

**Indicators on Science, Technology and Innovation  
History and new Perspectives**

*PRIME Network of Excellence  
European Network of Indicators Producers (ENIP)*

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**Towards an  
European Network of S&T Indicators Designers (ENID)**

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The PRIME NoE gathers many of the European research teams working on S&T policy, including S&T indicators. One of its major activities has been, over the last two and a half years, the European Network of Indicators Producers (ENIP) programme, involving members from ten countries; in this context, several research projects have been launched, resulting in the design and production of indicators characterising the institutional actors of the national innovation systems, in particular universities, research organisations and research funding institutions<sup>1</sup>.

It was intended since the conception of the programme, that lessons would be drawn at the end of it, by December 2006, in the form of a position paper, to present proposals for future action, which could be taken into account within FP7.

This paper is a draft of this position paper, presented for discussion by the relevant stakeholders.

It is organised the following way: we first discuss the actual dynamics of the demand of S&T indicators, highlighting the need of new (positioning) indicators, which raises issues for S&T

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<sup>1</sup> Bonaccorsi A. and C. Daraio (2006), eds, *Universities as strategic units. Productivity and Efficiency Patterns in the European University System*, Edward Elgar Publishing, *forthcoming*.

Bonaccorsi A., Daraio C., Lepori B. (2006), *Indicators for the analysis of Higher Education Systems: some methodological reflections*, In Bonaccorsi and Daraio 2006.

Esterle L., Theves J. (2005), *Analysis of the different European systems for producing indicators*, paper presented at the Lisbon Workshop on S&T indicators production, Lisbon 22-23 September 2005.

Lepori B. (2006), "Public Research Funding and Research Policy: a long-term analysis for the Swiss case", *Science and Public Policy* 33 (4).

Lepori B. (2006a), "Methodologies for the analysis of research funding and expenditures: from input to positioning indicators", *Research Evaluation*, *forthcoming*.

Lepori B., Dinges M., Mamphuis R., Potì B., Reale E., Slipersaeter S., Theves J., van der Meulen B. (2006a), "Indicators for Comparative Analysis of Public Project Funding. Concepts, Implementation and Evaluation", paper presented at the International Conference on STI Indicators, Leuven.

Lepori B., Dinges M., Potì B., Reale E. (2005), *Public project funding of research activities. A comparative analysis*, paper presented at the Lisbon Workshop on S&T indicators production, Lisbon 22-23 September 2005.

Lepori B., Jongbloed B., Salerno C., Slipersaeter S. (2006), *Changing patterns of funding of European higher education institutions*, in Bonaccorsi and Daraio, eds, (2006), *forthcoming*.

Slipersaeter S., Lepori B., Jongbloed B., Salerno C. (2005), *Collecting Institutional Level Data for European Higher Education Institutions: Evidence from the CHINC Project*, CHINC report.

Slipersaeter S. (2005), "Comparisons of methodological approaches for determining research intensity at higher education institutions", *paper presented at the Lisbon Workshop on S&T indicators production*, Lisbon 22-23 September 2005.

indicators producers regarding both the innovation and production aspects ; in a second paragraph, we discuss the production issue, in terms of a capitalisation challenge ; in a third paragraph, we address the indicators innovation issue, as a creation and validation challenge, leading to a proposal for filling that gap through an European Network of S&T Indicators Designers (ENID) which can be initiated by PRIME.

## **1. Actual dynamics of the field of S&T indicators demand and uses**

The activities of PRIME in indicators research revealed both the feasibility and strong demand for indicators characterising institutions as specific entities, as opposed to indicators about whole countries or institutional sectors. In this paragraph, we elaborate on this striking phenomenon, and place it in a broader perspective.

### **1.1 The dynamics of innovation systems**

The research and innovation systems are in a stage of rapid and deep change, being re-shaped by the simultaneous effects of three fundamental drivers:

(i) the multiplication of the types of actors in interaction, both at the programming and research levels, such as research consortia and joint ventures of all sorts, technology transfer and platforms, start ups, KIBS<sup>2</sup>, venture capital firms, regional funding bodies and territorial cluster-level institutions, but also non profit organisations and stakeholders associations....; this taking place while the classical institutions, universities, research organisations and firms, are themselves quickly diversifying in their mode of operations, portfolio of activities and positioning in the system,

(ii) the transformation of innovation systems into distributed intelligence systems<sup>3</sup> where the key component is the differentiated, autonomous and strategic actor, engaged in a multiplicity of co-operations and competitions, with large competencies and responsibilities for developing their specialisation trajectories and institutional alliances,

(iii) the move towards the European Research Area (ERA), which is the ambition of building an EU level research and innovation system, which is widely expanding the scope of the interactions among the actors at the three basic levels of functioning of an innovation system, i.e. policy level<sup>4</sup> , (regional, national, European), programming level<sup>5</sup> (where intermediate institution transform policies into resources allocations) and the research operators level<sup>6</sup> (firms, universities, research organisations...).

In this context, the functioning and performance of the innovation system depends critically on the quality of the cooperation and linkages between its components, i.e. its actors. The landscape of S&T activities and policies is thus one of increased complexity, opportunities and threats. The strategy of the actor becomes central and so do the S&T indicators relevant to that actor<sup>7</sup>. Indicators must relate to institutions and characterise them in terms of their relations and position within the research and innovation systems.

### **1.2 The emergence of positioning indicators rationale**

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<sup>2</sup> Knowledge intensive business services

<sup>3</sup> Kuhlmann, S. et al. (1999), Improving distributed intelligence in complex innovation systems (ASTPP network – TSER contract SOE1-CT96-1013); A. Tubke, K. Ducatel, J. Gavigan, P.Moncada, Eds. (2001), Strategic policy intelligence: current trends, the state of play and perspectives, JRC-ESTO, EUR 20137 EN, 99 p.

<sup>4</sup> open method of coordination (OMC)

<sup>5</sup> ERANET, European Research Council (ERC), Technology platforms

<sup>6</sup> Integrated projects (IP), research infrastructures and researchers mobility programmes

<sup>7</sup> Interestingly, the conclusion of the recent “Blue sky indicators” conference of the OECD refers to similar issues, when it calls for better indicators about the linkages among actors “which tell some of the story about the dynamics of the STI system” (OECD, Outcomes of the Blue sky II form, 26-27 October 2006, DSTI/STP(2006)33

We call this ‘positioning indicators’ rationale, this situation where the indicators aim at characterising the elements of the national innovation system, considering it is made of differentiated, autonomous and strategic agents: the role of STI indicators is this to describe each singular entity in terms of its specific characteristics, its interactions, linkages as well as complementarities, competition and cooperation with other entities. The objective is to characterise the ‘positioning’ of the actors in the innovation system<sup>8</sup>.

This rationale is to be contrasted with the input/output (I/O) rationale<sup>9</sup>, in which the indicators are structured along the categories of ‘input’, ‘output’ and ‘outcome’, following a production function logic, in a national accounts paradigm. The level of analysis is the country and the indicators are built as aggregates at this level. In this rationale, the individual agents disappear and the national innovation system is reduced to a single item, described in its different aspects. This is a macro level vision of the STI activities, still necessary, but no more sufficient.

Our point here is that the above-mentioned general trends in the dynamics of the innovation systems generate a rising demand for positioning indicators: in a world of distributed intelligence where the key component is the strategic actor, the classical, input / output indicators are clearly no more sufficient.

### **1.3 Characterising the evolution of the demand of indicators: the “new S&T indicators”**

Indicators related to individual organisations are demanded for the needs of those in charge of the conduct of the organisations for their strategy making and monitoring, and for those in a position to evaluate the performance of the institutions, be they partners, clients, board members, financing bodies, citizens, policy-makers or political decision makers. The recent multiplication of widely published and publicised rankings of S&T institutions is a case in point, which accelerates this first observed trend of indicators demand, namely the need of positioning indicators.

A second trend is the demand for comparability among such indicators, which goes along with the principle of benchmarking, which has become the central concept and the hallmark for strategy making as well as evaluation. And in a Europe which is building the ERA, benchmarking means systematic comparison with actors of different EU countries. Thus, we witness an increasing demand for customised, yet comparable indicators.

A third major trend is the demand for RD impact measurements, be they ex-ante or ex-post<sup>10</sup>, such impacts concerning the macro-level, but also, more and more, the individual institution level. This is the issue of short term outcomes measurements and of longer terms impacts of innovation, with the comprehensive analysis of the effects of innovation on social, economic, political and environmental systems.

In other words, the field of S&T indicators is subject to a variety of demands which represent challenges, for S&T indicators producers in both the innovation and production aspects. We call them the “new S&T indicators”.

## **2. The new indicators production issue: facing the capitalisation challenge**

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<sup>8</sup> For examples of positioning indicators, see the Report on European S&T Indicators (REIST) issued by the European Commission in 2003,

<sup>9</sup> see for example : Godin, B., ‘The Input-Output framework : an accounting metaphor’, paper presented at the ENIP/PRIME international workshop, “S&T indicators for policy analysis: needs, status and new developments”, Lisbon, 22-23 September 2005

<sup>10</sup> see for example : Rose, A., McNiven, C., Biotechnology impact indicators; from measures of activities, linkages and outcomes to impact indicators, OCDE Blue sky II conference, op.cit.  
<http://www.oecd.org/dataoecd/10/63/37450288.pdf>

## 2.1 The capitalisation challenge

The variety of demands has led to a multiplication of S&T indicators producers, allowed by:

- the impressively decreasing cost of data handling, treatment and storage,
- the expanding possibilities of accessing various source data, through commercial or public source producers,
- the improvement of concepts and methodologies.

Thus, indicators have been produced by a number of teams pertaining to academic, public, semi-public and private institutions. A set of professional teams and institutions has developed over the years, with their journals, practices, conferences.

This situation is also one of a fragmentation of the production, which raises the possibility of two risks:

- the lack of comparability among indicators: there is a need of a common language among the STI actors at European level, for them to interact within countries, but also at European level in the drive for the ERA. The innovation system actors must therefore share and coordinate the indicators they use, so far built in very ad-hoc and contingent way, in order to accommodate the specificities of their strategic contexts,
- the impossibility to benefit from economies of scale, resulting in a waste of resources, a high cost of the indicators and ultimately in an artificially low use of S&T indicators, with further consequences on the quality of the governance of the innovation systems.

Our point is that such indicators are needed by the actors to develop relevant strategies and that such indicators, although they refer to individual organisations, should be produced in a coordinated way, or at least based on common principles and standards so that they can allow for comparisons and also lower the cost of production

## 2.2 Facing the capitalisation challenge: current initiatives

Given the importance of the stakes, most countries have taken steps to secure the production of specific indicators in a reasonably efficient way<sup>11</sup>, i.e. engaging in some sort of 'industrialisation'.

Beyond that, initiatives for producing ad-hoc indicators on a significant scale and time perspective have been taken by various directorates within DG Research, regarding scientific articles and patents bibliometrics, regional indicators, indicators for evaluation, universities<sup>12</sup>; these initiatives consist usually in a multi-year framework contract by which a major indicators producing institution is commissioned to develop a methodology and to produce the related indicators upon the specifications of DG Research.

These initiatives are a response to the need of capitalisation, which is relevant but incomplete, since progress must still be done to fully overcome fragmentation. Undoubtedly, the capitalisation challenge is being faced, but it will be necessary to monitor and assess the situation.

## 3. The new indicators innovation issue: an initiative to face the design creation and validation challenge

### 3.1. The design creation and validation challenges

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<sup>11</sup> see for example the mapping exercise of S&T indicators production produced by the ENIP-PRIME programme participating countries (the reports are available on [www.enip-europe.org](http://www.enip-europe.org))

<sup>12</sup> ERAWATCH is a framework for some of these initiatives

In the question of the ‘new indicators’, the issue of innovation is by definition central, but strangely often left aside, or reduced to the indicators research aspects. We raise here the issue of innovation, which means the “effective bringing of new products to the market”; this is what we call the design creation and validation challenges of new indicators.

The experience of ENIP-PRIME is here interesting and revealing, since the activities and achievements of that programme have essentially been the designing and experimentally testing of new indicators, in the higher education domain (CHINC, AQUAMETH, OEU) and for public project funding (ENIP-funding).

This is precisely the innovation function which should be addressed in a more explicit and mutualised way. It involves the establishment and functioning of relationships between the indicators design creators, the ‘lead users’ and the producers of indicators.

Our point here is that the innovation function of the new indicators must be done in an open context, so that the adopted designs can be appropriated and validated by the community of users as well as the one of the producers.

It is necessary that research on indicators can flourish in many places, having its regular academic conferences for debates among researchers; we make the case here that new indicators design is a public good (properties of non rivalry, cumulativeness) and that the social benefit resulting from their production is maximised when the use is maximum.

Hence the proposal presented by PRIME.

### **3.2 The proposal : a European Network of Indicators Designers and experimental projects**

Both these overall reflections and the PRIME experience point to some key ingredients of a successful indicators development in PRIME:

- Firstly, we need to build a partnership integrating three different cultures: academics for the design and theoretical foundation of indicators; indicators producers for methodology, feasibility and robustness; stakeholders for policy relevance and acceptance.
- Secondly, PRIME needs to pursue a niche strategy working in domains not adequately covered by existing indicators (see the case of public project funding).
- Thirdly, the network has to be open, since new ideas and new people are constantly needed for this experimental work. This is not compatible with a project structure with closed partnership.

Hence we propose for the indicators domain in PRIME a two-track strategy:

- To build a network referring to the indicators innovation function with the name of the *European Network of S&T Indicators Designers* (ENID) to promote reflection, exchange and nurture new projects
- To launch new experimental projects to be selected through a call for proposals in PRIME.

#### **a) European Network of Indicators Designers**

ENID will be an open network to promote the reflection on needs and design of new (or improved) STI indicators

With an open partnership with institutions declaring to adhere to the network

- Coordinated by OST for the next two years, then to be decided

We propose that ENID develops inside PRIME the following activities for 2007-2008:

- Organisation of the next PRIME Indicators conference in 2008.
- Organisation of the indicators workshops at the PRIME annual conference
- Support to the exploratory workshops for promoting the new projects.

- Maintenance of the network website and of the indicators part of the PRIME website, including in particular information on on-going PRIME activities concerning indicators and related publications
- Internal mailing list including alter for tenders of interest to the community (to promote the construction of consortia).

**b) Indicators experimental projects**

We propose that PRIME launches a dedicated call for small-scale project dealing with the design and experimental development of indicators in areas not yet covered; these projects should be evaluated and selected through the normal PRIME procedures.