



UNESCO INSTITUTE FOR STATISTICS (UIS)

**INTERNATIONAL REVIEW OF SCIENCE AND
TECHNOLOGY STATISTICS AND INDICATORS**

**In cooperation with
UNESCO Division of Science Policy and Analysis
UNESCO Regional Office for Science and Technology
in Latin America and Caribbean**

Working Paper:

**TOWARDS A NEW UNESCO SHORT AND MEDIUM TERM
STRATEGY IN SCIENCE & TECHNOLOGY STATISTICS**

March 2003

This working paper presents basic elements for the UNESCO Institute for Statistics strategy in the field of Science and Technology, to be discussed at the March Meeting in Paris. It describes the most important areas of S&T policy for which the UIS would provide indicators, and proposes ways of addressing them in the immediate future, based on the existing and expected resources that will be available in the near future for these activities. After discussion during the Meeting, an appropriately amended paper is expected to serve as a guideline for the work of the UIS in S&T statistics for the upcoming years.

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SECTION 1 – Introduction

1. The World Conference on Science held in Budapest in 1999 placed emphasis on the necessity for countries to have access to reliable and policy-relevant statistics on science and technology (S&T):

“Governments should promote the further development or setting up of national statistical services capable of providing sound data, disaggregated by gender and disadvantaged groups, on science education and R&D activities that are necessary for effective S&T policy-making. Developing countries should be assisted in this respect by the international community, using the technical expertise of UNESCO and other international organizations.”

(Science Agenda - Framework for Action, World Science Conference, Budapest, 1999)

2. Following this recommendation, the UNESCO Institute for Statistics, jointly with UNESCO’s Division of Science Analysis and Policy (SC/AP) and Regional Office for Science and Technology in Latin America and the Caribbean (ROSTLAC), has carried out a fundamental international review of policy priorities and information needs in the fields of science and technology.
3. The objective was to identify priorities and current and emerging information needs that could serve as a basis for development of strategies for improving the relevance, availability and quality of S&T statistics in countries around the world, and, through this, to help define a new UNESCO statistical programme in the field of S&T. The ultimate goal is to revitalize efforts at both the international and national levels to build S&T statistical systems that are highly responsive to policy information needs, and to strengthen UNESCO’s role in stimulating and facilitating this revitalization process, especially through its activities in standard setting and in the gathering of cross-nationally harmonised data.
4. UNESCO designed this fundamental review as a three-stage process. The first stage began with a meeting held in April 2002 with a group of international experts in the field of S&T statistics and policy to discuss policy information needs. The main outcome of this meeting was a Background Paper, which reviewed some of the current policy concerns and existing S&T data areas, systems and indicators.
5. The Background Paper was used as a starting point for the second stage of the review, aimed at obtaining a worldwide reflection and feedback from relevant institutions and experts within UNESCO Member States, as to the key S&T policy issues and information needs, in order to define the priority areas in which the UIS should develop its S&T statistical programme. The main instrument was a questionnaire sent to a large number of relevant stakeholders all over the world. The principal outcome of this consultation was a paper called “Science & Technology Policy Priorities and Information Needs - Issues for a New Strategy in S&T Statistics”, which analyses the priority given by respondents to proposed S&T policy issues, and the information needs related to this policy issues. The analysis is conducted by region, institutional background, type of involvement in S&T policy, and gender of respondents, showing interesting patterns. The analysis found the “region” to be the most significant variable from the point of view of the design of a strategy.
6. The present document builds on the previous steps of the process, taking also into account important input and suggestions received from key experts in the field of S&T policy and indicators. It presents basic elements for the design of a new UNESCO Institute for Statistics S&T medium term strategy, for discussion at the “International Meeting Towards

a New UNESCO Strategy in Science and Technology Statistics”, to be held in Paris 24 to 26 March, 2003.

7. Section 2 of this document presents S&T Statistics issues directly related to S&T policy priorities. It outlines a way to address the demands of information related to the main policy priorities, especially those identified in the consultation process.
8. Section 3 discusses strategies for data collection and fostering data quality. It proposes to collect a core set of data for the whole world, and special projects related to specific interests of groups of countries. It also analyses strength and weaknesses of the UIS S&T Statistics Database. Later in this section, the importance of a dialogue with policy makers is discussed, as well as strategies for the development of methodologies in key areas of interest for groups of countries. Furthermore, statistical capacity building activities for the development of S&T indicators production systems at local level are proposed. Finally, this section discusses future UIS networking and co-operation activities, and possible new forms of data collection.

SECTION 2 – S&T Statistics and Policy-Making

9. The use of statistics in S&T policy-making is widespread in developed countries, especially in the framework of OECD. In other regions of the World, the situation is rather heterogeneous. The lack of data on S&T in many developing countries, as will be discussed in section 3, shows that these data have not been demanded by policy-makers, or that these demands could not be met by data producers. ***In order to foster the production of sound S&T statistics and indicators, it is essential to build a greater understanding of the needs of policy-makers and to discuss ways in which they might use S&T data.***

2.1 S&T policy priorities

10. In the framework of the UNESCO International Consultation on S&T Policy Priorities and Information Needs, the following Science and Technology policy issues were found as being extremely important. These issues were also the main focus of the information needs expressed during the consultation, and therefore turned into main priority lines for the production of statistics and indicators:
 - **“Human Resources”** is the highest S&T policy priority, obtaining a worldwide consensus. A programme to develop and collect better human resources statistics, focusing both on ***personnel active in R&D*** and issues related to the broader concept of ***human resources in S&T*** is needed. This includes: the measurement of the stock of professionals and practitioners (and not only of researchers); employment, education of S&T personnel; recruitment to S&T careers; and ***international mobility*** of highly qualified people (or “brain drain”).
 - **“Financial Resources”** also emerged as a highly important S&T policy issue. There is a need to strengthen the collection of data on expenditure on R&D, providing help where appropriate in order to create local capacities for this type of data collection. In this regard, ways of adapting Frascati Manual^[1] guidelines to the characteristics of certain groups of developing countries need to be evaluated. ***International comparability of R&D data*** should nevertheless be sought as widely as possible.

- The high importance given to issues like “*Technology Output*”, “*Economic Impact of S&T*”, and “*Innovation*” is clearly related to a general perception of the important contribution that Science and Technology bring to development. Nevertheless, the use of data to prove this relationship has not been that wide. Recent economic theories propose that certain characteristics of Systems of Innovation and of the technological behaviour of the firms are useful to explain the different paths of developments countries take. Therefore, indicators related to these issues need differentiated treatment by groups of countries, taking account of marked differences in national systems of innovation and in capacities for producing high technology output throughout the world. The strategy in these fields includes the sharing of experiences in the field of *innovation statistics*, participating in the activities of OECD and Eurostat, such as the Oslo manual review process, as well as taking into account the experience of developing countries, such as the application of RICYT’s Bogotá Manual in Latin America. The incorporation of other indicators of this group, like the *Technology Balance of Payments*, indicators regarding *International Trade of High Technology Goods and Services*, or *Patent Statistics* in the UIS database require data collection and capacity building activities, as well as increased partnership with international organizations in charge of the production of other international statistics, like UN Statistics Division or WIPO.
- “*Social impact of S&T*”. An important demand for indicators related to this issue has been evident throughout the consultation process. Since there is currently no agreement about the exact definition of such indicators, as well as the actual way of measuring social impact of S&T, there is a need to carry out a great deal of research and development activity in this field. “*Public perception of S&T*” is one of the areas covered by the broad concept of social impact of S&T. Public and private institutions in countries with different levels of development have carried out exercises in order to measure this variable. Nevertheless, up to now it has been difficult to construct comparable cross-national statistics on this issue, particularly taking into account the different cultural issues involved.
- “*Impact on Agriculture*”. The necessity of quantifying different aspects of the impact of S&T on agriculture is another one of the issues related to impact to which high importance was given by Africa and America during the consultation. Specific indicators in this field have still to be developed.
- “*Scientific output*”. Current tools for the production of scientific output indicators, usually included in the term “Bibliometrics” or “Scientometrics”, are biased towards the scientific production of developed countries. The widespread use of the Science Citation Index and other indexes produced by the Institute for Scientific Information (ISI) as unique tools for the production or indicators –and therefore, the artificial restriction of “Science” to “Mainstream Science”- is at the root of this bias. The utility of bibliometric indicators based on these types of sources is often questioned since scientific production in developing countries does not necessarily follow the same path towards publication as it does in other countries in the world. Not every discipline in developing countries publishes results and scientific communications in journals registered by the ISI, nor have scientific journals in developing countries the profile to be included in the international databases. In spite of these difficulties, these indicators are not easily replaceable for measuring scientific outputs. The more consolidated or “internationalised” areas of science in some developing countries are gradually accepting the use of bibliometric indicators.^[2]
- “*Related statistics*”. The UIS work in S&T statistics will give special attention to *higher education* and *information society* statistics, in close co-ordination with other agencies and other teams inside the UIS.

11. All these different thematic areas are considered as highly important for the UIS work. Nevertheless, specific strategies are needed to approach the different subjects, given not only the different nature of the problems and the differences in existing S&T capacities in the Member States, but also the limitations in the amount of resources available at UIS.
12. In the same sense, there will be differentiated strategies to address issues with the highest priority and a worldwide coverage, and other issues involving only a subsample of countries.

2.2 Specific strategies related to information needs

13. In order to meet both S&T policy priorities and information needs manifested in the International Consultation process, some groups of statistics and indicators were selected for the UIS medium-term strategy. For those groups, the following strategy guidelines are presented:
 - **“R&D resources” data.**
 - The current UIS database is composed by data on R&D personnel and R&D expenditure. The collection of such data will continue to be carried out by UIS, seeking to improve quality and coverage of the data.
 - UIS will continue to take part in the follow-up of the Frascati Manual revision process, as well as in projects aimed at developing complementary methodologies for applying and/or adapting this manual to the specific conditions of developing countries.
 - **“Human resources in S&T” data.**
 - A first evaluation will be carried out in order to assess as to what extent this type of data is collected worldwide, and the level of international comparability of available data. This study will take into account the different criteria presented in the Canberra Manual^[3], and will propose strategies for expanding the measurement of these variables - especially the measurement of the “stock” of professionals- to interested countries.
 - UIS will take part in OECD’s and Eurostat’s efforts to revise this Manual, and will also inform national efforts to include appropriate questions and to utilize international classifications in different types of statistical instruments, including population censuses, household surveys, and employment surveys or registers.
 - These types of data will be closely linked to **Higher Education Statistics**, focusing on **S&T careers**. The possibility of carrying out pilot studies of Higher Education Students and Graduates following ISCED Field of Study codes with the highest level of disaggregation -jointly between the UIS S&T and Education teams- will be studied.
 - Special attention will be given to the problems involved in the measurement of **“international mobility”** of highly skilled people, in the search for adequate methodologies to permit a quantitative approach to the analysis of the “brain drain”.
 - **“Innovation” indicators.**
 - A first study will be conducted surveying the existing experiences of innovation surveys in developing countries. A report will be produced with the analysis of the reports of the identified surveys, comparing methodologies used in the countries.
 - UIS will continue to participate in the activities of OECD and Eurostat, such as the Oslo manual review process. Methodological experiences in developing countries, such as the development of the Bogotá Manual by RICYT in Latin America will be followed-up, in order to assess its possible application to countries in other continents.
 - **“Economic Impact of S&T” indicators.**

- The *Technology Balance of Payments*, indicators of *International Trade of High Technology Goods and Services*, or *Patent Statistics*, will be incorporated into the UIS database in a second step, in joint projects with organization like the UN Statistics Division, World Intellectual Property Organization (WIPO), European Patent Office (EPO) and United States Patent and Trademark Office (USPTO).
- **“Social impact of S&T”& “Impact of S&T on Agriculture”.**
 - A long term R&D programme will be prepared in order to develop indicators of social impact of S&T. This research programme will bring together interested groups from different regions, including particularly researchers from Africa and Latin America, since these regions gave higher priority to this subject throughout the consultation process. The possibility of launching an open call for projects on this issue will be evaluated.
 - Indicators quantifying different aspects of the impact of S&T on agriculture need also to be developed, in close co-operation with International and local agencies specialized in this field, such as FAO.
- **“Public perception of S&T”.**
 - Studies will be carried out in order to assess the possibility of developing cross-nationally comparable statistics on public perception of S&T, taking into account the different cultural issues involved. These studies will draw on the experience of the US National Science Foundation, as well as other institutions and organizations active in this field in countries with different levels of development.
- **“Scientific output”.**
 - The design of bibliometric tools adapted for the analysis of scientific output in developing countries is another line of work that will be carried out in the medium term. The work on this issue will include the utilization of different sets of databases for the production of indicators, such as ISI databases, PASCAL, MEDLINE and other thematic databases. Another aspect of this work will be to analyse ways of supporting the creation and expansion of regional publication databases which could help to improve the measurement of developing countries’ scientific output.

SECTION 3 – Strategies for data collection and fostering data quality

14. In order to propose different strategies for data collection and fostering data quality, the weaknesses and strengths of the current UIS S&T statistics database and of the current S&T statistics collection process have been analysed:

3.1 UIS S&T Database

15. The structure of the UIS S&T Database includes indicators on Human and Financial resources. Data collection started in 1967 and data are available from 1970 to 2000. The scope of the database includes all 188 UNESCO member States. The UIS S&T Database is therefore the most comprehensive database on these issues available worldwide. One of the strengths of UIS in the field is that Member States are obliged to provide data to UNESCO, even if this requirement does not always translate to reality.
16. The following indicators are included in the database:

- Human resources
 - number of personnel engaged in R&D
 - by category of personnel ;researcher, technicians and equivalent staff and other supporting staff
 - by sector of performance
 - by field of R&D activity
 - by branch of economic activity

- Financial resources
 - Gross domestic expenditure on R&D
 - by type of expenditure
 - by sector of performance
 - by field of R&D activity
 - by source of funds
 - by branch of economic activity
 - by major socio-economic objective
 - Current intramural expenditure by type of R&D activity

- Government budget appropriations or outlays for R&D
 - by major socio-economic objective
 - by sector of destination

17. Data for the following non-OECD countries are available:

Africa	Asia	Europe	Latin America & Caribbean	Oceania
Benin	Armenia	Belarus	Argentina	Fiji
Burkina Faso	Azerbaijan	Bulgaria	Bolivia	Guam
Burundi	Bangladesh	Croatia	Brazil	New Caledonia
Cameroon	China	Estonia	Chile	
Central African Republic	China, Hong Kong SAR	FYR Macedonia	Colombia	3
Congo	Cyprus	Latvia	Costa Rica	
Egypt	Georgia	Lithuania	Cuba	
Guinea	India	Malta	Ecuador	
Libyan Arab Jamahiriya	Indonesia	Moldova	El Salvador	
Madagascar	Iran, Islamic Republic of	Monaco	Guatemala	
Mauritius	Israel	Romania	Jamaica	
Nigeria	Jordan	Russian Federation	Nicaragua	
Rwanda	Kazakhstan	Serbia and Montenegro	Panama	
Senegal	Kuwait	Slovenia	Paraguay	
Seychelles	Kyrgyzstan	Ukraine	Peru	

South Africa	Macao		St. Helena
Togo	Malaysia	15	Trinidad & Tobago
Tunisia	Mongolia		Uruguay
Uganda	Oman		Venezuela
	Pakistan		
19	Philippines		19
	Qatar		
	Singapore		
	Sri Lanka		
	Syrian Arab Republic		
	Tajikistan		
	Thailand		
	Uzbekistan		
	Viet Nam		
	29		

18. However, the database does not include data for every indicator for all the countries and for every year. In fact, data density is rather low. Moreover, there is a marked lack of data from many developing countries and in particular African countries.
19. Besides the availability issues, the quality of the data contained in the database is not homogeneous. The following analysis is based on the responses given by member States to the two last UNESCO STS/Q/981 questionnaires, sent out in 1998 and 2001.
20. During the two last rounds of UIS data collection, around 50 non-OECD countries^[4] filled the questionnaires each year. Among these countries, 10 are from Africa, 16 from Asia, 10 from Latin America and Caribbean, 11 from Europe and 2 from Oceania. In terms of regional coverage, only 18% of African countries filled the questionnaires, 10% of Oceania, 32% of Asia, 35% of Europe non OECD and 20% of Latin America and Caribbean countries. However, other regional publications such as RICYT's "Principales Indicadores de Ciencia y Tecnología Iberoamericanos / Interamericanos" indicate that many Latin American countries do collect R&D data. This might show that the channels through which UIS has been operating up to now need to be revised. This issue will be further discussed in Section 4.
21. Although 90 % of the questionnaires provided data on aggregate level with relatively good quality^[5], disaggregated data was of poor quality and were not often available at all (only around 40% of the questionnaires provided disaggregated data on R&D expenditure).
22. The lack of this type of data in many countries could have different origins and causes:
- Lack on information on methodologies, and difficulties for applying the Frascati Manual (definitions, concepts and nomenclatures).
 - Weaknesses in data collection mechanisms (no unit responsible for the collection and centralisation of S&T data within the countries).

- Lack of demand by S&T policy-makers for S&T data for decision-making.
- The UNESCO STS/Q/ questionnaires themselves (i.e. being too detailed for some countries).

23. In order to respond to the above-mentioned problems, one of the main axes of the future UIS strategy in S&T statistics and indicators will be to develop a working programme targeting a more complete reporting of good quality data on S&T resources, eliminating gaps in the UIS database, and fostering *quality*, taking into account all its different components.

24. Therefore, the UIS strategy in S&T data collection will include:

- Dialogue with policy-makers on the importance of S&T data
- Development and diffusion of methodologies
- Capacity building activities
- Networking and co-operation activities
- Improving data collection

3.2 Dialogue with policy-makers

25. The dialogue with policy-makers should be held on a continuous basis, and founded on two complementary premises. First, the search for an understanding of the advantages of implementing evidence based policy-making process. Second, paying attention to the needs and views of the policy-maker as a (potential) user of statistics.

26. Dialogue with policy-makers has to be led by local interested institutions, with UIS playing an advisory or catalyst type of role.

27. In order to improve this dialogue, UIS should take into account the importance of the *analysis of data* both nationally and comparatively. Promoting the use of data both for analytic and policy-making purposes will result in greater support for data collection and a resultant improved quality of data. This should include a new UIS S&T publication strategy, which in addition to sharing statistical data –mainly via the web- should also include the development of “Special Reports”, devoted to key issues (i.e. Women in Science), or presenting global pictures (as in “The State of Science and Technology in the World”), or regional pictures.

28. One of the expected outcomes of the dialogue with policy-makers is the implementation of sustainable S&T indicators systems based mainly in S&T policy institutions –such as Ministries of S&T or Science Councils-, working together with national networks of institutions that carry out S&T activities.

3.3 Methodologies

29. In order to meet the requirements of new indicator areas, UIS will be active in the *development of methodologies*, in close co-operation with other organizations, agencies or interested countries. The first priority will be to clarify conceptual and methodological issues related to new data areas identified during the consultation, as described in Section 2.

30. Another line of action in this area will be de *adaptation of existing methodologies to developing countries characteristics and needs*. This will focus not only on concepts to be applied, but also on scale-related problems, or on how to collect and update S&T data in contexts of marked resource shortages.

31. UIS will also be active in the *diffusion of methodologies*, both those that may be developed with UNESCO leading, and also those coming from OECD, Eurostat or other regional organizations.
32. Methodological projects will be structured to seek the participation of groups of experts coming from countries with similar priorities and concerns. In some cases, open competitions for projects could be launched, in order to assess a range of different possibilities before choosing a particular approach. This could also include carrying out thematic workshops or expert meetings in order to discuss and evaluate the proposed options, as well as to expand the work to the largest possible number of research groups. Methodological development could also include cases studies, to be carried out in volunteer pilot countries.
33. It is generally recognized that information is a central tool for S&T management activities, at international, national and institutional level. This information is frequently found in form of statistics, but in some cases, a more dynamic approach to information is needed, focusing on special characteristics of the S&T system to be managed. The implementation of *S&T Management Information Systems (STMIS)*^[6] could provide responses to those kinds of needs, building at the same time a strong basis for the production of statistics.
34. This STMIS would provide ways of producing and sharing information related to S&T institutions, mechanisms and policies, as well as research personnel, including a whole range of demographic characteristics that otherwise would be difficult to obtain in some countries. The feasibility and desirability of developing a methodology for the implementation of Modular STMIS should be studied. These systems could be developed and tested in groups of countries interested in each issue, in close co-operation with existing activities in this field.

3.4 Capacity Building

35. One of the key instruments for fostering data availability and quality will be Statistical Capacity Building (SCB). SCB will include training workshops for National and Institutional statisticians. It will also be closely related to the dialogue with policy-makers, as stated in section 3.2.
36. As a first step for the development of a SCB strategy, a survey of S&T statistics capacities will be conducted, inquiring about existing infrastructure and resources, as well as about capacity building needs.
37. As a second step, a draft capacity building strategy will be developed, in order to present it to possible funding partners. This strategy will present priorities based on the survey of statistical capacities, in the framework of the general UIS strategy in the field of S&T statistics.
38. Based on country diagnosis, SCB will include the following activities:
 - Establishment of “country strategies”, including, where possible, country visits of UIS staff or UIS consultants to develop full working programmes tailored to country needs.
 - Identification of local institution to co-ordinate S&T indicators collection
 - Local policy-dialogue – visits to key S&T institutions
 - National networking
 - Diffusion of concepts – Training seminars

- Search for the best ways to apply and –if necessary- adapt concepts and methodologies
- Assist countries to develop strategies for the production of S&T indicators
- Regional workshops to share experience and discuss better ways of producing S&T indicators.

3.5 Networking and co-operation activities

39. The UIS will follow a strategy based on co-operation with other organizations active in the field of Science and Technology Indicators. Special attention will be given to the participation in OECD's National Experts in S&T Indicators group (NESTI) and to the relation with Eurostat and its Working Parties. The other main type of partners will be existing regional networks, such as for example the Ibero American Network on S&T Indicators (RICYT), or the African Technology Policy Studies (ATPS) network.
40. UIS will promote the organization and expansion of *S&T indicators networks*, especially involving those developing countries not yet covered by these activities. These networks should become a way of sharing experiences between countries with similar interests and characteristics, taking advantage of skills already accumulated in some countries, and to discuss results and difficulties found in data collection processes.^[7]
41. For some groups of indicators, as mentioned in Section 2, partnerships with other organizations and UN Agencies will be established in order to share data and broaden the scope of the analysis of S&T data.
42. In order to increase the efficiency in the process of communication with institutions in the member states, co-operation with UNESCO Field Offices and National Commissions will be strengthened. Both Offices and NatComs will have a key role in the identification of partners and leading institutions in their countries, which will constitute the base of the UIS networking strategy.
43. UIS will continue to work closely with other UNESCO sectors, and especially with the Science Sector, through its Science Analysis and Policy Division. In this regard, S&T statistics produced by UIS have to be designed as a tool not only for National S&T policy-making, but also for UNESCO Science policy making.
44. As one of the main tools for networking and co-operation, but also for capacity building, the possibility of creating a *Worldwide S&T Statistics and Indicators Web Portal* will be studied. This project would include making available the UIS database, statistics web sites from different countries or regions, links to available methodological documents, news and other resources, such as an electronic discussion list. This web site should be constructed with partners who would help to keep it updated.

3.6 Improving data collection

45. All stages of data collection processes will be reviewed in depth:
 - The existing R&D questionnaire will be revised, taking especially into account item-non-response rates.
 - The new questionnaire will be based on a modular approach, with universal core questions and different additional groups of questions for different countries.
 - A new user-friendly electronic questionnaire will be developed, giving different options for replies.

- Direct contact and communication with data producers will be established, where necessary after consulting with Regional Offices and National Commissions.
- The periodicity of regular surveys will be assessed.
- For some indicator areas, special surveys will be proposed.
- The UIS database will be revised, both regarding quality of data and technological implementation. Technology statistics from other sources will be integrated.
- Quality assurance criteria will be incorporated to the whole process of data collection, processing, analysis, publication and response to external demands.

[1] Frascati Manual 1993: The Measurement of Scientific and Technical Activities: Standard Practice for Surveys of Research and Experimental Development (OECD).

[2] See the Background paper. "Science & Technology statistics and indicators in developing countries: perspectives and challenges" (July 2002).

[3] Canberra Manual: Human Resources in Science & Technology (Canberra Manual) OCDE/GD(95)77

[4] Following member countries demand, there is an agreement between UIS and OECD to share the data collected by the latter.

[5] The criteria used are the number of countries that had provided coherent and consistent data across tables within the questionnaires as a percentage of total countries.

[6] "S&T Management Information Systems (STMIS) are an organized assembly of resources and procedures required to collect, process, and distribute data for use in S&T decision-making. STMIS can be also defined as integrated, user-machine system for providing information to support operations, management, and decision-making functions in Science and Technology organizations. STMIS utilize computer hardware and software; manual procedures; models for analysis planning, control and decision-making; and databases." Adapted from Gordon B. Davis, Margrethe H. Olson, Management information systems: conceptual foundations, structure, and development (2nd ed.), McGraw-Hill, Inc., New York, NY, 1984.

[7] For Latin American and Caribbean countries, an agreement will be establish to co-operate with RICYT, the Ibero American Network on Science and Technology Indicators.