of electronic scientific journals in the Republic and the lack of incentives to publish in e-journals on the whole.

The study of obstacles for scientific communication allowed, firstly, the identification of a considerable dependency of the STI system in The Kyrgyz Republic on the availability of print books or journals in libraries, since they are the major source of information. Secondly, the study presented a serious language barrier facing almost every second scientist in The Kyrgyz Republic. The existence of this obstacle considerably limits the efforts of donor organizations which provide free access to resources in English to scientists. The most vulnerable group of scientists are older scientists who have a weaker command of the English language as compared with younger generations. The analysis of ICT-related barriers has shown that they are not high compared with language issues.

The national strategy "Information and Communication Technologies for the Development of The Kyrgyz Republic" states that "thanks to technological opportunities available, the policy should be refocused on the formation of an integrated information environment in the country and the development of information resources, data-bases, knowledge bases and information infrastructure, which can equally be used by both state bodies and the population in general". This policy applied to scientific and technical communication is formulated to establish the national scientific information system.

On the other hand, the Concept of the State Innovation Policy states that “practical results are achieved faster by concentrating resources on certain directions of the technological progress”. The directive of the Government “On the Approval of the Priority Fields List for the Development of Science and Critical Technologies List in the Priority Fields in Kyrgyz Republic in 2003-2005” provides an inventory of such priorities. One of the development alternatives for the national STI system is participation in collaboratories (virtual laboratories) in the science priority fields. Here, the accent is not mainly on the progress of the national STI system on the whole, but on specific scientific directions by the closest collaboration through Internet – that is defined as cross-national virtual collaboration. The experience of other developing countries, such as Brazil, entitles us to believe that in the case of due funding participation in collaboratories may advance a specific scientific direction in the country to the cutting-edge over a comparatively short period of time. Promoting collaboratories will directly address such problems as brain-drain and contribute to the ongoing training of qualified young scientists.

An analysis of the global tendencies and the situation in The Kyrgyz Republic demonstrate the necessity of a new integrated policy in scientific communication, formulated by all stakeholders (this topic is described in more detail in a policy paper based on this research (Djenchuraev 2004)). Stakeholders are those who can influence STI policy or who can be influenced by this policy, namely: government, scientists, academic communities, libraries and their associations, science publishers and their associations, etc. The integrated policy should include the proportional implementation of correspondent policies on telecommunications, computerization, the national system of scientific and technical information, the establishment of a correspondent legislative base and standards and the development educational programs considering priorities. Priorities include the accelerated development of components based on ICT technologies and, simultaneously, supporting paper technologies to a certain degree. Proportionality implies the simultaneous development of a legislative framework, the system of STI and education of scientists, librarians and publishers to avoid bottlenecks in the process of reforms.

This paper clearly demonstrates that there are all the necessary prerequisites to narrow a digital divide in scientific and technical communication of The Kyrgyz Republic. Much will depend on the coordinated efforts of all stakeholders involved.

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Appendix I. Study of Scientific Communication in Kyrgyzstan

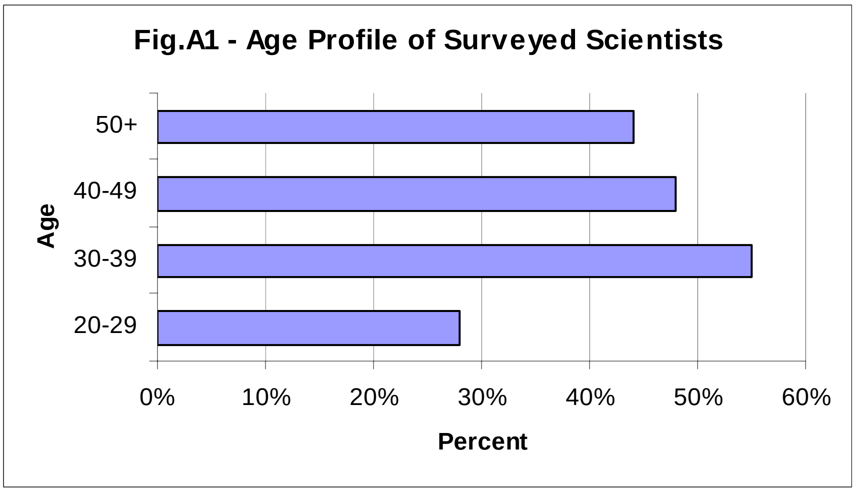
Methodology

The methodology used in this study included both quantitative and qualitative approaches. Three focus groups with scientists in Bishkek, Osh and Kara-Kol were conducted as well as one round table with librarians and, interviews and discussions with publishers and authorized body for scientific communication (The State Agency on Intellectual Property). A quantitative survey of academic society involving a random sample of 100 scientists in Kyrgyz Republic was carried out in September – November 2003.

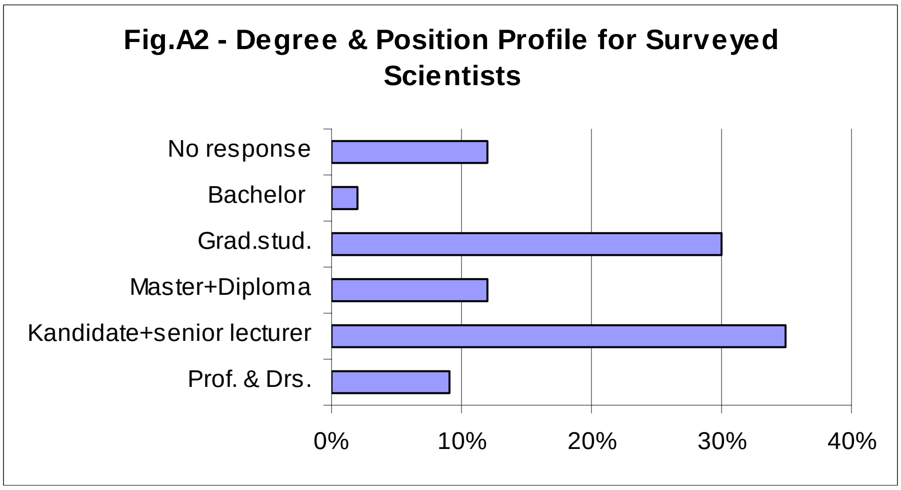
Profile of sample

The age, gender, qualification, and affiliation profiles of scientists surveyed are demonstrated below.

Referring to Fig.A1 it will be observed that young scientists represent one third of all scientists surveyed. The average age is around 37 y.o.

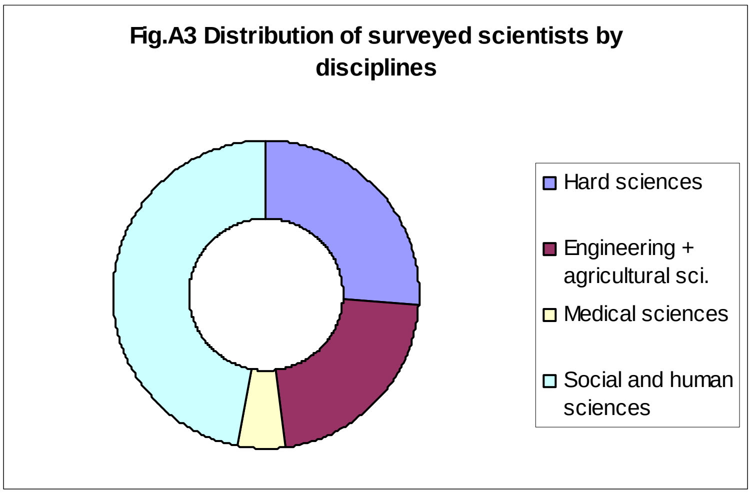


As for the gender ratio for scientists the sample turned to be uniform, i.e. equal number of men and women were surveyed 50%-50%.



It is evident from Fig. A2 that the largest part of scientists surveyed are represented by “kandidate” (first higher degree awarded on dissertation) and senior lecturers (35%). The share of graduates is somewhat less – 30%.

Figure A3 demonstrates a profile of surveyed scientists by discipline. The most represented turned out to be social and human scientists. Hard sciences and engineering are represented in smaller shares.



Appendix II. EBSCO Statistics - Kyrgyzstan

Session Usage Report Site: All Detail Level: site Period: March 2003 - March 2004

	Sessions		Requests							
Site	**Count**	**Average Length**	**Searches**	**Total Full Text**	**PDF Full Text**	**HTML Full Text**	**Image**	**Smart Link**	**Custom Link**	**Abstract**
AMERICAN UNIV IN KYRGYZSTAN	2390	11	7332	4472	1628	2820	24	3	0	4485
KYRGIZ-RUSSIAN SLAVONIK UNIV	317	14	484	2131	962	1169	0	1	0	465
NATIONAL LIBRARY OF BISHKEK	318	13	861	578	125	452	1	0	0	546
SOROS FOUNDATION - KYRGYZSTAN	194	17	540	350	188	158	4	0	0	69
MANAS UNIV CENTRAL LIBRARY	239	38	657	254	86	168	0	0	0	417
BISHKEK HUMANITARIAN UNIV	122	8	151	233	78	155	0	0	0	151

CENTRAL SCIENTIFIC LIBRARY OF NATL ACADEMY OF SCIENCES	84	16	122	138	22	116	0	1	0	167
LIBRARY AT THE INTL UNIV OF KYRGYZSTAN	77	20	526	95	8	38	49	0	0	25
STATE PATENT TECHNICAL LIBRARY	175	12	202	71	27	43	1	0	0	52
REPUBLIC LIBRARY FOR CHILDREN AND YOUTH	43	0	24	57	13	44	0	0	0	44
LIBRARY OF THE UN HOUSE IN KYRGYZSTAN	31	10	176	45	4	34	7	0	0	67
INFO CENTER OF KYRGYZ TECH UNIV	67	19	33	30	8	22	0	0	0	22
AMERICAN UNIV IN KYRGYZSTAN	9	0	29	12	6	6	0	0	0	13
TOKTOGUL REG OSH LIBRARY	23	44	39	11	2	9	0	0	0	15
KIRGHIZ MINISTRY OF HEALTH	5	15	7	6	6	0	0	0	0	18

KYRGYZ STATE MED ACADEMY	24	37	65	3	1	2	0	0	0	25
KYRGYZ RESEARCH INST OF ONCOLOGY RADIOLOGY	1	47	7	3	0	0	3	0	0	0
KYRGYZ STATE PEDAGOGICAL UNIV - WORLD LANGUAGES INST	20	7	0	0	0	0	0	0	0	0
Grand Total	4139		11255	8489	3164	5236	89	5	0	6581