THE INFORMATION IMPERATIVE:

A FRAMEWORK FOR MEASURING IMPACTS OF STM INFORMATION SERVICES AND STM INFORMATION ORGANIZATIONS

Prepared for

International Council for Scientific
and Technical Information

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July 14, 2003

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Abstract

This report presents results of a study prepared for the International Council for Scientific and Technical Information (ICSTI) by Bytown Consulting (Ottawa, Canada). This study was first initiated as a project by Canada Institute for Scientific and Technical Information (CISTI) to provide a framework for identifying and measuring impacts of scientific, technical and medical information (STM) services on the knowledge-based economy, and to describe the roles of STM information organizations in the context of national and regional innovation systems.[1] ICSTI subsequently decided to contribute to the CISTI initiative, to include the participation of several of its member organizations.

STM information is a foundation for innovative thinking. Technology is transforming the infrastructure that delivers highly specialized and other information to researchers and innovators in science, technology and medicine. Economic development and societal wellbeing depend on a well-informed intelligentsia. Decision-makers in industry, government, academia, and the non-profit sector are now more than ever better informed to make critical decisions that shape our future. A nation's ability to collect, store and deliver STM information impacts on its economic and social environment. The challenge is to measure the impacts in a credible and effective way.

What are the economic and social impacts of STM information services and STM information organizations that need to be measured? And how can these impacts be measured? These are central questions posed by this study. STM information organizations are currently challenged to demonstrate the added value of their role and services, particularly given advances made in data and information collection, storage, dissemination, and use. There is a need to determine the extent and value of these organizations, and to describe their impacts. In order to do this, however, an appropriate contextual framework for measuring impacts needs to be developed, as a starting point.

This study is based on a review of literature that deals with methods and results for assessing economic and social impacts, and a survey of STM information organizations. The intended outcome of the study is to provide information useful to STM information organizations in planning and carrying out impact assessments.

[1] The views expressed in this document are those of the author and do not necessarily represent those of the International Council for Scientific and Technical Information. The author is solely responsible for any errors or omissions.

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I Introduction: The Need to Measure Impacts

This document presents results of a study prepared for the International Council for Scientific and Technical Information (ICSTI) by Bytown Consulting (Ottawa, Canada). This study was first initiated as a project by Canada Institute for Scientific and Technical Information (CISTI). ICSTI subsequently decided to contribute to the study to include the participation of several of its members. Currently with forty-seven members from thirteen nations, ICSTI cuts across scientific and technical disciplines, as well as international borders. Headquartered in Paris, ICSTI provides a unique forum for interaction between organizations that create, disseminate and use scientific and technical information.[2] It seeks to reduce or eliminate barriers to effective transfer of information on a global basis, and promotes the value of scientific and technical information to the world's economic, research, scholarly, and social progress.

1.1 Purpose

The purpose of this study is to develop a framework for identifying and measuring impacts of scientific, technical and medical information (STM) services on the knowledge-based economy, and to describe the roles of STM information organizations in the context of national and regional innovation systems.[3] The intended outcome is to provide information useful to STM information organizations in planning and carrying out impact assessments.

The term "impacts" is used in this report to refer to external consequences attributable to STM information organizations, and to the services they offer to their customers. Impacts may be described as immediate, intermediate or final, direct or indirect, intended or unintended. This will be discussed in more detail in Chapter III.

In recent years the environment for STM information organizations has changed dramatically, with the introduction of digital technology and the wide availability of online access to STM information sources. The growth of the body of scientific knowledge and the ease of access to information are, without a doubt, unprecedented in human history. Yet, alas, the ability to measure the economic and social impacts of this growth in knowledge and access to information has not evolved in proportion.

Intuitively, however, most will argue that there are significant positive impacts. Judgment as to the extent of the impacts depends on the context, and on individual points of view. It is often too difficult or costly to pin down with great accuracy what these impacts are, or

[2] According to the "ICSTI Statutes" the words "scientific and technical" are to be interpreted in the broadest sense, and include *inter alia* the fields of pure and applied science, social and behavioral science, mathematics, and technology. The word "information" includes *inter alia* bibliographic information, textual information, factual information, and data, both numerical and non-numerical. These definitions are assumed here for the purpose of this document. See "ICSTI Statutes", Section 2, posted on the ICSTI website: "www.ICSTI.org/statutes.html".

[3] The "knowledge-based economy" is now a widely used metaphor to denote a dynamic economy that is driven by modern-day information and communication technologies (ICT) that enhance the creation, diffusion and use of knowledge. The "national innovation system" is discussed in Chapter II.

how they should be measured. Impacts may be conceptual and not proven, and the precision of the tools used to identify and track them varies.

Managers in publicly funded STM information organizations, and managers in the private and non-profit sectors, need to know the economic and social impacts of their products and services, to assess the performance and value of their initiatives within a broad societal context. The need to apply the best available methods for impact assessment is very real and a matter of some urgency. Government central agencies, private and other funding sources, STM information users and corporate decision-makers, all need to assess the value of their investments in STM information.

Competition for scarce funds compels decision-makers in the public, private and non-profit sectors to make strategic choices about their investments in, and access to, STM information. The challenge is to make the best investments in STM information infrastructures[4] based on a good understanding of their impacts. Yet the extent that decision-makers have the right measurement tools, to assess the value of STM information and STM information organizations, is lagging. The growth and adoption of knowledge-management techniques in corporate environments, and the recognition that the STM information infrastructure is an integral part of a country's innovation system, attest to the need to understand and accurately assess impacts.

1.2 Approach

The research for this study involved a review of literature dealing with methods and results of assessing economic and social impacts,[5] and a survey of STM information organizations.[6] The following two questions guided the research work:

- What is an appropriate framework for measuring the economic and social impacts of STM information services and STM information organizations?
- How can these impacts be measured?

Generally, the literature on evaluation of economic and social impacts of STM information, such as it is, has not adequately addressed these questions in a practical way, to help STM information organizations apply the analysis of impacts to their particular strategic planning or operational needs.

1.3 Participants

The following member organizations of ICSTI contributed funding and information for this research work:

[4] The phrase "STM information infrastructure" is used in this report in a broad sense that includes the physical facilities and technology used to collect, store, process, and disseminate STM information, as well as the information itself, the underlying standards and management practices, and the people involved.

[5] See Appendix C for a list of documents reviewed.

[6] See Appendix B for an overview of the survey.

- British Library (BL) – United Kingdom
- Cambridge Scientific Abstracts (CSA) – United States of America
- Canada Institute for Scientific and Technical Information (CISTI) – Canada
- Commonwealth Scientific and Industrial Research Organisation (CSIRO) – Australia
- Institut de l'Information Scientifique et Technique (INIST) – France
- Japan Science and Technology Corporation (JST) – Japan
- National Library of Medicine (NLM) – United States of America
- Royal Institute of Technology Library (KTHB) – Sweden.

The following organizations also contributed information included in this report:

- National Council for Science and Technology (CONACYT) – Mexico
- National Information System for Science and Technology (NISSAT) – India
- National Science Foundation (NSF) – Sri Lanka.

In addition, the International Development Research Centre (Canada) contributed some supplementary funding, to include in the study the role of STM information organizations in the economic and social growth of developing nations.

Fact sheets on the STM information organizations that participated in this study are provided in Appendix A. These fact sheets provide an overview of the strategic directions of each of these organizations, activity profiles and descriptions of the products and services they offer. The information contained in the fact sheets is derived from the survey conducted for this study, and from published literature and web sites of the respective organizations.

1.4 The Nature of this Report

The first premise for preparing this report is that there is value in describing measurable impacts of STM information services such as provided in the current literature. Chapter II describes where STM information organizations add value. In order to identify where STM information services add value, this chapter draws on the review of literature and the survey of the STM information organizations that participated in this study.

Chapter III of this document provides a framework to help address the research questions of this study: "What is an appropriate framework for measuring the economic and social impacts of STM information organizations" and "How can these impacts be measured?" Since there is little evidence from among the STM information organizations that participated in this study, or from the literature reviewed, of definitive approaches to measuring impacts, the second premise of this study is that there is value in establishing an appropriate framework for approaching this challenge.

This document seeks to lay out a framework for measuring impacts of STM information organizations, taking into account the importance of their contribution to the knowledge-based economy and the national (or regional) innovation system on the one hand, and the complexity of relationships and interactions involved in delivering STM information services on the other hand. The framework, however, is not intended to be a master plan for analysis of impacts of STM information organizations, but rather the purpose is to

provide guidelines for thinking about how these organizations could identify their impacts in a practical and credible way. The generic framework can then be tailored to suit the particular situation of each STM information organization, as deemed appropriate and consistent with its mission and mandate for service.

II Where STM Information Organizations Add Value

This chapter underscores the value of STM information services and STM information organizations in several areas of society including: national (or regional) innovation systems, research and development, health and wellbeing, business and industry, economic development, and education. The significance of the publishing side of STM information organizations is also discussed.

2.1 STM Information Organizations, R&D and Innovation

STM information is the cornerstone for building innovation systems and the knowledge-based economy. The "knowledge-based economy" is now a widely used metaphor to denote a dynamic economy that is driven by modern-day information and communication technologies (ICT) that enhance the creation, diffusion and use of knowledge. Throughout the world researchers and innovators in science, technology and medicine are working to create new products, improve processes, and discover new frontiers. Finding the right information fast can mean the difference between success and failure in achieving economic and social goals.

Developing new knowledge through innovation[7] provides an impetus for improved economic performance and social wellbeing. The dense and interconnected network that produces innovations based on scientific and technological advances is made up of a number of major actors—including universities, government agencies and labs, non-profit research institutions, and the private sector. This complex network of major actors, including the people, processes and outputs involved, constitutes what has come to be labeled as the "national innovation system".

A recent report of the OECD project on National Innovation Systems (a project that has spanned seven years) concluded that economic development and growth now relies more on innovation than ever before, and that information and communication technology is becoming more important for innovation as more knowledge is codified and becomes transferable through information networks. In particular, the report points out that:

> "Innovation reposes on economy-wide knowledge flows. Such flows have both market and non-market features, as exemplified by clusters and there are emerging markets for knowledge as outsourcing of R&D and service functions increases, and market mechanisms for knowledge commercialization through increased patenting and licensing are becoming more important." [8]

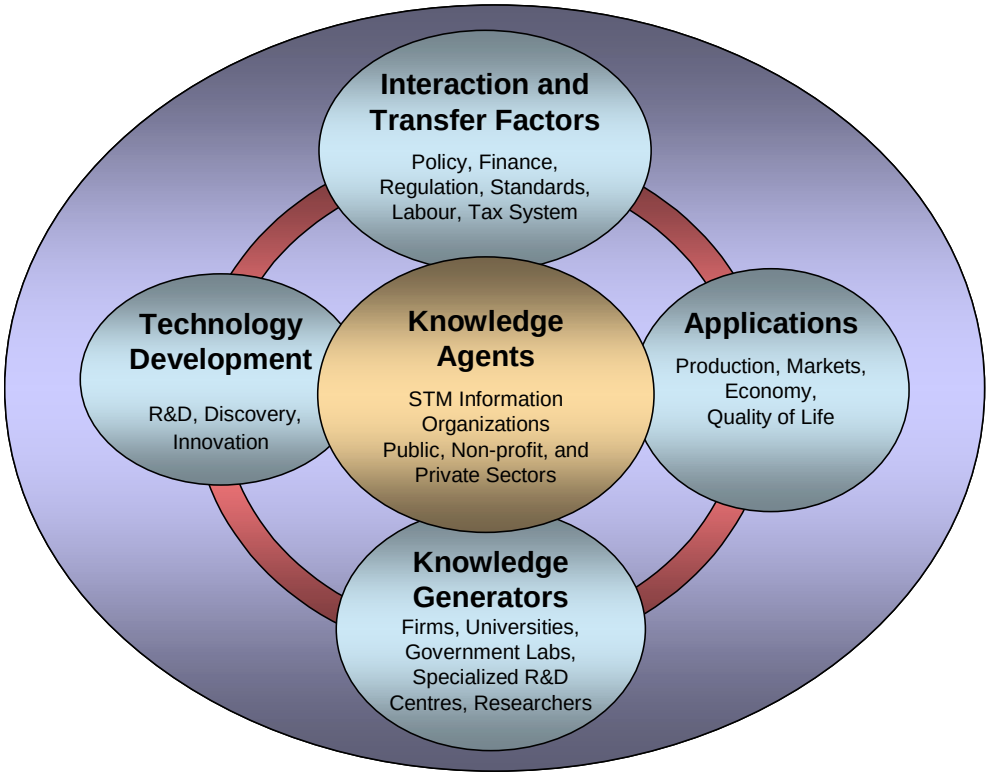
[7] Innovation is defined as "a process through which economic and social value is extracted from knowledge through the generation, development and implementation of ideas to produce new or improved products, processes and services" (as defined by the Conference Board of Canada, see *The Road to Global Best Leadership, Innovation and Corporate Culture*, Conference Board of Canada, Innovation Challenge Paper #1, Ottawa, May 2002, page 2).

[8] *Dynamising National Innovation Systems*, report of Organization for Economic Co-operation and Development (OECD), OECD Publications, Paris, 2002, page 13.

For this reason, among others, the report challenges developed and developing countries to establish National Innovation Systems (NIS) that encompass policies for managing knowledge, interactions and institutions that are the foundation of a country's scientific and technological R&D infrastructure, and to adopt a research agenda that focuses on complex mechanisms that promote knowledge distribution. How knowledge is created, diffused and used in the economy, is the underlying challenge in developing an effective innovative system. The role of STM organizations is a key link in this system—i.e., in that they are instruments, agents if you will, for the diffusion of knowledge.

Exhibit 2.1 is a very simplified depiction of a generic national innovation system, which positions STM information organizations as an integral part of the network—which includes the knowledge generators (in universities, firms, government labs, etc.); technology developers (through research, discovery and innovation); interaction and transfer factors (such as policies, regulations, and finance); and applications (for education, markets, quality of life, etc.). As the illustration shows, there are many

Exhibit 2.1: Positioning the STM Information Organization Within the Knowledge-based Economy and the Innovation System (Simplified)

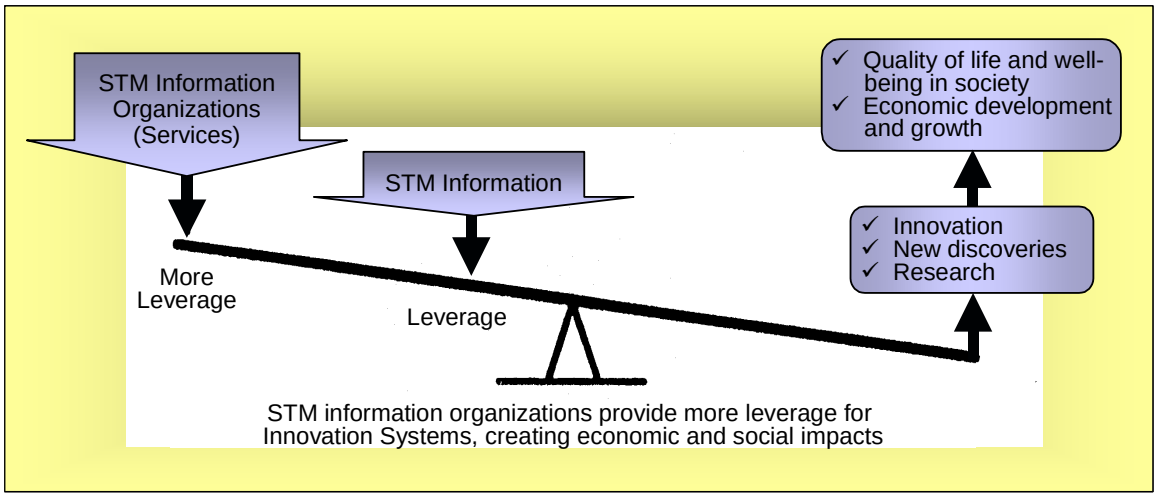


institutions, interaction and transfer factors that make up the system. Knowledge agents such as the STM information organizations can play an integral role if they are able to add value (i.e., provide speed and convenience in delivery, and quality and efficiency, at competitive costs).

The value added (or leverage as shown in Exhibit 2.2, below) of STM information organizations is the many information products and services that these organizations are able to develop and offer to their customers.[9] Beneath the highly touted wonder of the Internet lies the hard working knowledge workers who collect, store and distribute scientific, technical and medical information. Business successes, breakthroughs in medical research, and economic growth of nations, depend on access to highly specialized and other information. The value of information organizations only continues to grow, as they provide researchers in science, technology and medicine with indispensable information tools to support new discoveries and to better understand contemporary economic and social challenges.

Exhibit 2.2 demonstrates conceptually in fairly simple terms the leverage that STM information organizations exert on the national innovation system. Clearly, it is understood that the true picture of information dissemination and diffusion of knowledge is far more complex than the "teeter-totter" scenario, but intuitively this scenario is convincing. As one government official put it: "we all know that STM information organizations add value, so why do we need to measure impacts?"

Exhibit 2.2: Contribution of STM Information Organizations to Research and Innovation



While the OECD referred to the "innovation system" as a "national" system, STM policies and programs can also be regionalized or localized. For example, it is now valid to talk about a Europe-wide Innovation System with the coming of the European Union. Member states are now collaborating in S&T programs and initiatives, which take advantage of a vast and complex R&D infrastructure across the entire region. STM information organizations in Europe are now challenged to position themselves within this broad spectrum of opportunity and relevance.

It is also possible to refer to "local" innovation systems. Many governments have adopted national S&T policies that nurture "industrial clusters", to stimulate local

[9] Chapter III discusses the services provided by the eleven STM information organizations that participated in this study. Fact sheets on these organizations in Appendix A provide more details about these services.

innovation and economic development. Industrial clusters are geographic concentrations of similar and often intimately related industries. They evolve over time and present competitive advantages that are hard to duplicate by any other means. The industries operating within well-established clusters usually share technical knowledge, financial, or structural advantages. Industry clusters typically include highly specialized supply-demand relationships and dependencies that serve to tightly bind the component industries.

Typically, these geographic concentrations lead to the development of specialized skills, institutions, and alliances within the cluster. Businesses enjoy a collective regional advantage by locating near each other. They more easily acquire information, communicate, and share resources. These are all key factors to the success both locally and internationally of the cluster and of its member groups.[10]

STM information organizations are now also challenged to integrate their services within these highly dynamic innovative environments. Several concrete examples of initiatives to localize STM information services in industrial clusters were found in the programs of STM information organizations that participated in this study. Local information centres are set up by these organizations, to support the activities of local researchers, and to provide integrated information services and information specialists to provide scientific, technical, medical and related business information.

2.2 Business and Industry Impacts

Productivity, job growth, competitiveness, and commercialization of technology are some of the business imperatives that industry is preoccupied with. R&D and innovation contribute to industry's needs on all of these fronts. Information services also contribute. In a landmark 1995 study sponsored by the Special Libraries Association (Washington D.C.) the authors, Matarazzo and Prusak, examined the attitudes and perceptions of 103 senior managers with budgetary responsibility for the library facilities of their company, as a way of evaluating the performance of the corporate library and of gauging its perceived value as a resource to the organization. They found that there is a positive correlation between a company's information-related expenditures and their profit and/or productivity.[11] STM information organizations, as knowledge agents for R&D and innovation systems, can and do play a vital role in providing elements needed for discovering business solutions that contribute to industry successes.

But what kind of information is needed for business use by industry? One of the research papers reviewed for this study attempts to itemize the information needed by industry, and the uses that this information is needed for.[12] Exhibit 2.3 lists the information types, information processes, and information uses identified by this study. While this may not

[10] *Silicon Valley North: Regional Clustering in Canadian Technology Industries*, by Samir Rostum, unpublished paper, Princeton University, February 2000, page 3.
[11] *The Value of Corporate Libraries: Findings from a 1995 Survey of Senior Management*, by James M. Matarazzo, with Laurence Prusak, Special Libraries Association, Washington, D.C., 1995.
[12] *The importance of information*, by David Kaye, Library Management, MCB University Press, Volume 16, Number 5, 1995, pp. 6-15.

be an exhaustive list, it serves to indicate the complexity and all-pervasiveness of information for any organization in industry, or otherwise for that matter.

Exhibit 2.3: Information for Business and Industry

Information Types	Information Processes[13]	Information Uses
The main types of information are as follows: – Numerical data and their derivatives – Factual knowledge – Instructions and commands – Requisitions, orders and requests – Reports and accounts – Codes and guidelines – Narratives and descriptions – Publicity, public relations and advertisements – Opinions and interpretations – Evaluations and critiques – Arguments, debates and discussions.	The following are some of the processes to which information can be subjected: – Recording, filing and storing – Editing and publishing – Copying, reprography and printing – Tabulation – Collation – Analyzing and interpreting – Criticizing and evaluating – Classifying, cataloguing and indexing.	The main purposes for which information can be used are: – Learning and understanding – Teaching, instructing and training – Discovering and inventing – Problem solving – Decision making and choosing – Informed action and operation – Justifying, explaining and accounting – Selling and marketing – Image creation – Persuading, influencing and manipulating – Domination and subordination – Misleading, deceiving and betraying.

So now we can ask: What is the value-added that an STM information organization can bring to this landscape? The answer lies in the information-processing component of the list drawn in Exhibit 2.3. By acting as an efficient and effective information processor, the STM information organization can bring value to industry, and thereby contribute to achieving economic impacts for the firm and by extension for the economy at large. This is the underlying essence in the quest to measure impacts of STM information organizations on business and industry. The link between the information itself, the processing of the information and the use to which the information is put is the mechanism by which impacts occur. This will be discussed further in Chapter III, where a framework and logic model that links STM information services (the processing component) to results (the impacts) is developed.

2.3 Health and Wellbeing of Society

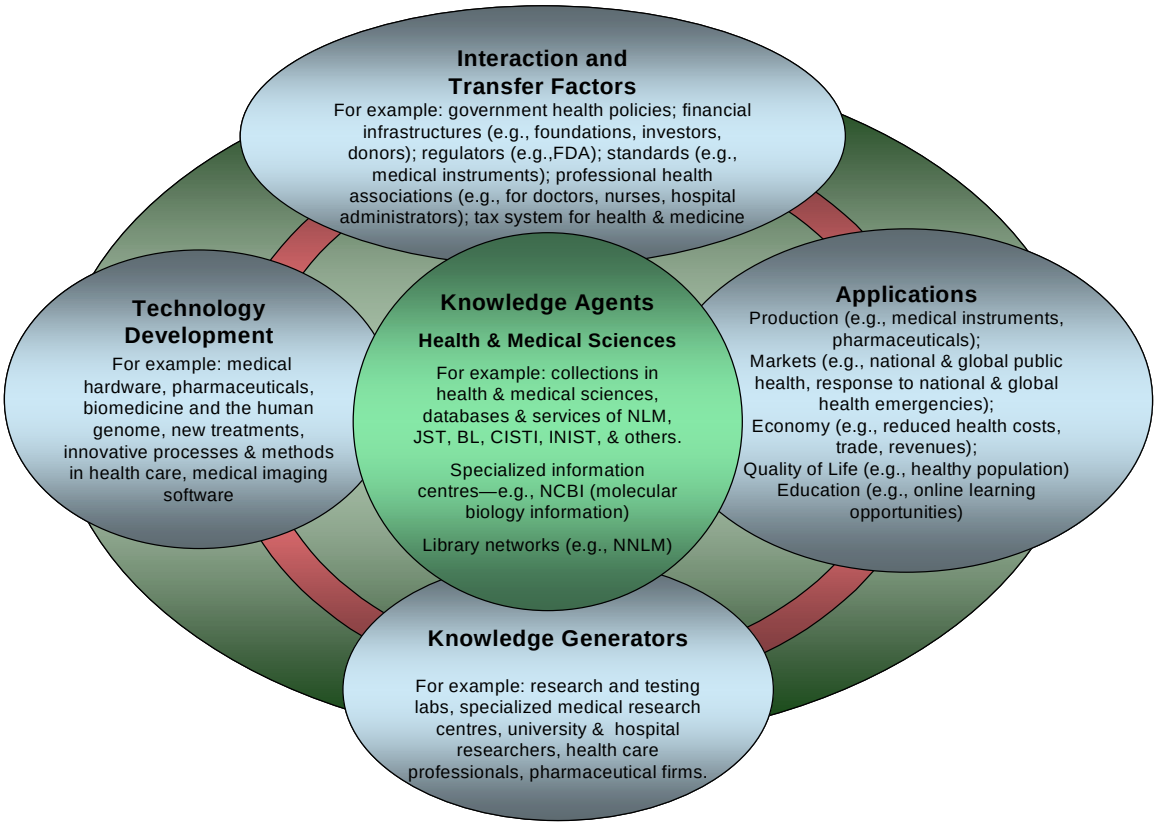
One of the most, if not the most, dynamic fields where knowledge is growing at exponential speed is health and medical science. Globally, the leading STM information organization in this field is the National Library of Medicine. Other STM information organizations also have large medical collections and information services that are ever growing, such as the British Library, the Japan Science and Technology Corporation, Canada Institute for Scientific and Technical Information, Institut de l'Information Scientifique et Technique, and others.[14]

[13] It should be noted that Exhibit 2.3 does not list all possible information processes of STM information organizations.
[14] See the fact sheets in Appendix A for more information on these organizations.

Keeping up with the rapid advances in medical technologies and adapting to the changing health needs of society, are two of the major challenges facing the health and medical science information field. These challenges are amplified by trends such as the aging of populations, the growth of new generations of viruses (such as SARS), the increased travel between nations and continents which globalizes the spread of diseases, and humanitarian crises caused by wars and natural disasters. Given these challenges, the role of STM information organizations as agents of health knowledge is critical. Exhibit 2.4 positions the health and medical sciences information organization within a national health system that is also an integral component of the knowledge-based economy.

Health and medical science represents one of the major sectors within the national innovation system, with its intricate institutional infrastructure, complex interactive factors, and related technological and economic trends (see Exhibit 2.4). In the U.S., for example, some economists estimate that medical research is an investment with a return

Exhibit 2.4: Positioning the Health and Medical Science Information Organization Within the Knowledge-based Economy and the Innovation System (Simplified)



that should be measured in the trillions of dollars. In 1998, health expenditures in the United States accounted for 12.9 percent of national income—the highest share of income devoted to health in the developed world. The United States also spends more on medical research than any other country—in 2000 the federal government dedicated $18.4 billion to it, compared to $3.7 billion for the entire European Union. In a recently

published book, leading health economists ask whether the U.S. is getting its money's worth.[15] They find the answer is "yes".

From the evidence presented in a series of papers in this book, among the authors' conclusions are the following: that the historical gains from increased longevity have been on the order of $2.8 trillion annually from 1970 to 1990; that medical advances producing 10 percent reductions in mortality from cancer and heart disease alone would add roughly $10 trillion (a year's GDP) to national wealth; and that the average new drug approved by the FDA yields benefits worth many times its cost of development. When these numbers are compared against the amounts the U.S. federal government has invested annually in medical research over that same period of time, the gains seem to more than justify the expenditures.

On the other hand, expenditures on health and medical information dissemination are only a small fraction of the total government expenditures on medical research. The budget estimate for the NLM, for example, for fiscal year 2003 is $306 million. Compared to similar government appropriations for other STM information organizations, in the U.S. and around the world, this may seem like a lot of money, but it represents well less than 2 percent of U.S. government appropriations on medical research. When put in the context of the recently published findings on returns from research, mentioned above in the Murphy and Topel book, it seems like only a small amount is allocated to dissemination and flow of knowledge generated from the U.S.'s multi-billion dollar investment in the medical sector.

While there are many examples in the literature on the socio-economic impacts of medical research, there is a paucity of research on the impacts of health and medical information organizations. One pertinent research paper focuses on developing a taxonomy of the contributions of library and information services (LIS) in hospitals and academic health sciences centers.[16] The preliminary taxonomy that emerges from this research is based on a review of the literature, twelve semi-structured interviews with LIS directors and institutional administrators, and a focus group of administrators from five academic, teaching, and non-teaching hospitals. This taxonomy offers a good framework for the collection of both quantitative and qualitative data in support of communicating the value of LIS in hospitals and academic health sciences centres. Exhibit 2.5 illustrates a selection of findings from this study about some of the areas of expected results of STM information delivered by libraries and information services. The areas are categorized by "organizational mission concepts" listed as follows: clinical care, education, research and innovation, and service (a fifth area, manage operations, is not included in Exhibit 2.5). The LIS information services are expected to achieve results relevant to each of these mission concepts—such as "support informed and timely clinical decision making", "promote academic excellence", "provide information necessary to prevent duplication of

[15] *Measuring the Gains from Medical Research: An Economic Approach*, edited by Kevin M. Murphy and Robert H. Topel, University of Chicago Press, Chicago and London, 2003.

[16] *The contributions of library and information services to hospitals and academic health sciences centers: a preliminary taxonomy*, by Eileen G. Abels, Keith W. Cogdill, and Lisl Zach, College of Information Studies, University of Maryland, published in *Journal of the Medical Library Association*, 90(3), July 2002.

Exhibit 2.5: Preliminary Taxonomy: The Value of Library and Information Services (LIS) in Hospitals and Academic Health Sciences Centres[17]

Organizational Mission Concept	Organizational Goals	LIS Contributions [i.e., expected results/impacts]
Clinical care	Provide excellent clinical care	Support informed and timely clinical decision making. Support the development of policies and procedures relating to clinical care.
	Promote clinical learning	Provide new knowledge and substantiate prior knowledge about clinical practice. Inform users about current developments in clinical practice.
Education	Provide excellent educational programs	Enhance educational programs. Promote academic excellence. Promote satisfaction with quality of educational programs.
	Provide resources and services necessary for teaching and learning	Support the identification of information resources to be used for instruction. Provide easy and convenient access to information resources. Provide information about developments in information technologies and resources. Support preparation for licensing, certification and re-certification examinations.
Research and Innovation	Foster research	Support research-related needs. Provide information necessary to prevent duplication of research efforts. Participate on research grants.
	Adopt innovative technologies and practices	Support development of innovative technologies and practices. Support the use of innovative technologies and practices. Disseminate information about developments in information technologies and resources. Provide leadership in information management for the organization.
Service	Improve lives of patients and families	Support the education of patients and families on health-related issues. Educate patients and families about information resources and the evaluation of health information.
	Improve lives of community members	Support the education of community members. Educate community members about information resources and the evaluation of information.

[17] See Appendix in *The contributions of library and information services to hospitals and academic health sciences centers: a preliminary taxonomy*, by Eileen G. Abels, Keith W. Cogdill, and Lisl Zach, *Journal of the Medical Library Association*, 90(3), July 2002, page 284.

research efforts", and "support the education of patients and families on health-related issues".

An upcoming follow-up article by the authors of the research paper referenced above (Abels, Cogdill, and Zach) is expected to introduce a systematic approach to identifying and communicating the value of library and information services (LIS) from the perspective of their contributions to achieving organizational goals. The approach to be proposed by the authors involves seven steps: "selecting appropriate organizational goals that are meaningful in a specific setting; linking LIS contributions to organizational goals; soliciting data from users on the correspondence between LIS contributions and LIS services; selecting measures for LIS services; collecting and analyzing data for the selected measures; planning and sustaining communication with administrators about LIS contributions; and evaluating findings and revising selected goals, contributions, and services as necessary."[18]

Later in Chapter III of this current ICSTI/Bytown report, a framework for analyzing impacts is developed for STM information organizations, starting from the strategic contexts of these organizations. Chapter III starts by describing the strategic contexts of each of the eleven STM information organizations that participated in this study, then it links the services provided by these organizations to the intended impacts. The framework presented in Chapter III is a generic framework, but is adaptable to the health and medical science field, and to other economic or industry sectors.

Another research paper worth noting in this section of the report involves determining how the NLM's MEDLINE database, the world's largest storehouse of health information, "makes a difference" in what physicians do, when confronted with a medical problem requiring new or additional information.[19] The results of this research show that MEDLINE searches are being carried out by and for physicians to meet a wide diversity of clinical information needs. The following specific aspects of clinical problem solving were affected: choice of the most appropriate diagnostic test; recognition and proper diagnosis of a medical problem or condition; development of an appropriate treatment plan; implementation of a treatment plan; maintenance of an effective physician-patient relationship; modification of patients' health behaviours; and discharge of responsibilities to third-party payers (e.g., for eligibility for worker's compensation or receipt of insurance benefits).

The above noted research paper concludes that a wide range of benefits has been derived by physicians being able to gain rapid and, in many instances, direct access to the biomedical literature. These benefits include life saving and limb or organ-sparing consequences for patients, as well as reduced costs of care and the quality of care given. Benefits relating to the efficiency and safety of health care institutions, the outcomes of medically related litigation, and the public's understanding of health issues. MEDLINE is being used to support decisions regarding individual patients, and is also used to obtain crucial information under emergency circumstances, often with dramatic results.

[18] Quote from abstract of paper provided by authors, submitted for review prior to publication.
[19] *Use of MEDLINE by Physicians for Clinical Problem Solving*, by Donald A.B. Lindberg; Elliot R. Siegel, Barbara A. Rapp, Karen T. Wallingford, and Sandra R. Wilson, *The Journal of the American Medical Association*, June 23/30, 1993.

Though the MEDLINE database is often used under emergency circumstances, other services of STM information organizations have also been developed to address health related emergencies. A notable service in this category is the "hot topics" service that quickly responds to health emergencies such as the current situation with severe acute respiratory syndrome (SARS). The MEDLINEplus health information service of NLM is providing a very useful SARS focal point on its web site with information for doctors and patients (see http://www.nlm.nih.gov/medlineplus/severeacuterespiratorysyndrome.html). This kind of ready access to timely information is an added value of STM information organizations, for the public and medical professionals alike, to be better informed to effectively deal with disease and the consequences of disease.

Furthermore, the need for this kind of responsive service appears to be growing, particularly with the increased globalization of access to information, and the ability of STM information organizations to reach out to crises wherever they happen in the world. The global reach of MEDLINE, and NLM as an STM information organization, is testament to the value of information services. The appetite for pertinent information during times of crises is not confined to STM professionals. The public at large also hungers for relevant, reliable information provided by STM information organizations. Usage surveys, that organizations that participated in this current ICSTI study conduct periodically, show that public access to STM information services is on the rise. With the continuing advances in the Internet, it is now possible to package all kinds of STM information applications that serve an ever-widening clientele.

One of the methods used to identify benefits of health and medical information services is to identify research transcripts that make explicit mention of how the services were used, and what kind of impacts they had. The National Center for Biotechnology Information (NCBI),[20] for example, can cite numerous examples of the benefits derived from their services. Exhibit 2.6 lists just a sample of such citations. These examples may be described in technical specifics, but they nonetheless make a point about the significance of NCBI, and the real and potential impacts of their services.

Another approach to demonstrating impacts of STM information organizations in health and medical science, and other fields, is by demonstrating success through testimony made by members of the STM community. Two examples from the British Library make a case in point:[21]

Testimony 1:

> "The FBI closed the offices of the National Enquirer's publisher, American Media Inc., after a photo editor, Bob Stevens, died from the extremely rare inhaled form of anthrax and a colleague was found to have been exposed to the bacillae. Three of American Media's six tabloids—the *Enquirer*, *Globe* and *Star*—were scheduled to go to press as more than 100 employees lined up outside a clinic in Delray Beach to be screened for anthrax. Against this backdrop of alarm the British Library was called upon to support investigations by journalists needing to understand and report on what was happening."

[20] NCBI is part of NLM. See the fact sheet on NLM in Appendix A for a brief description of NCBI's services and activities.

[21] See references to complete testimonies in *From Knowledge to Innovation: Twenty-ninth Annual Report 2001/2002*, British Library, London, 2003.

Testimony 2:

"Dr Wilf Powell, a research programme leader in invertebrate Ecology, finds the British Library fundamental to his work: 'Scoping a project requires a thorough literature search to make sure that we're advancing ideas and not repeating mistakes. Then as we progress we keep an eye on any new developments.' As the work moves to commercial trials, the British Library continues to play a role, keeping biotechnology, pharmaceutical and agricultural businesses abreast of newly published experimental work, which they may want to bring to market."

Exhibit 2.6: Sample of Citations Concerning Benefits of NCBI Services

1. Over 200 potential prostate specific/abundant transcripts were identified by comparison of SAGE libraries for cancer cell lines to those at NCBI.

Xu LL, Su YP, Labiche R, Segawa T, Shanmugam N, McLeod DG, Moul JW, Srivastava S. Related Articles, Links
Quantitative expression profile of androgen-regulated genes in prostate cancer cells and identification of prostate specific genes.
Int J Cancer. 2001 May 1;92 (3) : 322-8.
PMID: 11291065 [PubMed – indexed for MEDLINE]

2. PCR-amplified transcripts derived from the Trabecular Meshwork of a 67 year-old eye were compared to UniGene sequences to find candidate genes important in Glaucoma. The authors stress the importance of UniGene in their work and used UniGene reports to see patterns of tissue-specific expression and to get chromosomal locations for their candidates.

Gonzalez P, Epstein DL, Borras T. Related Articles, Links
Characterization of gene expression in human trabecular meshwork using single-pass sequencing of 1060 clones.
Invest Ophthalmol Vis Sci. 2000 Nov; 41 (12) : 3678-93.
PMID: 11053263 [PubMed – indexed for MEDLINE]

3. Galperin's paper on using NCBI resources to find drug targets in pathogenic microbes.

Galperin MY, Koonin EV. Related Articles, Links
Searching for drug targets in microbial genomes.
Curr Opin Biotechnol. 1999 Dec;10 (6) : 571-8. Review.
PMID: 10600691 [PubMed – indexed for MEDLINE]

4. Authors used the NCBI human genome assembly and UniGene to help characterize NPHP4, one of 4 genes implicated by linkage analysis in Nephronophthisis, a frequent cause of kidney failure in young adults. They found that the gene coded for a novel protein that they called nephroretinin.

Otto E, Hoefele J., Ruf R, Mueller AM, Hiller KS, Wolf MT, Schuermann MJ, Becker A, Birkenhager R, Sudbrak R, Hennies HC, Nurnberg P, Hildebrandt F. Related Articles, Links
A gene mutated in nephronophthisis and retinitis pigmentosa encodes a novel protein, nephroretinin, conserved in evolution.
Am J Hum Genet. 2002 Nov: 71 (5) : 1161-7.
PMID: 12205563 [PubMed – in process]

Another testimony is from CISTI's experience:

Testimony 3:

"The development of new medicines is an extremely challenging responsibility," explained Dr. Daniel Bouthiller, Director of Research Administration. "On the one hand, patients urgently need new treatments that are more effective and better tolerated. On the other hand, the field of pharmaceutical innovation is extremely competitive on a global basis; research centres need to be at the leading edge. It is critical for world-class R&D organizations, such as the Merck Frosst

> Centre for Therapeutic Research, to be able to count on CISTI in order to be at the forefront of scientific knowledge and ensure the leadership of Canadian innovation."[22]

There are also numerous other similar testimonies that STM information organizations participating in this study could cite, to demonstrate benefits of their services from the perspective of their customers.

2.4 Information Infrastructures for Economic Development

The Secretary-General of the International Telecommunication Union (ITU), Mr. Yoshio Utsumi, said in one of his addresses "to build the information-oriented society we do not necessarily require those pre-conditions that helped to create the industrial revolution such as the accumulation of wealth to be able to invest in the facilities for mass production. What you need is creative individuals and a comparatively smaller amount of investment in ICT [Information and Communication Technology] infrastructure", and "ICTs may help countries to leapfrog the development process by moving directly to an information-driven society…."[23]

To realize the benefits of an information-driven society, possessing the means to get information to the people who need and use it is essential. Consequently, for the past two decades or so, developed and developing countries alike have been busily working to modernize their information "pipelines" (i.e., their electronic and telecommunications infrastructures). It is now a common opinion that without these pipelines it is not possible for a nation to be part of the modern world, and to participate in the benefits of economic prosperity. The absence of an information pipeline built on modern technology is what has come to be known as the problem of the "digital divide". The digital divide means, "between countries and between different groups of people within countries, there is a wide division between those who have real access to information and communications technology and are using it effectively, and those who do not".[24]

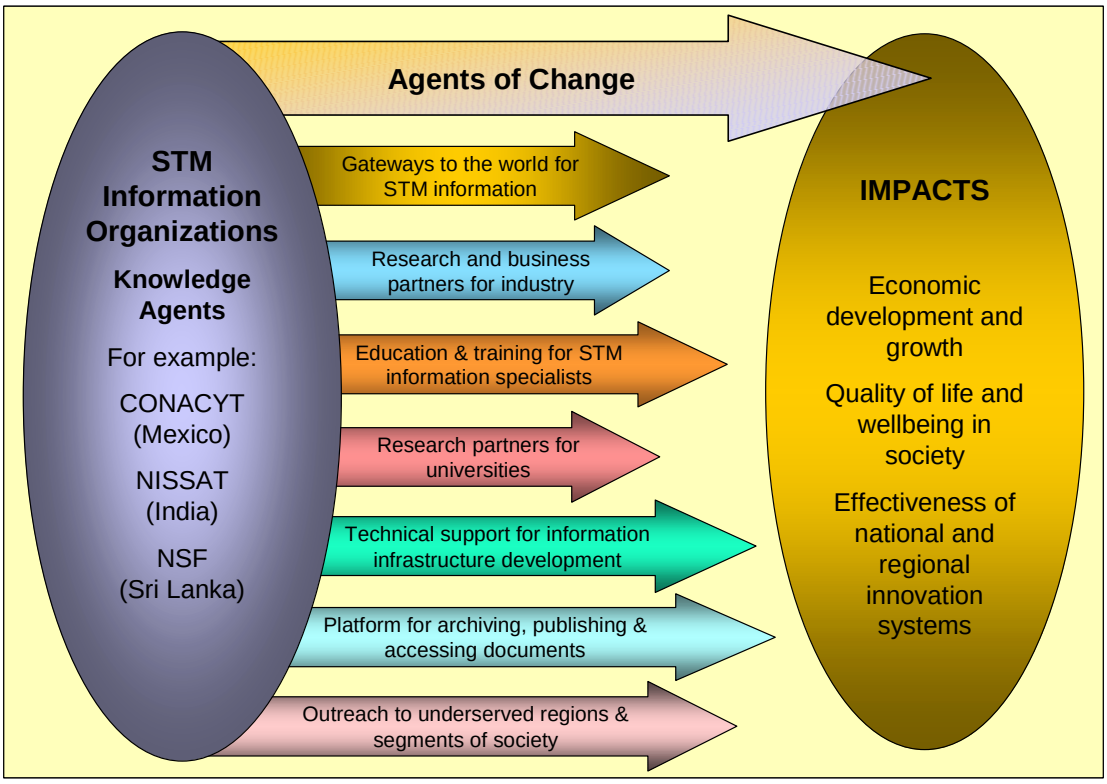
Notwithstanding the benefits of modern communications technology, one can argue that having access without content (i.e., something to communicate—information) would be a pretty useless investment. Eight decades ago when the late Iyyanki Venkata Ramanayya who is considered the "architect of the public library movement in India" decided to organize the Bengal Library Conference in 1925, he invited Dr. Rabindranath Tagore as Chairman of the reception committee.[25] At that time Dr. Tagore in his opening address asked: "What makes a library big?" And he answered, "it is not the big building, …, the

[22] "CISTI Success Stories 2001-2002", unpublished notes provided to author from CISTI staff personal project files.
[23] *The Rise of the Information Society*, by Yoshio Utsumi, Secretary-General of the International Telecommunication Union— a brief two-page speech delivered to the United Nations General Assembly, New York, June 17-18, 2002.
[24] See definition of "digital divide" in http://www.bridges.org/digitaldivide/. Bridges.org is an international non-profit organisation with a mission to help people in developing countries use information and communications technology (ICT) to improve their lives.
[25] Rabindranath Tagore (1861-1941) was Nobel laureate for literature (1913), and was one of modern India's greatest poets and the composer of independent India's national anthem.

big finances and big staff that makes the library big, but it is the big use of the contents of the library that earns the big name to it."[26]

So now we can ask: Where do STM information organizations add value for economic development? The value of STM information organizations for economic development is proportionate to their ability to transform themselves from agents of knowledge to agents of change. Exhibit 2.7 illustrates what this transformation entails. From the research undertaken for this current ICSTI study of three well-developed developing countries, India, Mexico and Sri Lanka, it seems clear that there is a very important role for STM information organizations to play in economic development. The respective STM information organizations in these countries—National Information System for Science and Technology (NISSAT) in India; National Council for Science and Technology (CONACYT) in Mexico; and National Science Foundation (NSF) in Sri Lanka—are all active as agents of change. The fact sheets in Appendix A show that the menu of STM information services and activities offered by these organizations is comparable to those of the other nations that participated in this study. The framework for evaluating impacts presented in Chapter III of this report is therefore equally relevant for these STM information organizations as it is for the other participants.

Exhibit 2.7: STM Information Organizations as Agents of Knowledge and Agents of Change For Economic Development



The scenario shown in Exhibit 2.7 is not only applicable to developing nations, but it is

[26] Excerpt from *The Value of Books, Information and Libraries, A Review and Analysis*, by P.N.Kaula, in Herald of Library Science, V36, N1-2, January-April, 1997, page 66.

also very true for developed nations when organizing and delivering their own information outreach programs, to reach rural or remote areas, and to certain segments of society that may not have access to important information that they need (for example, for health and wellbeing).[27]

To conclude this section, it is worth noting that in a context of economic development it is certainly understood that people cannot live on information alone. But it is also quite true that all nations, for better or worse, are now in an age where the consequences of information-oriented activities play a major part of GDP. The packaging and delivery of STM information in particular, has now become key to competitive advantage for business, in both developing and developed nations alike. STM information is also a key for societal health and wellbeing. The pipeline by which STM information is made accessible is necessary, but not sufficient. STM information organizations in developing countries should now seize the opportunity to deliver highly specialized and other information services, to all locations where its use is needed, through initiatives that foster economic growth and development. The framework discussed in Chapter III can become a tool to measure how effective these organizations are in becoming agents for change for economic development.

2.5 Role of STM Information Organizations in Education

Delivery of STM information services is not only a key for competitive business advantage and for societal health and wellbeing, but also for education. STM information organizations play a vital link in the national library system, contributing to establishing linkages and collaborative arrangements between academic libraries. In doing this, they have a dual purpose: to support the education system, at all levels, in educating future generations; and to provide STM information services for researchers in academic institutions, laboratories, and teaching hospitals.

All eleven participating STM organizations in this study provide their services to educational institutions. Exhibit 2.8 shows the percentage of customers from educational institutions that make use of the services of these STM information organizations. The data provided in this Exhibit is based on survey responses from each of the organizations.

Because of the increasing costs of collections and subscriptions, and the financial burden of acquiring new technology, and training for it, national STM organizations are finding new opportunities for collaborating with libraries in academic institutions. As part of the national system of libraries, STM information organizations can play a leadership role, to coordinate and facilitate national network-wide initiatives—to help achieve economies of scale in the system, to facilitate licensing agreements, and to develop standards and guidelines. They also help train information specialists to acquire the appropriate skills in new technology and library work.

[27] NLM for example has an active "outreach program" which targets underserved parts of the U.S. population, particularly ethnic minorities, the elderly, non-English speaking individuals, and Americans living in rural areas.

Exhibit 2.8: STM Information Service to Educational Institutions

STM Information Organization	Approximate Percentage of Customers from Educational Institutions
BL	50
CISTI	50
CONACYT	55
CSA	80
CSIRO	Researchers at CSIRO are main customers
INIST	Up to 30
JST	15
KTHB	Large proportion 70 to 80
NISSAT	10
NLM	60
NSF	30

2.6 Significance of the Publishing Side

All of the public sector STM information organizations participating in this study have a traditional role in STM publishing (e.g., journals, monographs, guidelines, standards, educational materials, scientific bulletins). This tradition has grown, in part, out of a prevailing conviction that STM information could be considered a public good. With the increasing emergence of STM information as a valued commodity in society, conflicts and complexities have arisen in some of the previously assumed publishing modalities that effect the advancement of knowledge. Commercial interests are guarding their publishing rights with licensing practices that restrict access to scientific and technical information. And now the division between public and commercial publishing interests has been blurred by the need to extract information from multiple public, academic and commercial sources in order to advance knowledge in many STM fields. This development has readjusted the underlying supply and demand economic model for STM publishing, with increasing cost implications for researchers and innovators in science, technology and medicine. New library consortiums and licensing agreements have evolved to combat the rising tide of commercialism in the world of scholarly communications.

The debate between public-good and public-interest approaches to publication, and the established scientific tradition of openness serving the advancement of science, on the one hand, and the commercial economic model on the other hand, is alive and well throughout the scientific publishing community. And now the coming of e-publishing has made this debate even more turbulent than before. With e-publishing, new and innovative modalities have been inserted into the situation.

The future of the debate is still uncertain, and so a most cogent argument arises to continue to support the publishing side of STM information organizations. This argument is that the STM community is better served through a variety of publishing models, until our understanding matures about the implications of evolving commercialism in scholarly communication, and about the economic impacts of e-publishing on the advancement of STM knowledge.

III A Framework for Measuring Impacts

This chapter provides a framework that establishes a context for measuring impacts of STM information services and STM information organizations. This framework is designed to encompass a wide range of strategic objectives and services of STM information organizations. Different organizations may share most or only a few of these objectives and services, so the framework would need to be tailored to each situation. A logic model that traces plausible relationships between STM information services and their impacts is also presented in this chapter. In addition, performance indicators and methods for analysis of impacts are identified.

3.1 Strategic Context of STM Information Organizations

Understanding the strategic context of STM information organizations is essential to establish a framework for measuring impacts. This section provides an overview of the strategic context of the STM information organizations that participated in this study. More information about the positioning of each of these STM information organizations is provided in the fact sheets in Appendix A.

BL—The British Library is a worldwide leader in the provision of STM information to the scientific, technical and medical community. By any measure it is considered one of the top three world research libraries in terms of both its collection and expertise. Its strength is in its international capability. At the same time, the British Library has maintained its position as the national library in the United Kingdom. It is the key player in improving the effectiveness and efficiency of the UK's library network, as well as the leader in maintaining the national archives. It is positioned as the national centre for reference, study and bibliographic and other information services, in relation both to scientific and technological matters and to the humanities. It is the main library in the UK that serves institutions of education and learning, other libraries and industry. The BL is mandated by Parliament to operate under the British Library Act (1972). As an organ of the Department for Culture, Media and Sport, it is a public sector organization that serves the public at large as well as business, academic and government institutions, not only in the UK but also all over the world.

CISTI—The Canada Institute for Scientific and Technical Information is one of the institutes of the National Research Council (NRC), which in turn is one of the agencies of the Federal Department of Industry Canada. CISTI has a dual responsibility: to provide scientific and technical information support to the other NRC institutes and labs, and to provide STM information products and services to the Canadian science and technology community at large, including researchers and innovators in business, government and university institutions. CISTI's mandate as written in the NRC Act, is to "establish, operate and maintain a national science library" and "publish, sell and otherwise distribute scientific and technical information". CISTI serves all the scientific disciplines and technologies at NRC. CISTI's broader mission is to support the research and innovation communities by managing and disseminating high-value scientific, technical and medical information products and related services, and by so doing to help achieve Canada's economic and social goals.

CONACYT—The National Council for Science and Technology (CONACYT) was established in 1970 to implement the government of Mexico's policies on science and technology. Its mission is to foster the advancement of science and technology by allocating public funds for the support of research and advanced training, and by the dissemination of scientific and technological information. Through national and affiliated regional centres it implements various programs aimed at improving the S&T infrastructure of the nation. The mandate of CONACYT is derived from the Special Law of Science and Technology. CONACYT delivers a number of information services which are aimed at supporting educational institutions, industry and government R&D facilities, to result in an innovative, productive and competitive society.

CSA—Cambridge Scientific Abstracts is a private organization not affiliated with government institutions. CSA is committed to aggressively broadening access to the latest thinking in the sciences and social sciences. It operates with a large customer base mainly from academic institutions (universities and colleges), but private sector organizations, and government research laboratories and science and technology departments also use its products and services. CSA's content coverage includes the life sciences, environmental and aquatic sciences, computer sciences, materials science and engineering, aerospace, social sciences, and humanities.

CSIRO—The information services of the Commonwealth Scientific and Industrial Research Organization are directed mainly at CSIRO scientists and their collaborators. An extensive library network serves the internal needs of the organization. CSIRO is helping to build the scientific and technological infrastructure necessary for Australia to meet the challenges of national competitiveness and sustainability. The staff of CSIRO is focused on providing new ways to improve the quality of life of Australian citizens, as well as the economic and social performance of a number of industry sectors through research and development.

INIST—The mission of the Institut de l'Information Scientifique et Technique is to collect, analyze and disseminate the results and findings of worldwide research in science, technology, medicine, humanities, economics and social sciences. INIST is a CNRS service unit created in 1988. CNRS is the National Centre for Scientific Research, which is France's scientific and technological government agency under the authority of the Deputy Minister of Research. INIST serves scientists and researchers in public S&T institutions such as CNRS, in the academic world (universities and engineering schools) and in the private sector. It aims to promote knowledge transfer in the research and industrial worlds, and to contribute to the dissemination of S&T culture by participating in national and international events, and by promoting public awareness of the contributions of S&T to society.

JST—The Japan Science and Technology Corporation, as an organization that implements national science polices, is engaged in a broad range of activities such as the promotion of creative basic research, processing and disseminating scientific and technological information, and encouraging technology transfer for starting up new businesses. JST promotes information activities as a core organization in the field of scientific and technological information in Japan. JST is an organization that acts under

the Ministry of Education, Culture, Sports, Science and Technology. JST's role is one of being a primary government STM information organization directly aligned with the science and technology policies of the national government. A high priority of JST is developing new partnerships (e.g., with private organizations, public institutions and universities). Another high priority is continuously improving the organizational efficiency and delivery of STM information services.

KTHB—The Royal Institute of Technology Library (KTHB) serves as a resource centre to support the teaching and researching goals of the Royal Institute of Technology (KTH), and to provide quality national information services in the field of engineering and related disciplines. The Royal Institute of Technology itself provides one-third of Sweden's technical research and tertiary level education. KTHB is part of a national network of eleven resources libraries aimed at bringing S&T information in the service of Swedish society. It is the largest of the Swedish libraries for technology and basic sciences (physics, chemistry and mathematics), has the largest group of subject information specialists in the country and leads the Swedish consortium of technology libraries Teknologibiblioteken. One of KTH's goals is to cooperate with the public and industry for the development of society and as such, KTHB is working more specially with the Office for Industry Contacts providing information searches in support of consulting activities.

NISSAT—The National Information System for Science and Technology (NISSAT) is a division of the Department of Scientific and Industrial Research (DSIR), Government of India. NISSAT commenced its operations in 1977 with the objective of organizing information support facilities for people engaged in research and academics. NISSAT has the mandate to cover the entire spectrum of science and technology. NISSAT is directly aligned with national innovation, science and technology policies of India, and it aims to strengthen the library movement in the country through the introduction of modern information technology, tools and techniques; and through the development and promotion of existing national information services.

NLM— The National Library of Medicine is on the campus of the National Institutes of Health in Bethesda, Maryland, and is the world's largest medical library. It is a publicly funded organization, which is part of the U.S. Department of Health and Human Services. The NLM is a key player in the development of a national medical scientific knowledge network (for example, it is a key participant in CENDI, an interagency working group of senior scientific and technical information managers from nine U.S. Federal Agencies, representing 85 percent of the U.S. public sector R&D). NLM is positioned as the national resource for all U.S. health science libraries through a National Network of Libraries of Medicine (NNLM). The goal of the NNLM is to provide U.S. health professionals, researchers, educators, and administrators, and the public, with timely, convenient access to biomedical and health information resources. The NNLM program is a core component of NLM's outreach initiatives.

NSF—The National Science Foundation of Sri Lanka is the major provider of scientific and technical information in that country. As an organization that is part of the Ministry of Economic Reform, Science and Technology, the role of NSF is one of being a primary government STM information organization. It has broad responsibilities to deliver S&T

services, but it also has the mandate to function as the main STM information organization in Sri Lanka. The Sri Lanka Scientific and Technical Information Centre (SLSTIC) is the division of the National Science Foundation that provides a national focal point of information on science and technology.

3.2 Identifying the Intended Impacts

The narrative in the previous section, the information provided in the fact sheets in Appendix A, the literature reviewed, and responses to the survey and interviews with representatives of STM information organizations, all imply that these organizations generally endeavour to have impacts in the areas listed below, to one degree or another, and with different emphasis in terms of subject specialty areas and sectors of society:

- Economic Impacts: Economic Development and Growth
  - Help decision makers in private sector companies make informed decisions
  - Accelerate business performance in industry
  - Improve productivity in private corporations
  - Enhance competitiveness of small and medium-sized enterprises
  - Help private sector organizations save time and money.

- Social Impacts: Quality of Life and Wellbeing in Society
  - Provide opportunities for improving the health system and advancing medical science
  - Support STM educational institutions in their mission to teach future generations
  - Improve the quality of work and work environments
  - Enhance the health, safety and security of citizens
  - Improve the standard of living in society
  - Help public and non-profit sector organizations save time and money.

- STM Policy Impacts: Effectiveness of the National (or Regional) Innovation System
  - Improve decision-making for government STM programs and policies
  - Increase the innovative capabilities of national and regional R&D organizations and personnel
  - Help researchers be more effective to make new discoveries and create new knowledge
  - Support technology diffusion and improve the environment for the transfer of new technology to commercial uses.

The STM information organizations that participated in this study undertake activities, including collecting, storing, and disseminating STM information, publishing and developing information products and services that are intended to help achieve impacts relevant to the areas of impact listed above, to one degree or another.

3.3 STM Information Services

A strategic context by itself is necessary but not sufficient to establish a framework for measuring impacts. It is also important to understand the menu of services offered by STM information organizations to establish a workable framework. The services are the tools for delivering information to the customers. They are the instruments by which impacts are created.

Exhibit 3.1 provides an overview of services offered by the STM information organizations that participated in this study. Clearly, there is a robust menu of activities

Exhibit 3.1: STM Information Services—Instruments for Creating Impacts[28]

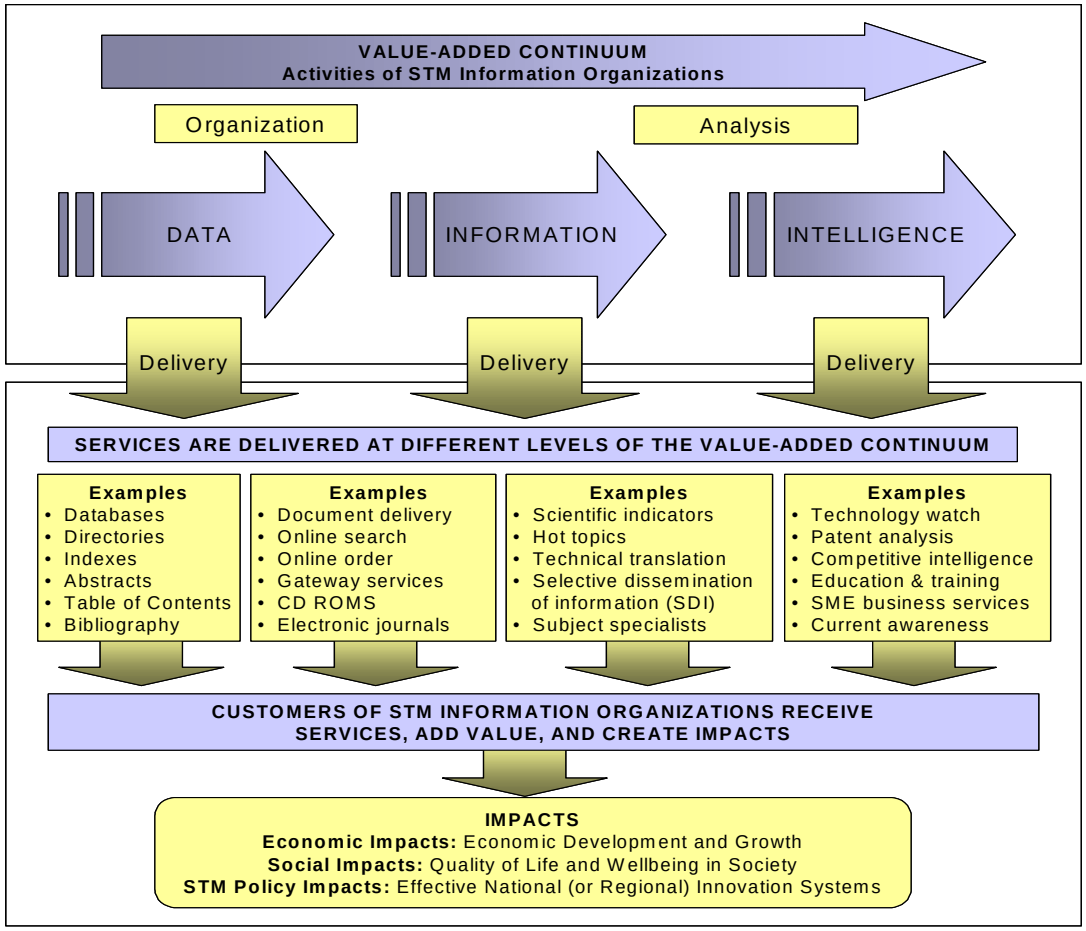
STM Information Services	STM Information Organizations										
	BL	CISTI	CONACYT	CSA	CSIRO	INIST	JST	KTHB	NISSAT	NLM	NSF
Document delivery (books, journals, articles, theses, conference reports, official publications, grey literature, etc.)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Catalogues (including bibliographic and scientific index information, serials)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Search abstracts, table of contents	✓	✓	?	✓	✓	✓	✓	✓	✓	✓	✓
Research publications (journals, monographs, educational materials, etc.)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Editorial and peer review	✓	✓	?	?	✓	✓	✓	?	?	✓	?
Producing or giving access to electronic journals	✓	✓	?	✓	✓	✓	✓	✓	✓	✓	✓
CD-ROM catalogues and databases	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Directories of research information (including government funded R&D projects)	✓	✓	✓	?	✓	✓	✓	?	✓	✓	✓
National registries/directories of institutions/companies/STM investigators	✓	?	✓	✓	?	✓	✓	✓	✓	✓	✓
Gateway services to international sources of STM information	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Technology watch and information alert services (e.g., biblio-alerts)	✓	✓	?	✓	✓	✓	?	?	?	✓	✓
Hot topics service (issues in the news)	✓	?	✓	✓	✓	?	?	?	?	✓	?
Online access to various databases, catalogues, and ordering services	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Library network service (partners, licensed collaborators, other national libraries)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Regional/local/cluster information centres	✓	✓	✓	?	?	?	?	✓	✓	✓	✓
Customized bibliography and database management modules	✓	✓	?	✓	?	✓	?	?	?	✓	?
Education and training for information specialists, researchers and students	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Tailored services for small and medium-sized enterprises	✓	✓	✓	?	?	?	✓	✓	✓	?	✓
Business information and consulting service	✓	✓	✓	?	?	✓	✓	?	✓	?	✓
Subject specialists service	✓	✓	✓	✓	?	✓	✓	✓	✓	✓	✓
Formal unit for competitive technical intelligence (CTI) services[29]	?	✓	?	?	?	?	?	?	?	?	?
Current awareness and selective dissemination of information (SDI)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Public STM awareness activities and events	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Patent search and/or analysis	✓	✓	?	?	✓	✓	✓	✓	✓	✓	✓
Technical translation service	?	?	✓	?	?	✓	✓	?	✓	✓	✓
Scientific and technological indicators databases	✓	?	✓	?	?	✓	?	?	✓	?	✓
Preservation and collection management	✓	?	?	?	?	?	?	?	?	✓	?
SMS—short-messaging service (mobile) alerts on status of library documents	?	?	?	?	?	?	?	✓	?	?	?
Reading rooms, onsite electronic access, walk-in and reference customer service	✓	✓	✓	?	?	✓	✓	✓	?	✓	?

[28] ✓ = service.
? = not identified, in development, or no service.

[29] Although no formal CTI units were identified as a part of the organizations in this study, most of the organizations deliver CTI in one form or another through various other services (e.g., technology watch), and subject specialists. Some of the organizations either have considered or are considering establishing a formal CTI unit as part of their service portfolio.

and delivery instruments by which these organizations can and do provide value-added services to their customers. These delivery instruments can roughly be described along a progressive sequence of value (a continuum), corresponding to the underlying level of organization and analysis of data and information delivered. Exhibit 3.2 is a depiction of this continuum. The underlying premise of the continuum is that the more organization and analysis is built into the services, the more value is delivered to the customer.

Exhibit 3.2: A Continuum of Value-Added by STM Information Services



This presumption is valid only if several prerequisites for delivering STM information services are satisfied. In addition to potential users being aware of the availability of the services, the prerequisites are as follows:

- that the service is accessible and easy to use,
- that the service provides accurate information,
- that the information is provided in a timely fashion,
- that the information is relevant for the customer's purpose,
- that the quality of service is of the highest standard, and
- that the service is affordable and provided at competitive prices.

Furthermore, the value-added continuum does not preclude the possibility of a high return resulting to the customer from a service provided on the left side of the continuum, or conversely a low return from a service provided on the right side.

The delivery of information services, in and of themselves, does not necessarily create the kind of impacts that are described in the previous section of this chapter—i.e., economic impacts (economic development and growth), social impacts (quality of life and wellbeing in society), and STM policy impacts (effectiveness of the national, or regional, innovation system). The customers of STM information services (e.g., researchers and innovators in science, technology and medicine) carry out additional activities and value-added initiatives (e.g., research and development, new discoveries, commercialization of technology, better processes and standards, new business transactions, improved health services), and it is these additional activities that are more directly linked to impacts on society. The difficulty in measuring the broad societal impacts and attributing results to the services of STM information organizations is evident, in that these organizations are usually indirect (though important) contributors to the work of others.

The review of literature on measuring impacts (see Appendix C for a selected list of relevant documents reviewed) resulted in the following key findings:

- The analysis of impacts is mostly focused on measuring the costs and value of library and information services—emphasizing user satisfaction with access, timeliness, accuracy, ease of use, and quality of services. This is known as the traditional program or service model for evaluation, which incorporates the traditional library measurements of input, activities and outputs.

- Measures of impacts in terms of STM policies and innovation are mostly focused on the role of research and development per se, and not on the role of STM information services.

- Assessments of the value of STM information and STM information organizations are mostly focused on service and service value from the perspectives of the user, based on soft (qualitative and some quantitative) information derived through feedback mechanisms such as surveys, focus groups, or word of mouth.

- Not surprisingly, there is a lot of discussion in the literature about taxonomy of information, how best to use new technology to organize and disseminate information, and the role of information in the decision-making process. But there is not much in the literature that provides a framework for analysis of impacts (exceptions include very narrowly focused cost-benefit applications) to help in addressing the challenge of valuing STM information organization services.

In short, this current ICSTI study did not find much in the literature on STM information organizations that provides clear evidence of best practices for analyzing impacts—from a strategic perspective in terms of near to long-term societal results, particularly in an economic, social or STM policy context. One excellent exception, however, is work funded by the Institute of Museum and Library Services and undertaken by the University of Michigan and University of Washington. This initiative, called "How Libraries and Librarians Help", is focused on the role of the public library in helping citizens obtain community and other information. This initiative, in the opinion of the author, is indeed a "best practice" for developing outcome evaluations of public library services. A toolkit and other relevant documentation on this initiative are available at http://www.si.umich.edu/libhelp/toolkit. The approach proposed here in this chapter of

the current ICSTI report, for evaluating impacts of STM information organizations, is consistent with the approach for public libraries presented by the University of Michigan and University of Washington.[30] Clearly, however, each STM information organization requires a customized framework, that is context-centred, and focused on its particular mission and mandate for service.

3.4 Logic Model – Linking Services to Impacts

There is likely no one model for measuring impacts that fits all needs, because the strategic context and menu of services of different STM information organizations are not identical. However, there are enough similarities to enable one to formulate a generic framework for measuring impacts that could then be tailored for individual use.

To be able to trace a chain of results attributable to the STM information organizations, one needs to discover the logical linkages (i.e., cause and effect) between STM information services and impacts, and visually array these linkages in a "logic model".[31] The findings from this study, including the evidence derived from interviews with STM information organizations, and the review of various documents obtained from these organizations (see Appendix C), as well as the survey results, all suggest the following:

- The linkages between services and impacts are not necessarily direct, but more likely through a results chain—that starts from the activities undertaken by an STM information organization, to the products and services offered, to direct, intermediate and final outcomes.

- Generally, the linkages between services and impacts may be conceptual and not proven. The more indirect the results the more difficult it is to attribute the impacts to the STM information organization. Societal results involving economic growth and development, quality of life and wellbeing, and overall effectiveness of national or regional innovation systems, are indirect and difficult to quantify.

- STM information services, by their very nature, may contribute to multiple results. These services are provided to many clients for many reasons, and results will vary depending on the purpose, and the scope and value of assistance.

- The results may be influenced by multiple organizations and multiple services—and by external factors that are not in the control of the STM information organization. There are no STM information organizations that have a complete monopoly on information and services in any single field, although some organizations do dominate in certain specialties. Increasingly, competition between STM information organizations in offering services has become globalized.

[30] *How Libraries and Librarians Help—Putting Outcome Evaluation in Context: A Toolkit*, a project led by Joan C. Durrance, School of Information, the University of Michigan, and professor Karen E. Fisher, The Information School, University of Washington—web link: www.si.umich.edu/libhelp/toolkit.

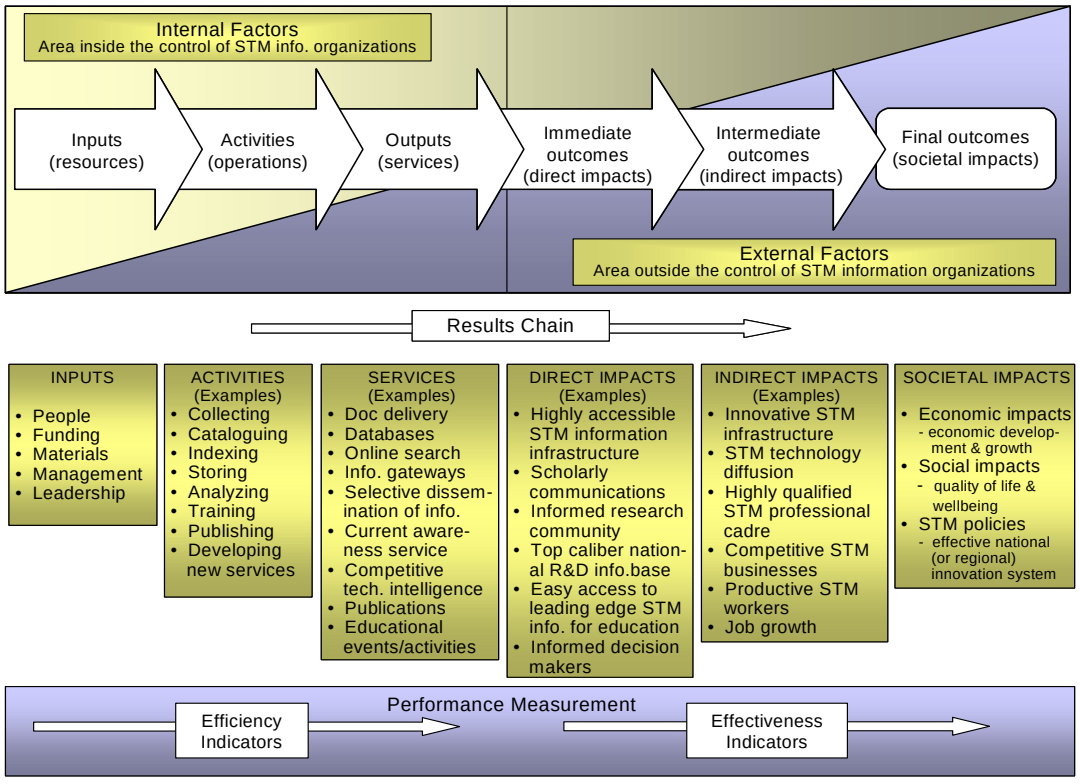
[31] Logic models are systematic and visual ways to present and share ones understanding of the relationships among resources to operate a program, the activities planned, and the changes or results that are to be achieved. A good reference on logic models is *Logic Model Development Guide*, published by W.K.Kellogg Foundation, Battle Creek, Michigan, December 2001.

- The tools used to track and measure results of STM information services vary in their precision—depending on methodologies used, and services measured. Some services are likely to have a more direct and greater impact depending on their position along the value added continuum (see Exhibit 3.2).

- Capacity and resources devoted to the task of measuring impacts of STM information organizations are generally insufficient. In times when budgets are cut or frozen, revenues are declining and costs increasing, the challenge of measuring impacts is forfeited, not surprisingly in favour of the actual delivery of services.

Exhibit 3.3 depicts the results chain and illustrates the study findings listed above. The services are the tools an organization has, to deliver results. To the extent that these tools are more direct (for example, competitive technical intelligence), their impacts are more discernable and attributable to STM information organizations. On the other hand, the more indirect the service (for example, providing access to a directory of databases), the more difficult it is to attribute a linkage between the individual service and impacts. The difficulty of attributing results to STM information organizations increases as the focus of analysis shifts to the societal level of impacts—i.e., economic and social impacts.

Exhibit 3.3: Logic Model: Linking Services to Results



In relation to the left-hand side of Exhibit 3.3, the literature on measuring results is replete with examples of methods and indicators of *efficiency*.[32] All the STM information organizations that participated in this study, to one extent or another, frequently measure

[32] *Efficiency* is the extent to which an STM information organization is producing its planned services within an appropriate budget, and on time.

the efficiency of their services using well-honed efficiency indicators. The right-hand side of Exhibit 3.3, however, is concerned more with the *effectiveness*[33] of the delivery instruments (the services) used to create impacts. To the extent that the intended impacts occur, and to the extent that these impacts are attributable to the STM information organization, and consistent with its mission and mandate for service, the delivery instruments would be deemed effective.

For private sector STM information organizations the results may "speak for themselves" if sales are robust. However, for public sector STM information organizations, success in achieving results usually needs to be measured in the context of a government accountability framework, and not necessarily in terms of revenue gains. Public sector organizations are held accountable to their respective finance or treasury departments, and of course to the public and business taxpayers. The need to measure results and effectiveness in creating desirable societal impacts is therefore important within this context.

There are many issues and constraints involved in delivering STM information services—including management systems, availability of resources, marketing, customer needs, and service standards. It is also possible, therefore, that the tools for delivering STM information services in themselves may be effective instruments, but that the capacity of the STM information organization is such that it is unable to effectively make use of these tools. A capacity assessment of the organization (e.g., involving resources, personnel, management and leadership issues) would be needed to evaluate overall organizational performance and effectiveness in achieving intended impacts. In other words, an evaluation of the effectiveness of services in creating the intended impacts should also address issues involving the inputs (depicted in the far left of the chart in Exhibit 3.3). It should be noted here, that the focus of this report is mainly on the right-hand side of the chart—i.e., on measuring results, and not inputs.

3.5 Methods and Indicators to Measure Impacts

Now that a general (generic) framework for measuring impacts has been outlined, it is possible to suggest individual indicators and related methods for measuring impacts that are relevant to this framework. Exhibit 3.6 will highlight these suggested indicators and methods. But first, examples of some of the measures sometimes used by STM information organizations, and how these organizations obtain feedback, are summarized in Exhibit 3.4 and Exhibit 3.5, respectively.

A large proportion (82 percent) of the STM information organizations participating in this study said that they use narratives to describe the successes that their clients are able to attribute, in some way, to the STM information services they provide. These narratives are usually in the form of a "story line" that describes how the service made a difference in the customer's work—for example, in terms of time saved, costs cut, or spin-off benefits that create an advantage for the customer over competitors.

[33] *Effectiveness* is the extent to which an STM information organization, through the service it offers, achieves its planned outcomes.

Exhibit 3.4: Measures of Impacts

Examples of Measures of Value and Benefit	STM Information Organizations Reporting Some Use of this Measure (Sample of 11 Organizations)	
	Number	Percent
Impacts on successful business decisions	5	45
Impacts on successful government policy decisions	4	36
Cost-savings impacts for clients	4	36
Revenue generation impacts for clients	6	55
Discoveries resulting from information services provided by the STM information organization	5	45
Technology improvements or new products/services resulting from information provided by STM information organization	5	45
Client narratives about various successes attributed to the STM information services	9	82
Clients' returns on investment in information services from the STM information organization	5	45

Another important indicator is the extent to which the STM information service resulted in generating new revenues for the customer. Forty-five percent of STM information organizations mentioned that they try to track this indicator, though not necessarily on a regular basis.

Other indicators used by almost half of the organizations responding to the survey are: discoveries resulting from information services provided by the STM information organization; impacts on successful business decisions; technology improvements or new products/services resulting from information provided; and clients' assessments of their return on investment in information services. While these indicators are sometimes used by the STM information organizations to value their services, they are costly to track down with a great deal of scientific accuracy, and hence are generally collected on an ad hoc basis.

Other indicators used by STM information organizations to measure the value of their services are as follows:

- In private sector organizations, the key indicators used to measure value are the renewal rates for subscriptions, and purchases of service offerings measured in sales and revenues. For Internet delivered services, customer usage data is also a value indicator—e.g., number of access sessions, hits, downloads.

- In public sector organizations that provide fee-based services, the main measure of value is revenue generation, although related usage statistics are also tracked regularly, such as speed of service, ease of use, comprehensiveness of collection, and quality of service.

None of these indicators, however, give a read on the kinds of impacts described in the previous sections of this report: namely, economic and social impacts, and STM policy-related impacts.

In any selection and application of indicators to assess impacts, the methods for collecting the required information have to be practical, affordable and effective. As part of the survey of STM information organizations participating in this study, key measures that these organizations use for getting feedback from customers were identified. Exhibit 3.5 summarizes the methods used.

The most obvious and dominant method is through "personal contacts". All respondents to the survey said they do this. These personal contacts occur at different levels of the organization, both informally and formally. Informal contacts are made, for example, through phone conversations and correspondence, over lunch, and during meetings and networking events such as symposia, conferences, workshops, etc. Personal contacts are also made during formal events such as committee meetings, advisory board sessions, consultative fora, focus groups, and so on.

The next most prevalent form of obtaining feedback from customers is through routine service and client satisfaction feedback forms. Seventy-three percent of respondents said that they have a feedback system that relies on standardized forms. These forms are either received in hardcopy directly from the clients, or via an Internet-based module, or over the phone via a helpdesk representative who poses standard questions designed to solicit client satisfaction information and comments.

Exhibit 3.5: Methods for Getting Feedback from Customers

Examples of Measures for Getting Feedback from Customers	STM Information Organizations Reporting Some Use of this Measure (Sample of 11 Organizations)	
	Number	Percent
Through personal contacts	11	100
Regular mail-out surveys	5	45
Online (e.g., web-based) surveys	4	36
Routine service and client satisfaction feedback forms	8	73
Audits of information services	5	45
Client forums/events (e.g., focus groups, workshops, roundtable discussions)	7	64

Other methods of obtaining feedback from customers utilized by STM information organizations involve surveys of user opinions, structured and unstructured interviews, and consultative forums organized to obtain feedback. Formal and comprehensive program evaluation studies are also undertaken, particularly in the U.S. and Canada.[34]

Exhibit 3.6 is a compilation of results on impacts indicators and methods and data sources for collecting information, as gleaned from the literature on impacts, and identified to be relevant to the key impact areas outlined in Section 3.2 of this chapter.

The information provided in Exhibit 3.6 is a generic set for measuring impacts, and from which an approach could be customized for different STM information organizations by selecting components that suit individual needs and purposes. However, based on consultations made for this study, and the review of literature, some challenges need to be pointed out in customizing this framework for specific needs:

- Validating conceptual linkages between specific STM information services and impacts is challenging.
- The measurability of impacts varies in level of precision, and quantitatively attributing results to services may be difficult.
- The timeframe for achieving impacts due to a particular service may be long and could pose problems. Often in an R&D context, impacts are only realized over several years.
- In measuring impacts, accounting for external factors that the STM information organization cannot control is not easy.

Notwithstanding these challenges, a context-centred evaluation framework for each STM information organization, based on an outcomes approach such as that proposed in this chapter, has the potential to be a powerful tool, to help STM organizations substantiate the claims that they know to be true about the impacts they have on the STM community, and society at large.

[34] See for example, *A Guide to Planning and Evaluating Health Information Outreach*, Catherine M. Burroughs, Principal Author, National Network of Libraries of Medicine, and Fred B. Wood, National Library of Medicine, September 2000; and *From Strategy to Impact—Benchmarking Study for the Evaluation of the Canada Institute for Scientific and Technical Information (CISTI)*, by Hussein Rostum for CISTI, National Research Council, Ottawa, 2000.

Exhibit 3.6: Indicators and Methods to Measure Impacts

Impacts	Effectiveness Indicators	Methods and Data Sources
Economic Impacts: Economic Development and Growth		
➢ Help decision-makers in private sector companies make informed decisions	Evidence of critical decisions made that led, for example, to company successes, in sales, revenue gains, cost savings, improvement in work conditions, and client satisfaction; and that can be attributed to an STM information service. Renewals of subscriptions and registrations to STM information services, by decision-makers in industry. Opinions of private sector decision-makers about the value of the STM information services they invested in.	Survey of subscribers/registrants and other users Interviews with decision-makers Analysis of subscriber/registrant records and statistics, by service offerings and reach Review of feedback forms Benchmarking analysis of costs and benefits
➢ Accelerate business performance in industry	Extent to which STM information organization has enabled the development and commercialization of technologies that produce economic benefits. New products/services resulting from information provided by STM information services. Jobs created or saved as a result of STM information provided. New technologies or processes developed and used that led to accelerated business performance in industry—and that are in some way attributable to STM information services.	Survey of subscribers/registrants and other users Interviews with business users of services Review of feedback forms Case studies and success stories
➢ Improve productivity in private corporations	Extent to which STM information organization worked in partnership with industry, to implement information services that help enhance productivity. Degree to which services provided helped to increase the capacity of industries and firms to adopt and use more efficient and effective new technologies and practices. Benchmarking comparisons of productivity between businesses with access to STM information services.	Survey of service recipients, including subscribers/registrants and other users Analysis of effectiveness of partnerships Benchmarking analysis of technology use and productivity of users of information services
➢ Enhance competitiveness of small and medium-sized enterprises	Extent to which STM information services proved critical for SMEs in responding to business opportunities—e.g., to gain access to national or international markets. Evidence of increased returns on investments made by SMEs that resulted from services provided by STM information organization. Contribution of STM information service in helping SMEs bring new products to market quickly	Survey of subscribers/registrants and other users Interviews with business users of services Review of feedback forms Case studies and success stories
➢ Help private sector organizations save time and money	Evidence of time and money saved due to services rendered and any multiplier effects resulting in efficiencies gained. Benchmark comparisons between STM information organizations, nationally and internationally, in effectiveness of services to save time and money of private sector organizations.	Survey of service recipients, including subscribers/registrants and other users Review of feedback forms and records of registrants and subscribers Benchmarking analysis of costs and benefits

Exhibit 3.6 (continued): Indicators and Methods to Measure Impacts

Impacts	Effectiveness Indicators	Methods and Data Sources
Social Impacts: Quality of Life and Wellbeing in Society		
➢ Provide opportunities for improving health system and advancing medical science	Evidence of STM information services that contributed to discovery of new cures, improved patient knowledge, better patient care. Improved learning opportunities for medical students due to STM information services provided. Contributions in providing medical information to deal with health emergencies and epidemics. Effectiveness of partnerships established to deliver medical information and knowledge, nationally, regionally, internationally. Extent to which timely information is delivered to medical personnel in health institutions. Opinions of medical and pharmaceutical researchers about the value of medical information services provided. Extent to which health and medical institutions subscribe and use STM information services.	Survey of service recipients, including subscribers/registrants and students Analysis of feedback forms Review of subscriber/registrant records and statistics, by service offerings and reach Interviews with medical personnel and researchers Analysis of effectiveness of partnerships Case studies and success stories
➢ Support STM educational institutions in their mission to teach future generations	Reach of STM information organization in supporting educational institutions to improve access to STM information (e.g., number of educational institutions helped). Effectiveness of partnerships established with educational institutions to deliver STM information services, at affordable costs. Involvement of STM information organizations in training initiatives for information specialists. Extent to which STM information organization helped educational institutions in establishing systems to gain ready access to STM information and STM information services.	Survey of service recipients, including subscribers/registrants and students Review of subscriber/registrant records and statistics, by service offerings and reach Analysis of effectiveness of partnerships Interviews with educational institutions
➢ Improve the quality of work and work environments	Evidence that STM information services led to innovative solutions and technologies that helped improve the quality of work and work environments. Degree to which information provided by STM information organizations helped improve the quality of work and work environments. Extent to which STM information services provide information that is relevant or focused on the quality of work and work environments.	Survey of service recipients, including subscribers/registrants and other users Interviews with cross-section of users Review of feedback forms Case studies and success stories
➢ Enhance the health, safety and security of citizens	Degree to which information provided by STM information organizations helped address health, safety and/or security issues. Evidence that STM information services led to lives saved, disasters averted, improvements in standards of health, safety and security. Extent to which health, safety and security agencies subscribe and use STM information services.	Survey of service recipients, including subscribers/registrants and other users Interviews with cross-section of users Review records of subscriber and registrant usage and change in trends
➢ Improve the standard of living in society	Opinions of users about the role of STM information, and the value added by STM information organizations, in contributing to the standard of living of society.	Interviews with cross-section of service users
➢ Help public and non-profit sector organizations save time and money	Evidence of time and money saved due to services rendered and any multiplier effects resulting in efficiencies gained.	Survey of service recipients, including subscribers/registrants and other users Review of feedback forms Analysis of costs and benefits

Exhibit 3.6 (continued): Indicators and Methods to Measure Impacts

Impacts	Effectiveness Indicators	Methods and Data Sources
STM Policy Impacts: Effectiveness of National (or Regional) Innovation System		
➢ Improve decision-making for government STM programs and policies	Evidence of critical decisions made as a result of STM information services, that led, for example, to new program or policy initiatives resulting in benefits to the national/regional STM community. Renewals of subscriptions and registrations to STM information services, by STM decision-makers in government. Opinions of government decision-makers about value of STM information services.	Survey of subscribers/registrants Interviews with decision-makers Consultative sessions (e.g., focus groups) Review of feedback forms
➢ Increase the innovative capabilities of national, regional, international R&D organizations and personnel	Extent to which STM information services contributed to innovative processes and technologies developed by researchers. Contribution of STM information services in enhancing knowledge of R&D personnel. Reach of STM information services to the R&D community within a national, regional, international scope. Benchmark comparisons between STM information organizations, nationally and internationally, in effectiveness of services in increasing innovative capabilities of organizations and personnel.	Survey of service recipients, including subscribers/registrants and other users Review of subscriber/registrant records and statistics, by service offerings and reach Interviews with researchers Benchmarking study of STM information organizations and services provided
➢ Help researchers be more effective to make new discoveries and create new knowledge	Extent of integration of STM information workers and services in the research and development work environment. Degree to which STM information workers and services are utilized by researchers in identifying and accessing specialized/technical information. Opinions of researchers about the relevance of STM information services provided—e.g., subject specialties of STM information organization.	Survey of service recipients, including subscribers/registrants and other users Interviews with researchers Review of feedback forms Case studies and success stories
➢ Support technology diffusion and improve environment for the transfer of new technology to commercial uses	Opportunities provided by STM information services that led to technology diffusion and commercialization of new technology. Appropriateness of partnerships established to deliver information services. Benchmark comparisons between STM information organizations, nationally and internationally, in effectiveness of services in supporting technology diffusion and commercialization.	Survey of service recipients, including subscribers/registrants and other users Analysis of effectiveness of partnerships Review of feedback forms Benchmarking study of STM information organizations and services provided Case studies and success stories

IV Challenges and Opportunities Identified by Participants

As part of the survey and interviews undertaken for this study, questions about challenges and opportunities were discussed with the representatives of the organizations. There are many similarities in the perceptions of challenges and opportunities among the eleven organizations that participated. It is useful to understand these perceptions, to put the measurement of impacts into perspective.

Exhibit 4.1 lists key challenges identified and sorted in descending order of significance. The average scores of response from the eleven organizations indicate that "increasing cost of maintaining STM information collections" is the highest ranked challenge, followed by "pressures to find new sources of funding", and "anticipation of future strategic areas of STM information needs". Other significant challenges, ranked high on the scale (on average) are "the need to keep pace with technology advancements in information retrieval, storage and delivery", and "developing and maintaining collaborative arrangements and partnerships with similar organizations". The ranking of these challenges may differ between one organization and another, however, on average, it seems clear that practical issues involving financial and cost constraints seem to be foremost in most cases. This finding is also confirmed from the interviews conducted.

At the other end of the scale, it is interesting to note that national and international competition from similar STM information organizations is ranked lowest among the challenges listed. One explanation for this low average response score about "competition" may be the traditional collegial and cooperative nature of the STM information community. Alternatively, a dissenting perspective from the private sector is that one of the other important challenges, not listed, is "the unfair competition undertaken by government [STM information] institutions".

Another low ranked challenge, from the list provided, is "the need for greater efficiencies in the use of resources". While this might be a reality, it would seem that most of the STM information organizations have already faced many downsizings and austerity measures, and now seem well experienced in gaining efficiencies in their operations. The challenge is now perceived more as one of adding efficient resources, than as one of "cutting out the fat".

Respondents suggested a number of other challenges, not listed in Exhibit 4.1, as follows:

- Applying new technology in structuring and delivering STM information services.
- Resistance to change within the community, due to entrenched mindsets within the traditional library model.
- Knowing the needs of clients and knowing how to address these needs by taking advantage of the opportunities that new technology allows.
- Addressing issues involving the relations between STM information service providers and publishers.

- The increasing need for the STM information community to collaborate and work in tandem by sharing findings of research, to address common issues facing the community.
- The current financial infrastructure that supports (or does not support) local vs. national vs. international STM information needs. There is a need to re-examine the "business-models" for funding network systems of libraries that encompass local, regional, national and international spheres (e.g., one suggested model is to reduce costs by centralizing public funding on a national level).
- Technical delivery issues including technological cooperation aimed at interoperability of systems; ensuring digital preservation and permanent access to STM information; and developing authentication and DRM tools as a basis for co-operation with rights holders.

Exhibit 4.1: Challenges

CHALLENGES	Average Score[35] From a 1 to 5 response scale
Increasing cost of maintaining STM information collections	4.11
Pressures to find new sources of funding	4.00
Anticipation of future strategic areas of STM information needs	4.00
The need to keep pace with technology advancements in information retrieval, storage and delivery	3.78
Developing and maintaining collaborative arrangements and partnerships with similar organizations	3.78
Increasing need for accountability and rationalization of products and services to funding sources and or clients	3.44
The need for developing new and better ways of measuring performance and quality of services	3.44
Intellectual property and licensing agreements	3.33
Pressure to commercialize and market products and services	3.33
The need to attract and retain highly qualified STM information workers	3.11
The need for greater efficiencies in the use of resources	3.11
International competition from similar STM organizations	3.11
National competition from similar STM organizations	2.44

- Being prepared to become an actor in the open access movement (e.g., developing partnerships with academic institutions in addressing this challenge).
- Development of e-learning as an answer to the growing need for training in information research and retrieval (in the context of the decreasing number of qualified STM information workers in private sector companies).
- Increasing the impact on the industrial sectors (SMEs in particular) by co-operation with economic development and technology transfer agencies.
- Creating an impacts analysis framework to measure value, to demonstrate the contributions of STM information organizations as they face increasing economic pressures.

[35] Sorted in descending order of significance, based on a 1 to 5 response scale, where 1 means "not a challenge" and 5 means "a major challenge".

Exhibit 4.2 lists areas of opportunity as perceived by the STM information organizations surveyed. It is perhaps worth noting, however, that the interpretation of a "challenge" versus an "opportunity" could be a bit of a conceptual blur. One person's challenge is another person's opportunity, and vice versa.[36] Notwithstanding, the highest ranked opportunity, on average, lies in educating customers about the benefits of STM information services. This perhaps could be interpreted as marketing, or spreading awareness about the availability of new and exciting ways to take advantage of STM information for researchers and innovators in science, technology and medicine.

Exhibit 4.2: Opportunities

OPPORTUNITIES	Average Score[37] From a 1 to 5 response scale
Educating your clients on the benefits of STM information services	3.78
Developing new partnerships (e.g., with private organizations, public institutions, universities)	3.67
Improving your organizational capacity to deliver STM information services	3.56
Managing intellectual property and licensing agreements	3.22
Reaching out to a broad clientele at a global level (e.g., through collaborative activities, shared resources, joint projects)	3.11
Creating diversity in your STM information services and products	2.78
Developing new sources of funding	2.56

Other opportunities suggested by respondents, not listed in Exhibit 4.2, include the following:

- Because important steps have already been made in creating a diversity of on-line information services, there are opportunities to build on this capacity.
- Building national and international frameworks of a digital STM information system opens up new opportunities of service and client reach.
- The ongoing development of staff that is highly qualified, with new scientific and IT proficiencies, expands the potential of innovative information service delivery.
- Opportunities exist for new business, by building on long-time partnerships with various types of STM information players (commercial publishers, learned societies, libraries, information brokers, academic institutions, research laboratories, standards developers, international and government organizations, development agencies, professional associations, etc.).

[36] A case in point is the observation made by one respondent that reduced budgets leaves little room for taking advantage of "opportunities".
[37] Sorted in descending order of significance, based on a 1 to 5 response scale, where 1 means "not an opportunity to respond to" and 5 means "a major opportunity to respond to".

V Conclusions

There appears to be some urgency for developing a capacity within STM information organizations to go beyond the traditional measures of performance efficiency, client satisfaction, and indicators of sales and usage—to get a better read on the effectiveness of these organizations in creating desirable societal impacts. This is particularly true for organizations that are in the public or non-profit sectors. The reasons for conducting impact assessments given by the eleven organizations consulted for this study can be summed up as follows: for accountability to funding sources, for planning new initiatives, for ensuring relevance of the organization, and for improving service offerings.

A context-centred framework for measuring impacts of STM information organizations was proposed in this report. This context-centred framework is based on key intended impacts identified in the study through a review of the strategic directions of the eleven STM information organizations consulted, from a survey and a set of interviews with representatives of these organizations, and from a review of literature on impacts of STM information organizations. These intended impacts were summarized in the report as follows:

- Economic Impacts: Economic Development and Growth
  - Help decision makers in private sector companies make informed decisions
  - Accelerate business performance in industry
  - Improve productivity in private corporations
  - Enhance competitiveness of small and medium-sized enterprises
  - Help private sector organizations save time and money.

- Social Impacts: Quality of Life and Wellbeing in Society
  - Provide opportunities for improving the health system and advancing medical science
  - Support STM educational institutions in their mission to teach future generations
  - Improve the quality of work and work environments
  - Enhance the health, safety and security of citizens
  - Improve the standard of living in society
  - Help public and non-profit sector organizations save time and money.

- STM Policy Impacts: Effectiveness of the National (or Regional) Innovation System
  - Improve decision-making for government STM programs and policies
  - Increase the innovative capabilities of national and regional R&D organizations and personnel
  - Help researchers be more effective to make new discoveries and create new knowledge
  - Support technology diffusion and improve the environment for the transfer of new technology to commercial uses.

These intended impacts are delivered by the STM information organizations through a robust menu of information services. The extent to which this menu of services, or components within this menu, is effective is the essence of the impact assessment model proposed. There is a need to establish cause and effect that relates the particular STM information services offered to the intended impacts. Such a model was proposed in this report. The model responds to the need to measure impacts of STM information

organizations on economic development and growth, on quality of life and wellbeing in society, and on the effectiveness of national or regional innovation systems.

Several challenges in the implementation of the proposed model were identified. Notwithstanding these challenges, the approach proposed has the potential to be a powerful tool, to help STM organizations substantiate the claims that they know to be true about the impacts they have on the STM community, and society at large.

The intended outcome of the study was to provide information useful to STM information organizations in planning and carrying out impact assessments. The next step for these organizations is to tailor the model included in this report to their specific programming and strategic needs. In doing this, it seems appropriate to identify some principles that are critical for measuring impacts. These principles were derived as an outcome from the consultations conducted for this study and are as follows:

- In measuring impacts, the measurer should really know and understand the menu of services that the STM information organization delivers.
- In measuring impacts, the measurer should address relevant and significant questions consistent with the mandate and strategic directions of the STM information organization.
- The method of measurement and its implementation should be credible, and suited to the areas of impact to be measured.
- Cost-justification should be taken into account when deciding on the method of measurement.
- The approach for measuring impacts should not impinge on the actual delivery of the STM information services.
- More than one source of measurement increases credibility of the analysis (i.e., for credible assessments one needs multiple lines of evidence).
- Assessing the capacity and mechanisms available to STM information organizations to deliver services is as important as measuring the results of these services.

The generic framework for measuring impacts described in this report was designed to encompass a wide range of strategic objectives and services of STM information organizations. Different organizations may share most or only a few of these objectives and services, but it is hoped that the framework provides information useful to STM information organizations in planning and carrying out their individual impact assessments.

Appendices

Appendix A: Fact Sheets on STM Information Organizations

The information included in the following fact sheets was compiled from various documents obtained from the STM information organizations that participated in this study (e.g., strategic plans, annual plans, slide presentations—see Appendix C). Interviews with ICSTI member representatives of these organizations and survey responses also provided additional information that was added to the fact sheets, and respective web sites of the organizations were scanned for other relevant information.

List of STM Information Organizations:

- BL – British Library, United Kingdom
- CISTI – Canada Institute for Scientific and Technical Information, Canada
- CONACYT – National Council for Science and Technology, Mexico
- CSA – Cambridge Scientific Abstracts, United States of America
- CSIRO – Commonwealth Scientific and Industrial Research Organization, Australia
- INIST – Institut de l'Information Scientifique et Technique, France
- JST – Japan Science and Technology Corporation, Japan
- KTHB – Royal Institute of Technology Library, Sweden
- NISSAT – National Information System for Science and Technology, India
- NLM – National Library of Medicine, United States of America
- NSF – National Science Foundation, Sri Lanka

Fact Sheet
BL – British Library, United Kingdom

Strategic Overview

- ✓ Vision
  - – Making accessible the world's intellectual, scientific and cultural heritage. The collections of the British Library and other great collections will be accessible on everyone's virtual bookshelf - at work, at school, at college, at home.
- ✓ Mission
  - – To foster the pursuit of knowledge for the benefit of scholarship, research and innovation, and encourage the broadest possible awareness and accessibility of the Library's collections for the benefit of the citizen.

Profile

- ✓ The role of the British Library is to help people advance knowledge to enrich lives.
- ✓ With a staff of 2,400 and expenditures of approximately £114 million (FY 2002-2003), the British Library is the National Library of the UK. Amongst other services, it provides document supply services, and it covers all areas of scientific, technical and medical information. The BL collections are considered one of the World's finest.
- ✓ The Library is a not-for-profit organization which earns approximately £28 million annually, 30 percent of which is from overseas trade.
- ✓ All UK universities and public library authorities use the British Library's services.
- ✓ The British Library is used by 90 percent of the UK's top R&D scoreboard companies as measured by the UK's Department of Trade and Industry, and over 75 percent of all new commercial registrations are small and medium sized businesses. Internationally, a large part of the clientele is corporate.
- ✓ The Library's Document Supply Centre specializes in supplying scientific, technical, business and medical information direct to people in the workplace. It fulfils nearly four million orders every year.
- ✓ Annually, over three million scientific, business and patent items and two million arts and humanities items are consulted in the reading rooms of BL.
- ✓ Approximately 50 percent of BL's customers are from academic institutions (universities and colleges); 35 percent are from private sector companies or industry consortia or associations; 10 percent are from government organizations (science and technology departments, research laboratories, etc.); and 5 percent are from health organizations and institutions.

Information Products and Services

- ✓ BL provides: document supply services, STM information services, services for libraries and the library community, reading rooms and enquiry services, and services for the public-at-large (e.g., exhibitions, learning and cultural events).
- ✓ The British Library Public Catalogue provides access to the main British Library catalogues, describing over ten million items available either in the BL reading rooms or for remote supply as photocopies or loans. BLPC is available 24 hours a day, seven days a week.
- ✓ Document Supply Centre services: These include databases, document delivery, current awareness service, and Table of Contents service. The BL Document Supply service covers every aspect of scientific, technical, medical and human knowledge, in many languages, and holds journals, books, conferences reports, theses, official publications, 'grey literature' of all kinds, music scores and images. Document Supply usage by main sector: 1,072,599 business/industry; 1,482,738 Higher Education; 183,757 public libraries.

- ✓ Online services of the British Library include:
  - British Library Public Catalogue (a comprehensive online catalogue, supplemented by catalogues for special materials);
  - Current Serials File (for browsing or searching the titles of over 60,000 serials currently received by the British Library's Science, Technology and Business services and its Document Supply Centre);
  - inside web (is a massive database that offers a fully integrated current awareness and document ordering service, to give access to the BL's journal and conference collections);
  - inside alert (a new email Table of Contents service from the British Library, which delivers contents pages from journals direct to the user's desktop;
  - British Library's Online Bookshop (to find a selection of books, CDs and CD-ROMs published by the British Library).
- ✓ Science Technology and Business Collections: The British Library houses one of the best reference collections of current science technology and business literature in the western world. The Library is unique in that it houses sci/tech literature and a collection of patents from almost every issuing authority in the world 'under one roof'. The stock is acquired from legal deposit intake, by purchase, from donated material and by exchanges. An increasingly large range of material is available in the reading rooms in a variety of electronic formats: electronic databases, electronic journals.
- ✓ The Business Information Service (BIS) holds the most comprehensive collection of business information literature in the UK. This includes market research reports and journals, directories, company annual reports; trade and business journals, house journals, trade literature and electronic sources.

Fact Sheet
CISTI – Canada Institute for Scientific and Technical Information, Canada

Strategic Overview

- ✓ Vision
  - – Through continuous innovation CISTI will provide leading edge scientific, technical and medical information products and services to enable the Canadian research, industry and health communities to support the Canadian innovation system and to achieve Canada's economic and social goals.
- ✓ Mission
  - – The mission of CISTI, as part of the National Research Council of Canada, is to support the research and innovation communities by managing and disseminating high-value scientific, technical and medical information products and related services.

Profile

- ✓ In a dual role as science library and scientific publisher, CISTI maintains, publishes, and provides access to the STM information and knowledge resources required for Canada's development as an innovative knowledge economy.
- ✓ CISTI houses one of the world's most comprehensive collections of publications in science, technology and medicine.
- ✓ CISTI employs about 300 staff with total expenditures of just over $44 million (FY 2001-2002). About 50 percent of expenditures are derived from fees for services, with the balance covered by public funding appropriations.
- ✓ Through its online services and its 17 NRC Information Centres located across the country, CISTI is accessible to Canadians, both virtually and in their region.
- ✓ CISTI ensures that it is known and used by all sectors of Canada through its presence and services to NRC institutes, consortia agreements with Canadian university libraries, support to the peer review system, and close links with the Industrial Research Assistance Program (IRAP) of NRC. There are well over 100 organizations with which CISTI collaborates to expand its resources, extend its reach and deliver its products and services.
- ✓ Through its document delivery service CISTI provided just under a million documents worldwide in 2001-2002. Of these documents, approximately 640,000 were ordered by Canadians in industry (20 percent), academia (50 percent), medical institutions (7 percent), government (11 percent), and other organizations (1 percent). In addition, NRC researchers ordered 69,873 documents representing 11 percent of the total for Canada.
- ✓ CISTI has actively expanded its international services. Revenue from international sales is used to support CISTI's collections and to develop new and enhanced products and services.

Information Products and Services

- ✓ CISTI is a world-class information resource for scientific, technical, medical and agricultural books, journal articles, conference papers and reports.
- ✓ The CISTI Collection includes over 50,000 different serial titles; over 13,000 currently received serials; over 600,000 books, conference proceedings and technical reports; 2 million technical reports on microfiche from around the world; 95% of journals on ADONIS; journals from the world's leading scientific publishers, such as Elsevier, Springer-Verlag and others; all languages and all countries where scientific and technical information is published; journals indexed in major scientific and medical databases. Nearly 500 new items are received every day in the CISTI Collection. It includes published information from around the world in all areas of physical and life sciences, engineering, technology and health sciences.

- ✓ An Online Catalogue allows the user to search the CISTI collection.
- ✓ Document Delivery services: Document delivery is one of CISTI's main business lines. This service provides books and copies of articles, reports and conference papers from CISTI's in-house collection, from partner collections and from any other library worldwide.
- ✓ A range of Document Delivery levels are offered with prices and service levels that depend on whether a requested document is in CISTI's collection, how fast it is needed, and the cost of retrieval.
- ✓ CISTI's Document Delivery system, IntelliDoc, is an integrated document delivery system which delivers large volumes of documents at high speed, and tracks the user's orders from receipt to delivery.
- ✓ NRC Research Press: NRC is the foremost scientific publisher in Canada and one of the most advanced electronic publishing services in the world. Since 1929 NRC has been publishing peer-reviewed international science with support from members of the Canadian scientific community. They provide editorial and scientific expertise to select top-quality manuscripts for publications in the journals and books published by NRC Research Press.
- ✓ Beginning in Janaury 2001, CISTI customers have benefited from free access to the electronic versions of the NRC Research Press journals through a national site license supported by the Depository Services Program of Canada.
- ✓ NRC Information Centres: One of CISTI's key roles is to support the activities of NRC researchers. NRC Information Centres (NICs) provide integrated information services for NRC institutes in regions across the country and in Ottawa. Currently there are eleven NICs in the regions. Information specialists associated with these Centres provide scientific, technical, medical, and related business information for internal and external users of CISTI services.
- ✓ NRC Virtual Library: Since it was launched in 1997, CISTI has continued developing the NRC Virtual Library (VL), which is a desktop Intranet service for NRC staff.
- ✓ The CISTI Catalogue provides access to electronic journals and other Internet resources, including web sites, Internet-available monographs and report series, technical reports, and conference proceedings. With the licensed and free resources combined, CISTI now provides access to 15,119 electronic titles on the NRC Virtual Library, which is comparable with that that is offered by major university libraries.
- ✓ NRC Expertise database provides an easy way for Canadians to identify and contact individuals within NRC research institutes and IRAP Industrial Technology Advisors (ITAs) across Canada.
- ✓ Health libraries service: CISTI collects significant journals in the health sciences and medicine regardless of language or format. The collection has grown to include over 10,000 medical serial titles, over 3,200 current medical serials, and over 340 current pharmaceutical serial titles. CISTI's collection contains approximately 70 percent of the serials indexed in MEDLINE.
- ✓ CISTI Source: CISTI provides an online browsing system which is a one-stop access to Tables of Contents, Current Awareness and Document Ordering services.

Fact Sheet
CONACYT – National Council for Science and Technology, Mexico

Strategic Overview

- ✓ The National Council for Science and Technology (CONACYT) was founded in December 1970 to implement science and technology policies of the government of Mexico. Its mission is to foster the advancement of science and technology by allocating public funds for the support of research and advanced training, and by the dissemination of scientific and technological information.

Profile

- ✓ CONACYT is a major national provider of scientific and technological information in Mexico, and it is directly aligned with the innovation and science and technology policies of the Mexican government. Through national and affiliated regional centres it implements various programs aimed at improving the science and technology infrastructure of the nation.
- ✓ CONACYT has been encouraging the development of S&T professionals of the highest quality for more than 30 years. Accordingly, it manages the largest scholarship program in Mexico for postgraduate studies. CONACYT does not run postgraduate programs itself, but supports students for the time they are enrolled in such programs, locally or abroad.
- ✓ CONACYT's customers account for 80 percent of the scientific and technological national infrastructure.
- ✓ Approximately 35 percent of CONACYT customers are scientists, researcher and educators from academic institutions (universities and colleges); 25 percent are from private sector companies or industry consortia or associations; 15 percent are from government organizations (science and technology departments, research laboratories, etc.); 5 percent are from health organizations and institutions; and 20 percent are students.

Information Products and Services

- ✓ Data Banks Consulting Service (SECOBI): CONACYT runs a very useful online consulting feature called SECOBI, which provides information consulting services from several data banks (including bibliographic, statistical and technical information). SECOBI provides information consulting to government institutions, universities and firms. Information specialists provide advice and referrals to collections of pertinent materials and to research and other information sources, locally or internationally.
- ✓ Scientific and Technological Integrated Information System (SIICYT): The SIICYT online information system provides detailed information on all CONACYT projects. This module allows science and technology investigators and educators throughout Mexico to access data about CONACYT projects by field of knowledge, federal R&D organization, research or academic institution, voluntary or private institutions, and support programs. The module has two sections: (i) a portfolio of projects since 2001 that are part of the government's Special Program of Science and Technology; and (ii) a portfolio of CONACYT projects that span the period 1991-2000.
- ✓ Scientific and technological indicators: SIICYT also provides online access to a host of S&T indicators, including S&T activities and research undertaken by the major R&D and academic institutions in Mexico. The data goes back several years and includes statistics on research projects, R&D financing, educational programs, production and patents, technology diffusion and impacts, S&T human resources, and intellectual property data, among other information. The information is maintained and updated regularly, and in some cases the data go back to 1980. The construction of the indicators databases are based on methods recommended by institutions like the OECD and UNESCO, which provide similar statistics and indicators on their member countries.
- ✓ Information system on technological services (SISTEC): This is a free system of consultation provided by SIICYT, which makes available information from technological and consulting centres around the nation.

- ✓ CONACYT also undertakes a number of other initiatives on behalf of the science and technology community of Mexico, including:
  - a national registry of institutions, companies and science and technology investigators;
  - a program for repatriation of Mexican investigators and scientists;
  - a technological modernization program which emphasis assistance to small and medium-sized enterprises, to seek and obtain assistance to improve their management and productive processes;
  - evaluation of technology projects not only from a technical perspective but also in terms of their economic impacts;
  - diffusion of technology to all parts of the country by supporting the development of regional programs; and
  - publication of the magazine Science and Development (over a period of 26 years) to spread awareness of the latest discoveries in technology that impact on Mexican life.

Fact Sheet
CSA – Cambridge Scientific Abstracts, United States of America

Strategic Overview

- ✓ As information storage and retrieval technologies continue their rapid evolution, CSA is committed to aggressively broadening access to the latest thinking in the sciences and social sciences.

Profile

- ✓ CSA is a privately owned information company located in Bethesda, Maryland.
- ✓ CSA has primary offices in Hong Kong, France, and the UK.
- ✓ CSA has been publishing abstracts and indexes to scientific and technical research literature for over 30 years.
- ✓ Records of CSA go beyond citations to furnish valuable summaries of original research material, allowing scientists and researchers to identify articles appropriate to their needs.
- ✓ Over 70 databases are offered by CSA. The content coverage of these databases includes the life sciences, environmental and aquatic sciences, computer sciences, materials science and engineering, aerospace, social sciences, and humanities.
- ✓ Approximately 80 percent of CSA's customers are from academic institutions (universities and colleges); 10 percent are from private sector companies or industry consortia or associations; and 10 percent are from government organizations (science and technology departments, research laboratories, etc.).

Information Products and Services

- ✓ Internet Database Service provides access to more than 70 databases published by CSA and its publishing partners covering major areas of research. IDS provides cost-effective access to current research in multiple disciplines, including materials science, earth and environmental sciences, pollution management, biological and medical sciences, aquatic sciences and fisheries, biotechnology, engineering specialties, computer science, sociology, arts and humanities, and linguistics.
- ✓ Databases and collections published by CSA and its partners are outlined in useful and detailed fact sheets that are available for primary databases in the subject specialty areas of CSA. These fact sheets include sample records, update and size information, as well as links to other information relevant to searching each database.
- ✓ BiblioAlerts.com provides electronic delivery of customized, timely reports covering aquatic science, biological science, engineering, environmental science, linguistics, materials science, neuroscience, and sociology.
- ✓ Print journals: for well over 30 years CSA's multi-disciplinary journals have been used by scholars to explore the massive amount of data published worldwide. Available via the World Wide Web, CSA's Internet journals can be accessed by their users from any workstation on their site-wide networks.
- ✓ RefWorks: This is a web-based bibliography and database manager that allows users to create their own personal database by importing references from text files or online databases. They can use these references in writing their papers and automatically format the paper and the bibliography in seconds.
- ✓ Access to SAGE full-text collections: Sage Publications is a leading international publisher of journals, books and electronic media for scholarly, educational and professional markets.
- ✓ Search Abstracts: A search tool engineered for conducting research in a precise, quick and cost-effective way. Users can choose from more than 1,500 timely reports on important new topics in science and technology. Each report consists of abstracts or digests of the most current information

from over 10,000 research publications, including journals, books, patents, conference proceedings, and selected web sites.

- ✓ Social Services InfoNet: This service provides social workers and social service practitioners with a single access point to cutting edge research available on the Internet. Social Services InfoNet also aims to build the knowledge base of successful solutions to today's social welfare problems and encourage excellence in the field through an annual Best Practices competition.
- ✓ Hot topics information: CSA provides a comprehensive online information service on current issues with an overview of the subject, key citations with abstracts and links to web sites. Topics covered cut across a broad spectrum of issues involving biomedical, environmental, engineering, social sciences and humanities, and other research. The hot topics are archived into a cumulative reference database.
- ✓ Search help: A comprehensive search module on CSA's web site provides assistance to address the user's needs to access information easily and quickly. A CSA Quick Reference Card is also downloadable, which is a handy Internet database search tool for users.
- ✓ Other online services and CD-ROM databases: Many CSA databases are available through several other online services and on CD-ROMs. Other online providers each offer a customized interface to CSA databases. Some provide access on a "pay-as-you-go" or transactional basis, while others offer subscriptions.

Fact Sheet
CSIRO – Commonwealth Scientific and Industrial Research Organization, Australia

Strategic Overview

- ✓ As one of the world's largest and most diverse scientific global research organization CSIRO's work touches every aspect of Australian life. To help Australia meet the challenges of national competitiveness and sustainability, the organization is "building a new CSIRO for the new century".
- ✓ The staff of CSIRO is focused on providing new ways to improve the quality of life of Australian citizens, as well as the economic and social performance of a number of industry sectors through research and development.

Profile

- ✓ CSIRO's main customers for its STM information services are from within CSIRO. An extensive Library Network supports CSIRO scientists and their collaborators.
- ✓ Where CSIRO and other research organizations are adjacent or working in similar subject areas, various forms of collaborations occur between libraries. For example, joint library services are shared at the Australian Nuclear Science and Technology Organization site. In some instances, CSIRO purchases expensive resources in a consortium with the higher education and research community.
- ✓ Online access is available to a range of CSIRO publications through the CSIRO web site. The CSIRO online catalogue contains 222,000 bibliographic records relating to all science disciplines.
- ✓ CSIRO manages 11 national reference collections including: the Australian National Fish Collection, the Australian National Insect Collection, the Australian National Herbarium, the Australian national Wildlife Collection, the National Tree Seed Collection and the Scientific Marine Data Collection.
- ✓ CSIRO is funded mainly from government appropriation resources.

Information Products and Services

- ✓ CSIRO provides science and technology information services to its scientists and their collaborators through access to physical collections and digital library services, and by specialized information retrieval services similar to a research assistance role.
- ✓ CSIRO provides an integrated approach to information requirements for its internal customers, enabling access to electronic journals and a number of databases. Links with other libraries are maintained through interlibrary loans and subject databases.
- ✓ Library Network Catalogue: This online facility allows users to search the CSIRO catalogue, including books, journals, titles in the CSIRO E-Journal Collection, standards, etc. It also allows searches for multiple catalogues at the same time. MyVoyager is a feature of the Library Network Catalogue, which allows the user to view what items the user has on loan, personalize the searches, save searches and set up search alerts.
- ✓ CSIRO Libraries do not cater specifically to the general public, but walk-in users are sometimes permitted. Interlibrary loans and photocopies in accordance with the Australian Copyright Act may be requested via other libraries.
- ✓ CSIRO Publishing produces books and CD-ROMs as well as journals in partnership with the Australian Academy of Science. CSIRO Publishing is Australia's foremost science and technology publisher. It combines long-established and internationally respected scientific journal and monograph publishing activities with CSIRO's award-winning media production activities and magazines publishing. CSIRO Publishing's market consists of scientists and academics in research institutions worldwide, together with students at both tertiary and secondary levels.
- ✓ The CSIRO Journal Group, in collaboration with the Australian Academy of Science and various scientific societies, publishes fourteen international peer-reviewed journals.

- ✓ ScienceServer: This is a full-text service for scientists, which is part of the CSIRO Virtual Library and provides access to STM published materials, as well as to some of CSIRO's grey literature.
- ✓ Hot topics page: CSIRO also runs a "Hot Topics" page on its web site, which is an easy way to find out if CSIRO can provide information to help their customers. If a customer's topic is not something that CSIRO is involved in, links to web pages of relevant external organizations are shown.
- ✓ Issues in the news: CSIRO provides online snapshot information (with links for in depth follow ups) about scientific, technical or medical issues in the news– for example, information about gene technology in Australia, greenhouse gas effects, severe acute respiratory syndrome are covered both from the public and specialist perspectives.
- ✓ Education: CSIRO also operates a range of science education projects, which aim to alert school students, their families and teachers of the contributions of scientific research to the community; to encourage students to participate in scientific activities, especially those related to the applications of science; and to encourage students to take up careers in science.

Fact Sheet
INIST – Institut de l'Information Scientifique et Technique, France

Strategic Overview

- ✓ Mission
  - The mission of INIST, as a service unit of the Centre National de la Recherche Scientifique (CNRS), is to collect, analyze and disseminate the results and findings of worldwide research in science, technology, medicine, humanities, economics and social sciences.
- ✓ Priorities
  - To develop access to electronic information so that documents can be easily identified, localized and accessed via networks.
  - To develop technology and science watch tools and methods as an aid to search strategy formulation.
  - To prepare for the future by adapting to new information and communication technologies and by participating in NTIC research projects of European scope.

Profile

- ✓ With a staff of 270 information professionals, and a total budget of 30 MEuros (including 54 percent from government appropriations), INIST is France's foremost supplier of scientific and technical information, drawing from a unique collection that covers the core international literature in science, technology, medicine, humanities and social sciences and economics. INIST stores several million documents on some 17 miles of shelving or in its Digital Archiving System. These holdings are used to deliver (paper or electronic) documents on request and to create bibliographic records for the databases that INIST produces.
- ✓ INIST has 6,000 customers. It supplies 700,000 copies of documents each year and produces 600,000 new bibliographic records annually.
- ✓ INIST is committed to the new information and communications technologies. With over 20,000 users and over 15 million queries on all INIST online information services, INIST offers a whole range of access services to scientific and technical information on the Internet.
- ✓ CNRS has a private subsidiary, INIST Diffusion, whose purpose is to market and distribute INIST products and services in France and abroad through various distribution channels.
- ✓ Approximately 17 percent of INIST customers are from academic institutions (universities and colleges); 45 percent are from private sector companies or industry consortia or associations; 19 percent are from government organizations (science and technology departments, research laboratories, etc.); 5 percent are from health organizations and institutions; and 14 percent are from others such as individuals, students, and information brokers.

Information Products and Services

- ✓ Document Delivery Services: INIST uses its extensive document collections as well as a unique network of back-up libraries and documentation centres to fill the document copy orders it receives. To meet the needs of its customers, INIST offers both traditional and electronic ordering and delivery methods. With ARTICLE@INIST, a free access service on the INIST web site, the user can search the article catalogue of INIST collections and order copies of documents directly online. INIST's digital archiving system, containing over 3.5 million digitized articles, is used to fulfill requests for documents in a completely automated way.
- ✓ Databases: INIST produces and distributes the multilingual and multidisciplinary bibliographic databases PASCAL and FRANCIS. PASCAL has 14 million bibliographic records covering science, technology and medicine; and FRANCIS has 3 million bibliographic records covering the humanities, social sciences and economics.

- ✓ Science and technology watch: This is an INIST offering that helps researchers to monitor scientific and technological advances and keep up with the competition. Science and technology watch includes several analysis tools, current awareness, search, and alerting services tailored to the customer's needs.
- ✓ ConnectSciences is one of INIST's Internet services, which give access to a complete range of resources and services offered by INIST and its partners. This is a portal, which has both an English and a French version, and has been designed modularly to integrate new resources and services as needed. From a shared electronic space, users can customize their own spaces individually on the portal and have access to a number of services tailored to their specific needs.
- ✓ ArticleSciences is another Internet service, which provides a multilingual search engine (French, English, Spanish and Italian) to order online copies of scientific and technical articles available at INIST (more than 8 million), coupled with a secured online payment system.
- ✓ Service@INIST is a document services platform for information professionals, who often have to order large numbers of document copies.
- ✓ BiblioSciences is a dedicated portal for CNRS laboratories, providing access to Current Contents®, INSPEC®, MEDLINE®, PASCAL, FRANCIS, and INIS, with links to local or remote full-text repositories. TITANE is a national chemistry server for the French scientific community (CNRS, universities, etc.) providing access to several international databases.
- ✓ MISTER is an indexing and search engine for French academic and research web sites.
- ✓ Multimedia communication: INIST publishes two electronic newsletters, dealing respectively with Internet and NTIC news, and with electronic documentation in the network age.
- ✓ Current awareness and training: INIST provides a range of scientific document current awareness services drawing on new technologies for information analysis and processing. It also provides traditional training sessions and online e-learning (in new search software, searching for information on the Internet, and in the new information and communication technology applied to the documentation and information professions.

Fact Sheet
JST – Japan Science and Technology Corporation, Japan

Strategic Overview

- ✓ As an organization that implements national science policies, the Japan Science and Technology Corporation is engaged in a broad range of activities such as the promotion of creative basic research, processing and disseminating scientific and technological information, and encouraging technology transfer for starting up new businesses.
- ✓ JST promotes information activities as a core organization in the field of scientific and technological information in Japan.

Profile

- ✓ JST is an organization that acts under the Ministry of Education, Culture, Sports, Science and Technology.
- ✓ With a total budget of 114,954 million yen (FY 2002) and a staff of 467 (at year end 2002), JST provides STM information services to a wide community of users.
- ✓ JST's role is one of being a primary government STM information organization directly aligned with the science and technology policies of the national government.
- ✓ Approximately 15 percent of JST customers are from academic institutions (universities and colleges); 61 percent are from private sector companies or industry consortia or associations; 6 percent are from government organizations (science and technology departments, research laboratories, etc.); 4 percent from health organizations and institutions; and 14 percent are from individuals, academic associations and others.
- ✓ A high priority for JST is developing new partnerships (e.g., with private organizations, public institutions and universities). Another high priority is continuously improving the organizational efficiency and delivery of STM information services.

Information Products and Services

- ✓ Through a variety of diverse services, JST offers easy and extensive access to worldwide scientific and technical information.
- ✓ As an organization creating a comprehensive bibliographic database covering all STM fields, JST produces the largest database of STM articles published in Japan and also provides overseas STM information with records in Japanese.
- ✓ JST also dispatches bibliographic data and abstracts of Japanese articles to the world by translating them into English.
- ✓ JOIS (JST Online Information System) is a comprehensive fee-based bibliographic database service covering all STM areas with the largest number of scientific, technical and medical bibliographic records in Japan. It includes abstracts and indexes of STM information from Japan and overseas. Around 12,000 user accounts are issued for JOIS, which is serviced through three gateway distributors (NIKKEI TELECON, G-SEARCH, and BIGLOBE).
- ✓ JOIS is JST's flagship of information services. A new platform of JOIS is scheduled for release on April 1, 2003 with powerful linking functionalities toward original external documents. The new JOIS will include the following files: JSTPlus (scientific and technological information of Japan and overseas); JMEDPlus (medical information from Japan); and JCHEM (chemical substance information—substance names, molecular formula, and related numbers); and six other files.
- ✓ JST Science and Technology Information Aggregator, Electronic (J-STAGE) is the largest electronic journal site for journals of academic societies in Japan. It supports digitalization of academic journals published by academic societies. Over 100 journals will be opened to the public in 2003. J-STAGE is

now reference-linked internally and externally to JOIS, and other primary and secondary information services (such as ChemPort, PubMed, CrossRef).

- ✓ Directory Database of Research and Development Activities (ReaD) is the largest directory of research information in Japan with digital contents. The previous integrated system for decentralized digital contents was unified merging into the ReaD system from October 2002. ReaD is a directory database of information of research institutes, researchers, research projects and research resources of universities, national laboratories, independent governmental agencies, government-affiliated corporations, public testing and researching organizations and public-service corporations in Japan. ReaD is provided freely through the Internet.
- ✓ JST also has several other advanced STM databases—for example, databases for materials and chemical substances information, bioinformatics, and R&D management information. These databases include: material property databases (FACTrio), alloy databases (several), polymer databases (PolyInfo), genome databases (JSNP), the earth sciences and technology directory information system (EDIS), and technology seeds (J-STORE).
- ✓ JST provides its customers with document delivery services, including search and translation services. It has a machine translation system (JICST Machine Translation Network Service), and a Manual Translation Service. The CD-ROM version of this translation system turned out to have significant sales.
- ✓ JST delivers the services of STN International to 5,000 users. STN is an international database service operated in cooperation with Chemical Abstracts Service (USA), FIZ-Karlsruhe (Germany) and JST (Japan). STN is an online scientific and technical information service dedicated to meeting the information needs of scientists, engineers, and information professionals throughout the world. STN provides a complete collection of in-depth databases in science and technology to give the user quick, direct links to literature, patents, and chemical catalogues.
- ✓ Other JST services include a current awareness service, publications reviews, and projects for promoting public understanding of science and technology.

Fact Sheet
KTHB – Royal Institute of Technology Library, Sweden

Strategic Overview

- ✓ The mission of the Royal Institute of Technology Library (KTHB) is to serve as a resource centre to support the teaching and researching goals of the Royal Institute of Technology (KTH), and to provide quality national information services in the field of engineering and related disciplines. The Royal Institute of Technology itself provides one-third of Sweden's technical research and tertiary level education.

Profile

- ✓ KTHB is the largest library in Sweden for technology and basic sciences (physics, chemistry, mathematics) and has the largest group of subject information specialists in the country. KTHB is part of a network of eleven national resource libraries responsible for good coverage and service in Sweden.
- ✓ KTHB is open to the general public. The library consists of several branches. Library services and collections are available to students, researchers and staff from KTH and other institutions of higher education.
- ✓ KTHB's facilities and services are also available to businesses, government authorities and institutions, and to individuals wishing to use the library for research and study purposes within the fields of teaching associated with KTH.
- ✓ Most of the users of KTHB services are internal from the KTH (approximately 70 to 80 percent). Other users are external from highly research-oriented companies, or from other Swedish universities.

Information Products and Services

- ✓ Information and Documentation Center (IDC): A user can order from KTHB's IDC an information search, performed by a subject specialist within the fields of engineering, natural sciences, business or economics. IDC has access to most relevant international and Swedish databases and databanks covering technology, science and business. IDC's referral service and help desk, REFLINE, gives free-of-charge assistance on questions concerning databases and their hosts, e. g. accessing database hosts, searching techniques, contents of databases. IDC is the Swedish representative for the information hosts EINS, STN International and CAS Online.
- ✓ Information literacy training: KTHB undertakes regular courses in information retrieval for staff and students of the Institute. Customized courses and seminars are also organized on demand for academic institutions as well as industry.
- ✓ A selective dissemination of information service (SDI) offers current awareness on recently published documents on the basis of an individualized interest profile. Results are delivered on disk or paper, by fax or by e-mail.
- ✓ E-journal database: Users can browse the KTHB web site and select online from a large collection of journals, with links to original sources. With an assigned pin number registered users can have access to the full text of the articles in the journals subscribed to by KTHB.
- ✓ Reference shelf database: Users can browse and have online access to other selected reference materials, some of which are available to all users and some only for registered users.
- ✓ Using KTHB's online search services, external and internal users can search online for full text e-journals, books, conference material, literature in Swedish libraries and literature all over the world, citations, patents, reports, standards, sci/tech resources, and more. Users can also search through links to numerous library catalogs and serials databases. Registered users to the KTHB library can also get access to a number of full text e-books/publications, e-journals, e-papers and KTH dissertations.

- ✓ The “ask a librarian” service allows a user to interact online with KTHB librarians to ask questions about KTHB services and to get help finding information. Subject specialists are able to provide customized services to customers in a number of scientific and technological specialty areas.
- ✓ Short-messaging service (SMS): This is a mobile phone messaging service where KTHB sends users messages about their library books and other loans (e.g., to pick up, to renew, position in queue, expiration date).
- ✓ Using a grant from the Teknologibiblioteken consortium, KTHB has produced an introductory interactive course for information retrieval in Science and Technology in both Swedish and English. This course is freely available on the Internet from KTHB’s home page. A credit course has also been produced for distance learning.
- ✓ KTHB is responsible for KTH’s BILDA project, promoting the use of web-based teaching. The library educates the teachers in the usage of specialized web-based teaching software and gives technical support. The software itself, Ping-Pong, was developed in Sweden.
- ✓ KTHB participates in the Swedish NetUniversity effort and is currently developing a three-credit course in information literacy based on the Ping Pong software.
- ✓ One of KTH’s goals is to cooperate with the public and industry for the development of society and as such, KTHB is considering developing a competence center for active help to companies and the public in their information quests.

Fact Sheet
NISSAT – National Information System for Science and Technology, India

Strategic Overview

- ✓ The National Information System for Science and Technology (NISSAT) is a division of the Department of Scientific and Industrial Research (DSIR), Government of India. NISSAT commenced its operations in 1977 with the objective of organizing information support facilities for people engaged in research and academics.
- ✓ NISSAT has the mandate to cover the entire spectrum of science and technology.
- ✓ NISSAT aims to strengthen the library movement in the country through the introduction of modern information technology, tools and techniques.
- ✓ Priorities:
  - Development of national information services.
  - Promotion of existing information systems and services.
  - Introduction of modern information handling tools and techniques.
  - Promotion of international co-operation in information.
  - Development of indigenous products and services.
  - Organization of skill development programs.
  - Promotion of R&D in information science and technology.

Profile

- ✓ The role of NISSAT and the information centres it helps to build throughout India represent a primary STM information service network for the country. NISSAT is directly aligned with national innovation, science and technology policies of India.
- ✓ Approximately 10 percent of NISSAT customers are from academic institutions (universities and colleges); 20 percent are from private sector companies or industry consortia or associations; 60 percent are from government organizations (science and technology departments, research laboratories, etc.); and 10 percent make up the rest of the customers.
- ✓ The main customers of NISSAT are government organizations, including research laboratories. In India these make up about three quarters of the investments and activities in R&D.
- ✓ NISSAT uses public telecom facilities for networking and service generation; organizes training workshops through professional bodies and institutions; adopts and supports database development projects in institutions with significant information resources and expertise on specific subjects.
- ✓ Since the mid-80s NISSAT adopted the principle that products and services offered by its information centres be fee-based.

Information Products and Services

- ✓ National Information Centres (NICs): NISSAT builds on existing facilities to set up various national information centres. These are product/discipline oriented sectoral information centres, which have to have their own significant information base, considerable professional expertise and a large enough in-house user population. The emphasis is on information content, but the use of modern technology for collecting and disseminating information is also considered necessary.
- ✓ The NICs provide bibliographic as well as factual and numeric information to meet the various information needs of academicians, scientists, technologists, entrepreneurs, management executives and decision makers. Besides providing documents and preparing bibliographies on request, they offer selective dissemination of information (SDI), current awareness services (CAS), reprographic and micrographic services, industrial and technical enquiry services, and technical translation.

- ✓ Some of the sectoral information centres prepare serial publications of digests, indexing and abstracting materials, and news highlights. In addition to publishing these in print form, the information is often computerized, put on CD-ROM or on the Internet.
- ✓ Apart from developing information centres, networks, and database projects, NISSAT utilizes various training programs, workshops, seminars and annual "Information Today and Tomorrow" meetings, to propagate the importance of developing information content for the country's science and technology infrastructure.
- ✓ NISSAT also develops and propagates STM information handling tools, and it has specialist groups at different levels to guide implementation of a variety of information service projects and related activities.
- ✓ To address a need for education and training of information personnel, NISSAT encourages and supports a variety of skills development initiatives in information science and technology.
- ✓ NISSAT Access Centre to International Data Services (NACIDS): NISSAT initiated NACIDS to facilitate online access to international information services for researchers, scientists, and technologists in India. There are currently nine NACIDS across India with more planned. NISSAT helps the NACIDS in equipping them with the necessary hardware and software, documentation, human resources, materials and facilities.
- ✓ NISSAT also supports intellectual property rights (IPR) information services.
- ✓ NISSAT has established two Value Added Patent Information System (VAPIS) centres, with the objective of providing value added services in analyzing patent contents, preparing trend reports, and making technology forecasts; and identifying technology alternatives, promising research areas and business opportunities.
- ✓ A quarterly periodical issued by NISSAT is distributed free to 5,000 individuals and institutions. The periodical, called "Information Today and Tomorrow", attempts to project major developments in the field of information science at the national and international levels.

Fact Sheet
NLM – National Library of Medicine, United States of America

Strategic Overview

- ✓ The National Library of Medicine assists the advancement of the medical and related sciences and aids in the dissemination and exchange of scientific and other information important to the progress of medicine and public health.
- ✓ NLM's fundamental priority is to sustain the collection of the Library and to provide high quality library and information services.

Goals

- ✓ According to NLM's Long Range Plan (2000-2005), NLM's goals are to:

    1. Organize health-related information and provide access to it.
    2. Promote use of health information by health professionals and the public.
    3. Strengthen the informatics infrastructure for biomedicine and health.
    4. Conduct and support informatics research.

- ✓ The Long Range Plan also targeted seven areas for new emphasis as follows:

    - Health information for the public.
    - Molecular biology information systems.
    - Training for computational biology.
    - Definition of the research publication of the future.
    - Permanent access to electronic information.
    - Fundamental informatics research.
    - Global health partnerships.

Profile

- ✓ NLM is a pioneer in the creation and stewardship of computer-driven systems allowing users all over the world ready access to medical information databases, as well as keeping abreast of all the papers and other reports produced by the world's community of health sciences.
- ✓ With a budget of approximately $306 million (FY 2003) and a staff of 677 (FY 2003), NLM is the world's largest medical library.
- ✓ NLM supports a national network of local and regional medical libraries.
- ✓ NLM educates users about available sources of information so that they may conduct their own research concerning medical topics.
- ✓ NLM's fields of expertise: biomedicine, health care, biomedical technology, humanities as well as physical, life and social humanities.
- ✓ Approximately 60 percent of NLM customers are from academic and health institutions; 10 percent are from private sector companies or industry consortia or associations; 10 percent are from government organizations (science and technology departments, research laboratories, etc.); and 20 percent are from the general public.
- ✓ Closely linked to the NLM is the National Centre for Biotechnology Information (NCBI). Established in 1988 as a national resource for molecular biology information, NCBI creates public databases, conducts research in computational biology, develops software tools for analyzing genome data, and disseminates biomedical information—all for the better understanding of molecular processes affecting human health and disease. NCBI provides access to the staggering data on human genome resulting from genetic research.

- ✓ Also affiliated to NLM is the Toxicology and Environmental Health Program (TEHIP) that provides access to TOXNET (Toxicology Data Network) which provides access to databases on toxicology, environmental health, and hazardous chemicals.
- ✓ Yet another organization within the NLM family is the Lister Hill National Center for Biomedical Communications (LHNCBC). The LHNCBC explores the uses of computer, communication, and audiovisual technologies to improve the organization, dissemination, and utilization of biomedical information. Currently the Center is applying modern communications technologies to health care-related projects involving, for example, telemedicine, testbed networks, virtual reality, and a Unified Medical Language System. The Visible Human Project® has created, in complete anatomical detail, a 3-dimensional representations of the male and female human body, resulting in a large digital image library.

Information Products and Services

- ✓ MEDLINE/PubMed: MEDLINE is NLM's database of indexed journal citations and abstracts from 4,600 biomedical journals. MEDLINE citations and abstracts are available as the primary component of NLM's PubMed database, which is searchable via the Internet.
- ✓ PubMed Central: This is a digital archive of life sciences journal literature, developed and managed by the National Center for Biotechnology Information. With PubMed Central, NCBI is taking the lead in preserving and maintaining open access to the electronic literature, just as NLM has done for decades with the printed biomedical literature. PubMed Central aims to fill the role of a world-class library in the digital age. Access to PubMed Central is free and unrestricted.
- ✓ MEDLINEplus: Helps find answers to health questions, provides consumer-oriented information.
- ✓ ClinicalTrials.gov: Provides information for patients about clinical research studies.
- ✓ DIRLINE: This is a directory of health organizations.
- ✓ LOCATORplus: Catalogue of books, journals, and audiovisuals in the NLM collections.
- ✓ NIHSeniorHealth: Provides health information for older adults.
- ✓ NLM Gateway: This is a single Internet interface that searches multiple NLM retrieval systems.
- ✓ TOXNET: Databases on toxicology, environmental health, and hazardous chemicals.
- ✓ Tox Town: An interactive guide to commonly encountered toxic substances, health, and the environment.
- ✓ GenBank®: NCBI assumed responsibility for the GenBank DNA sequence database in October 1992. NCBI staff with advanced training in molecular biology builds the database from sequences submitted by individual laboratories and by data exchange with the international nucleotide sequence databases, the European Molecular Biology Laboratory (EMBL) and the DNA Database of Japan (DDBJ). Arrangements with the U.S. Patent and Trademark Office enable the incorporation of patent sequence data.
- ✓ MEDLARS: Medical Literature Analysis and Retrieval System allows rapid access to biomedical information. Also used to prepare publications like Index Medicus. Through the Internet, MEDLARS is available worldwide for free.
- ✓ Other products and services of NLM include:
  - leasing NLM databases,
  - preservation and collection management,
  - training and outreach activities (e.g., for HIV/AIDS, toxicology and environmental health, and minority organizations),
  - information for publishers,
  - reference and customer services,
  - serial programs and services,
  - reading rooms, interlibrary loans, and onsite electronic access to NLM services.

Fact Sheet
NSF – National Science Foundation, Sri Lanka

Strategic Overview

- ✓ The key objectives of the National Science Foundation are:
  - To initiate, facilitate and support basic and applied scientific research by universities, science and technology institutions and scientists.
  - To foster the interchange of scientific information among scientists in Sri Lanka and foreign countries.
  - To award scholarships and fellowships for scientific study or scientific work at science and technology institutions.
  - To maintain a current register of scientific and technical personnel, and in other ways to provide a central clearing house for the collection, interpretation and analysis of data, on the availability of, and the current and projected need for, scientific and technical resources in Sri Lanka, and to provide a source of information for policy formulation on science, technology and other fields.
  - To popularize science amongst the people by funding programs for that purpose.

Profile

- ✓ NSF is the major national provider of scientific and technical information in Sri Lanka.
- ✓ As an organization that is part of the Ministry of Economic Reform, Science and Technology, the role of NSF is one of being a primary government STM information organization. NSF is directly aligned with the innovation and science and technology policies of the national government.
- ✓ NSF is also the country's primary gateway to major international STM information organizations, and provides a capacity for technology watch on behalf of Sri Lankan research scientists, engineers, technologists and educators.
- ✓ The Sri Lanka Scientific and Technical Information Centre (SLSTIC) is the division of the National Science Foundation that provides a national focal point of information on science and technology.
- ✓ Approximately 30 percent of NSF customers are from academic institutions (universities and colleges); 15 percent are from private sector companies or industry consortia or associations; 30 percent are from government organizations (science and technology departments, research laboratories, etc.); and 25 percent are from health organizations and institutions.

Information Products and Services

- ✓ NSF assists Sri Lanka libraries and information centres in utilizing information technologies to provide better services; provides training for library and information science professionals; supports STM institutions in hosting web sites on the Internet; provides information on the latest technology developments to the STM community; and supports educational institutions in their mission to teach future generations.
- ✓ The Sri Lanka Scientific and Technical Information Centre (SLSTIC) is the major disseminator of S&T information and promoter of resource development and cooperation among the S&T libraries in Sri Lanka. SLSTIC does not intend to develop a large collection of printed materials, but it does compile reference materials, reports and theses of NSF research grants, and serves as a repository of Sri Lankan S&T documents and NSF publications. In addition, it has a large collection of CD-ROMs from diverse national and international sources. SLSTIC also acts as a nodal point for LEARN (an online communications network for education and academic research) to disseminate S&T information to the academic community.

- ✓ NSF and SLSTIC have developed and maintain several online S&T databases, including:
  - the Sri Lanka Science Index (SLSI);
  - the Union List of S&T Periodicals in Sri Lankan Libraries (ULIST);
  - the Union Catalogue of PURNA (PURNA UCAT) with collections from 35 libraries (PURNA is an integrated information system based on UNESCO's WINISIS database management system);
  - SLSTIC Catalogue (SLSTIC), which includes the Sri Lanka Science and Technology Information Centre's book collection (NSF Library);
  - a directory of scientific and technical personnel in Sri Lanka (SLSTEP);
  - a database on ongoing research projects in Sri Lanka (DBOSR);
  - a database on documents of projects funded by NSF (RGRA);
  - a newspaper articles index (NEWS); and
  - a directory of web sites (WEB).
- ✓ Sri Lanka Scientific and Technical Information Network (SLSTINET): This is an umbrella network, which is a non-profit membership organization serving to develop strategies for information distribution and access in the field of S&T to assist various end-user communities in gaining access to information. SLSTINET provides access to a wide array of library products and services, and acts as a catalyst through which S&T libraries can pool their resources and address problems cooperatively. SLTINET's membership includes over 100 libraries.
- ✓ NSF is also the key S&T publisher in Sri Lanka. A variety of literature is published by NSF such as: the Journal of the National Science Foundation of Sri Lanka, the Sri Lanka Journal of Social Sciences, Vidurava (a science bulletin), a Science Education Series, NSF Monographs, science newsletters, and other materials.
- ✓ Technology Watch Centre (TWC): The NSF's TWC mainly focuses on helping local organizations to identify global developments in relevant and applicable technologies, and thereby is a partner in industrial growth and development, and in nation building. The TWC capacity provides an outlook on innovations and findings regarding technology related to industries. The databases it compiles consist of several articles on technology related to key areas of aquaculture technology, food science technology, textiles technology, and rubber and polymer science technology. Information in these databases is derived from international and local journals, magazines, newsletters, etc.
- ✓ S&T Indicators Unit: The S&T Indicators Unit of NSF was established in 1995 to conduct surveys, analyze and report on S&T human resources, R&D expenditures, research output, and R&D facilities in the country. The Unit maintains, updates and disseminates online the nation's S&T indicators and statistics. It has also published many documents since its inception, including the National Survey of R&D in Sri Lanka, an S&T statistical handbook, and directories of ongoing research, scientific instruments, and technical personnel in Sri Lanka.

Appendix B: Overview of Survey

The survey of eleven STM information organizations that participated in this study included a series of face-to-face interviews with ICSTI representatives of BL, CISTI, CSA, INIST, KTHB, and NLM, supplemented by a questionnaire administered to all eleven participants—including CONACYT, CSIRO, JST, NISSAT, and NSF. In total, 22 persons from the participating organizations were interviewed for this study. In addition, literature supplied by the interviewees and survey respondents was reviewed in the context of key questions addressed. The survey questionnaire is included for reference in this Appendix.

ICSTI Study: Impacts of STM Information Organizations

Questionnaire for ICSTI Member Organizations Participating in the Study

Competitive Challenges and Opportunities

1. In your opinion, what are the fundamental challenges that are currently facing scientific, technical and medical information organizations? For each challenge listed below, please provide a response on a scale of 1 to 5, where 1 means "not a challenge" and 5 means "a major challenge".

CHALLENGES	RESPONSE From 1 to 5
Increasing cost of maintaining STM information collections	
The need to keep pace with technology advancements in information retrieval, storage and delivery	
Pressure to commercialize and market products and services	
Intellectual property and licensing agreements	
The need for developing new and better ways of measuring performance and quality of services	
Pressures to find new sources of funding	
Anticipation of future strategic areas of STM information needs	
The need to attract and retain highly qualified STM information workers	
National competition from similar STM organizations	
International competition from similar STM organizations	
The need for greater efficiencies in the use of resources	
Developing and maintaining collaborative arrangements and partnerships with similar organizations	
Increasing need for accountability & rationalization of products/services to funding sources & clients	

Please provide any additional narrative that you believe best describes fundamental challenges that are currently facing STM information oganizations:

[Type here]……

2. How well is your organization prepared to respond to opportunities that lie ahead (during the next 3-5 years) in the following areas?

OPPORTUNITIES	RESPONSE From 1 to 5
Developing new sources of funding	
Developing new partnerships (e.g., with private organizations, public institutions, universities)	
Reaching out to a broad clientele at a global level (e.g., through collaborative activities, shared resources, joint projects)	
Managing intellectual property and licensing agreements	
Improving your organizational capacity to deliver STM information services	
Creating diversity in your STM information services and products	
Educating your clients on the benefits of STM information services	

Please provide any additional narrative that you believe best describes how prepared your organization is for responding to opportunities that lie ahead:

[Type here]……

Positioning of the Organization Within a Broader National Policy Framework

3. How would you position your organization as a provider of scientific, technical and/or medical information in your country? Check appropriate space.

	CHECK
Our organization is the major national provider of ST and/or M information in our country.	
Our organization is one of the three top national providers of ST and/or M information in our country.	
Our organization is one of many providers of ST and/or M information in our country.	

Comments [type here]……

4. How would you describe the role of your organization in relation to national scientific, technical and medical policies and goals of your country? Check appropriate space.

	CHECK
Our role is one of being a primary government STM information organization and we are directly aligned with the innovation and science and technology policies of our national government.	
Although we are a private sector organization our role is strategically aligned with the innovation and science and technology policies of our national government.	
We service our client's needs for STM information, and are not necessarily strategically aligned to any specific government innovation or S&T policies.	
We are a university organization and are not strategically aligned to any government innovation or S&T policies.	
We are a university organization and consider ourselves to be strategically aligned with the innovation and science and technology policies of our national government	

Please provide any other relevant characterization of your role as a national STM information organization that you deem appropriate:

[Type here]…….

5. What specific STM information services of your organization are most widely used by your clients? Please list the top two or three STM information services of your organization in order of use:

[Type here]…….

6. How does your organization continue to ensure its relevance and usefulness within the broad science, technology and/or medical policy framework of your country?

[Type here]…….

7. How does your organization continue to ensure its relevance and usefulness directly to its clients?

[Type here]…….

Client Reach

8. What is the approximate percentage of your organization's clients that are:

From academic institutions (universities and colleges)	%
From private sector companies or industry consortia or associations	%
From government organizations (science and technology departments, research laboratories, etc.)	%
From health organizations and institutions	%
Other (specify) [type here]	%

9. In your opinion, how significant are your clients to your country's science and technology, and/or medical infrastructure?

	CHECK
All of our clients are major players in our country's STM infrastructure	
Most of our clients are major players in our country's STM infrastructure	
Some of our clients are major players in our country's STM infrastructure	
None of our clients are major players in our country's STM infrastructure	

Please provide any additional narrative that could describe the position of your clients within the broader STM infrastructure of your country. [For example, "our clients are mostly international organizations"; or, "our clients are subsidiaries of international organizations and are not necessarily focused on our national goals for STM infrastructure"; or "our clients are government-owned and constitute the major part of our country's strategic directions in STM infrastructure"; and so on … .]

[Type here]…….

10. Do you have a client feedback system in place? If yes, please indicate how this feedback is obtained.

	CHECK
Through personal contacts	
Regular mail-out surveys	
Online (e.g., web-based) survey system	
Routine service and client satisfaction feedback forms	
Audits of information services	
Client forums/events (e.g., focus groups, workshops, roundtable discussions)	

Please provide any additional or other narrative that could describe how your organization obtains client feedback.

[Type here]…….

11. What measures (if any) do you use to assess how clients value the benefits of your STM information services?

EXAMPLES OF MEASURE OF VALUE AND BENEFIT	CHECK
Impacts on successful business decisions	
Impacts on successful government policy decisions	
Cost-savings impacts for clients	
Revenue generation impacts for clients	
Discoveries resulting from information services provided by your organization	
Technology improvements or new products/services resulting from information provided by your organization	
Client narratives about various successes attributed to your STM information services	
Clients' returns on investment in information services from your organization	

Please indicate any other measures you use to assess how your clients value the benefits of your organization's STM information services:

[Type here]…….

12. What is the relevance to your organization of measuring the impacts of your STM information services? For example: for evaluation and planning, for accountability, to rationalize strategic context, and so on … .

[Type here]…….

Organizational Performance

13. In your opinion, how well is your organization recognized within the scienctific, technical and medical community?

NATIONALLY (WITHIN YOUR COUNTRY)	CHECK
Very highly recognized	
Highly recognized	
Recognized	
Moderately recognized	
Not recognized	

INTERNATIONALLY	CHECK
Very highly recognized	
Highly recognized	
Recognized	
Moderately recognized	
Not recognized	

Please provide any additional comments that best describe your organization's relative position within the broader STM information services infrastructure of your country, and internationally.

[Type here]…….

14. Please list up to three STM information services for which you would describe your organization as "the leader in this STM information service area".

[Type here]…….

15. Please list up to three STM information services for which you would describe your organization as "one of the best among others in this STM information service area".

[Type here]…….

Impacts: Value of Your STM Information Services

16. To what extent do you believe your organization's STM information services create positive impacts in the following areas:

A response of "1", at the low end of the scale, means "creates no positive impact".
A response of "7", at the high end of the scale, means "creates a very high positive impact".
A blank means not applicable to your organization.

AREAS OF IMPACT	RESPONSE From 1 to 7
Supports educational institutions in their mission to teach future generations	
Generates an improved environment for the transfer of new technology to commercial uses	
Helps decision makers in private sector companies make informed business decisions	
Improves decision-making of government policy on science and technology	
Increases the innovative capabilities of national R&D organizations	
Provides opportunities for increasing health, safety and well-being of people	
Leads to new cures to human diseases	
Enhances competitiveness of small and medium-sized enterprises	
Helps accelerate business performance in industry	
Helps private and/or public organizations save time and money	
Helps research scientists create new inventions and develop new knowledge	
Increases the quality of work and work environments	
Helps improve productivity in private corporations	
Enables economic development and growth	
Improves the standard of living and quality of life in society	
Improves national production processes and the manufacturing infrastructure	
Other impact(s) that you would suggest – please specify	
[type here]	
[type here]	
[type here]	

Please e-mail completed questionnaire to
rostum@bytownconsulting.com

Thank you for taking the time to answer these questions.

Appendix C: Bibliography

A selection of relevant references is listed in this Appendix that readers may wish to consult. A search of published literature on impacts analysis was done through the services of the Canada Institute for Scientific and Technical Information (CISTI) and the National Library of Medicine (NLM). Searches were conducted using a number of key words, and word groupings, such as "impacts analysis", "value-added of STM information", "innovation system", "economic indicators", "socio-economic impacts", and so on. The representatives of the participating STM information organizations also provided some suggestions and other useful references included in this Appendix.

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