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## Developing science and technology indicators at the OECD: the NESTI network

Giorgio Sirilli

*giorgio.sirilli@cnr.it*

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*Statistics are among the most visible and most extensively-used outputs of the OECD. If the OECD were to close its doors tomorrow, the drying up of its statistics would probably make a more rapid and bigger impact on the outside world than the abandonment of any of its other activities (OECD, 1994a)*

## **A profile of NESTI**

The OECD Working Party of National Experts on Science and Technology Indicators (NESTI) is a forum composed of a group of delegates from member countries, supported by the OECD Secretariat.

NESTI enjoys a status as the pre-eminent, official S&T indicators group in the world. Its manuals are amongst the most widely cited of any OECD publication and its data are the standard for the analysis of S&T trends.

NESTI meets annually to discuss agenda items on which to reach consensus. It may be recalled that the OECD is a consensus organisation whose decisions are not binding: they represent recommendations which member countries are expected to implement.

The Working Party was established in 1962 to finalise the Frascati Manual and to carry out the first R&D surveys. In fact, the initial activity of this group can be traced back to 1957, prior to the formation of the OECD, when the Committee for Applied Research of the European Productivity Agency of the Organisation for European Economic Co-operation (OEEC) convened an *ad hoc* group of experts to discuss methodological problems of surveys of research and experimental development expenditure. In 1961 the OECD was formed and the Directorate for Scientific Affairs took over the work of the European Productivity Agency and convened a conference in 1962 to address technical problems of measuring R&D. Christopher Freeman was commissioned as consultant to write a background document for that meeting. This document, "Proposed Standard Practice for Surveys of Research and Development," was subsequently discussed, revised and accepted as the "Frascati Manual" by experts meeting in Frascati, Italy in 1963. Since then, the Manual has been revised five times (1970, 1976, 1981, 1994 and 2002) (OECD, 2002).

Over more than forty years NESTI assisted the OECD Committee for Scientific and Technological Policy (CSTP) or its predecessors in developing and interpreting indicators in the light of policy making acting also as a clearing house through which member countries could exchange information and experience on methods of collecting, compiling, analysing and interpreting data and indicators. In sum, NESTI is a forum where national experts exchange ideas, take decisions and reach consensus.

## **The mandate of NESTI**

Up to 1988 NESTI had not a proper mandate, and its activities were described in CSTP's deliberations regarding the implementation of the Frascati Manual guidelines through surveys conducted in member countries, and the coverage of input and output indicators. The mandate was explicitly defined in 1988 and the following activities were envisaged: the improvement of the Frascati manual methodology, its use in member countries and the preparation of similar methodologies for measuring the output of science and technology; the timely availability of R&D data, and the promotion of data collection and diffusion systems

for S&T output indicators; the assistance to CSTP in interpreting S&T indicators in policy making and in evaluating the technical validity of reports based on such indicators.

In 2000 the NESTI's mandate was renewed to 2004 by CSTP. The renewed mandate extended its scope from indicators of R&D to a broader spectrum including innovation data, patents, S&T human resources, globalisation and knowledge indicators. The role of NESTI as a co-ordinating body with other OECD groups and a clearing house was added, reflecting NESTI's evolving role as a node for S&T indicators even though NESTI *per se* may not be directly involved in the development of these indicators. Little changes have been introduced in the new mandate adopted in 2005 (OECD, 2004b).

## **The NESTI members**

NESTI members belong to two categories: data producers and data users. The first category is composed of R&D statisticians working in statistical offices and of civil servants working in ministries and public institutions who are in charge of collecting and publishing official statistics. They represent roughly 60% of delegates attending the NESTI meetings over the last few years. Occasionally other statisticians (working in areas like industrial statistics, national accounts, ICT statistics, TBP, etc.) attend NESTI meetings. The second category is made of science and technology analysts who use S&T indicators in connection with policy making at the national level; they may be working in S&T ministries and public and private research agencies. Needless to say, the two groups have different objectives and priorities: data producers are mostly concerned with methodology, data capture (and the resources involved), timeliness, comparability, while users tend to underscore the importance of the analysis of indicators and of broadening the spectrum of indicators to be used for addressing emerging analytical and policy needs.

While it is important to look at NESTI as an organisation, it is even more important to look at the people who are part of it. From this perspective the key factor behind the network is the personal and the professional dimension, not the institutional one. It is this collective group of people that truly defines NESTI.

NESTI is a quite special group of colleagues who take pleasure to work together. The "NESTI spirit" has been associated with a *Weltahnshauung* which puts values at the heart of the human endeavour well before the institutional duties. This "spirit" can be traced in various manifestations: the commitment and individual personal charm of the members of the bureau who are able to energise and motivate the colleagues well beyond the professional dimension (meals together, visits to special places on the occasion of meetings, hosting parties in members' houses, receiving colleagues, visiting families, gifts presented to colleagues retiring, the NESTI album of photos, etc.); the production of the NESTI tie and scarf, symbols of belonging to a special group, which is quite a unique arrangement within the OECD; a friendly kind of relationship: during the meetings delegates are not addressed from the chair as "the distinguished delegate from Norway or France" but as "Hans or Pierre"; the inclusive attitude towards the new colleagues entering the group as delegates from new OECD member countries or from observer countries; the applause by the translators on more than one occasion for the group's friendly way of resolving issues or conflict and being collaborative and productive; the stability of the chairmanship for a long time. Various former NESTI colleagues, especially retired delegates and Secretariat colleagues, are part of an informal alumni group who continue to collaborate in the field of S&T indicators and policy.

On top of regular OECD meetings, NESTI members have a host of opportunities to meet, in a "variable geometry" fashion, on various occasions such as meetings organised by national governments and international organisations, conferences, workshops, training courses, etc. This makes the network a flexible one.

NESTI members are motivated not only by their institutional duties as government delegates but, in most of the cases, and even more important, by the fact that they belong to a professional/scientific community: in this sense they are a network.

### **NESTI: a loose but dedicated network**

People working in the field of S&T indicators may be located in three “circles”.

The first circle, the “inner circle”, is made by the NESTI members. It is characterised as follows:

- the number of experts is a little more than one hundred;
- the affiliation of experts is heterogeneous (statisticians working in national statistical offices, policy analysts, government officials, OECD and other international organisations staff, academics);
- the disciplinary background of experts is diverse (statisticians, economists, scientists, sociologists, etc.).

Members of the “inner circle” may be spotted within and outside the OECD premises wearing official ties and scarves.

The “second circle” is made of people who interact with the first group in developing the methodological work and in providing feedback from competent users, i.e. academics, consultants, policy-makers directly involved in the use of indicators, possibly associated with the CSTP and international organisations. This group may be measured in hundreds.

The “third circle” is made of non-specialised and occasional users such as policy-makers, academics who use data for research purposes, journalists, politicians, industrialists, the general public. This group is rather large, and difficult to be counted - maybe it is composed of many hundreds of people.

Characterising and measuring the network beyond the “inner circle” is not an easy task. The field of S&T indicators is rather new, a little more than forty years, and heterogeneous. It has not yet received full recognition of the academic community (there are no chairs in the subject in universities, nor specific scientific journals) and a bibliometric analysis would identify only a small part of the membership (a significant share of NESTI members do not publish in journals but produce official and government documents which are not normally authored and not covered by the scientific literature).

### **The relationship between NESTI delegates and the OECD Secretariat**

The relationship between national delegates and the secretariat has always been quite satisfactory. This is basically due to the fact that both groups feel members of the same professional and scientific community and the dialogue is based on an equal footing: what counts is the work to be done together rather than the power struggle between the political masters (the “distinguished delegates”) and those who work for them in the intergovernmental organisation.

In this connection two periods can be identified. The first period, from the inception of the Science Indicators Unit to 1985, was characterised by the “domination” of the Secretariat. It was basically Yvan Fabian, the head of the Unit, who run the business. In practice it was Fabian who “appointed” the chairman of the yearly NESTI meeting (usually the American delegate in view of his knowledge and of the experience accumulated at the National Science Foundation) whose role was basically to run the discussion. Fabian made the operational and strategic decisions, and delegates followed his leadership. He was very successful in involving the academic community in the process of identification and use of indicators: in

such a way the OECD was able to bring new ideas and fruitful suggestions for future work. After the Fabian period, the Secretariat has spent less time and resources in this “scouting” process, relying perhaps too much on the “wisdom” of the CSTP which, by definition, is very much concerned with emerging and pressing policy needs. This has led to devote less efforts and resources to stimulate the scientific-academic community to provide food for thought for the development of indicators.

Things changed dramatically when a new director joined the Directorate for Science, Technology and Industry in 1985. Delegates wanted to take more leadership in terms of their own work and that of the Division (the Unit was upgraded to Division within the OECD organisation)), also due to the proven leadership and expertise of the NESTI group. The Group appointed a chairman for three years and three vice-chairs for two years. This was a quite significant departure from the OECD rules which envisage that the chair of a Group or a Committee should rotate very quickly. Such an arrangement is more functional to the need of sharing power and prestige amongst countries than to the quality of the leadership and the technical competence of the elected delegates. However, since 2002, the rules of the OECD have been followed and the bureau, in its entirety, is elected each year. The only difference with previous practice is that the chair is not expected to serve more than six years. The chair, with the other members of the bureau and the secretariat, actively engages in seeking and training a successor to ensure continuity of the NESTI programme.

The fruitful cooperation between delegates and the Secretariat staff is also due to the organisation of statistical work at the OECD: the indicators division in charge of collecting and analysing S&T statistics is part of the Directorate which is the prime user of the data. This allows a constant dialogue between users and producers of indicators within the Organisation. NESTI successfully opposed the proposal to move the S&T Division to the OECD Statistics Directorate, a strategy adopted by the European Commission where statistics are centralised within Eurostat. The cooperation is furthermore enhanced by the fact that the stability of Secretariat staff allows them to accumulate the experience necessary to provide a high level contribution to the work (at Eurostat the strategy is different: the secretariat members rotate all too often, reducing the scope for accumulating a depth of knowledge and rendering the dialogue between delegates and the Secretariat more difficult. Also the staff of national statistical offices tend to circulate rather quickly during their careers and no-one stays with S&T data for a long time. This facilitates cross-fertilisation with other types of statistics but cuts down on deep knowledge of the subject matter).

## **Modus operandi of NESTI**

As NESTI takes on a more diverse number of subject areas, it has begun to use workshops or *ad hoc* meetings to specifically focus on a subject area, thereby allowing delegates with specific expertise to attend these meetings. The results of these meetings are then reported back to the annual meeting of NESTI where in some cases additional work is requested by the broader group. While the somewhat dire resource constraints that prevailed in the mid-1990s have been reduced through reallocation of resources within the Secretariat, the amount of new work that can be undertaken is still limited. To address this problem, several Member countries and the European Commission have made voluntary financial contributions to offset the large initial costs associated with establishing new indicators series; some countries have contributed to the work of the Secretariat through the secondment of national experts.

One model used on various occasions, in particular in the revision of the manuals, is the “lead country approach”: a national expert takes voluntarily the lead of a group of volunteering national experts (between 5 and 8) for a specific topic, produces a discussion

document and suggests possible solutions to be discussed and adopted at the meeting. This approach has also been used in the development of new indicators. Possibly this approach is going to become more and more relevant to the NESTI's work due to resources constraints, the specific skills required to properly address the work programme, and to the institutional and personal cultural interests of national delegates. In many cases the willingness of member countries to assume a leadership role was essential to the project's success.

Organisationally speaking, NESTI work falls into two distinct, but interdependent areas: statistics, indicators, methodology; and analysis. In general, the past and future work focuses on extending the self-reinforcing triangle (data, methodology and analysis) to a broader set of topics while improving the quality of existing statistics and indicators.

For some time two principal delegates attending NESTI meetings were identified: one from the science and technology agency (representing data users) and the other from a survey agency, usually the central statistical office (representing data producers). This arrangement, which was put in place in order to facilitate the secretariat's burden to distribute the documentation and to offload the decision on who in the outer NESTI circles was entitled to receive the papers, proved to be not particularly effective, and has been abandoned.

As mentioned above, as the scope of what is considered S&T indicators broadens beyond formal R&D to include aspects of human capital, general purpose technologies like ICT and an attempt to measure S&T outputs and impacts like productivity, NESTI has become a forum where various parts of the OECD Secretariat are invited to present their relevant work and where delegates are increasingly expected to co-ordinate across a range of topics back in their home capitals. Alternatively, NESTI also reports on its work at various relevant OECD Working Groups.

Another significant shift in the way NESTI works is the increased emphasis on S&T developments that occur outside of the membership of the OECD. While this work with non-members has been underway for some time, its importance was underscored in the conclusions to the 1999 Science Ministerial meeting where Ministers requested the OECD to continue to assist key non-member country S&T players in adapting their S&T statistical systems to OECD standards, with a view to eventually incorporating their statistics in the Organisation's databases. To respond to this mandate, NESTI has expanded its observer members beyond the Russian Federation to include Israel and South Africa and representatives from regional organisations such as RICYT and APEC. Other countries (China, Brazil, India, South Africa, Brazil, Chile, Argentina) are in various ways involved in NESTI's activities. Increasingly, the work with non-member countries strives to achieve two goals simultaneously: assist non-member countries in the development of their S&T indicators so that they adhere to international statistical methodologies established by NESTI, and address S&T policy issues with a global dimension.

NESTI and the supporting Secretariat have made use of advances in information and communication technologies to streamline the work of the group. NESTI-net, an electronic discussion group, was set up and has been operational since December 1998. A number of specific discussion groups have been set up, notably for the preparation of the revision of the Frascati Manual and of the Oslo Manual (OECD, EUROSTAT, 2005), the management of the OECD international R&D survey, the new experimental innovation survey and the "Blue Sky" indicators network - which has more than 200 participants. The NESTI-net has been only partially successful with respect to the expectations due to the exceedingly fast growth of the internet and the development of the OLIS-net, which represents a very useful means to access OECD documentation and data. The other development in this area is the transition from the dissemination of data in disk or by CD to on-line access via OLIS-net. By 2000, every EAS database was accessible by this medium. As the ease of use of these systems improves, it is expected that users will increasingly rely on these tools.

One of the main preoccupations of NESTI has always been to anticipate the demand for new indicators from users rather than merely respond to them retrospectively. Building indicators takes a long time. Between the conception of a new indicator, the development of a measuring system, the data collection, the experimental analysis of the results it may well take even more than ten years. This is the reason why indicators experts have made special efforts to detect well in advance emerging issues for which demand for indicators is likely to emerge in the future, and therefore to be prepared to deliver in time. This led to the organisation of two major events: a Conference on “S&T indicators” in 1980, and a Conference on “New S&T Indicators” promoted in the framework of the “Blue Sky” project in 1996. The OECD is currently organising a second “Blue Sky” Conference which will take place in Ottawa, Canada, on September 25-27, 2006 (OECD, 2005a). While science and technology, especially new information technologies, were a key determinant of growth performance across countries in the 1990s, with the advent of the new millennium broader trends have become apparent and create a new context for STI indicators. In particular, new measurement challenges come from changes due to globalisation, demography and the environment, including the demand and supply for natural resources.

Agreement has always easy to be achieved. There is a sort of rule of thumb: proposals get through when one third of the countries have a clear interest and some useful experience in the area, one third of the countries are thinking about doing something anyway, and might welcome the push from NESTI to be “spent” at home, and no country in the remaining third wants to explicitly stop the others.

All in all, NESTI’s major strengths are the following (OECD, 1999):

- NESTI has a broad, diverse membership of countries that includes all three parts of the triad (Asia, North America, Europe),
- has strong links to policy analysis and policy-makers,
- has a collegial environment that encourages co-operation; a willingness and ability to take on new issues; a proven track record of accomplishments; a mix of policy analysts and statisticians which adds depth and breadth and fosters relations and joint work that extends beyond NESTI meetings;
- a stable, professional OECD Secretariat hired on a competitive basis, which is relatively free of political intervention, and knows both statistics and policy analysis;
- a transparent and easy access to data and analysis; a design of data that suits analysis.

## **The development of indicators**

S&T indicators are defined as “a series of data which measures and reflects the science and technology endeavour of a country, demonstrates its strengths and weaknesses and follows its changing character notably with the aim of providing early warning of events and trends which might impair its capability to meet the country’s needs” (OECD, 1976). Indicators can help “to shape lines of argument and policy reasoning. They can serve as checks, they are only part of what is needed”. They can describe and state problems more clearly, signal new problems more quickly, and obtain clues about promising new endeavours; their use, however, should not be mechanical but requires a massive application of judgment.

The aim of science and technology indicators is therefore similar to that of social indicators: to obtain a picture of the state of science and technology and to anticipate the consequences of scientific advances and technological change.

Statistical data are the basic elements (“atoms”) with which indicators (“molecules”) are constructed; thus, the questions indicators have to answer concern aspects of the more general problems which can be tackled using quantitative techniques (OECD, 1992).

By definition indicators illustrate a particular aspect of a complex, many-sided matter. We therefore need an explicit model that can describe both the scientific system itself and the way it relates to the rest of society. This ideal model would offer the possibility to establish the meaning of each indicator and allow relations to be established among the various indicators themselves (Sirilli, 1997).

The development and diffusion of science and technology is an extremely complicated process due to the multiplicity and intensity of links between the various components of the system. What appears as a result from one point of view may represent the starting point from another. While respecting the integral nature of the process, a distinction has traditionally been made between input, output and impact indicators. More recently this distinction has been superseded by a vision of innovation as a process where feedbacks play a crucial role (OECD, 1992), and national systems of innovation propose a perspective in which science and technology should be analysed simultaneously with organisational, institutional, economic and other factors.

In practice, as things stand we have no explicit model capable of determining causal relations between science, technology, economy and society in a single synthesis; as a rule, reference is made to implicit or partial theoretical schemes such as models of the link between innovative activities and the economy.

The limitations and short-comings of science and technology models must not, however, be considered an insurmountable obstacle to the devising and application of a set of indicators. On the contrary, they should be considered a natural part of a knowledge-developing process that has already yielded significant results and that promises to live up to the expectations of researchers, the scientific community and the decision-makers in the coming years.

The fact that statistical data on various aspects of S&T have been continuously gathered for over forty years (Table 1) attests to the interest of the scientific community and the decision-makers, while at the same time demonstrating that there are in fact theories, at least implicit, that can guide the operator in the choice and analysis of certain data, rejection of others and appreciation of the need to acquire further data.

National and international organisations have published for many years indicators resulting from *ad hoc* surveys and data gathered for administrative, accounting, operating and scientific purposes (European Communities 2003, 2005a, 2005b; National Science Board, 2004; OECD, 2005b). Taken individually these data do not yield a full picture of the various aspects of science and technology but, analysed together, they shed light on the multi-faceted aspects of the same phenomenon, providing greater depth and range to the analysis. However, it should be pointed out that, at the level of science policy, science and technology indicators cannot replace the assessment and capacity for choice of the decision makers but are a useful support and mechanism for integrating all relevant knowledge.

### **The focus on the economic dimension**

Very little is really known about the impact of science. First, most studies and indicators are concerned with economic impact. While economic impact is important and, above all, non negligible, it represents only a small fraction of the whole which extends to the social, organizational, and cultural spheres of society. As Cozzens argued: “The majority of [the measurement effort] has studied the process of innovation and not its outcomes. Traditional innovation studies still focus narrowly on making new things in new ways, rather than on whether the new things are necessary or desirable, let alone their consequences for jobs and wages” (Cozzens, 2002). Furthermore, the increasing request for the economic return on R&D investment has led to place an excessive emphasis on applied research at the

expense of basic research, on applications rather than generation of knowledge. This swing of the pendulum may represent a threat for the well functioning and integrity of the scientific infrastructure (Sirilli, 2005). Second, the few discussions and measurements that go beyond the economic dimension concentrate on indirect rather than ultimate impact.

Several factors contributed to focusing indicators on the economic dimension of science.

The first relates to the mission of the OECD, which is mainly an economic organisation. The OECD was very influential in regard to the methodology for measuring science used by national statistical offices, and its approach considerably influenced the statistics collected and the indicators developed (Godin, 2005).

Second, economists have been the main producers and users of statistics and indicators on science and technology. Nelson argued that: “One would have thought that political science, not economics, would have been the home discipline of policy analysis. According to some, the reason it was not was that the normative structure of political science tended to be squishy, while economics possessed a sharply articulated structure for thinking about what policy ought to be” (Nelson, 1977). Godin and Doré suggest that “it is the mystique of numbers that was at play here. Numbers have always seduced bureaucrats, and it was the economists, not the sociologists or political scientists, who were reputed to produce them, who were hired as consultants, and emulated.” (Godin, Doré, 2003).

Third, the economic dimension of social phenomena is the easiest to measure. Most of the output and impact of science and technology is non-tangible, diffuse, and manifests itself with significant delay.

## **Building indicators at the OECD**

There are various reasons why the OECD succeeded in developing the measurement of science and technology without any opposition from member countries.

The first reason is that few countries collected data on R&D before the OECD started its operations. The OECD offered a ready-made model for those countries who had not yet developed the necessary instruments, while for other countries that already had experience in the field the OECD methodologies reflected their own practices fairly well. Secondly, the standardisation was proposed by an international organisation with a high reputation and not by a specific country. This was perceived as evidence of neutrality. Third, the process developed progressively, step-by-step. This allowed statistical organisations to “absorb” the impact of the new methodologies also in terms of resources necessary to implement them.

At variance with several episodes in the history of official statistics, like the census, S&T is not an area of conflict. From the beginning the work was conducted in the framework of the interaction between statisticians, analysts and policy-makers and these actors developed a sense of common interest which prevented major controversies from arising. From the early 1960’s to the present time only three debates occurred that raised some tension amongst delegates and between delegates and the secretariat: the Gaps Study at the end of the sixties, the proposed cuts to the OECD statistical Unit in 1972, and the measurement of strategic or oriented research in the early nineties (Godin, 2005).

Also the decision not to adopt the bibliometrics manual created some tension: the opposition of one delegation prevented the necessary consensus being reached in the context of the NESTI’s strategy to produce manuals both for data collection and for the use of existing data (like the TPB manual). This opposition may be the reflection of statisticians’ attitude to have full control of the data they generate, while being hesitant to grant the statistical quality mark to data outside their sphere of competence. Godin puts this attitude rather bluntly: “In general, any statistics that do not come from government surveys are

discredited by the national statistical organisations: measuring the production of knowledge counting scientific papers or measuring invention by counting patents. The arguments used in refusing these tools are that statistics produced are neither reliable nor standardised. More honestly, it is that this information and the associated data banks come from a source external to the national statistical office, a source it does not control” (Godin, 2004a). The bibliometrics manual possibly failed also for other reasons: the author was not part of the inner NESTI ring, the draft was not properly written in the Frascati manual style, bibliometrics is a particularly divisive topic. All in all, in this particular occasion NESTI did not seize the opportunity to be the key player in the area, at variance with the decision to adopt the Technological Balance of Payments manual (OECD, 1994b) which, like bibliometrics, deals with an indicator based on data collected for administrative purposes outside the core competences of NESTI members) (OECD, 1999).

### **The relationship between indicators and policy-making**

Policy-making and indicators building are two processes that reinforce each other in a circular process. Ideally, the policy-making process is a rational process which rests on theory which, in its turn, is verified or falsified through data. In practice, policy-making is based on a partial knowledge of the world and on a limited comprehension of the phenomena, and statistics can enlighten only a part of the picture. It is not uncommon that the sheer availability of some data attracts the attention of analysts and policy-makers, so that statistics shape policy agendas. This has to do with the old story of the drunk in the middle of the street looking for his keys under the lamp only because that area is lighted – while he lost his keys in the vicinity somewhere else. After fifty years of studies, one still looks in vain for hard data on the links between science, technology, productivity and, more in general, society. The parameters for measurement “appear to be chosen not for their relevance but, either because of data are already available or, because they are in line with dominant theoretical concepts” (Bell et al., 1991).

This raises the issue of the socio-political responsibility of statisticians who are not simply technocrats responding to requests of their political masters, but who have the power to influence others’ strategies and decisions.

At the same time, it is well known that while sometimes the user is open to whatever the data show, more often they want the data to back up their existing policy views linked to their political or ideological objectives. People in specific S&T sectors need data for “advocacy” to back slogans. Even academics are inclined to use data or equations that suit their models, while.

The use of indicators for policy purposes is a tricky affair.

As mentioned earlier, a theoretical model enabling the understanding of the links between knowledge and socio-economic progress is still lacking and, at the present moment, the links between research results and socio-economic impact are postulated more than demonstrated. The mechanisms which preside over the use of new knowledge are not sufficiently well known and one must be generally content with either correlations – often produced thanks to econometric models – or, as the OECD has done, with putting together a series of statistics whose implicit objective is to produce in the reader a sense of causality (OECD, 1999): simply putting numbers together leads one to believe that the first numbers (relative to research activities) are the cause of the second ones (relative to economic growth).

The OECD has recently been criticised in connection with the study on the New economy (OECD, 2001a) in which, along with some questionable analyses of impact of new technologies on growth, a very long section on policies that should be promoted by

governments in order to participate to the New Economy is added. In the study the OECD constantly reminded the reader that the links between science, technology and productivity have not been demonstrated but, in order “to make a convincing case for the New Economy, balanced the limitations of the data and the methodology with a plethora of figures and graphs” (Godin, 2004c). The lesson suggested by W.C. Mitchell as early as 1919 looks still valid: “Secure a quantitative statement of the critical elements in an official’s problem, draw it up in concise form, illuminate the tables with a chart or two, bind the memorandum in an attractive cover tied with a neat bow-knot (...). The data must be simple enough to be sent by telegraph and compiled overnight” (Mitchell, 1919). Other rhetorical strategies are adopted by the OECD through “a large series of graphs and figures which could persuade the reader of the seriousness of the study” and the use of “umbrella concepts”, slogans, buzzwords which are supported by indicators (Godin, 2004b). With reference to the OECD scoreboard of indicators for the knowledge-base economy, Godin points out that “Most, if not all, of the indicators collected are indicators that the OECD had already been measuring for years or even decades, or are variations on old indicators that had suddenly become subsumed under the concept of the knowledge-based economy. The documents simply aligned a series of indicators and fact-sheets placed under a new umbrella – the knowledge-based economy”. The “umbrella” concept applies as well as to work in countries and at other international organisations like the European Union (European Communities, 2003, 2005a).

### **The impact of the work of NESTI**

Assessing the impact of NESTI is a difficult task. In fact the group is basically an intermediate instance, while it is the OECD, through its documents, publications, data bases, which delivers the “goods” to customers. The OECD is a think tank for its member countries, not an advocacy one, but a research-oriented think tank: one of its missions it to promote greater understanding of (economic) issues among national policy makers through meetings, seminars, workshops, studies and publications (Godin, 2004c).

Various types of impacts may be identified.

A first type of impact is on the community of experts in the field of S&T indicators outside the “inner circle”. In this respect it may be assumed that NESTI’s work is generally regarded as quite useful.

A second type of user is the CSTP, which uses S&T indicators for their analyses, documents and publications. These documents and publications rely very much on data. As mentioned before, one of the weaknesses of the extensive use of indicators is the absence, as mentioned before, of a solid theory behind the analysis.

A third type of impact of NESTI’s work is on national governments, who receive data, indicators and analyses produced by the various parts of the Directorate for Science, Technology and Industry. Also in this case the output is generally well received. Some of these users consult regularly the OECD on-line data bases and use the OECD quantitative analyses for their further elaborations.

Academics also are beneficiaries of the work of NESTI. There is an increasing number of scholars, in particular economists, who make use of various indicators. One of their emerging needs is the access to micro data, a need that is being met by national statistical offices as well as by EUROSTAT.

Also consultants working in the field of science, technology, industry, technology, economy are amongst prime users of indicators, and the impact of NESTI on their activities is significant.

S&T indicators have an impact also on the scientific community who find in the data a way to reflect on their activities and on themselves. Two types of indicators are their

favourites: R&D data, which measures the resources available to the system, and bibliometrics data which are currently used for evaluating the scientific merit – the lack of an OECD manual represents a missed opportunity for NESTI, who decided not to adopt the statistical manual, leaving the indicator completely in the hands of private data producers without any transparent and internationally agreed methodology.

Journalists quite often base their articles on S&T indicators published by the OECD and the European Union. While it is difficult to evaluate the impact of the OECD data on the general and specialised public via the press, it is safe to say that the use of statistics is on a constant increase.

Also politicians, who in many countries until recently even ignored the science and research dimension, are now using some data. The most widely used indicator is the “magic” R&D/GDP ratio, which became particularly popular in the political sphere in Europe after the Lisbon-Barcelona meetings where the 3% target was set for the whole Europe to be achieved in 2010 (Sirilli, 2004). It is interesting to note that this target is a pretty old one: it was mentioned in the first edition of the Frascati Manual as the ideal to which OECD member countries would aim (3% was the ratio GERD/GNP in the US in the early 60s).

One problem, which is becoming progressively less severe, but which still is with us, is the limited diffusion of OECD publications and indicators in countries where English or French are not the national language, or are not widely spoken.

## **Conclusion**

The NESTI network faces a number of challenges in the future including: how to balance the need to maintain and improve existing indicators while developing new ones; accommodating an increasingly diverse membership and heterogeneity of subject areas, striking the correct balance between data, methodological and analytical work, facing resource constraints both at the OECD and in national capitals.

A number of things have changed over the last few years that affect the work of the NESTI group:

- the development of NESTI work beyond R&D to other types of S&T indicators and new indicators which are generally more varied (e.g. from human capital to globalisation),
- a shift in the S&T policy agenda towards issues relating to skills and human capital (knowledge-based economies), general purpose technologies (information and communication technologies, biotechnology), measurements of S&T performance and greater attention to the systemic aspects of innovation systems,
- the number of delegates to NESTI has increased as new members have joined the OECD and as new observers have participated in the group, bringing different demands, questions and topics of discussion. For a variety of reasons, the number of delegates per country is restricted. As the breadth of indicators increases, this forces delegates in some cases to discuss issues where they lack expertise or engage in active co-ordination with national colleagues prior to the meeting which can be difficult to achieve.
- Eurostat and the EU are now more active players in the field of S&T and S&T indicators, placing new demands on EU Member countries and therefore affecting the NESTI,
- private data providers such as CHI, MERIT, ISI, etc. complement and, at times, substitute for the NESTI role as a source of S&T data, especially in issue areas that are emerging (e.g. internet),
- increased emphasis on the creation of indicators at both the supra national (regional) and sub-national (e.g. clusters) level,
- over the last two decades, every country in the OECD has been faced with “doing more with less” limiting their ability to engage in new statistical exercises.

While it is most likely that NESTI will continue to be a leading forum on S&T indicators, some challenges will have to be faced:

- reduced resources and increased demand for S&T indicators both in member countries and at the OECD;
- changing and increasing number of priority areas for work; need to focus efforts while maintaining responsiveness to decision-makers and retaining a leadership role in S&T indicator development;
- some new areas of demand for work are not in traditional areas of NESTI work or beyond the direct competencies of standard NESTI delegates;
- the enlargement of the OECD membership may weaken the focus and make the management of the network more difficult;
- need to co-ordinate with other countries and regions who require technical assistance to better understand the internationally accepted OECD definitions and norms;
- a tendency to increase the number of data producers in NESTI membership, with the ensuing emphasis on data collection at the expense of data analysis and of the design and implementation of new indicators;
- the major opportunities offered by the internet in interconnecting the NESTI network and in improving the efficiency of the S&T indicators operations.

In conclusion, the NESTI network will continue to be the leading group in the field of S&T indicators as long as its members, individually and collectively, maintain their forward-looking attitude and their professional autonomy in the presence of institutional and financial constraints. At the same time a particular effort should be made to ensure that existing and new indicators are appropriately used, avoiding interpretations which are not sufficiently supported by the data and which, in the long run, may delegitimise the indicators exercise.

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**Table 1. The Development of S&T Indicators since the Second World War**

Indicators, theories, experts	50s and 60s	70s	80s	90s
Main indicators used	R&D	R&D Patents Technological balance of payments	R&D Patents Technological balance of payments High-tech products Bibliometrics Human resources Innovation surveys	R&D Patents Technological balance of payments High-tech products Bibliometrics Human resources Innovation surveys Innovations mentioned in technical literature Surveys of production technologies Public support to industrial technologies Intangible investment Indicators of information and communication technologies Input-output matrices* Productivity * Risk capital * Mergers and acquisitions *
Conceptualisation of the innovation model	Linear	→	Chain-linked	Systemic
Role of experts in the field of S&T indicators	Suppliers of methodologies and data	→		Suppliers of data, methodologies, analyses, integrators of various types of indicators, both S&T and economic indicators

\* Indicators borrowed from economic analysis. Source: Sirilli, 2003.