Workpackage 1

Indicators for a KBE: Interviews with policy analysts

Deliverable 1.3a

2008

List of contributors:
Anthony Arundel, Adriana van Cruysen, Wendy Hansen, MERIT

Main responsibility:
Adriana van Cruysen, Anthony Arundel, MERIT

C1S8-CT-2004-502529 KEI

The project is supported by European Commission by funding from the Sixth Framework Programme for Research.

http://europa.eu.int/comm/research/index_en.cfm
http://europa.eu.int/comm/resarch/fp6/ssp/kei_en.htm
http://www.corids.lu/citizens/kick_off3.htm
http://kei.puplicstatistics.net/

Table of contents

1. Introduction

European policy analysts and decision makers face many challenges in promoting a knowledge-based economy (KBE), as part of meeting the Lisbon Agenda goals. Some challenges are well understood, such as the need to encourage structural change in the new member states or to respond to demographic changes that could result in a decrease in the supply of scientists and engineers. Other challenges are still emerging, including issues of globalization and the rapid growth of developing economies, such as China and India. In order to face these challenges, there might be a need to improve currently available indicators or to create new ones in science, technology, and innovation; and in particular in the areas of education, environment, employment and mobility of human resources.

The development of new or improved indicators requires the input of academics who are often experts on specific issues, statisticians who are familiar with what is possible to measure, and policy analysts who have a thorough knowledge of the types of information that are necessary for policy development. The KEI project includes the first two groups but does not include policy analysts, who are one of the main users of indicators. In order to obtain their input into what is needed, we conducted a series of semi-structured interviews with 40 policy experts from countries both within and outside Europe.

Recent debate on indicators and their use in policy was conducted during the Blue Sky II Forum in Ottawa, Canada. Participants discussed science, technology and innovation (STI) indicators and their policy applications, concluding that it was necessary to developed internationally comparable indicators which would allow for comparability of countries' attractiveness as locations to conduct research and / or entrepreneurial activities. Furthermore, the Blue Sky II Forum suggested that although there are current indicators on activities such as R&D, innovation, diffusion of knowledge, technologies and practices, and the development of human resources for all of these, there are limited indicators of linkages among the actors (such as governments, institutions of education and research, businesses among others). Moreover, there are even fewer indicators of outcomes (such as market share, change in profits, employment, skills and others) and fewer still on the impact of supporting and engaging in the activities and their linkages. This survey supports the Blue Sky II conclusions, and comes up with similar conclusions and recommendations. Both the Blue Sky II Forum and this survey call for co-ordination and a need to respond to changes in the economy and the society.

2. Methodology

2.1 Questionnaire development

One of the main goals of the interviews was to collect the views of the respondents without influencing their opinions on two key questions: what policies are likely to be introduced over the next decade, and what indicators are needed to develop such policies or measure their success. Consequently, the interviewers did not immediately refer to specific concerns such as demographic change or China and India. Instead, the

respondents were only prompted about specific topics of interest if they did not refer to them during the interview.

The 40 interviews lasted between 30 minutes and 1.5 hours, with an average length of approximately one hour.

The semi-structured questionnaire covered the following topics:

1. The respondents background – the policy areas for which she or he was responsible.
2. Indicators in current use for policy and reasons for using them.
3. Problems with current indicators.
4. Types of indicators that would help current policy but which are not available.
5. Major policy challenges for the future.
6. Indicators that would be needed to address future policy challenges.

The questionnaire is included in Annex A.

The interviews asked about indicator needs and policy challenges, as both are relevant to identifying improved or new indicators. Policy analysts are not always aware of the types of indicators that could be obtained and therefore the information on policy challenges can be used to identify additional indicators that they did not mention. In addition, information on policy challenges can help identify which indicators are of higher priority.

2.2 Selection of interviewees

Interviewees were selected by first contacting country TrendChart representatives and following their recommendations as the most suitable candidates to participate in this study. Apart from those recommendations, interviewees were also selected based on their role in key government institutions, acting either as policy advisors, policy makers, or in policy implementation and coordination. Experts from academia or national statistical offices (NSOs) were mostly not included, except for five individuals (three from NSOs and two from academia) with a thorough understanding of policy issues.

Names and contact numbers were collected using TrendChart information, more specifically under the classification of National Government Ministry/department and National public agency. Finally, a few of the interviewees were selected based on UNU-MERIT's awareness of their involvement and knowledge in this particular field.

As mentioned, interviewees were selected mostly from government institutions such as national government ministries or departments, science advising committee members as well as national public agencies (statistics institutions), and academia.

Selected ministries cover the following general areas: business affairs, culture, development, economics, education, energy, entrepreneurship, finances, innovation, technology, information society, labor, research, industry, sciences and trade.

Main sub-areas within governmental institutions related to broadcasting, cooperations, clustering, e-commerce, education, e-government, employment, entrepreneurship, environment, financing, ICT, incentives, information society, internationalization, partnerships (enterprises and universities), qualifications, R&D infrastructure (technology parks), services, SMEs, social security, spin-offs, taxation, telecommunications, and venture capital.

Science advising committee members belonged to task groups in the areas of science in general or basic research, energy and human resources.

Furthermore, interviewees from statistical offices were involved with statistics in the areas of education, human resources, ICT, innovation, knowledge society, labor market, mobility, population, R&D, S&T (sciences and technology), and social statistics.

Finally, interviewees coming from academia were involved in S&T, innovation, and entrepreneurship.

In order to solicit the full opinions of the respondents, the survey protocol offered full confidentiality. This means that no information is provided that can be used to identify the respondent or his country.

The KEI proposal stated that we would conduct 20 interviews with policy experts in a selection of EU member states and 10 interviews with policy experts in competitor countries such as the United States, Japan, Canada and Australia. The number of actual interviews exceeded these totals, with 28 interviews conducted with European policy experts and 12 interviews with experts from competitor countries. To protect confidentiality, the numbers of interviews are only given by four regions, as indicated in Table 1. The number of interviews in a single country varied from one to five, with a median number of three interviews per country. Interviews were not necessarily conducted with a policy expert in each of the countries listed in Table 1.

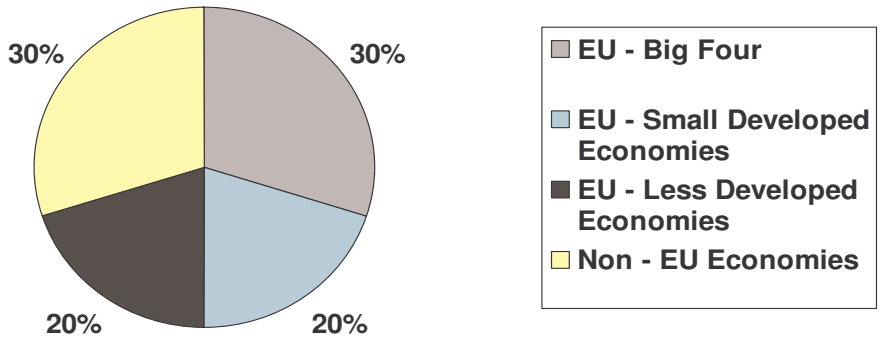
The primary purpose of the interviews was to identify new and improved indicators that can address future policy challenges. Consequently, the interviewees were selected to represent a diverse range of policy experts in areas of relevance to a knowledge economy. No attempt was made to obtain a representative sample of policy experts, either by the main regions listed in Table 1 or for individual countries. For the same reason, we do not provide results by region, but combine our findings from all 40 interviews.

Table 1. Interviews by region

Region	Total n. countries	Number of interviews	%
EU – Big Four (Italy, France, Germany and the United Kingdom)	4	12	30%
EU – Small Developed Economies (Austria, Belgium, Denmark, Finland, Ireland, Luxembourg, the Netherlands, Sweden)	8	8	20%
EU – Less Developed Economies (Greece, Portugal, Spain, plus 10 new members states)	13	8	20%
Non – EU Competitor Economies (Australia, Canada, Japan, Mexico, South Korea, New Zealand, United States)	7	12	30%
Total	**32**	**40**	**100%**

Our sample was well distributed among the four regions. Countries representing the EU Big Four and Non- EU Economies, contributed both with 30% of the interviews. On the other hand, Small Develop Economies in the EU and Less Developed Economies in the EU contributed each with 20% of the interviews. Figure 1 shows the distribution of interviews per region.

Figure 1. Interviews per region – in %



As mentioned, interviewees selected came from different backgrounds, but with a common interest and involvement with policies and indicators. Since the topic of the knowledge based economy and its indicators appeals to professionals at different stages of the policy making process, the sample of interviewees tried to cover this diversity in terms of areas of interests.

Backgrounds were assigned according to respondents' job titles and their own definition of main tasks performed in their daily activities. Table 2 lists all tasks mentioned by

respondents as the ones that take most of their time when executing their jobs, while Table 3 groups the same tasks into five job backgrounds.

Table 2. Respondents' main tasks

Tasks		
Advising	Developing indicators	Managing
Analyzing data	Disseminating information	Measuring
Carrying on studies	Editing	Monitoring
Collecting information	Evaluating	Orienting
Conducting surveys	Following up	Producing indicators
Consulting	Implementing policies	Producing statistics
Coordinating efforts	Looking at performance	Promoting new policies
Drafting	Making comments	Recommending
Drawing new policies	Making suggestions	Supporting
		Teaching

Table 3. Backgrounds according to main tasks

Job	Main tasks
Policy Advisor	
	Advising
	Consulting
	Disseminating information
	Making comments
	Making suggestions
	Orienting
	Recommending
	Supporting
Policy Maker	
	Drafting
	Drawing new policies
	Promoting new policies
Policy Coordination/ Implementation	
	Coordinating efforts
	Implementing policies
	Managing
	Monitoring
Policy Evaluation	
	Editing
	Evaluating
	Following up
	Looking at performance
	Measuring
Statistics Institutions	
	Analyzing data

Job	Main tasks
	Collecting information
	Conducting surveys
	Developing indicators
	Producing indicators
	Producing statistics
Academia	
	Teaching

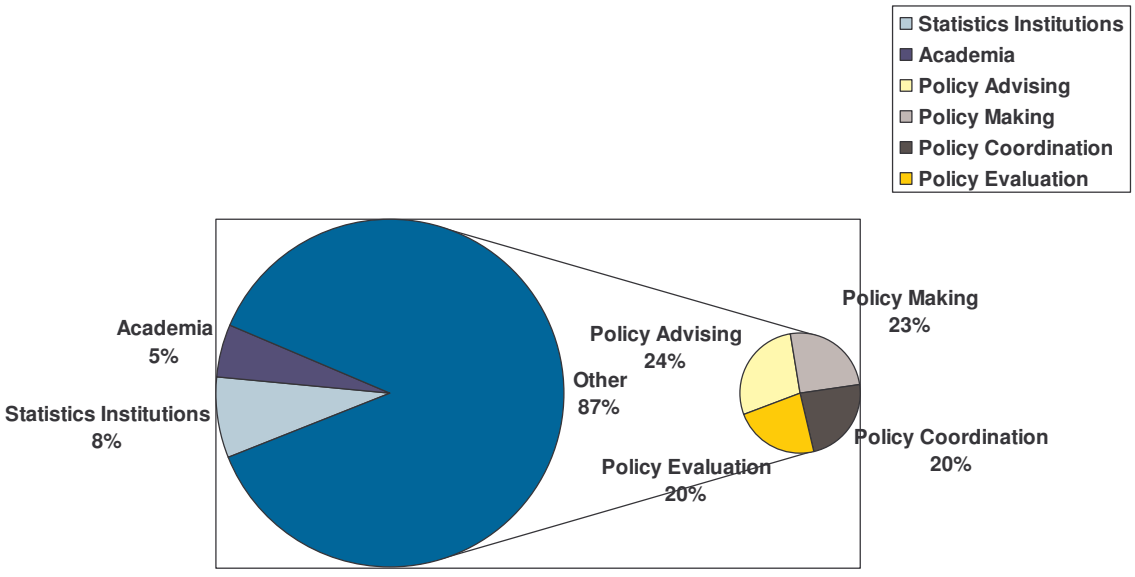
Table 4 provides a breakdown of backgrounds, while Figure 2 illustrates the distribution of backgrounds, with a clear concentration on policy related ones.

Table 4. Interviewees' background – Total and %

	Total	%
Policy Advisor	10	**25%**
Policy Maker	9	**22.5%**
Policy Coordination / Implementation	8	**20%**
Policy Evaluation	8	**20%**
Statistic Institutions	3	**7.5%**
Academia	2	**5%**
Total	**40**	**100%**

Note: One mark per region if the interviewee had the correspondent background. Interviewees might have jobs that cover more than one background.

Figure 2. Interviewees' background – Breakdown in %



The number of interviewees involved in policies is balanced among policy advisors, policy makers, policy coordinators and policy evaluators, each one of these classifications with either eight, nine or ten interviewees. Interviewees working for statistical institutions or in academia were fewer, two or three for each of those rubrics. The difference was due to the nature of this survey. The main goal was to concentrate on the direct users of indicators, instead of the institutions that provide them or academia, although the inclusion of the last two was necessary in order to search for the whole spectrum of professionals that are in direct contact with indicators on their daily activities.

3. Current policies

3.1 Drivers of current policies

Current policies are a result of the changes in society that have occurred in the last years. Those changes were likely to have influenced the workings of societies, the relationships among different agents, and priorities, apart from the emergency of new sectors, and consequently brought with them new requirements. Policies can be considered a response for these new set of priorities, either to develop them from their beginnings, or to give them further support. In a few words, the changes that have occurred in the past conditioned the type of policies that are in effect now, which have been developed to cope with those modifications. The policies of today reflect the transformations that have been taken place during some time in the past.

We asked interviewees about their opinion on the main changes that have occurred in the last five years and the main drivers behind them. Such changes should have conditioned the type of policies that are in force today.

Table 5 summarizes the main drivers mentioned by all interviewees from the sample covering all the four regions. Sometimes, interviewees mentioned more than one change and driver.

Table 5. Main drivers of present policies

	Total citations	%
Government Initiative (EU or National level)	13	24.1%
Need for Collaborations, Networks, Clustering in Applied Research	10	18.5%
Recent developments in Human Resources (Education and Mobility)	6	11.1%
Information Society (Use of internet)	5	9.3%
Globalization	5	9.3%
Infrastructure / ICT	4	7.4%

	Total citations	%
Venture Capital / Entrepreneurship	4	7.4%
New Technologies / Convergent Technologies	4	7.4%
Process Innovation	3	5.5%
Total	54	100 %

From Table 5 we can observe that the main driver that conditioned the development of policies in place was the one that relates to government initiative either coming from the EU (European Commission) or from government at national level for countries outside the EU range. The EU sets up the direction on where EU countries should be in the short and medium terms, leaving for national governments inside the area to develop their own policies in order to achieve the objectives set at the EU level. The direction of the policies comes from outside the individual member countries. It is the group that decides and then it is left to the individual countries to pursue the goals at national level.

In certain countries, the government is spending on R&D to gain more competitiveness, substantially increasing funds available. Apart from making available more resources, such initiatives have brought up the need for more accountability on employed resources, a finding that also showed up in the Blue Sky II Forum.

Another important driver was the need to collaborate in a world of increasing competition, constant development of new technologies and knowledge, specialization, more focus on applied research, pressure for economic results from commercialization of new products and services, leading to an increase in associations between businesses and universities (collaboration) as well as among businesses (partnerships). The goal is to concentrate on applied research. Research seems to be more focus oriented into topics that may lead to commercialization. In parallel with the development of such associations, there has been the emergence of more complex networks, industrial parks, and clustering. Today businesses and universities need each other due to high costs of R&D and the need for returns for continuing development of new products and services. Furthermore, businesses need to come together due to the complexities of new products, involving different and specialized technologies. Consequently it comes with no surprise that due to today's environment, cooperation is not only necessary but fundamental if businesses are to survive, requiring policies that would support these new relationships among the different actors. Again, the topic of collaborations and its increasing importance were part of the Blue Sky II Forum discussions.

These two drivers, government initiative and need for collaboration, were the most important ones mentioned by respondents. Other drivers were mentioned, although less frequently.

Development towards more service oriented economies brought about the need to educate people to be employable. With the advent of new actors in the economic scenario, which compete in terms of low cost labor, countries that were competing in those grounds

realized that they need to add value to their economic activities as they could not compete with countries such as China and even with other European countries that came into the picture after the European enlargement. In order to add value, those countries need to invest in education. Governments are focused in keeping students in education after the age of 16. It is fundamental that people get qualifications and further specialization if they are to have a role in the knowledge economy. Standards need to be raised, starting from primary education until university degrees. Empirical research conducted in countries interviewed in this survey, pointed out that "good experiences in childhood have a positive impact in studies later, so there is a good return in investing in primary education. Returns are also high in university degrees". Adult qualification, re-training, vocational training, apprenticeship and mobility are all important variables in a larger picture, where qualification and specialization are absolutely necessary for a country's competitiveness. The understanding that sciences and businesses can be complementary and, as a consequence, the emphasis on applied research and support for spin-offs, give further support for human resource development.

The Bologna Declaration signed by 29 European countries to reform their structures of higher education systems in a convergent way is a result of mainstream changes at a more global level. According to the Bologna Declaration " European higher education systems are facing common internal and external challenges related to growth and diversification of higher education, the employability of graduates, the shortage of skills in key areas, the expansion of private and transnational education, etc. The Declaration recognizes the value of coordinated reforms, compatible systems and common action".[1] The deadline for main specific objectives, such as the adoption of a common framework for comparable degrees, introduction of undergraduate and postgraduate levels in all countries, compatible credit systems, quality assurance and elimination of obstacles for free mobility was set for 2010. Many countries interviewed in this survey were signatories of the Bologna Declaration and are currently implanting those changes at national level.

Moreover, the Shanghai ranking of universities placed a strong challenge for certain countries that scored low in the ranking, leading governments to come up with new policies in this area.

Furthermore, certain countries mentioned the need to increase the number of students in sciences and engineering, the need to improve professional qualifications, and others considered education as one of the main drivers of growth, stating that education is the basis for innovation and competitiveness in the knowledge society.

Subsequent drivers mentioned referred to the information society and the use of internet in terms of e-business, e-commerce and e-government. Globalization and the need to compete with emerging economies, such as China, and to a lesser extend India, were also mentioned as important drivers for policies now in place. Globalization also brought profound changes in the way countries relate to each other. The general view among interviewees was that new players, such as low cost eastern European countries, and

[1] "The Bologna Declaration on the European space for higher education: an explanation" – Confederation of EU Rectors' Conferences and the Association of European Universities (CRE).

Box A: Globalization

"India and China's competitive advantages are not just cost related, but they have also started to compete in areas of innovative products, ones that are also R&D intensive"

"India and China are important in certain areas. They represent both opportunities and challenges. They should not be seen just as a threat"

"We recognize that we will have to compete more and more with emerging countries, which are also investing in R&D"

Globalization has two important aspects: one relates to relocation of activities, the other relates to migration, the opening of borders…"

Asian countries, most specifically China, have captured a great proportion of manufacturing, causing countries with significant portion of their economies in the secondary sector (manufacturing) to re-adjust their economies, either abandoning the market or moving to more added value manufacturing.

The development of an infrastructure that facilitates R&D has also been an important driver. More specifically, ICT and its continuous development are seen as facilitators for continuous research. The importance of an appropriate infrastructure for further development was particular relevant for countries which economies are considered already developed. On the other hand, venture capital and entrepreneurship were considered important drivers for both advanced economies, as well as for economies that are still highly dependent on the secondary sector. Taking risks and initializing new ventures are important factors for both types of economies. Policies in this area focus in creating the proper environments for individuals to either start new companies or to develop spin offs from other business and / or university labs. Finally, the emergence of new technologies, such as nanotechnology and biotechnology and technology convergence have been important drivers in the creation of policies that facilitate further development of these important sectors as well as that guarantee the participation of countries in those technologies.

When specifically raising the question if government policies to promote the KBE, globalization or new technological development have been the main drivers behind present policies, respondents in their majority mentioned both globalization and new technologies as the most important ones.

3.2 Use of targeting

In many circumstances, countries adopt a policy of targeting certain areas or sectors of the economy or even segments of the population in order to promote the KBE in certain directions. Targeting is specifically used when certain areas or groups of people require more efforts in order to develop further or to catch up with other countries.

Box B: Targeting – Side Effects

"The problem of targeting specific programmes without understanding larger system effects often leads to unintended consequences"

All countries interviewed do targeting to a certain extend. Some of them, no matter which group they were in, make extensive use of targeting, while others, again no matter which groups they belong to, are

more generalists in their policies approach. Moreover, although countries make use of targeting, the problem of using it without understanding its repercussions in other areas has been raised as an important issue. It is claimed that first the whole system and its interconnections should be understood and then targeting could be used. Most of targeting policies tend to fail. Even though emphasis can be placed on women or minorities, such as the disabled, in fact the problem will not be solved that easily. Due to the fact that the whole system is interconnected, targeting a specific group is not effective, if certain other areas are not included, for example, the education system.

Table 6 summarizes the most frequently mentioned target areas. Note that in many cases countries and their respondents mentioned more than one target area. All cases mentioned have been accounted for.

Table 6. Targeting

Targeting area	Total	%
SMEs	10	11.8 %
Education / Training	10	11.8 %
Collaborations / Networks / Clusters / Spin offs	10	11.8%
Women	8	9.4%
Energy / Environment	7	8.2%
Entrepreneurship / VC	7	8.2%
ICT	6	7.1%
Nanotech logy	4	4.7%
Elderly	3	3.5%
Social	3	3.5%
E (government, commerce, business)	3	3.5%
Rural areas / Regions	3	3.5%
Fashion / textiles	3	3.5%
Agriculture / Food / Flowers	3	3.5%
Aerospace / Defense	2	2.4%
Exports sectors	2	2.4%
Biotechnology	1	1.2%
Total	**85**	**100.0%**

According to Table 6, main areas of concern are SMEs (small and medium size companies), collaborations (networks, cluster formation and support for spin-offs) as well as training and education. The last one is particularly important for the KBE, representing the basis for further economic development. The creation of collaborations, the use of complementary resources, including human resources specialized in different areas, seemed to be a constant in most of the countries researched. Support for SMEs, which are the main employers in most countries, is also a priority for most countries in this research.

Women, in terms of participation in the work force and as researchers are important areas that have been target by many countries, including highly developed ones.

Moreover, many of the surveyed countries emphasized entrepreneurship and venture capital, energy (and alternative types of energies) and environment. Finally ICT is seen as an important target as a basis for development.

4. Current indicators

4.1 Current use of indicators and indicator assessment

Considering the policies in place, interviewees were asked which were the main statistics and indicators that they currently use in their areas of interests. Most used indicators could be grouped into six categories:

a) Knowledge creation, such as BERD, GERD, and other R&D related indicators (input indicators) and patent indicators (output indicators)

b) Human resources and mobility (education related input indicators and employment related output indicators)

c) Transmission, application, and output covering clustering, networking, knowledge building and knowledge sharing, collaborative R&D, connectedness, transfer of knowledge, linkages between science and innovation, linkages between universities and businesses, spin offs, as well as new to market (products and services) , new to firm (products and services) and non-technological innovation

Box C: Need for Indicators

"It is difficult to get ideas on future indicators from the policy community. We asked them what the big issues are, but we always hear the same things from them. The policies are the same, the indicators are the same, and nothing is new"

"As for R&D indicators, we have more than what we requested"

"We do not give much importance to the indicators"

"We have the traditional measures, but talking about innovation, that is the wrong set of indicators ….need information on innovation systems…. need to measure real activities… keep using the wrong proxy."

"No one really understands what an innovation system or knowledge production system is"

d) Innovation finances, such as venture capital and entrepreneurship, ICT expenditure and innovation expenditures (input indicators)

e) Macro–economic performance (structurally related as input indicators and performance related as output indicators)

f) Broadband, e-government, e-commerce, and e-health (input indicators)

Table 7 summarizes the main types of indicators in use as well as their classification in terms of input and output indicators. Sometimes countries and respondents mentioned more than one type of indicators. All cited indicators are included in the table.

Table 7. Main indicators in use per type of indicator

Type of indicator	Classification	Total	%
Knowledge Creation	Input + Output	14	28%
Human Resources and Mobility	Input + Output	11	22%
Innovation Finance	Input	9	18%
Transmission, Application and Output	Output	8	16%
Macro-economic Performance	Input + Output	5	10%
Broadband, e-government, e-business, e-health	Input	3	6%
Total		50	100%

Countries continue to use traditional indicators, such as the ones related to knowledge creation (public R&D expenses, business R&D expenses, EPO and USPTO patents indicators, hi-tech patents) and to human resources and mobility. Less used, but still important, are the indicators that relate to innovation finances (venture capital and entrepreneurship, ICT expenditures) , and the ones that measure innovation in terms of transmission (diffusion), output and commercial application (collaborations, new to market and new to company products as well as non-tech innovation). Macro-economic indicators related to structural conditions and to performance are still important, including indicators such as GDP, GDP per capita, employment and unemployment rates.

Other indicators, such as broadband and e-indicators which measure sectors such as e-government, e-business and e-health were also mentioned, although less frequently than any other type of indicators.

There is a clear concentration in the use of input indicators; including education related ones, R&D, entrepreneurship and venture capital. On the other hand, indicators that

measure output and impact (at the economic and social level) are either lacking or not been used as much as input ones.

In summary, countries still rely on the same type of indicators that they have been using for a long time. Those are mainly input indicators. Although new indicators (output related) are available, the traditional ones have not been discarded. On the contrary, they are still most frequently used.

Apart from being asked what the current indicators in use are, this survey was also interested in assessing missing dimensions of indicators in use. An indicator can be assessed in terms of scope / detail and timeliness. Scope and detail refer to the aspects that an indicator covers as well as the level of information that an indicator provides when broken down per sector, per gender, per region, per company size; timeliness refers to the gap between current year and data availability.

Box D: Indicators – Assessment

"There is far more emphasis on quality than on timeliness. Reducing the time and compromising quality is unthinkable"

"We would like to have more detailed information, but not compromising the quality of the data"

"There is too much data available; it is difficult to make use of all the information"

"We need to deal with issues of confidentiality, level of details"

"The country is too small, so it doesn't really matter to have data at regional level"

"Statistics are old, which is a problem when technology is changing very fast"

"Today technology' changes happen every 2 or 3 years. We don't know how to deal with these rapid changes"

Table 8 shows that there is still, for the majority of the countries work to be done to improve both aspects: scope / details and timeliness. Interviewees would like to have present available indicators with more scope and more level of details. Timeliness is definitely a problem to be addressed. Except for two developed countries that did not mention any of the two features as being problematic, all other countries mentioned either scope/detail or timeliness as a concern. A total of 9 countries out of 16 mentioned both features as a concern. Furthermore, while 5 out of 16 countries in the sample did not seem to have a concern about lack of scope / details, only 4 out of the 16 countries interviewed did not mentioned timeliness as an issue.

Table 8. Assessment of indicators

	N. of countries	%
Lack of Scope/Detail	11	68.75%
Timeliness	12	75%
Total countries interviewed	**16**	**100%**

4.2 Adequacy of present indicators

Based on present indicators available, interviewees were asked if there were any indicators that they currently rely on that could be considered to be inadequate, outdated or even obsolete in their respective policy areas.

All countries, except for one pointed out negative aspects of present indicators, indicating that there is room for improvement. Main negative remarks were related to problems of definition, classification, measurements, differences in approach, lack of precision, need for standardization, comparability, need for consistency, coherence, reliability and finally, interpretation. Such remarks were in line with the debate and conclusions of last September's Blue Sky II Forum, which came up with the same issues.

The main criticism was in terms of definition. If concepts are not defined the same way for all countries involved, then the measurements of these concepts will not be correct, and consequently the indictors will not be reliable, leading to misinterpretations of the realities in countries examined. Interviewees feel that there is an urgent need for standardization in terms of definitions and measurements. Only once these two basic steps are solved, indicators can be considered reliable and can lead to appropriate interpretation. There is a feeling that due to lack of a common definition and well-defined measurements, indicators lack reliability, they do not measure the same concept in different countries and consequently, they are prone to misinterpretation. Furthermore, there has been criticism in terms of changes in measurements along the years. Lack of consistency is seen as problematic, making it impossible to look for trends if there is no consistency in either how an indicator is defined or how it is measured. The same need for standardization was discusses in the Blue Sky II Forum, where participants also called for comparable indicators which would allow countries to make comparisons. Furthermore, the forum concluded that standard classifications of industry, occupation, education were not only necessary to the development of new indicators of economic activity but they also had to be revised in a

Box E: Indicator Evaluation

" We look at relevance, number of countries included, precision, availability and coherence to evaluate the indicators… some do not fulfill the criteria….some areas are not included"

way that reflected the needs of analysts who were trying to present such indicators to the policy community in an accessible manner.

Still related to the problem of definition, some respondents pointed out that it is necessary first to clearly understand what an innovation system is, or what the measurable attributes (such as grants, intellectual property) of an innovation system are. Just by understanding the knowledge production system we will be able to evaluate how competitive the whole system is, how open it is, how transparent. Some attributes can be measured, but only after we have a sound understanding of the whole system and its parts, we will be able to make policy decisions that can influence innovation into the right direction.

Box F: Indicators – Need for update

" Old data around … don't use them much …collected for a long time and did have a significant purpose at one time, but need to look at phasing out due to lack of relevance"

" Current suite of indicators fairly useless… does not explain what is happening out there"

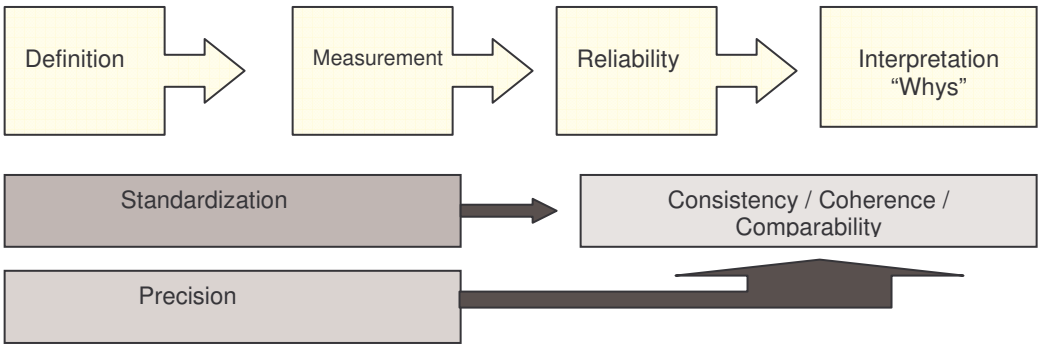
"We are now stuck with classifications that have been decided before and can not be changed…. Consequently the data is of limited use"

"Not only think of new things, but measure traditional ones

Another serious problem with the use of indicators is that most of them are considered "useless" if one cannot explain what is happening in real life. Indicators do not reflect the behavioral aspects of the knowledge economy. Why things happen the way they do cannot be explained by present indicators. To answer the "whys" (why people collaborate, why students move to and from certain countries, and related questions) new indicators should be developed.

Figure 3 summarizes the main problems with present indicators and the effects that these factors cause in terms of use and interpretation of indicators.

Figure 3. Main concerns about indicators



Other negative aspects raised were again in terms of timeliness, lack of details (or excessive details), sample definition, sample representativeness, and cultural differences.

Moreover, interviewees were questioned about specific indicators that they considered obsolete or inadequate. **Telecom** as well as **patent** related indicators came across as

being the most inadequate ones. Furthermore, **R&D** indicators and data on **numbers of researchers**, **publications and citations** have also being criticized for their inadequacy.

Table 9. Indicators considered obsolete or inadequate

Indicator	Details
Telecom Indicators	Penetration, tariffs, % of telephone use
Patent Indicators	Number of patents per inhabitant; does not measure value
R&D Indicators	Too many details, R&D expenditure as a number, R&D intensity Need for breakdown into basic, applied and development research
Graduates / Researchers	Researches per 1000 of population, Graduate students outcomes, Number of PhDs students
Papers and Citations	Lack of purpose

Box G: Future Indicators – A systematic approach

"Concepts are linked, but there are no indicators to show such linkages. Indicators are interdependent but not treated as such"

"Anything that measures linkages"

"Indicators are often used in one dimension, too focused. We need to understand a wider environment"

"Network analysis, linkages"

"Significant interaction and dynamic indicators"

"Not looking for isolated data, but systemic information …Innovation is always based on the work of multiple players ….we need indicators on connectivity performance"

"Understand relationships among technologies, people and institutions"

"Indicators are not dynamic; they are a picture of a certain moment. What matters is how things are changing"

"We would like to understand flows of knowledge, from one sector to other…Traditional indicators are not enough. They do not measure processes. There are no indictors to measure processes"

"Clearly the traditional approach is too static…we need dynamics, different sets of data"

"To understand how technology works, to understand the flows of knowledge and collaborations"

"We do not have enough to understand the dynamics, knowledge flows"

"Processes among companies and between companies and research centers. The question is: how to measure these interactions and the efficiency of those? "

"Wider understanding of innovation: not only R&D"

"Need to wider overall picture of innovation"

"How we measure, implement and evaluate interdisciplinary approaches"

"The wish list is too long"

"Changes and services will demand a new set of indicators"

While telecom indicators are considered the most obsolete ones, patent indicators are seen as being controversial. Respondents criticized that patents are simply counted for but that no indicator exist to reflect the impact of those patents. Just reporting number of

patents is not enough. Since there is a time gap between filling a patent and its commercialization, just the number of patents filled does not say much about its value.

4.3 Availability of indicators

Apart from criticism on present indicators, respondents also raised concerns on the lack of available information. Examples of areas lacking information at the moment relate to "soft indicators", measurements of impact, need for new measurements as a consequence of new technologies that did not exist in the past, need to follow technological changes and update the spectrum of available indicators, need to develop further composite indicators, more information on non-technological innovation as well on services indicators.

When asked about availability of indicators for **current** and **future** policy development, respondents basically gave the same answers. In other words, indicators that are considered important and that are missing today were basically the same as the ones that interviewees seen would be important in the future.

The most important area lacking indicators relate to **innovation flow**, from creation to commercialization. Interviewees would like to have more detailed information in terms of fields of research, type of innovation, innovation capabilities, new products, number of firms doing research in a certain country, adoption and diffusion of innovation, and the value added due to innovations. Ten out of sixteen countries in this survey pointed out the importance of having more information related to flows of innovation.

The Blue Sky II Forum pointed out in the same direction, claiming that commercialization is an important linkage measure as it is the creation of market value from knowledge. According to the debate that took place in Ottawa, Innovation Surveys do not focus on the money made by the source of ideas; consequently "there is a place for collecting more information on commercialization and the value chains in which the activities are embedded".[2]

Crucial information that is seen lacking is the economic **impact of innovation,** measured in quantitative terms. It would be important to know the quantitative results of grants, subsidies and tax exemptions in order to evaluate innovations results. Appropriate indicators that could be used to measure economic results of policies are lacking. Consequently it is difficult to evaluate the effectiveness of certain policies and to make the necessary adjustments. Governments not just develop new policies but they also support them by offering grants, loans and other financial mechanisms. But many interviewees pointed out that it is very difficult to assess the economic results of such policies. Were the funds used appropriately? What were the financial results? What was the impact of such measures in terms of employment, wealth, externalities and so on? How are companies doing after they received the funds?

[2] As per Draft "Outcomes of the Blue Sky II Forum" – Ottawa, 25-27 September, 2006

*In summary, interviewees pointed out that more **output** indicators need to be developed. There is a very specific need to measure the **impact** of policies on the economy and the society.*

Box H – Future Indicators – Impact

"Impact measures – linkages between what goes in and what comes out"

"We need to better understand impact"

"There are no indicators to measure the impact of investments"

"Indicators of impact: how companies are doing after receiving the funds"

"Examine cause and effect relationships"

"What does the input result in?"

"We need to find out how effective is the money being used and to compare among projects, countries"

"Indicators should reflect the impact and effectiveness of measures taken, they should reflect evolution, they should be dynamic, and they should measure impact in GDP…"

"How to measure the Knowledge Economy? How to measure costs of externalities? How to measure impact on society? "

The Ottawa Forum also discussed the need for impact measurements, signaling that the impact of an activity is difficult to be determined as STI systems are not linear. They pointed out the need for indicators describing short term outcomes as well as the longer term impacts and their implications.

Apart from these two main areas, two others were mentioned by at least seven countries out of the sixteen present in our sample: **collaborations and researchers**. Collaboration refers to linkages, clustering and networks. Information on researchers should be broken down per country, per institution, per categories of researchers, per gender, per term of contracts, type of financing and mobility.

The Blue Sky Forum approached the topic of linkages and the need to measure them to understand the dynamics of the STI system. While a contract is a linkage measure, representing a formal agreement between organizations, collaborations are more difficult to be measured, unless they are included in a contract and there is commercialization of intellectual property.[3]

Another important area that needs to be developed further in terms of new indicators refers to the **young population** as a source of future human resources. Interviewees would like to have more information in terms of type of education, number of students, mobility and job market.

ICT was also mentioned as lacking relevant information. Respondents would like to measure usage and impact of ICT both at enterprises and households.

Box I – Future Indicators – Composite Indicators

"Need for combining indicators from different fields, subjects"

"Need for composite indicators …… to move away from the classic, separate indicators"

Furthermore, apart from economic impact of innovation, **social impact** also needs to be measured. Respondents cited

[3] As per Draft "Outcomes of the Blue Sky II Forum" – Ottawa, 25-27 September, 2006.

externalities as consequences of innovation, an area that needs to be explored. More specifically, **security** issues and its impact on immigration, research and foreign scientists have been particularly stressed. Moreover, there was concerned with the **involvement of consumers** in the innovation process. In both cases, countries call for indicators in these areas.

Service innovation and its related areas, such as e-government, e-health and e-commerce were also mentioned in the list of priorities for indicator development.

Other areas cited relate to entrepreneurship, venture capital, technology start ups, number of new firms, broadband, organization aspects of innovation and human resources; the last one in terms of migration, mobility, employment and social policy.

The Blue Sky II Forum stressed the need for a more comprehensive picture of institutions involved in education, training and mobility, stating that human resource indicators should be an integral part of all STI related analyses due to its fundamental role in the system.

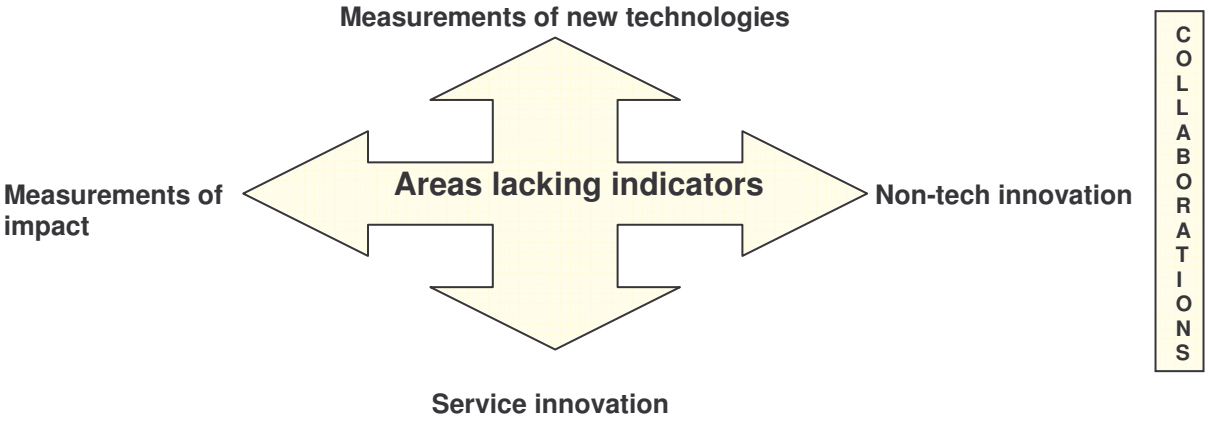
Table 10 provides a breakdown on important areas lacking information, while Figure 4 summarizes main areas of concern in terms of lack of related information.

Table 10. Availability – Need for new indicators (present and future policy needs)

Types of indicators	Total	%
Innovation Flow	10	15.4%
Economic Impact	10	15.4%
Collaboration	9	13.8%
HR: Researchers	7	10.8%
HR: Young	5	7.7%
ICT	5	7.7%
Social Impact	5	7.7%
Innovation Services	4	6.1%
Entrepreneurship / Venture Capital	3	4.6%
HR: Employment / Migration	3	4.6%
Broadband	2	3.1%
Organizational aspects	2	3.1%
Total	65	100%

There were a few exceptions in terms of the classifications used in Table 10**:** one country mentioned the need to develop new indicators to measure **nanotechnology,** another one mentioned **environmenta**l issues and finally a third one was concerned with the lack of indicators that could measure **non-economic value** of public funded research.

Figure 4. Areas lacking indicators



Box J: Indicators – A New Approach

"Innovation should be seen as a system, as a whole… new basket of indicators are necessary… More econometrics…Shift to modeling framework for best estimation …. More system oriented"

"Simulations…what if…and look at different outcomes"

"Reasonable approach to understanding knowledge economy…. To have a road map…"

"Focus on modeling techniques…a system dynamic model…. Interactions….a working model that would explain innovation system"

"There may be a better way to manage the system"

Furthermore, there are studies under way for developing dynamic modeling techniques, which will include economic and social behavioral sciences. Such models will use quantitative data related to different aspects of innovation, requiring new information, new data, and new indicators. The systemic model will bring together large firms and their interactions, R&D performers, consumers, and government. This model is expected to be more suitable to the understanding of the knowledge economy and to better explain the innovation system.

In general, concerns raised by respondents from this survey were in line with the debate that took place in the Blue Sky II Forum last September, claiming that "there are limited indicators of linkages among the actors (governments, education institutions, businesses) which tell some of the story about the dynamics of the STI (science and technology innovation), fewer indicators of outcomes (market shares, change in profits) and fewer still on the impacts of supporting and engaging in the activities and the linkages".[4]

[4] See the draft document "Outcomes of the Blue Sky II Forum" – Ottawa, 25-27 September, 2006.

5. Future policies

Interviewees were asked about what types of policies or policy areas they considered would be important in the future (in five to ten years' time). **Human resources** and **education** came up in the first place, with fifteen countries including them as a priority, just above **clustering, collaborations, technology centers or technology parks,** with fourteen countries mentioning these as top priority. Development of human resources and proximity for joint efforts for innovation development reflect an already familiar tendency, looking back to Table 5 on the main drivers of present policies: collaborations, networks and clustering were mentioned there by ten countries while human resources – education and mobility, were mentioned by six countries.

It is clear that current priorities are also priorities for the near future. Both human resources and collaborations are main topics that will continue to gain attention from professionals involved in policies.

Moreover, according to Table 6 on targeting, many countries already have policies in place to specifically assess both topics. Education and training as well as collaboration, networks and clusters were both mentioned by ten countries as being targeted today. Furthermore, according to Table 10 on the need for new indicators, both topics are again on the top of the list as important areas for which new indicators should be developed: innovation flow was mentioned by ten countries, collaboration by nine, human resources – researchers by seven, and human resources – the young, was mentioned by five countries.

Box K: Indicators – Need for update

" Old data around … don't use them much …collected for a long time and did have a significant purpose at one time, but need to look at phasing out due to lack of relevance"

" Current suite of indicators fairly useless… does not explain what is happening out there"

"We are now stuck with classifications that have been decided before and can not be changed…. Consequently the data is of limited use"

"Not only think of new things, but measure traditional ones

The third priority for the near future is **ICT** related. ICT is seen as the base on which technology development and transmission take place. It is a support to allow for further development.

ICT was mentioned by four countries as part of their present policies, as per Table 5, as well as six countries as part of their actual targets (please refer to Table 6). Furthermore, need for ICT indicators were mentioned by five countries according to Table 10.

Box L: Future Policies

"The focus has changed from academic research to applied research"
"Before, research was too academically oriented, now is more business related"

"A perception that sciences can be complementary to businesses, allowing for the development of new technologies. In summary, a stronger link between businesses and research"

"Competitive pole … bringing together industry and research"

"More applied research"

"More and more drive of value for money in science "

"We opted to concentrate on applied R&D and less university and research institute research….We want projects that end up with a clear output and not a report. The goal is: concrete, tangible results"

"The role of universities is not just to teach, but also to be entrepreneurial and to create enterprises"

"Emphasis is on policies that bring together universities and industries, in terms of R&D and linkages…"

"Universities should work closer to enterprise"

"There is a need for policies to help the transition from academia into business. Public policies must focus on support risk taking and not on subsidies"

"Move from the national level when making policies to a more global level…. Companies have a more global attitude"

"New policies' areas will be more integrated with other participants"

"Connectedness, especially international"

Nanotechnology came up as the fourth top priority for the future. Twelve countries mentioned it while nine mentioned biotechnology. **Biotechnology** is considered by respondents to be a sector that one needs to be already in to develop further, while nanotechnology is a sector where countries can still get in and catch up with others. Those explanations were based on the fact that biotechnology is a sector that has been around for some time while nanotechnology is a new one. Some countries have a well developed biotech sector and are well known for that. It is very difficult for other countries to catch up with those. On the other hand, nanotechnology is a new sector, making it easier for countries to get in while in its early stages. Not surprising, when interviewees were asked about present policies, four countries included new technologies as an answer (please refer to Table 5). To corroborate with the idea that biotechnology is a sector that is more difficult to catch up while nanotechnology is more accessible to more countries, Table 6 on targeting indicates that while four countries are presently targeting nanotechnology, only one is presently targeting biotechnology.

Energy and environment, including pollution and climate change came up in fifth place, with eleven countries mentioning it as a priority for the short and medium future. Although this topic was not mentioned as part of present policies, it was included by seven countries as being target (please refer to Table 6). If Energy and environment were not as important in the past, they are definitely topics in the minds of policy professionals for the future. Table 10 points out needs for new indicators for economic and social

impacts, measure of externalities and their related costs, also including the costs of pollution and impact on the environment. Need for indicators of economic impact were mentioned by ten countries, while need for indicators of social impact were mentioned by five countries, undoubtedly an important group of indicators for the near future.

Areas related to society, such as **welfare, health and aging population** are included in the top priorities group according to the countries surveyed. Nine countries included them in their list of future priorities. Although not directly mentioned as part of their present policies, three countries in the EU are already targeting the area (please refer to Table 6 – Targeting – Elderly plus Social).

Another important area that professionals have already started to look upon and that will become even more important in the future is the one related to **venture capital and entrepreneurship**, even more in Europe where certain countries are far behind in this matter. Eight countries emphasized entrepreneurship as an important topic for the future, while according to Table 5, only four had mentioned this as part of today's policies. The increase in the number of countries concentrating in this area is significant. Entrepreneurship and venture capital have already being targeted by seven countries searched in this study. As a consequence, new indicators for this area will be necessary. As per Table 10, three countries mentioned the need for new indicators to measure entrepreneurship and venture capital.

Box M: Resources Allocation

"Resources are limited, it is more difficult to target certain areas… we are not interested in certain industries…."

"There is a consensus that we can not fund all technology ….selection process to be put in place"

"The world is changing. We will not be able to catch up on everything"

"Where research is being done…The world is expanding. We need to make sure we can hold our own"

"….the recognition that this is not just a matter of giving money to do something, but that the type of portfolio needs to be carefully managed as these types of innovation systems evolves…"

"….question is what kind of return on investment?"

Related areas to the above mentioned priorities, and mentioned by eight countries, are **labor, migration and mobility**, which can have a direct impact on welfare, and the ageing population. Interviewees stressed the need for more indicators on social impact to measure changes in these areas.

Countries also mentioned **globalization** (including here not just most feared newcomers, China and India, but also Eastern European countries that have recently gained EU membership) and the **information society** as important issues for the future, each of them mentioned by eight countries.

Another very important group of policies was **security, privacy and terrorism,** mentioned by eight countries. Security is important not just as a topic itself but even more due to its effects in other areas, such as migration, human resources, mobility of students and scientists, which cannot be looked upon without also looking at their interdependencies.

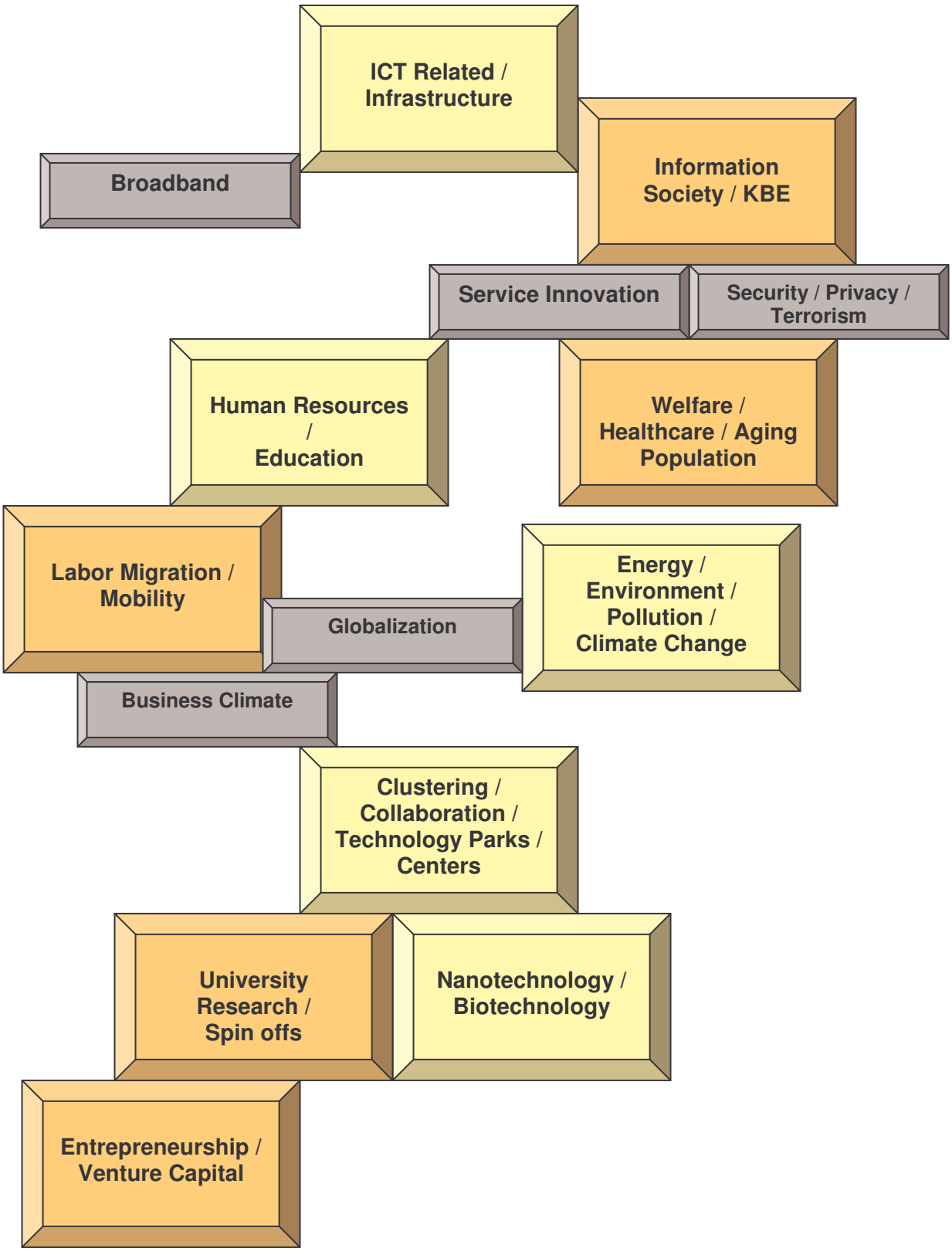
Finally, another related topic, **university research and spin-offs**, was mentioned by seven countries. This area is directly related to entrepreneurship and venture capital, collaborations and clustering and the development and mobility of human resources.

It is not possible to think about all these priorities without looking at how they link with each other. While Table 11 summarizes main policies concerns for the future per country, Figure 5 looks at interdependencies of future policy priorities.

Table 11. Main policy concerns – Future

Main policy concerns	N. of citations	%
Human Resources: Education	15	9
Clustering/ Collaboration/Technology centers/parks	14	8
ICT related	12	7
Nanotechnology	12	7
Energy/ Environment/ Pollution/ Climate change	11	6
Biotechnology	9	5
Welfare/ Healthcare/Aging	9	5
Entrepreneurship / V. Capital	8	5
Globalization	8	5
Information Society/ KBE	8	5
Labor/ Migration/Mobility	8	5
Security/Privacy and Terrorism	8	5
University research/spin offs	7	4
Business Climate	5	3
Convergence / Standardization	4	2
e-business / e-commerce / e-government	4	2
Infrastructure	4	2
Service Innovation	4	2
Taxation	3	2
Communications Technology	3	2
Fashion	3	2
Sustainable Development	3	2
Aerospace and Defense	2	1
Agriculture/ Food/ Flowers	2	1
Automotive	2	1
Broadband	2	1
Chemicals	2	1
Engineering and Machinery	2	1
Total	**174**	**100%**

Figure 5. Future policy concerns – Medium and long term



6. Conclusions

This survey was conducted among policy related professionals, and a few statistical institutions and academia in a wide range of countries at different stages of development. Our conclusions are in line with the ones from the recent debate on indicators and their use in policies, which took place last September 2006 in Ottawa, Canada: the Blue Sky II Forum.

Both this survey and the Blue Sky debate concluded that there is a need for standardization of indicators among countries to facilitate comparison. Although indicators are presently used for basic benchmarking, there is a growing interest for public accountability of public spending programme and public institutions (return on investments), demanding indicators that can support such evaluations.

Furthermore, there is a need to understand what is happening in terms of innovation activities. Although we do have indicators on activities (R&D, inventions, innovation, diffusion of knowledge, technologies and so on), we lack **indicators of linkages** among the actors, as well as indicators of **outcomes, impact** indicators and **human resource** indicators in terms of institutions involved in education, training, life-long learning and mobility of STI (science, technology and innovation) .

The economic environment and society have changed as a result of globalization; service industries are becoming even more important, new products and new types of jobs have been developed while old ones have disappeared. New technologies have gained importance, such as biotechnology, nanotechnology, but indicators still measure the same old-concepts. Nowadays, existing classifications systems are less relevant. It is fundamental that new indicators and classification systems are developed to reflect such changes.

Table 12 summarizes most important issues that need to be assessed to reflect continuous changes in the environment, according to this survey and the Blue Sky II Forum.

In summary, due to continuous and profound changes in the environment, previous indicators and classifications became outdated. Although they are still used for comparison purposes, they do not reflect present reality of innovation systems. It is necessary to not just develop new policies based on update information, but also to evaluate them and make the necessary changes when appropriate. Globalization brought about extremely competitive markets with new actors, new opportunities and also new obstacles. To help countries and policy makers to make sense of this new environment, new indicators that are compatible with this changing scenario need to be developed. Just then policy makers will be able to use them to come up with new policies which will allow countries to keep their presence in certain areas or to explore new ones, but also to measure results. What they have available today is simply not enough.

Table 12. Main issues surfaced in the current survey and at the Blue Sky Forum

This survey	Blue Sky Forum	Importance	Explanation
Co-ordination, standardization, classifications, concepts and definitions	Need for co-ordination, focus and synthesis, classification and guidelines	* * *	Standardization, inter-country comparisons, reliable and accurate information, linking data sets
Innovation flows	Value chain, commercialization of innovation	* * *	From creation to commercialization
Measurement of impact	Moving from activity to impact measures	* * *	Quantitative results, return on investments, Innovation results
Collaborations	Linkages	* * *	Linkages, clustering, networks
Human resources / entrepreneurship	Human resources measures, entrepreneurship	* *	The young population, researchers, education, training, learning, mobility and job market
Service innovation	Dominance of services	* *	E-government, e-health, e-commerce
Measurement of new technologies	Diffusion of technologies	*	ICT, biotechnology, nanotechnology, materials, energy

Annex A: Semi-structured questionnaire

QUESTIONNAIRE ON KBE POLICIES AND INDICATOR NEEDS

Before I start, I would like to stress that all interview results will be kept confidential. We won't release any information that can be used to identify yourself or your policy area.

Background: What policy area(s) are you responsible for?

A1.1 CURRENT POLICY. What significant changes, if any, have occurred in the past five years or so in your area of policy? What drove the change(s)?

a. **PROMPT** for any changes in policy in the last 5 years due to:

i. Government policy to promote a knowledge-based economy?

The general idea behind a knowledge-based economy is that economic competition increasingly depends on the use of knowledge and innovation. This includes not only high tech sectors, but also the application of new technology and organizational methods across the economy – services, 'low tech' manufacturing, and the public sector.

If YES – what has changed to reflect this?

ii. Change due to increasing concern over globalization issues?
If YES – what has changed to reflect this?

Includes increasing off-shoring of production or R&D, mobility of skilled workers (including international migration of highly skilled workers), increasing global competition, increasing economic power of China and India, which increases both competition and potential markets for European goods and services, etc.

iii. Change due to new technological developments?
If YES – what?

Could include biotechnology, nanotechnology, ICT applications, new organizational methods, global supply chains, etc.

A1.2 CURRENT POLICY. Policies to promote a knowledge-based economy are often **targeted** - designed for specific sections of a population or economy. For example, some educational programmes are targeted to women, while many countries target innovation programmes to small firms or to specific sectors or technology fields. Are your national policies using any form of targeting?

A2.1 CURRENT INDICATORS. Which statistics or indicators do you currently find the most important for policy development in your area of interest, and what do they use them for?

a. **PROBE** for: are these indicators adequate for your needs in terms of:

i. *Scope* (cover all aspects of what they would like, for instance gender for education/skills, or sector for R&D)?
ii. *Detail* (for instance, available at the regional level, or for different firm sizes, etc)?
iii. *Timeliness*: not too long a gap between current year and data availability?

A2.2 CURRENT INDICATORS. Do you find any of the indicators that you currently rely upon to be inadequate, outdated, or even obsolete for your policy area needs?

If YES, can you summarize the main problems?

A2.3 CURRENT INDICATORS. Can you think of data or indicators that are crucially important for **current** policy development in your area and which are simply not available today?

I would now like to ask you a few questions about policy concerns and indicator needs for the future, and if you see any necessary changes coming up. By future, we mean in the medium to long term, such as over five years from now.

B1 FUTURE POLICY: Do you see any major new developments or challenges in the future that would require a change to your current policies?

If YES: what will be causing the need for these changes, and what types of policies will be needed to meet them?

B2 FUTURE INDICATORS: Are there **new** types of data or indicators that will be needed to help policy meet these future challenges?

B3 More broadly speaking, do you see other challenges on the horizon for policy development outside your policy area?

We will be producing a short summary of the results of this survey. Would you be interested in a copy?