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Economic statistics: statistics of science and technology

Report of the United Nations Educational, Scientific and Cultural Organization and the Organisation for Economic Cooperation and Development on statistics of science and technology

Note by the Secretary-General

In accordance with a request of the Statistical Commission at its thirty-fourth session,** the Secretary-General has the honour to transmit to the Commission the report on statistics of science and technology, jointly prepared by the Institute for Statistics of the United Nations Educational, Scientific and Cultural Organization and the Directorate for Science, Technology and Industry of the Organisation for Economic Cooperation and Development.

* E/CN.3/2004/1.

** *Official Records of the Economic and Social Council, 2003, Supplement No. 4* (E/2003/24), chap. I.A., para.1.

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Report on statistics of science and technology

Summary

The present report was prepared in response to a request of the Statistical Commission for a status report on science and technology statistics. The report primarily describes the current situation and highlights some of the challenges faced in this area, but it also attempts to outline some of the expected developments in the near future. It has been jointly prepared by the secretariats of the Institute for Statistics (UIS) of the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the Directorate for Science, Technology and Industry, of the Organisation for Economic Cooperation and Development (OECD) with assistance from the Statistical Office of the European Communities (Eurostat). For the purposes of this report, the field of science and technology statistics has been interpreted as statistics on research and development, innovation, and human resources for science and technology, though the areas of patents and biotechnology are also discussed. It is important to bear in mind the scope of the report since a broader definition would have included such areas as information society statistics, statistics on science education or information on the activity of multinational enterprises, which are also of relevance to science and technology.

Contents

I. Introduction

1. Statistics on science and technology are fundamental to an understanding of the processes by which developments in these areas have an impact on societies and their economies, impacts which are very uneven across the world. The increased pace of change emanating in part from advances in information technology and biological sciences places demands upon the statistical systems to ensure that new science and technology policies are based on evidence and that the general public is better informed about the changes. Attention has focused upon empirical targets based on science and technology statistics. For example, Canada has set the goal of becoming one of the top five countries in terms of research and development intensity (research and development/gross domestic product (GDP)) by 2010 and the European Union (EU) has set a target of reaching a research and development intensity of 3 per cent also by 2010. However, the setting of such targets is not new. More than 30 years ago, the United Nations set the target for developing countries to spend 0.5 per cent of GDP in research and development[1] and 1 per cent in science and technology,[2] and these figures are still being cited in policy documents within the developing world. Such targets place pressure on science and technology statistics to be both timely and internationally comparable. The collection of cross-nationally harmonized data is complicated by the need for the regular updating of science and technology statistics concepts, classifications and methodologies in order to encompass emerging scientific fields and technologies which may not easily fit into the existing frameworks. This problem is exacerbated by the fact that many of the important new areas are of a multidisciplinary nature (e.g., biotechnology and nanotechnology).

II. Modus operandi for work on science and technology statistics

A. Governance and management at OECD

2. OECD work on science and technology statistics is conducted under the aegis of the Committee on Science and Technology Policy (CSTP) by its working party, the National Experts on Science and Technology Indicators (NESTI). The NESTI group is chaired by Fred Gault (Statistics Canada), supported by a bureau composed of four vice-chairs: Lynda Carlson, National Science Foundation, United States of America; Karl Messmann, Statistics, Austria; Giorgio Sirilli, National Research Council, Italy; and Kirsten Wille-Maus, Norwegian Institute for Studies in Research and Higher Education. Working with the OECD secretariat, the bureau formulates a biennial schedule of projects which might be included in the overall programme of work of CSTP. The projects are reviewed by CSTP, with each proposed activity being debated and ranked according to priority. The CSTP programme covers a range of projects, from those with a statistical emphasis through those with an exclusive focus on policy issues. Low-priority work is only carried out if sufficient resources are available. During the two most recent programmes of work (2001-2002 and 2003-2004), science and technology statistical activities consistently ranked among the top priorities.

3. NESTI meets once a year, although typically one or two workshops are held between meetings so as to prepare a subject for the full NESTI meeting. In addition,

for the past four years an ad hoc meeting of NESTI has been held to develop definitions and survey methodologies in the area of biotechnology. A fifth, and most likely final, meeting of this ad hoc group will be held in 2004, after which point it is expected that the topic will be included in the agenda of the normal NESTI meeting.

4. Delegates attending the NESTI meeting include the 30 OECD member countries, as well as 4 observer countries (China, Israel, Russian Federation and South Africa), as well as representatives from Eurostat, the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the Regional Network on Science and Technology Indicators (RICYT), a consortium of science and technology indicator producers from Ibero-American countries. Following the admission of China as an observer to the OECD Committee on Science and Technology Policy, statistical cooperation between China and OECD has increased, with China sending an official to OECD for a six-month training secondment, 28 Chinese statisticians visiting OECD for a two-and-a-half day training course in October 2002 and the publication of Chinese science and technology data in various OECD publications, including *Main Science and Technology Indicators* and the *STI Scoreboard* (see para. 30 below).

5. Given their common membership and close alignment of interests, the work of OECD in science and technology statistics is closely coordinated with that of Eurostat, with the two organizations collaborating on a number of projects, such as the revision of the Oslo manual on measuring innovation, research and development data collection and treatment and the use of each other's meetings to advance work on selected topics. OECD has recently reaffirmed its cooperation with UIS through its strong participation in the Institute's international consultation (see paras. 6 and 7 below). OECD and UNESCO are currently exploring a common project on human resources for science and technology.

B. UNESCO Institute for Statistics

6. In 2002 and 2003, UIS, supported by the UNESCO Division of Science Analysis and Policy and the Regional Office for Science and Technology in Latin America and the Caribbean, carried out an extensive international review of policy priorities and information needs in the fields of science and technology in order to feed into UNESCO strategic planning.

7. The response to the consultation was very positive and enabled the Institute to prepare a paper entitled "Immediate, medium- and longer-term strategy in science and technology statistics", which was distributed for further comment within and outside UNESCO and was debated at an expert meeting to which a range of countries with different policy interests were invited. The document describes the priority areas of science and technology policy for which the Institute proposes to collect and provide indicators, taking account of the required resources within countries and internationally. The paper was among those made available to the 190 States members of UNESCO at its recent biennial General Conference, at which an afternoon was devoted to a discussion of the UIS policies and programmes for 2004-2005.

8. The immediate priority identified was the need to focus on data on human, financial and institutional resources in science and technology, organizing the data within systems of "input indicators". It is likely that data relating to research and

development will be easier to collect in some countries than data relating more broadly to science and technology. There is widespread interest in developing countries in the adaptation to their specific needs of international methodologies and indicators to measure innovation in all sectors of the economy, ensuring that innovation is interpreted to encompass innovative applications as well as innovative products. This constitutes the medium-term priority for the UIS science and technology statistics programme. In the longer term, interest has been expressed in the development of "output indicators", though several of the current measures such as publications and patent counts are biased in favour of the richer economies. UIS will discuss further the feasibility of developing programmes with a specific focus on poorer countries to address the methodological problems of measuring the social impact of science and technology and exploring how science and technology is exploited in agriculture, health, energy and the environment.

9. UNESCO has been collecting science and technology statistics from its member countries since the late 1960s. Currently, the data-collection instruments and procedures are being revised, and data-sharing agreements have been put in place with OECD, Eurostat and RICYT, so as to avoid duplication of efforts and to lower the burden to the respondents in the countries.

10. In order to foster the production of science and technology statistics of high quality worldwide, it will be necessary to ensure that the data are of value for policy purposes within countries and that national statistical systems are not distorted by international demands. Thus more attention will need to be paid to statistical capacity-building in the area of policy analysis and the use of data. The Institute will collaborate with existing programmes and is seeking to increase its networking activities in the poorer parts of the world.

C. Other organizations

11. Eurostat collects research and development statistics through an annual survey, together with innovation statistics by means of the Community Innovation Survey (CIS), from EU and European Economic Area (EEA) member States, EU candidate countries and the Russian Federation. The Eurostat Working Party on Science, Technology and Innovation (STI) Statistics is also involved in methodological work in various domains. It is working closely with OECD on the first revision of the Oslo manual and is strongly involved in the ongoing revision. The innovation survey methodology in use in many countries is based on the Community Innovation Surveys prepared and coordinated by Eurostat. The preparatory work to be led by Eurostat for the Fourth Community Innovation Survey, CIS 4, has already begun.

12. Eurostat has developed a manual on the regional aspects of research and development and innovation statistics and has developed guidelines for collecting data on government appropriations for research and development which complement those in the previous edition of the Frascati manual. Eurostat also participated actively with OECD in the development of the Canberra manual on human resources in science and technology and has pioneered the collection and publication of statistics consistent with that manual (mainly based on the Community Labour Force Survey).

13. Some other regions of the world have in recent years significantly improved their capacity for the production of science and technology statistics. In Latin

America, RICYT started its activities in 1995, under the auspices of the Ibero-American Programme on Science and Technology for Development (CYTED). Its stated main objective is to promote the development of instruments for measuring and analysing science and technology in Ibero-America, in a framework of international cooperation, in order to improve knowledge of them and to achieve their optimal utilization as instruments for the decision-making process. RICYT collects and publishes research and development and innovation statistics from countries of Latin America and the Caribbean and is also active in studies relating to methodological issues and training at the regional level.

D. Publications and databases

14. OECD publications on science and technology are available both in hard copy and electronically (CD or via SourceOECD) and mirror the OECD databases. They include: *Main Science and Technology Indicators*, a semi-annual publication featuring data on research and development, human resources and patents; *Basic Research and Development Statistics*, which includes full details on the data obtained from the questionnaire on research and development which OECD sends to national statistical offices and is produced annually electronically and in hard copy on a biannual basis; and the Analytical Business Enterprise Research and Development Database (ANBERD), an analytical database in which the OECD secretariat adjusts the data to correct for known anomalies and deficiencies in the official data. ANBERD is produced both annually electronically and in hard copy.

15. In addition to these standard publications, OECD produces science and technology indicators in a number of other publications, such as *STI Scoreboard 2003*. The objective of the *Scoreboard* is to provide a comprehensive picture of countries' performance in the areas of science, technology, globalization and industry. New indicators address such emerging policy issues as international mobility of researchers and scientists, innovation as measured by patent families, biotechnology and nanotechnology. In addition to being available as a hard-copy publication and via SourceOECD, the *Scoreboard*, complete with the underlying data, is freely available from the Web.[3]

16. A new ad hoc publication on patent statistics was released in September 2003. The *Compendium of Patent Statistics* presents various patent indicators to reflect the recent trends in innovative activity across a wide range of OECD member and non-member countries. Patent-based statistics reflect the inventive performance of countries, regions and firms as well as other aspects of the dynamics of the innovation process (cooperation in innovation, technology paths, etc.). Patent indicators, along with other science and technology indicators, thus contribute to our understanding of the innovation system and factors that support economic growth. The current *Compendium* presents the first results of the OECD Patent Project, the objective of which is to develop an international statistical infrastructure for patents, including databases and methodologies. A set of pre-defined indicators, based on the practice of the European Patent Office, the United States Patent and Trademark Office and the "triadic" patent families, has been made available on the OECD web site.[4]

17. For new and emerging work of both a statistical and a methodological nature, OECD increasingly uses its Working Papers series as a dissemination tool. Recent

titles have included a compendium of biotechnology statistics and a consultant's report on the availability and characteristics of surveys on the destination of doctoral recipients and numerical targets of research and development.[5]

18. An extract of the UIS database is available online.[6] During 2004, the coverage of the freely accessible database will be expanded, in terms of both number of indicators and years of data collection. The UIS database provides statistics to many different stakeholders, such as the UNESCO programme sectors, the World Bank (for the *World Development Indicators*), the United Nations Statistical Division (for the *Statistical Yearbook*), the United Nations Development Programme (for the *Human Development Report*), as well as organizations and scholars from public and private institutions throughout the world.

19. Eurostat has released its research and development statistics under theme 9, "Science and technology" in its New Cronos database. Recent updates include research and development statistics (up to the reference year 2001), statistics on human resources in science and technology, and innovation statistics (based on CIS 3). The pocketbook entitled "Science and technology in Europe" as well as a number of smaller publications in the Statistics in Focus series have been released. Two Panorama publications (on science and technology and on innovation) will be produced in 2004.

III. Current work and future challenges

20. The main challenges for science and technology indicators are manifold. There is a critical need to extend the production of high-quality statistics on science and technology to more countries throughout the world, as science and technology becomes increasingly recognized as an engine of growth and developing countries base their development policies on science. This can only be achieved through increased focus on and dedication of resources to statistical capacity-building activities. In addition, there are well-known methodological challenges: to collect better data on the service sector; to broaden the measurement of innovation beyond the somewhat restrictive area of research and development (which, it could be argued, is an input rather than an output of the innovation process); to widen the focus to include elements of the innovation process that may be more appropriate for developing countries; to develop a better understanding of the role of human capital in the innovation process; to capture new phenomena that are of interest to policy makers such as those in biotechnology; to develop indicators that reflect the impact of science and technology on society; and to establish frameworks for the collection of comparable statistics in the field of science education.

A. Research and development statistics

Revision of the Frascati manual

21. Within the realm of science and technology indicators, data relating to research and development statistics are undoubtedly of the highest quality since the work has extended over four decades. Nevertheless, changes in the nature of research and development have created new challenges, necessitating a review of how to maintain the relevance of current measurement methods. The sixth revision of the Frascati

manual, the most important and standard methodological work for the collection of research and development statistics with worldwide acceptance, first published by OECD in 1963, marks the most recent attempt to improve the statistical methodology for measuring research and development. Initiated by NESTI in 2000, the revision was completed in 2002 and focused on providing improved guidelines for the measurement of research and development performed by services and of certain other areas such as information and communication technology (ICT), biotechnology and health; improved coverage of research and development personnel (with an emphasis on head counts); bridging the gap between Frascati and National Accounts; better integration of research and development with globalization indicators; and strengthening guidelines regarding survey methodology.

22. In parallel, the OECD secretariat, with the help of national experts, has set up a database of research and development survey sources and methods, which will be available shortly on the Internet to all users. The database aims to track all the current as well as historical methods used by member countries when compiling research and development data to be reported to OECD. It complements the Frascati manual by giving information on how countries actually build their research and development statistics and assessing the comparability of their data and will help users interpret the data published by OECD. A similar exercise, involving developing a sources and methods database for Government Budget Appropriations and Outlays for Research and Development (GBAORD), has been completed in cooperation with Eurostat.

Research and development and national accounts

23. NESTI has decided to continue work in particular areas that deserve further investigation following the revision of the Frascati manual: bridging the gap with National Accounts data (which would make research and development figures more comparable with economic data such as investment or GDP), and revising the classification by fields of science.

24. Capitalization of research and development in the National Accounts, should this be accepted in the next revision of the System of National Accounts, is a major aspect of the development and recognition of research and development statistics. It will improve their use in economic analysis as it will allow direct comparison of research and development with other economic aggregates such as GDP and gross fixed capital formation (GFCF). A Task Force on Research and Development and National Accounts was established following the 2002 meeting of NESTI. Its purpose is to examine the remaining methodological issues raised by an accounting of research and development in a System of National Accounts framework after the 2002 Frascati manual eliminated further differences between the two systems.[7] Working under the aegis of the Canberra II Group on intangibles, the Task Force has started examining the question of the capitalization of research and development and the determination of how Frascati-type data collected through national surveys could serve as a basis for producing figures compatible with the National Accounts. Among the issues considered by the Task Force are: coverage and valuation of research and development production, methods required for estimation at constant international prices, research and development imports/exports, constructing research and development stocks and estimating their depreciation, and overlaps in the data on research and development and software. The Task Force met in

Voorburg, the Netherlands, in April 2003 to report on progress, and identify areas for future work. During the October 2003 meeting of the Canberra II Group, countries reported on their progress, including the implementation of "bridge tables" (for converting research and development data from a Frascati to a National Accounts framework), and some initial methodological challenges, including the borderline between research and development and software, constructing research and development stocks and estimating depreciation, and problems related to the deflation of research and development. The next meeting of the Canberra II Group is scheduled for March 2004; it will be an opportunity to submit recommendations for more concrete proposals should there be a need to adapt future research and development data collection to System of National Accounts requirements.

B. Indicators of the output of innovation

Revision of the Oslo manual

25. Research and development statistics primarily measure the inputs into the innovation process, not the outputs of that process. Innovation surveys are designed for this purpose and have been carried out in almost all OECD countries. The methodology of the surveys has been criticized in recent years, however, as the changes in the innovation process have made it more difficult to define and therefore to measure innovation. At the 2002 meeting of NESTI, it was therefore agreed to undertake a second revision of the Oslo manual. Following the meeting, a core group of eight countries (Canada, France, Germany, Italy, Japan, Netherlands, Norway and Spain), coordinated by Eurostat and the OECD secretariat, volunteered to begin working on a set of priority issues which should be covered in the current revision of the manual. A workshop, held on 5 and 6 March 2003, jointly organized by OECD and Eurostat and hosted by the French Ministry of the Economy, Finance and Industry, and served as an initial forum for sharing national experiences on the implementation of innovation surveys and discussing four specific areas to be examined within the scope of the revision, namely non-technological innovations, measurement of output, measurement of expenditure and statistical methods. Following the NESTI 2003 meeting, six focus groups were established to begin work on the following topics: definitions; innovation output; innovation expenditure/inputs; linkages; data collection and panels; and statistical units. The focus groups presented a first progress report in November 2003, in conjunction with the meeting of the Eurostat Working Group on STI Statistics, in order to coordinate with the ongoing preparations for CIS 4. Norway has offered to host a conference in Oslo on 22 and 23 April 2004 to present the results of the work of the focus groups and provide more detailed recommendations for NESTI to consider at their 2004 meeting, during which the implementation and drafting stage of the revision will also be discussed.

26. At the same time, Eurostat has started the process of designing CIS 4, with a focus on the survey questionnaire and the methodology. At the first task force meeting in October 2003, discussions focused on appropriate strategies such as the advisability of having continuity in the questionnaire. The questionnaire design should be finalized in the second half of 2004.

27. As indicated above, there is a need to adapt Oslo manual methodologies and indicators to measure innovation in all sectors of the economy in a manner that is

more appropriate to developing countries. This involves issues such as measurement of innovation in agriculture and other sectors not always considered in current innovation measurement practices, promoting the use of indicators reflecting subnational innovation systems, including those related to linkages among the actors and the outcomes of the activity of innovation, and measuring minor or incremental innovation, which in some developing countries can be the most frequent category of innovation, as well as innovative applications of existing products or processes. The last of these issues could require surveys on the use of technologies and management practices. UIS will track the developments in statistics on innovation in developed countries with a view to spreading this experience but also supporting its adaptation in other parts of the world.

Patent data

28. An additional way to capture research outcomes is to trace patenting activity and to construct analytical databases from data available from patenting offices. Patents have their own drawbacks, though, mainly because they miss out on the non-patented outcomes of the innovation process. At the OECD secretariat, work on patent statistics has focused on the following areas: (a) database, (b) methodology, (c) dissemination of patent statistics, and (d) organization of a workshop on patent statistics. The main focus of the database work has been on the updating and maintenance of the OECD patent database, including patents from the United States Patent and Trademark Office and the European Patent Office and patent families. However, preliminary work is under way to enlarge the database. The enlargement of the database comprises the inclusion of information from national patent offices, Patent Cooperation Treaty applications and citations. The methodological work has focused on the development of definitions of patents for specific technology areas, such as biotechnology (including pharmacy), ICT (including telecommunication), software, etc.

29. Given that the source data do not originate from national statistical offices, the direct involvement of NESTI in this work has been limited and the project has largely been supported by voluntary contributions (both in kind and financial) from a task force composed of users and producers: World Intellectual Property Organization (WIPO), Eurostat, European Commission DG-Research, United States National Science Foundation, Japanese Patent Office, European Patent Office and United States Patent and Trademark Office. The task force sponsored a patent statistics workshop jointly organized by OECD and WIPO in September 2003, which led to a clarification of the directions that methodological work in this area should take in the future, based on discussions on where demand could meet with feasibility constraints. A second workshop has been proposed for September 2004.

30. In an effort to stimulate use by users and receive feedback on the methodological work that has been undertaken, the patent statistics have been made available on the OECD web site[8] and patent indicators were published in the recent *Main Science and Technology Indicators* and *Science, Technology and Industry (STI) Scoreboard* publications as well as in a free-standing compendium on patent statistics that was published in August 2003 and is available electronically also at the OECD web site.[8]

C. Biotechnology

31. While much attention has been focused in recent years on ICT, other technologies are also important as potential engines of growth, biotechnology being the best example. Developing international indicators for biotechnology presents numerous challenges, partly because biotechnology is a process rather than a product or activity and also because, until very recently, there was no international statistical definition of biotechnology. At the request of the OECD Working Party on Biotechnology, NESTI has held ad hoc meetings on developing biotechnology statistics since 2000 with the objective of helping countries to pool resources so as to collectively develop methodologies in this new area and seek to ensure international comparability. A draft definition of biotechnology was agreed upon in 2001 and has been reviewed each subsequent year; a set of "model" questions to be added to research and development surveys was developed in 2002 and forms part of an annex on biotechnology added to the revision of the Frascati manual; a more comprehensive model survey on the use and development of biotechnology was developed in 2003 together with a selection of patent classes falling under the definition of "biotechnology". The forward work plan includes the development of a biotechnology statistics framework that will encompass the various methodological building blocks and a paper on measuring the economic impacts of biotechnology. As data have been developed, statistical compendiums on biotechnology have been issued in 2001 and 2003 as working papers.[9]

D. Human resources in science and technology

32. The measurement of stocks and flows of human resources in science and technology is of key interest to policy makers and will be one of the two issues on the agenda at the meeting of OECD Science Ministers in January 2004. In particular, policy makers want to ensure that there is an adequate supply of researchers to meet the heightened demand as countries expand their science capabilities and become more knowledge-based.

33. This issue also was given the highest priority in the international consultation carried out by UIS, where respondents from all parts of the world stated that they considered human resources in science and technology to be their top concern, with little variation among regions. The improvement of the coverage of these statistics will therefore be a key element of the immediate-term strategy for the Institute's science and technology statistics programme.

34. The reinforced policy-interest in these statistics requires that data on researchers provide more demographic detail such as sex and age as well as information on the field of study and on the mobility of this cadre of talent so as to analyse the transition from school to work, the links between university and industry and the flow of people across borders ("brain drain/gain").

35. In 2002, NESTI held a one-day workshop, jointly organized with Eurostat, on human resources in science and technology. Outcomes of the workshop included the identification of the key issues involved in measuring these resources and a decision by NESTI to start background work prefatory to a revision of the Canberra manual. A follow-up workshop was held in 2003 which produced a forward programme of work with four objectives: (a) improving the demographic data associated with data

on human resources for research and development; (b) enhancing the compilation of human resource stock and flow data for non-EU OECD countries so as to be comparable with Eurostat work in this area; (c) launching of new work on the career paths of doctorates; and (d) inserting variables into the results of the first three exercises so as to obtain data on the international mobility of human resources in science and technology.

36. The proposal to develop a more harmonized survey of the career path of doctorates will be brought to the attention of the Ministers at the January 2004 OECD Science Ministerial. If resources become available, this work will be closely coordinated with Eurostat, and with UNESCO as well, since the brain drain is of great concern to many developing countries. With a view to minimizing the burden on national statistical offices and respondents, an inventory and comparison of existing survey instruments across OECD has been completed. Similar scoping exercises are under way for the OECD non-member countries that are observers to the OECD Committee on Science and Technology Policy (China, Israel, Russian Federation and South Africa) as well as India. UIS is considering a project proposal to launch methodological research on the collection of data relating to the mobility of science and technology human resources, using the broader concept of "higher-qualified people" rather than restricting the research to those with doctorates, but this work is dependent upon resources being made available to enable countries to participate in such developments.

37. One important area of study of the UIS work programme will be science education, with particular focus on availability, access, reception and quality. The issue is of the greatest importance not only for the establishment and maintenance of a vibrant science and technology workforce, but also for enabling people to function as active citizens in a knowledge society and to participate successfully in a knowledge-based economy.

E. Statistical capacity-building

38. One of the key instruments at UIS for improving both data availability and data quality will be the implementation of a statistical capacity-building programme, including training workshops for national and institutional statisticians, within appropriate regional and country-based modalities. The programme will stress the need to undertake a process of dialogue with policy makers, in order to discuss the importance of science and technology statistics for evidence-based policy-making. One of the main objectives of the statistical capacity-building programme is therefore to create institutional capacities and sustainable science and technology statistics production systems.

39. The success of statistical capacity-building activities will depend on the funding raised from external sources, as the core budget of UIS received from UNESCO does not include sufficient funding for such activities. Thus its extent will rely on extrabudgetary funding from international and bilateral organizations which support the need of developing countries for good-quality data to inform policy and strategies for poverty reduction, economic development and monitoring of progress towards international objectives such as the Millennium Development Goals. For 2004, a pilot project for countries of Sub-Saharan Africa has been developed and has already received positive responses from donor agencies. Complementary

funding will be raised in order to implement the project as widely as possible. A key element of such a programme of work within a country will be the identification of a "map" of data providers and the establishment, where needed, of a coordination system with the strong involvement of the national statistical institutes since the quality of science and technology data is often hampered by the decentralized nature of data provision.

IV. Conclusion

40. Because of the speed of development of information and communication technologies, the spread of multinational enterprises and the increasing mobility of people, scientific and technological developments seem to be occurring at a faster rate and are being diffused more quickly. The ability of countries to exploit these discoveries is seen as a key source of comparative advantage and a means of improving the standards of living of their people. As this role of science and technology has become more pronounced, so has the need for statistics that measure this activity and inform relevant policies.

41. A worldwide problem facing many statistical offices whose statistical work has not yet been brought into equilibrium in relation to science and technology, is how to determine which statistics are essential. Although other national statistical systems have achieved a certain degree of maturity in their science and technology statistics, especially compared to the situation 20 or 30 years ago, there are still difficulties of prioritization, since methodologies supporting the collection of science and technology statistics are constantly evolving to reflect the changing ways in which scientific knowledge is produced and applied.

42. In many countries increased resources are needed for the collection of timely and relevant science and technology statistics of high quality, based, where applicable, on international methodologies. The community of statisticians as a whole needs to make a better case for the importance and relevance of such data.

43. International activities in this area involve multiple agencies, both international and regional, which inevitably risks duplication of work, or what is worse, differing demands upon countries. We are pleased to report that we are concentrating our efforts on cooperation and the avoidance of duplication of work in order to optimize the use of the relatively scarce resources available. The present paper, produced jointly by OECD and UNESCO with assistance from Eurostat, is an indicator of the ongoing collaboration. We welcome the views of the members of the Statistical Commission as to how this cooperation can be further strengthened.

Notes

[1] International Development Strategy for the Second United Nations Development Decade, General Assembly resolution 2626 (XXV), para. 2 (63).

[2] See *World Plan of Action for the Application of Science and Technology to Development* (United Nations publication, Sales No. E.71.II.A.18).

[3] See www.oecd.org/sti/scoreboard.

[4] www.oed.org/sti/measuring-scitech.

[5] See www.oecd.org/sti/working-papers.

[6] www.uis.unesco.org.

[7] See DSTI/EAS/STP/NESTI(2003)19.

[8] www.oecd.org/sti/measuring-scitech.

[9] See www.oecd.org/sti/working-papers.

Annex

Methodological manuals and relevant documents

UNESCO

Recommendation concerning the International Standardization of Statistics on Science and Technology, Paris, 1978.

Manual for Statistics on Scientific and Technological Activities (ST-84/WS/12), UNESCO, Paris, 1984.

“Immediate, medium and longer-term strategy in science and technology statistics”, UNESCO Institute for Statistics, Montreal, 2003.

UNESCO Institute for Statistics web site: www.uis.unesco.org.

OECD/Eurostat

Type of data	*Title*
Research and development	The “Frascati family”: The Measurement of Scientific and Technological Activities Series Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development (OECD, 2002) R&D Statistics and Output Measurement in the Higher Education Sector. “Frascati Manual Supplement” (OECD, 1989).
Technology balance of payments	Manual for the Measurement and Interpretation of Technology Balance of Payments Data — TBP Manual (OECD, 1990).
Innovation	OECD Proposed Guidelines for Collecting and Interpreting Technological Innovation Data — Oslo Manual (OECD, 1997).
Patents	Using Patent Data as Science and Technology Indicators — Patent Manual 1994 (OECD, OCDE/GD(94)114, 1994).
Science and technology personnel	The Measurement of Human Resources Devoted to Science and Technology — Canberra Manual (OECD, 1995).

Type of data	*Title*
Other methodological frameworks for science and technology	
High-technology	Revision of High-technology Sector and Product Classification (OECD, STI Working Paper 1997/2).
Bibliometrics	Bibliometric Indicators and Analysis of Research Systems, Methods and Examples, by Yoshiko Okubo (OECD, STI Working Paper 1997/1).
Globalization	Manual of Economic Globalization Indicators (provisional title, forthcoming).