THE REVIEW IN THE FIELD OF KEY NATIONAL INDICATORS DESCRIBING THE PROCESSES OF KNOWLEDGE-BASED ECONOMY AND SOCIETY

1. Three hypotheses as starting points

The 'knowledge-based' description of economy and society, first of all, is a qualitative category. It is very important that it should pervade the economic-social sectors, their respective segments, as much as possible. Thus, measuring it by indicators is a complex, complicated process and makes it necessary to utilize international experiences.

It should be obvious that being knowledge-based in itself and indirectly cannot be apprehended, cannot be measured, therefore it is not by chance that the various indicators, first of all, grasp the inputs and outputs, respectively the cause and effect elements of the processes. To lay the foundation a varied system of statistical indicators and metrics has been elaborated in the past decades for describing and characterizing knowledge-based (or knowledge) economy and society.

Nowadays the regularly and generally calculated indicators prove that these days knowledge economy and society are a reality, the bearers and expressions of real relationship systems, albeit in different countries on different levels.

However, this development is not reflected adequately *in performance auditing*. Earlier, such an auditing focused on the development and maintenance of individual IT systems. Nowadays in the light of the increasing role of IT systems in public management the auditing turns, as its objects, to the evaluation of e-government programmes. Tomorrow, the shift will be followed by auditing of the development of knowledge economy and society (KES).

What *circumstances or ideas* form the basis of such a perspective? Firstly, the global economy is based not only on the key resources of land, labour and capital, but increasingly on knowledge, its value added in the production process and services. Secondly, this development trend offers the most appropriate routes for the transformation from the so-called natural-resource-based (or investment-driven) economy to the most recent developments for the developing (or transition) countries.[1] However, such a development could largely support strategy-seeking in the period of current crisis aftermath in the developed countries, as well. Thirdly, the perspective of KES offers some important conditions needed for putting citizens' needs in focus.

Taking into account these ideas the pilot project aimed at testing the following *three hypotheses*:

- *Hypothesis 1*: What was said above suggests that it is important to assess the economy, efficiency, and effectiveness in all government's supporting activities for the development of KES in order to

[1] For the working of such a transition Finland sets a very successful example during the last thirty year period. But countries like China, South Korea, Malaysia and Chile also illustrate the rapid progress in this field.

contribute to better public accountability and better public management and public services.

- *Hypothesis 2*: The available information on the economy, efficiency, and effectiveness of government programmes do not appear to be adequately public and reliable. So, the auditors can not represent the public interest unless this judgment is unjustified.
- *Hypothesis 3*: Consequently, the auditors can not contribute to improving the performance of government programmes and conditions for decision-making as much as it would be needed.

The *participants* of the project consist of a group of experts from the SAIs (Finland, Hungary). The participating countries prepared an empirical case study by the adaptation of the system of indicators of international organizations (European Union, Ecostat; World Bank), and by the method of using the statistical, audit-related or other system of indicators applied in the given country.

The project has taken a 'before-during-after' approach distinguishing steps in the development process of indicators. Firstly, at present we concentrate on the 'before' questions which examine the *reasons or frameworks* requesting the development of the indicator systems. Secondly, the summary paper *compares these needs to the actual capacities* of the existing statistical information systems in the countries and in the case of the Eurostat. Thirdly, the paper makes an attempt to conceptualize the *performance auditing* and, in connection with it, the *accountability perspective* as a main horizon of the audit of key indicators.

2. Frameworks for indicators

2.1. Framework for knowledge economy

On the basis of the studies one can easily compile a set of definitions suitable for the description of the knowledge economy. In accordance with a widely accepted one, the knowledge economy includes the knowledge industries, the knowledge-based industries, as well as the knowledge-based market and non-market services.

Knowledge is extremely wide-ranging, and includes concrete and general knowledge, experiences, intuitions, creativity, skills, the understanding of and judgment about things, the ability to understand and judge, etc. For the purpose of economic analysis usually four kinds of knowledge are distinguished.[2] The commonly used English terms for these categories are: know-what, know-why, know-how and know-who. It is being emphasized that knowledge is a wider concept than information. Information usually means the 'know-what' and 'know-why' components of knowledge.

- *Know-what*: objectified, i.e. accumulated knowledge recorded in books, data carriers, etc., which appears in the form of acquaintance with and understanding of figures, data, events, etc. pertaining to facts.

[2] See: The Knowledge-Based Economy. OECD, Paris, 1996. Knowledge Management in the Learning Society OECD, Paris, 2000. Both refer to Lundvall, B. and Johnson, B.: The Learning Economy. Journal of Industry Studies, Vol. 1, No. 2, 1994.

- *Know-why*: refers to scientific knowledge based on the recognition of principles, laws, objective laws, cause and effect correlations, with which one can explain the events, forms of movements and processes of nature, the human mind, the society and the economy. This kind of knowledge is extremely important in laying the foundations for product and process advances. The production of know-why is often organized in special organizations, such as research laboratories and universities, or related research places.
- *Know-how*: refers to skills, competence or the capability to do something. It can mean that a worker is able to perform the operations required by the production (technological) process, or a businessman is able to judge the market prospects for a new product, or a personnel manager is able to select the most suitable staff, etc. It cannot be stated that know-how is more practical than theoretical knowledge.
- *Know-who*: involves information about who knows what and who knows how to do what. An organic element, or even essence of know-who is the special social and personal ability to cooperate and communicate with various people and organizations.

According to the almost generally held notion, in the primary approach the knowledge-based economy means an economic structure in which the production, distribution and utilization of knowledge-intensive goods and services play a crucial role. By 'crucial role' the experts that developed the indicators and are working on the measurement process mean that these structures account for more than 50%, or an increasing share of economic performance (GDP). Knowledge-based industries can be found in the production processes based on high-technology manufacturing (aviation, information and office technology, radio, television and communication equipment manufacturing, pharmaceutical production). Knowledge-based market services include postal and telecommunication, computer and information services, the services of the financial and the insurance sectors, as well as the auxiliary business services. Knowledge-based non-market services include education and healthcare services financed by the state, the local governments and the voluntary sector, as well as ICT based public services.

It is almost always generally accepted that the interpretation of the KES includes first and foremost the growth and increasing proliferation of the production of knowledge-intensive products and services, i.e. this is the determining factor. The concept of the KES includes all such segments of today's economy – from high-tech manufacturing, information and communication technologies (CICT) through knowledge-based services to the definitely creative industries such as media and architecture –, in which the 'essence' or majority of the added value is knowledge.

In relation to economic growth researchers and analysts claim that among the impact factors knowledge and workforce abilities become increasingly valued, while – we may add – certain elements, such as traditional professional activities, physical work, etc. may lose value. However, not even the latter can change the fact that in the knowledge economy *a new economic growth model* is developing and is becoming more and more typical. The basic characteristic feature of this so-called *endogenous economic model* is that unlike the traditional growth models, it does not treat knowledge, technical and technological

development, and innovation as exogenous factors, but as endogenous elements, i.e. it describes and explains economic growth primarily with these factors.[3]

So, what is new in the knowledge-based economy? While acknowledging that human expertise stands in the focus of economic development, and therefore it is always right to put the emphasis on knowledge, after the turn of the century, or in fact the millennium, it is justified to speak about the start of a new phase of development, since *the economy is much more deeply and directly rooted in the production, distribution and utilization of knowledge than any time before.*

These considerations and *the Knowledge Assessment Methodology (KAM) of the World Bank* suggest that the *4 pillars of the knowledge economy framework* might be taken as follows:

- An *economic and institutional regime* to provide *incentives* for the efficient use of existing and new knowledge and the flourishing of entrepreneurship;
- An *educated and skilled population* to create, share and use knowledge well;
- An efficient *innovation system* of firms, research centres, universities, consultants and other organizations to tap into the growing stock of global knowledge, assimilate and adapt it to local needs and create new technology;
- *Information and communication technology* to facilitate the effective creation, dissemination and processing of information.

It is an important experience with the use of this framework that it is not enough to make a rapid progress with these pillars individually, but what is really needed it is *to bring about the pillars being in balance* as suggested by the Finnish experience, in particular. The need for such a policy to increase the country's preparedness for application of knowledge economy could be seen from Chart 1 informing on the indexes for the most recent available year on a scale of 0 to 10 relative to other countries in the comparison group.

The Chart 1 shows that the *Index KI* measuring a country's ability to generate, adopt and defuse knowledge as an indication of *overall potential* of knowledge development and the *Index KEI* taking into account the environment for knowledge as an indication of the knowledge to be *used effectively* are the highest in Denmark, Finland, United States and Western Europe; Hungary and Slovakia occupies a middle position; while Russian Federation, Mexico, Kazakhstan and China use knowledge remarkably less for economic and social development.

[3] Knowledge has played an important role in the economics since the beginnings. For example, the notions of Adam Smith about the advantages of the division of labour and special knowledge are well-known; Friedrich List linked knowledge to the infrastructure and institutions, as productivity increasing factors; while Schumpeter considered innovation as the driver of economic dynamics.

Chart 1. The pillars of knowledge economy in selected countries and region

	KEI[a]	KI[b]	Economic incentive regime (1)	Education (2)	Innovation (3)	Information infra-structure (4)
Denmark	9.52	9.49	9.61	9.78	9.49	9.21
Finland	9.37	9.39	9.31	9.77	9.67	8.73
United States	9.02	9.02	9.04	8.74	9.47	8.83
Western Europe	8.76	8.78	8.71	8.29	9.27	8.78
Hungary	8.00	7.88	8.35	7.73	8.21	7.70
Slovakia	7.47	7.35	7.78	7.26	6.89	7.95
Russian Federation	5.55	6.82	1.76	7.19	6.88	6.38
Mexico	5.33	5.42	5.06	4.88	5.82	5.56
Kazakhstan	5.05	5.17	4.70	7.07	3.68	4.76
China	4.47	4.66	3.90	4.20	5.44	4.33

Source: World Bank. Knowledge Assessment Methodology, www.worldbank.org/kam.
[a] Knowledge Economy Index which is the average of indexes 1, 2, 3, and 4.
[b] Knowledge Index which is the average of indexes 2, 3 and 4.

Likewise, Chart 1 shows that the country pattern of the roles of pillars indicates some characteristic features.

- In the last group of countries the economic incentive regime appear to be lagging behind relative to other pillars, particularly in the Russian Federation, while the contribution of this pillar is more pronounced for the knowledge economy in the countries of the first two (developed) groups.
- As opposite to this, the education seems to be less supportive in the countries of the first two (developed) groups relative to both the economic incentive regime and the innovation. This holds also true for the information infrastructure.
- The main policy message from this different pattern is twofold: (i) to increase the supportive policies for the development of economic incentive regime in the less developed countries, and (ii) to improve the quality of education in the more developed countries.

Moreover Chart 1 suggests that, because of the KEI Indexes are not ranked high in all sub-indices concerning the pillars in the case of less developed countries as the case for the more developed countries, *the need for a better balance among the pillars appears to be more*

pronounced in the less developed countries, particularly in the Russian Federation and Kazakhstan.

Turning to the framework of the knowledge economy as used by the *European Innovation Scoreboard (EIS)* it consists of *five pillars*: *innovation drivers; knowledge creation; innovation and entrepreneurship; application; intellectual property.* Comparing their scope with that of Index KI of the World Bank's KAM covering the pillars education, innovation and information infrastructure the two should be taken as identical for measuring a country's ability to generate, adopt and defuse knowledge in the economy.

The importance of this framework is to be increased by a recent major *Communication from the European Commission Europe 2020*[4] having a priority of strengthening knowledge and innovation as drivers of the *future smart growth*. This requires improving the quality of our education, strengthening our research performance, promoting innovation and knowledge transfer throughout the Union, making full use of information and communication technologies and ensuring that innovative ideas can be turned into new products and services that create growth, quality jobs and help address European and global societal challenges.

2.2. Framework of the knowledge (information) society

Beyond the knowledge economy the global development trends make the knowledge (or information) society development the target of all nations. This has been supported by the UN's World Summit on the Information Society 2003 and 2005, and also by the Lisbon Strategy and the Europe 2020 Strategy for the EU-member countries.

According to a concept based on the Finnish experience: 'In the Information society, knowledge is the basis of education and culture and constitutes the most important production factor. Information and communication technology (ICT) promotes interaction and exchange of information between individuals, business enterprises, and other organizations, as well as the provision of services and access to them.'[5]

Although, due to the different characteristic features of the countries, such a strategy of developing and information society cannot be followed in a unified way, however the three pillars of this society (See Chart 2) and their elements might be identified as follows:

- *Competent and learning individuals and work communities*
  - The ability of individuals and work communities to renew and continuous development of knowledge and learning are the foundation of competitiveness and well-being.
  - The development of digitalization, convergence of service production and globalization of business lead to a situation in which individual

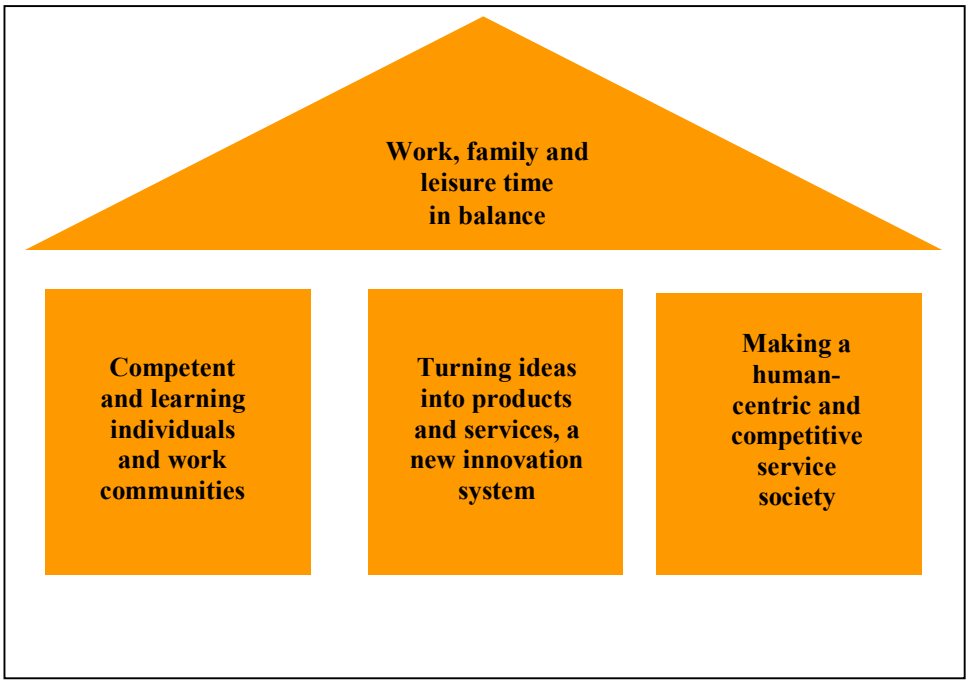
[4] See European Commission, Brussels, 3.3.2010, COM(2010) 2020.

[5] Source: National Information Society Strategy, Helsinki, 1998.

competitiveness is emphasized alongside national and organizational competitiveness.

- *Turning ideas into products and services, a new innovation system*
  - Innovations arise in networks as the result of multidisciplinary cooperation.
  - Networked cooperation between education, research and product development functions in a strategy-oriented and successful manner.
  - The establishment of multidisciplinary and international clusters of strategic competence in science, technology and innovation activity.
- *Making a human-centric and competitive service society*
  - Electronic public services appear to be more customer-oriented.
  - Implementation of ICT makes easier of daily life of citizens and enterprises in the SME sector.

Chart 2 **Pillars of the framework of knowledge society**



At the end, as a result of the knowledge society the trust in the society actors and services will be increased and the balanced social and regional society development will be ensured.

As an addition to it, the framework of *EU Community statistics on the information society*[6] is worthwhile to be mentioned, as well.

[6] According to the Regulation (EC) No 1006/2009 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 September 2009.

The Community statistics on the information society consists of two modules (pillars): *Module 1: Enterprise and the information society* provides a framework for the requirements in terms of coverage, duration and periodicity, subjects covered brake down of data provision, type of data provision and any necessary pilot or feasibility studies. As to the subjects (focus areas) covered, their list is as follows:

- ICT systems and their usage in enterprises,
- Use of the Internet and other electronic networks by enterprises,
- E-commerce,
- E-business processes and organizational aspects,
- Use of ICT by enterprises to exchange information and services with governments and public administrations (e-government),
- ICT competence in the enterprise unit and the need for ICT skills,
- Barriers to the use, the Internet and other electronic networks, e-commerce and e-business processes,
- ICT expenditure and investment,
- ICT security and trust,
- Use of ICT and its impact on the environment (Green ICT),
- Access to and use of the Internet and other network technologies for connecting objects and devices (Internet of Things),
- Access to and use of technologies providing the ability to connect to the Internet or other networks from anywhere at any time (ubiquitous connectivity).

The Module 2: Individuals, household and the information society is aimed at covering the following subjects:

- Access to and use of ICTs by individuals and/or in households,
- Use of Internet and other electronic networks for different purposes by individuals and/or in households,
- ICT security and trust,
- ICT competence and skills,
- Barriers to the use of ICT and the Internet,
- Perceived effects of ICT usage on individuals and/or on households,
- Use of ICT by individuals to exchange information and services with governments and public administrations (e-government),
- Access to and use of technologies enabling to the Internet or other networks from anywhere at any time (ubiquitous connectivity).

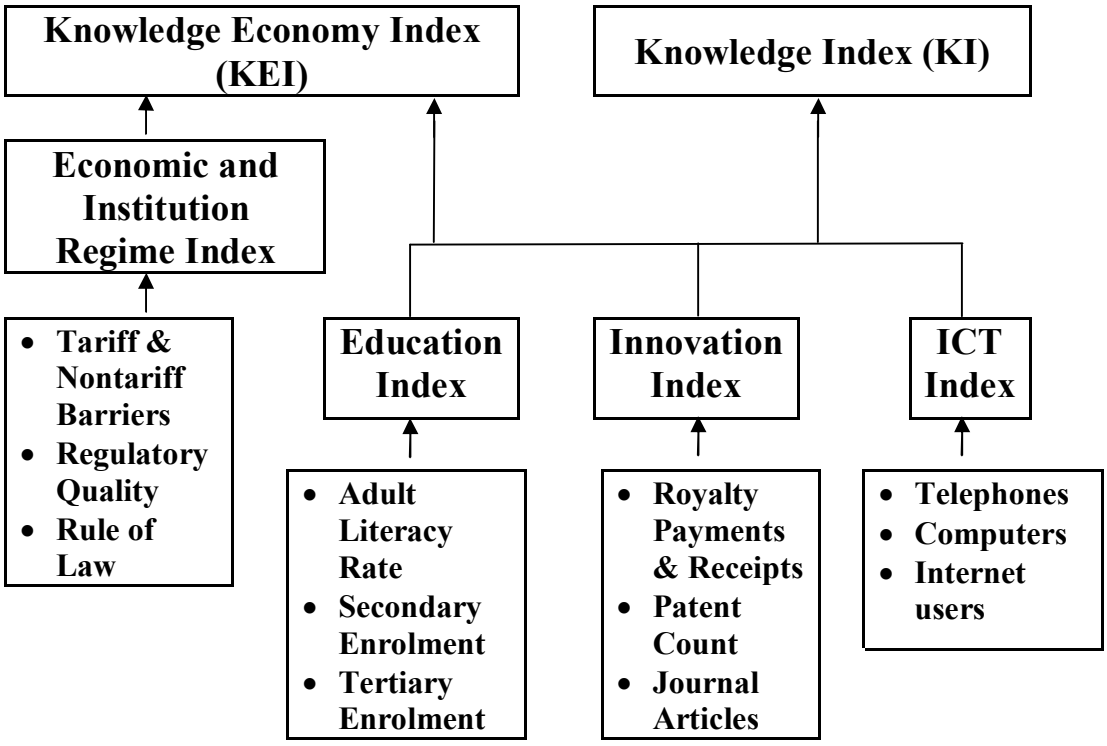
Of course from the two modules Module 2 suggests itself to better serve as a frame for indicators of societal type, while Module 1 appears to offer orientation for the indicators of knowledge economy.

3. The needs for indicators and the actual capacities of information systems

3.1. The case of knowledge economy

To move from the frameworks to the key indicators the basis of selection would be from among the KAM of the World Bank, the European Innovation Scoreboard (EIS) or that of countries, in our case Finland and Hungary. Taking into account that the greater number of indicators of the EIS than the number of indicators used by the KAM (Chart 3) on the one hand, and the EU-membership of Finland and Hungary on the other hand, the preference should be given to the EIS as a basis for selection.

Chart 3 **Knowledge Indexes**



Source: www.worldbank.org/kam.

The pillars of the EIS are represented by the information system with the help of 30 indicators. Twenty indicators, which are most commonly used during the preparation of decisions by the 32 European countries taking part in the system, are presented by Chart 4. The table also contains the data of 2008 for the 27 EU Member States, as well as for Finland and Hungary.

It can be concluded from Chart 4 that there is a big difference between the two countries elaborating case studies concerning the development of knowledge economy. Finland is a foregoer comparing to the average data of EU countries: in case of 16 indicators it shows better results than the EU average, and only 4 indicators fall behind (16:4). On the other hand the relevant data of Hungary reflect converse results (3:17).

Chart 4 **Key indicators of knowledge-based economy, 2008**

	EU27	FI	HU
INNOVATION DRIVERS			
S&E and SSH graduates per 1000 population aged 20-29 (first stage of tertiary education)	40.3	38.3	30.2
Participation in life-long learning per 100 population aged 25-64	9.7	23.4	3.6
Youth education attainment level	78.1	86.5	84.0
Broadband access by firm (% of firms)	77.0	91.0	70.0
KNOWLEDGE CREATION			
Public R&D expenditures (% of GDP)	0.65	0.94	0.46
Business R&D expenditures (% of GDP)	1.17	2.51	0.49
INNOVATION AND ENTREPRENEURSHIP			
Venture capital (% of GDP)	0.107	0.163	0.026
SMEs innovating in-house (% of SMEs)	30.0	40.9	13.2
Innovative SMEs cooperating with others (% of SMEs)	9.5	27.5	6.5
IT expenditures (% of GDP)	2.7	3.2	2.5
SMEs introducing product or process innovations (% of SMEs)	33.7	44.7	16.8
Reduced use of materials and energy (% of firms)	9.6	5.2	7.2
APPLICATION			
Employment in knowledge-intensive services (% of workforce)	14.5	16.4	11.3
Medium and high-tech manufacturing exports (% of total exports)	48.1	51.1	69.3
New-to-market sales (% of turnover)	8.6	10.8	7.8
New-to-firm sales (% of turnover)	6.3	4.8	2.7
Employment in medium-high and high-tech manufacturing (% of workforce)	6.7	7.0	8.8
INTELLECTUAL PROPERTY			
EPO patents per million population	105.7	267.6	7.8
Community trademarks per million population	124.6	137.3	26.0
Community designs per million population	121.8	116.8	18.3

Source: European Innovation Scoreboard 2008, Eurostat.

It is therefore understandable that in the order of development elaborated on the basis of the *composite index* of 32 countries Finland occupied the third place in 2008 – behind Switzerland and Sweden –, Hungary on the other hand only ranked 23. In the opinion of researchers, analysts and decision-makers of the user countries, the set of indicators serving as basis for establishing the order of countries concerning knowledge economy are applicable to describe the qualitative changes resulting from knowledge-based economy and to make an international comparison on the development of countries. This opinion is relevant, even if its power is reduced by those data collection deficiency that many indicator results are pertaining to the previous years. As a consequence, one of the tasks to be solved is to fully conform the indicators of the system to a given year.

This task can be solved by the common endeavour of Eurostat and the national statistical offices since the data provided by the latter form the basis for EIS. Therefore, and in order to improve the information system providing data essential for decision-making, it is reasonable to give a short overview on the main characteristics of preparing information.

The main resources for calculating indicators are the *activity of national statistical offices and independent information organizations* elaborating indicators. The activity of national statistical offices adequately complies with the international norms, but it is necessary that it focuses more on less concerned and new activity fields. For example, due to the inadequate cooperation of international companies in many countries it is difficult to calculate the Business R&D expenditures indicator or the calculation is inaccurate. The other important information resources, the independent information organizations do not receive appropriate support in most of the countries, therefore they operate with less intensity and the opinions and proposals of independent experts are missing from the information provision system.

Another important characteristic of the indicator systems is that acts, development strategies are important starting points for establishing indicators, but – according to the experiences – they do not adequately take into account *the needs of user groups* (state institutions, social and political stakeholders, business sector, researchers, media). Therefore, it is necessary to establish regular relationship between data providers and users when supervising indicators and defining new indicators. Otherwise, the current practice – that those, who are analyzing indicators and the researchers cannot contribute to the necessary extent to the definition of new indicators – will discontinue.

In connection with *the role of users* in developing indicators systems attention should also be given to the role of users in innovations processes and outputs, due to the fact that firms and consumers appears to be an important contributors to the success of innovation. One of its recent studies[7] distinguishing between: User Process Innovation, User Product Innovation and User Involvers has found that while a substantial minority of innovative forms in the EU are involved in process and product modification (around 30%), more than half such firms involve users in support of their innovative activities. Users' innovation is also more or less

[7] Stephen Flowers, Tanja Sinozic and Parimal Patel: Prevalence of User Innovation in the EU, Analysis based on the Innobarometer Surveys of 2007 and 2009. INNO-Metrics Thematic Paper. September 2009.

evenly spread across industrial sectors and across EU countries categorizes according to their innovative capabilities (Chart 5).

Chart 5 **Grouping of countries by overall innovative capability**

Country class	Countries
Innovation leaders	Sweden, Switzerland, Finland, Denmark, Germany, UK, Luxembourg
Innovation followers	Ireland, Austria, Netherlands, France, Belgium
Moderate innovators	Estonia, Norway, Czech Republic, Slovenia, Italy, Cyprus, Spain, Malta, Lithuania
Catching-up countries	Hungary, Greece, Slovakia, Poland, Portugal, Bulgaria, Latvia, Romania

Source: 2007 European Innovation Scoreboard (EIS)

A message from this analysis is that a higher proportion of user innovators carries out both intra extra R&D and applies for patents changing the needs for subsidies for R&D. This has some policy implications for the needed state supports which must be taken account when undertaking performance auditing.

For such an auditing it is a basic requirement that the indicators must make possible the assessment of the operations and results of government programmes, in the case of *GBAORD*[8] *indicators*, in particular. However, this requirement is hardly met, in Hungary at least. Consequently, the structure of R&D expenditures according to the economic policy objectives can not be compared with that of other EU- or OECD-member countries. So, Hungary is unable to meet its international commitments for data supply.

It also causes significant problems that *human resources* for defining and developing indicators are not available, there is no stability in this field. In order to move forward it is necessary to change this situation by the development of competency-based skills.

3.2. The case of information society

The field of societal indicators describing the processes of information society developing nowadays implies more problem than the indicators of knowledge-based economy. The definition of key indicators in this field – acknowledging the result of some countries – is in an early stage, even if we take into account that several indicators of knowledge-based economy can be considered also as societal indicators. From among the 30 EIS indicators 8 are societal indicators. These are the followings:

[8] Government budget appropriations or outlays on R&D — GBAORD.

- S&E and SSH graduates per 1000 population aged 20-29 (first stage of tertiary education);
- S&E and SSH doctorate graduates per 1000 population aged 25-34 (second stage of tertiary education);
- Population with tertiary education per 100 population aged 25-34;
- Participation in life-long learning per 100 population aged 25-64;
- Youth education attainment level;
- Employment in knowledge-intensive services (% of workforce);
- Employment in medium-high and high-tech manufacturing (% of workforce);
- Knowledge-intensive services exports (% total services exports).

To increase the number of societal indicators by selecting from among indicators of existing reservoirs or developing new ones the potentialities of *Community statistics on the information society* and the indicators systems used by *Finland* and Hungary have been studied. In the case of *Hungary*, a recently established system of *key indicators for measuring the social progress* should be mentioned as a source. The system, which was elaborated by the Central Statistical Office in a close cooperation with the Hungarian Academy of Science, under the aegis of the OECD's Global Project, consists of 66 primary indicators (See Annex 1) from among 2 are other the name of knowledge economy with 7 secondary indicators.

It is thus an important task of the project to promote – by utilizing the experiences of countries and international organizations – the determination and solution of methodological developments, which meet better the requirements for indicators of focus areas (subjects) covered by the framework of information society.

In the field of competent and learning individuals and work communities (Pillar 1) – besides indicators of knowledge-based economy – the application of the following indicators is recommended for the SAIs to describe processes and impacts.

1.1. % of persons employed with ICT users skills
1.2. % of persons employed with ICT specialist skills
1.3. Participation of life-long learning per 100 population aged 25-64 by regions
1.4. % share of enterprises organizing professional trainings
1.5. % share of employees participating in professional training
1.6. Developing the competence level of employees in SMEs
1.7. Directing more university research and knowledge at developing work process at workplaces
1.8. Close integration of the use of information and communication technology (ICT) in teaching with basic and further education for teachers
1.9. Developing and promoting the implementation of competence-based qualification and academic apprenticeship activities intended for information workers

1.10. Increasing the opportunities for people outside working life, particularly those at risk of becoming socially excluded, to complete studies and degrees related to ICT management

1.11. Promotion of mobile working and other mobile use by offering public transport passengers wireless broadband connections in various modes of transport, terminals and at stops

1.12. Total DSL coverage (as % of total population)

1.13. DSL coverage in rural areas (as % total population)

1.14. Broadband penetration (as % of population)

1.15. Speed – % of broadband subscriptions above 2 Mbps

1.16. % of households with an internet connection

1.17. % of households with a broadband connection

1.18. % of enterprises with a (fixed) broadband access

1.19. % of individuals using a mobile phone via UMTS (3G) to access the Internet

1.20. % of individuals using a laptop via wireless connection away from home/work to access the internet

In *the field of turning ideas into products and services, a new innovation system (Pillar 2)* the application of the following indicators might be suggested.

2.1. Using applications for integrating internal business processes (all enterprises)

2.2. Using applications for integrating internal business processes (large enterprises)

2.3. Using application for employees to access Human Resources services

2.4. Exchanging automatically business documents with customers/suppliers

2.5. Sending/receiving e-invoices

2.6. Sharing information electronically with customers/suppliers on Supply Chain Management

2.7. Using analytical Customers Relation Management

2.8. % enterprises selling online

2.9. % enterprises purchasing online

2.10. Growth in the relative share of public R&D financing directed at the reinforcement of business expertise and the productisation, spread, commercialization and internationalization of technology and service innovation

2.11. % share of financial support at small and innovative information society development projects in the micro-enterprise and third sectors

2.12. Number of guidance systems at institutes of higher education and of cooperations

2.13. Number of cooperation and innovation networks in secondary and vocational education and linking them to activities at centres of innovation and expertise

2.14. Number of electronic publication of research material produced by universities and of related operating models and open portals

2.15. Number of joint use of basic register information in public administration service production by reforming operating models and legislation

In *the field of making a human-centric and competitive service society (Pillar 3)* the introduction of the following indicators appears to be purposeful.

3.1. % basic public services for citizens fully available online
3.2. % basic public services for enterprises fully available online
3.3. % of population using e-government services
3.4. % of population using e-government services for returning filled in forms
3.5. % of enterprises using e-government services
3.6. % of enterprises using e-government services for returning filled in forms
3.7. Of which to submit a proposal in a public electronic tender system (e-procurement)
3.8. % population who are regular internet users (using the internet at least once a week)
3.9. % population who are frequent internet users (using the internet every day or almost every day)
3.10. Looking for information about goods and services
3.11. Ordering goods or services, over the Internet, for private use
3.12. Reading online newspapers/magazine
3.13. Selling goods and services (e.g. via auctions)
3.14. Internet banking
3.15. Downloading/listening to/watching music and/or films
3.16. Listening to the web radio/watching web TV
3.17. Seeking health information on injury, disease or nutrition
3.18. Looking for a job or sending a job application
3.19. Seeking information with the purpose of learning
3.20. % share of national digital library
3.21. % tax deduction for household services to cover support services for ICT
3.22. Number of electronic invoicing in the SME sector
3.23. % share of information flows between enterprises and authorities electric
3.24. % share of comprehensive digitalization of the real estate trading processes
3.25. % share of utilization of mobile and internet technology to arrange option polls for citizens/local people that will be used to support decision-making

Of course, the selection from among the indicators suggested above for auditing should be left to the discretion of the SAIs.

4. The main horizon of audit of key indicators

Audits performed by SAIs have not covered so far the development processes and achieved results in the field of knowledge economy and information society. Audits – e.g. in the European Union, Finland and Hungary – aimed only at narrower fields like the evaluation of R&D programmes. The experiences gained during auditing R&D serve currently as a starting

point for developing the audit culture of the wider scope of knowledge economy and information society.

R&D programmes are important audit fields because they, to a great extent, determine development and also, due to the large rate of state financing. Audits are generally characterized by *the perspective of accountability*, thus the evaluation aiming at finding out the results achieved by and the efficiency of the utilization of public funds.

In this respect it has to be noted that when evaluating R&D programmes learning perspectives are also important, which can contribute to increasing knowledge to be used in the future. Acknowledging the significance of the above it is to be stated that while auditing pays attention also to learning perspectives, it focuses on accountability and the principle of value for money.

4.1. Main experience of three audits

The *audit of the European Court of Auditors* covered the monitoring and evaluation arrangements of the Community RTD framework programmes (FPs) in place since 1995 for the last three programming periods (FP4, FP5, FP6) and also gives an outlook for FP7 (2007-2013). Through the FPs, the Community provides funding to researchers within the European Union, associated countries and international organizations. Their budgets have increased significantly over the years, reaching 7 217 million Euro per year under FP7 as against 2 761 million Euro under FP4.

The audit addressed the question of whether the Commission's approach to assessing the results of the FPs was adequate. In this context, the Court checked whether the Commission met the legal requirements for evaluation and ascertained whether its system for evaluation and monitoring met stakeholder expectations.

The Court's findings and conclusions[9] were as follows:

- the lack of an explicit intervention logic and the presence of poorly defined programme objectives and weak performance measurement undermined effective monitoring and evaluation;
- the absence of a comprehensive evaluation strategy, agreed among the 'research DGs' implementing the FPs, resulted in inconsistent approaches between the different Commission services. In particular, this is illustrated by an under-evaluation of significant parts of the FPs;
- evaluation of the FPs was decentralized, the existing coordination mechanisms among the DGs implementing the FPs were not effective and the Commission's central services had no enforcement role. In general terms, however, the 'research DGs' have complied with the Commission's formal requirements on evaluation.

[9] SPECIAL REPORT No 9/2007 concerning 'Evaluating the EU Research and Technological Development (RTD) framework programmes – could the Commission's approach be improved?' together with the Commission's replies, European Court of Auditors, Luxembourg, 2007.

- ❖ inadequate methodological guidance was provided, evaluators found difficulties in gathering relevant data and there were no evaluation studies that addressed the longer-term outcomes and impacts of the FPs, as opposed to short-term issues of programme implementation; and
- ❖ as a result of the above, and because the timing of evaluations was often premature for addressing the most relevant issues, the Commission's evaluation system for the FPs was of limited usefulness to policy-makers, stakeholders or even the Commission itself. Ultimately, little is known about the achievement of programme objectives and the results of the FPs.

The Court – among others – recommended that:

- intervention logic should be rendered explicit in future legislation. Underlying assumptions should be explained, the link between scientific and socio-economic objectives clarified and appropriate performance indicators developed;
- a comprehensive evaluation strategy should be developed by (and agreed among) the DGs implementing the FPs. In particular, this should entail a consistent approach with regard to the minimum level at which detailed evaluation must take place so as to take account of the specificities of each scientific field;
- consideration should be given to setting up a joint evaluation office for coordinating the 'research DGs' evaluation activities for the FP as a whole and creating a system of panels (and sub-panels) composed of external experts.
- the data requirements for evaluation and monitoring should be analyzed properly and more extensive use should be made of other existing sources of data.

Regarding *the audit practice of the National Audit Office of Finland*, it has focused on two issues[10]:

- ➢ R&D evaluations as a whole: how do the institutional preconditions and arrangement of the Finnish evaluation system of Government support the utilization of R&D evaluation on different levels and especially on the policy level?
- ➢ Single evaluation: how does the design (planning, organization, processing etc.) of R&D evaluation support the utilization of evaluation on different levels and especially on the policy level?

The main findings of a performance audit of 'R&D evaluation in Finland' finished in 2008 were, from the indicators point of view, the following:

- ♦ Accountability perspective of R&D evaluation in Finland has strengthened as the amount of e.g. impact evaluation of R&D has increased. New forms of reporting Parliament about the state, quality and result of R&D has been planned. However, there are still many cultural, institutional and practical barriers which weaken the link between R&D-evaluation and policy/politics.
    - The R&D evaluation culture in Finland, which includes and implies the accepted and legitimate forms of utilizing R&D evaluations, is dominated by development perspective and ethos.

[10] See Timo Oksanen: The Finnish R&D evaluation: Is there a real accountability perspective? National Audit Office of Finland, Helsinki, 2006.

- The information needs of decision-makers are not systemically met and analyzed.
- The output information of evaluations will not be aggregated and synthesized in reasonable ways and forms.
- The annual accountability procedures in the Parliament will not necessarily include all relevant R&D evaluation information.
- Instrumental use of R&D information in the annual budget procedure seems to be limited and insignificant, which is considered an important cultural and legitimizing factor beyond the R&D evaluations.

♦ Many kinds of cultural, attitude and practical factors (barriers or obstacles) will restrict the producing and applying of R&D information from the accountability perspective.

The *State Audit Office of Hungary* completed the comprehensive *audit of the Research and Technological Innovation Fund* (the Fund) in 2008.

The revenues of the Fund, as separated public funds increased from HUF 35,4 billion in 2004 to HUF 51,9 billion (about USD 260 million), in other words by half as big again. Its resources basically originated from the innovation affixes paid by economic companies. Their proportion has increased in the audited period from 45, 1% to 55, 3%. Another important resource of the Fund was the support received from the central budget, which increased from 34, 5% to 39, 6%.

Under the continuously changing supervisory management the Fund was first directed by the Minister of Economy and Transport until 1st May 2008 to be followed by the Minister without portfolio responsible for R+D in cooperation with the National Office for Research and Technology (Office).

The continuous changes and reorganizations in the management of the Office did not ensure adequately its rational and continuous operation. The monitoring strategy completed by the end of 2005 intended to implement a result-oriented support system; at the same time they did not create a system, which would have continuously tracked the risk management and the effective and efficient use of targeted resources, thus the Office did not accomplish the goals defined in the strategy.

In the course of the functioning of the tendering system the high number of programmes, the frequent and inadequately substantiated changes of the tender announcements made the support system hard to take in stock off. The goals of the programmes were usually general and they did not formulate clear result-, and effect indicators that would have had useful objective values to measure the results. The adequate functioning of the tendering system was set back by the fact that there was no system elaborated to filter the overlaps of the supports; certification of own contribution was not required and in lack of this the risk of the realization of the tender objectives thus raised. The censure of the tenders have been contradictory, lacked the assurance of its legality; the measuring of the public, economic-social effectiveness of public funds was lacking, just like the feedback of the results of the evaluation, while the comparison of the data of the various programmes and its most important characteristics was also missing.

Among its task the Fund also had to operate the National Research Register System (NRRS). The System serves as a database for Hungarian research projects, researchers and research institutes. When developing NRRS they took into consideration the recommendation of the European Commission, nevertheless there were shortcomings in the field of the practical implementation and utilization process.

Based on the findings of the audit report the SAO recommended the Government to discuss the yearly reports made about the utilization of the resources of the Fund; to initiate the release of the year-end residuals of the Fund as well as of the deregulation of the legal regulation and thus promote the simplification of the functioning of the Fund, in order to have a clear and unequivocal definition of the spheres of competences and responsibilities.

The SAO recommended the Minister without portfolio responsible for research and development to formulate the goals of the support programmes together with the professional organizations and attach to these goals indicators that have target values, which ensure accountability of the gained results and help the presentation of them. He should also have an evaluating system elaborated together with the necessary IT support and supervise the sanctioning orders of the support contracts. The Minister should also have a transparent and calculable financing and risk management system created together with decreasing the number of the support programmes and ensuring the stable operation of the remaining programmes.

4.2. Performance auditing and the system of key indicators

The three examples above demonstrate well that the audit on R&D programmes and, prospectively, on programmes of knowledge-based economy and society implies significant difficulties, due to the lack and deficiencies of evaluation indicators. Therefore, the definition, establishment and continuous development of key indicators are essential tasks.

The audit objects (those that might be subjected to performance audit by the SAI according to the mandate) can be described as policy, programmes, funds, organization and management. Form among these objects *the programmes and funds* offer themselves, in the most cases, as objects for performance auditing. With them the two main difficulties or bottlenecks might be identified as follows:

- lack of the audit criteria, and
- lack of the inadequate system of indicators.

As to *the audit criteria*, their lack is due to the absence of an explicit logical model and clearly spelled out programme and fund objectives, which has also impeded the development of performance indicators for monitoring the achievement of programme objectives in terms of outputs, outcomes and impacts, to the extent that, to date, such ‘effectiveness’ indicators have not been defined at all, or - if so - only in an inadequate way. In order to overcome these inherent difficulties and establish the basis for assessing long-term results, it is inevitable to use an explicit intervention logic in future programmes or fund designs, which would lead to more focussed and better structured programmes. Of course, it also needs a ‘better regulation’

policy aiming at a better designed, simpler, more effective and better-understood regulatory environment.

In the assessment of long-term results, it has to be recognized that certain types of analysis require a long-term perspective (e.g. the evaluation of outcomes and socio-economic impacts) and that some aspects are related to a specific programming period (e.g. programme objectives, even within a given scientific field), whereas others are not (see Chart 6). However, the auditors have not adopted an approach in their evaluation activities that takes these time horizons into consideration, so far.

Chart 6 **Monitoring and evaluation issues according to different time horizons**

Monitoring of programme implementation (on-going)	— Programme management issues (e.g. time-to-contract, time-to-payment, subscription and success rates, budgetary execution, funding rates, etc.)
Evaluation Short term (say, at the earliest after **1-2 years**)	— Programme management issues (e.g. efficiency of administrative procedures) — Programme design issues (e.g. accessibility and flexibility of instruments, barriers to participation, implications of non-success in calls for proposals, etc.) — Analysis of participation profile (mainly quantitative at this stage), Medium of evaluation
Evaluation Medium term (say, after **7 years**)	— Programme design issues (e.g. effectiveness of instruments) — Analysis of participation (combining qualitative and quantitative aspects, e.g. research networks analysis, impacts on the behaviour of researchers, etc.) — Analysis of project outputs (1) (e.g. publications, conference papers, patents, licences, prototypes, standards, trained scientists, etc.)
Evaluation Long term (say, after > **10 years**	— Assessment of outcomes and impacts

(1) It should be noted that grant agreements for projects are signed throughout the programming period, the first agreements generally coming into force at the end of the first year of a programme. The duration of these agreements is mostly three to five years. As a result, final outputs can be expected at the earliest after four to six years.
Source: European Court of Auditors.

As to *the lack of the inadequate system of indicators*, the assessment of programmes relies heavily on the availability of three kinds of data:

- data collected according to *effectiveness indicators*, the analysis of which provides information about the progress towards programme objectives. The lack of an intervention logic referring to the above means that it has been difficult to define such indicators. In practice, the data collected were of little relevance for measuring the achievement of programme objectives;
- data about *programme management* (according to efficiency indicators), and
- data about *participants* (such as the participation rates of major research organisations).

In particular, the latter two should be available at the EU Commission and the governments. However, e.g. due to problems with respect to *the Commission's internal IT systems*, which are the source of most of the data on programme management and participants[11], in practice, significant problems have been experienced in this regard..

As regards the effectiveness indicators, e.g. in the case of the large projects financed through tendering by *the Research and Technological Innovation Fund in Hungary,* the result-, and effect indicators were not formulated or, if so, not clearly. Consequently, it was not possible to assess the efficiency and effectiveness of the use of the Fund.

These or similar experiences suggest that *the three hypotheses of the pilot study appear to be verified*. Furthermore, they suggest that:

- *the SAIs should*, on the basis of principles of generic nature[12], *develop further their system of indicators* describing the processes of knowledge economy and information society *in considering the suggestions of the pilot study, as well for better auditing*;
- the *performance audits should*, in a 'knowledge-based' environment, *identify deficiencies in information systems needed to be corrected,* for supporting the further development of the knowledge economy in all countries and information society in the more developed ones, in particular.

[11] Whilst the Commission generally does have such information regarding participants, it often cannot easily be used for detailed analysis because data concerning a given participant is neither kept in a single place nor necessarily recorded in compatible formats. This makes it difficult to track the participant's involvement over time, for example to assess reasons for non-participation, and relations between participants, for example to study networking effects.

[12] See Rolf Elm-Larsen's report on Principles for SAI's application of KNI.

Annex 1. **'Measuring the Progress of Societies'**

Key indicators of measuring the progress of societies[13]

- 1. Economic indicators
  - 1.1. Level of development and growth
    - 1.1.1. Gross domestic product and income
    - 1.1.2. Trends in consumption and savings
    - 1.1.3. Trends in gross accumulation of fixed assets (investments)
    - 1.1.4. Level of development
  - 1.2. Efficiency, competitiveness and stability
    - 1.2.1. Productivity
    - 1.2.2. Balance and stability
    - 1.2.3. Trends in prices
    - 1.2.4. Demography and structure of enterprises
    - 1.2.5. Energy demand of the economy
  - 1.3. Knowledge-based economy
    - 1.3.1. Research, development, innovation
    - 1.3.2. Life-long learning
  - 1.4. Infrastructure
    - 1.4.1. Transportation infrastructure
    - 1.4.2. ICT infrastructure
    - 1.4.3. Public utility infrastructure
- 2. Social indicators
  - 2.1. Population, family
    - 2.1.1. Genuine, effective fertility/mortality
    - 2.1.2. Dependants' rates, ageing index
    - 2.1.3. Vital events
    - 2.1.4. Family composition
    - 2.1.5. Household composition
    - 2.1.6. Net migration rate
  - 2.2. Education
    - 2.2.1. Demographic indicators affecting education
    - 2.2.2. Investments in education
    - 2.2.3. Attendance of school-system education
    - 2.2.4. Individual, social outcome, efficiency of learning
    - 2.2.5. Conditions and circumstances of education
  - 2.3. Labour market
    - 2.3.1. Characteristics of the labour market
    - 2.3.2. Unemployment
    - 2.3.3. Equal chances in the labour market
    - 2.3.4. Inactivity in the age group of 15-64 years
    - 2.3.5. Income
  - 2.4. Situation of youth
    - 2.4.1. Employment of youth aged 15-29
    - 2.4.2. Unemployment of youth aged 15-29
    - 2.4.3. Youth poverty
  - 2.5. Situation of the elderly population
    - 2.5.1. Employment of the elderly aged 55–64

[13] Initial suggestion of the Hungarian Central Statistical Office. To be further discussed by the Hungarian Academy of Sciences.

        - 2.5.2. Unemployment of the elderly aged 55–64
        - 2.5.3. Poverty of the elderly population
    - 2.6. Financial situation, consumption, poverty
        - 2.6.1. Repartition of incomes, poverty
        - 2.6.2. Consumption structure of the households
        - 2.6.3. Disadvantages manifested in material consumption
    - 2.7. Housing
        - 2.7.1. Structure of housing
        - 2.7.2. Quality of housing
        - 2.7.3. Housing market
        - 2.7.4. Solvency
        - 2.7.5. Investments in housing
        - 2.7.6. Funding arrangements, state subsidies and taxation
        - 2.7.7. Social housing management
    - 2.8. Health
        - 2.8.1. Health status
        - 2.8.2. Factors determining health
        - 2.8.3. Medical interventions and services
    - 2.9. Social safety net
        - 2.9.1. Social allowances
        - 2.9.2. Family/Child support
        - 2.9.3. Social services for the sick and permanently disabled
        - 2.9.4. Pensions, social services for the elderly
    - 2.10. Culture, leisure time
        - 2.10.1. Cultural provision
        - 2.10.2. Cultural activity
        - 2.10.3. Cultural investment
        - 2.10.4. Travels of the population
    - 2.11. Public safety
        - 2.11.1. Crimes and delinquents
        - 2.11.2. Condemned and detained
- 3. Environmental indicators
    - 3.1. Climate change and energy
        - 3.1.1. Climate change
        - 3.1.2. Energy
    - 3.2. Natural resources
        - 3.2.1. Biodiversity
        - 3.2.2. Water reserves
        - 3.2.3. Land use
    - 3.3. Sustainable production
        - 3.3.1. Sustainable production, efficiency
        - 3.3.2. Emission of substances causing acidification and producing ozone