Annamária Inzelt – István Goldperger – Zsuzsanna Szunyogh

The information base of the science, technology and innovation policy

Decisions: on what basis?

The implementation of the European Research Area raises several new questions not only for Europe as a whole, but also for the shapers of the Hungarian science, technology and innovation (STI) policy. Policy-makers expect to receive assistance in answering these questions from the intelligent tools designed to support the development of the STI policy. The so called intelligent tools include technology forecasting, impact assessment studies, evaluations and indicators. A special feature of the indicators is that they exist not only as independent tools, but also as indispensable aids for the application of the other tools.

In our globalising world the international comparability of data and indicators is of key importance. This is supported by the existing international standards, and also by those that are being developed. Hungary, as an EU country that plays a role in scientific and innovation activities, has an interest in possessing a modern, high quality information system that also helps answer the questions raised by the new problems of development.[1]

The dynamically growing resource needs of social and economic development urge and force countries to lay the foundations of their respective governmental decision-making systems related to the knowledge based economy using high quality information (expenditure, performance and impact indicators) that responds to the challenges of our age.

In this article we attempt to determine to what extent the Hungarian STI information system meets the requirements for laying the foundations of strategy development in the fields of research, development and innovation, for the monitoring of the processes, for the evaluation of the STI policy, and to what extent it meets the international requirements. We present the existing and cost increasing parallelisms in certain data gathering practices, which can be eliminated by way of professional reconciliation. Furthermore, we describe how administrative data that are accumulating in the public administration system could be used in the information system. We outline the professional, institutional and legal conditions required for the operation of the information base of the knowledge based economy. All this is indispensable for the implementation of the R+D and innovation objectives of the National Development Plans and the tasks formulated therein. The review of the existing information system according to these aspects allows for the identification of several tasks to be completed. The completion of some tasks will bear fruit only in the long run, as it can be seen below, while the solution to some problems promise results

already in the shorter run. We formulate a few proposals in order to enable the system to meet the needs of the 21st century.

EXISTING FIGURES AND INDICATORS

Our starting point is the following: it is important for the shapers of the STI policy to base their decisions on facts, wherefore they are ready to contribute to the production and regular analysis of up-to-date and reliable indicators, and even for the development of new indicators that will foster finding the answers to questions that will crop up during development. As the report prepared by 4T said, "…a responsible modernisation policy committed to innovation will set up and run an institutional system that can foster governmental decision-making and implementation with appropriate 'reflection' skills. The shopwork (technological impact assessment, statistical data gathering and innovation in the fields of R+D and innovation, technology forecasting, commissioning of the system of institutional and programme evaluation) can be regarded as a token for proper political decisions."

The so called traditional research and development (R+D) basic data and the indicators derived therefrom have existed in Hungary for a long time for the purposes of meeting in part the above mentioned user needs.

THE HISTORICAL BACKGROUND OF THE TIME SERIES

R+D data gathering was first started in 1953 by the Scientific Higher Education Council, and was later performed by the Science Organisation Group of the Hungarian Academy of Sciences, and has been the task of the Hungarian Central Statistical Office (HCSO) since 1969. In the past decades the terms used in the *research and development surveys,* the questionnaires, the registers and the groups of collected information have also changed a lot. The data have become more detailed and refined, information has become available according to scientific fields, economic sectors, counties or regions. However, the information we have about the past half a century does not form a long, comparable time series. The economic reforms, the changes in the system and the related methodological changes disrupt the time series, and thus hinder the monitoring of temporal changes. On the other hand, the indicators based on responses to new questions or questionnaires introduced for the monitoring of new phenomena (e.g. the international mobility of researchers) lack any statistical background.

In relation to the temporal *comparability* of data and indicators, the biggest change – the modernisation of R+D data registration – occurred before Hungary's transition to democracy, in 1988, when the HCSO adopted the UNESCO methodology, and abandoned the COMECOM requirements it had previously followed, which interpreted the concept of research and development very broadly, i.e. development included all sorts of development, and not only experimental development. As a result of this methodological change, statistics and accounting came closer to each other, which is important for improving the reliability level of the data. Prior to 1988, R+D surveys that were based on the system of the COMECOM countries (an accounting system developed within the framework of the system of economic cooperation among socialist countries, which also included development investment projects) regularly yielded higher R+D figures than those that would have been yielded by the methods already used by UNESCO. Due to the adaptation of the UNESCO methodology in 1988, at the time of the political turnaround Hungarian statistics had a data series that was more modern than those used

by the other former socialist countries. This data series was closer to the OECD standards followed by the market economies, it could be more easily compared with the time series of OECD countries, but its methodology still differed from the methods used in the developed economies and summarised in the Frascati Manual. (OECD, 2002)

Since the political turnaround, the governmental structure, the mediating institutions, the Hungarian scientific life, the method of technological development and the system of innovation have all changed. New players have emerged, while the old ones have either ceased to exist or merged. Similarly to the STI system, the overall Hungarian statistical system has changed a lot too, it has become more modern. Using the opportunities that opened up after the transition, the review of the statistical system and the adoption of the OECD standards[2] began in the early 1990s, in the course of which not only the R+D questionnaires and measurement methods were renewed, but also the classification systems were modernised. (Hüttl, Inzelt and Varga, 1997) The classification systems that are widely used in economic and social statistics and are being adopted by Hungary on a continuous basis are also utilised by the STI statistics. These include the *International Standard Classification of Education* (ISCED), *the International Standard Classification of Occupations* (ISCO) the *Standard Industrial Classification of Economic Activities* (ISIC. Rev. 3, EU version: NACE), or the classification by scientific fields by the UNESCO and later the OECD.[3]

In addition to the R+D questionnaires, the HCSO also revised – with regard to the OECD recommendations – its methods it had used for the collection of *information and telecommunication data*, and started to work out new and modern indicators.

After around ten years of development and adaptation, the HCSO established its *innovation data gathering* practice harmonised with those of the member states of the European Union, and conducted the fifth such survey in 2007. These surveys are based on the methodology summarised in the OECD's Oslo Manual, and allow us to see the ratio of innovative enterprises, the frequency of innovation and the actions performed for the implementation of such innovations. (OECD, 2005) The Hungarian surveys conducted so far could cover a smaller segment of respondents than the surveys carried out in developed EU countries.

The study that reviewed the availability of traditional, internationally comparable STI data and indicators[4] in Hungary concluded that the Hungarian statistical services possess comparable, more than one decade long time series of several data and indicators. (Inzelt et al., 2005)

The International Statistical Service complies with all international data supply obligations prescribed by law[5], and issues its publications on R+D and innovative activities with increasing information year after year. While acknowledging this non-negligible performance we must point out that important information required for policy making are missing from the Hungarian information system. The next section deals with these shortcomings.

THE NEED FOR FACTS

When examining the missing information it is worth distinguishing two large groups of the STI indicators:

1. Classic indicators that are called inputs and outputs for the sake of simplicity, contained in the Frascati Manuals.
2. The new, "positioning" indicators.

In these two groups different problems arise when we examine the reasons behind the lack of data and indicators, and the possible elimination of these shortcomings.

From among the methodologically mature, classic indicators of the STI statistics – as it is

indicated in *Table 1* – a few basic and partial indicators are missing. When looking at the deficiencies in input indicators we find that indicators pertaining to the *funding of R+D activities* are missing.[6]

◗ The classification of public finance resources allocated for research and development according to social and economic objectives is still in its infancy, and the exact accounting of costs by functions is problematic in general.

◗ Programme financing indicators that do not pose any methodological challenge, but can be regarded as new for data communication are seldom available.

◗ The handling of the R+D expenses of higher education also needs revision, because data supply on the R+D expenses of higher education is currently based on estimates influenced by interests, too, instead of controllable financial and accounting figures.

◗ The more accurate assessment of the financial resources of R+D expenditure also requires that funds from enterprises and state resources should be registered separately within foreign resources.[7]

The majority of classic indictors on *R+D and innovation related human resource expenditures* are accessible. However, new information, the examination of which is given growing attention by the developed countries in the competition for highly qualified human resources, is missing. The pilot surveys and feasibility studies of research workshops that are also funded by the EU highlight the importance of measuring this phenomenon. Such indicators include:

- intersectoral mobility of people employed in the STI field,
- relationship between the new technology and job creation,
- data on brain drain, brain gain, international circulation of brains,
- the rate of knowledge utilisation and "squandering",
- participation of working age people in education and further training. (This figure can be accessed for Hungary as partial data within various sources, however it is not available as a comprehensive figure.),
- number of people within the companies that pursue graduate studies in science or technology.

In the statistics of scientific human resources *figures on the career path of PhD holders* are gaining importance. Surveys have been conducted in several EU member states in this topic. Currently pilot surveys are being carried out by the OECD in cooperation with UNESCO and EUROSTAT. In Hungary the related work is in the preparatory phase.

As far as the *output indicators* are concerned, it is a characteristic feature of accessible information that the available time series are shorter than in the case of expenditure indicators. It also often happens that the output indicator, if it is accessible at all, only reflects the momentary situation.

◗ One of the important groups of indicators regarding the effectiveness of the R+D activities includes the publication performance of scientific fields and institutions. Publication performance based on high impact factor journals and the citation indices could be measured by the extension of the purchased part of the Web of Science software, or by international cooperation implemented for regular target evaluation. The indicators pertaining to Hungary could be established and analysed based on the purchase of international data sources or international cooperation.[8]

◗ *The patent indicators* of the Hungarian patenting activities are available. No indicators exist on patent citation. The international patent data stocks (EPO, USPTO, TRIÁD) are suitable for the measurement of scientific performance manifesting in the invention activity and the preliminary assessment of innovations. It is up to politics whether it gives priority to

these indicators, or it finds the available, regular and ad hoc additional information sufficient.

A classic indicator is missing or missing in part from the group of *technological indicators.*

◗ The *technological balance of payment,* which would be suitable for defining Hungary's status against the international environment, is still non-existent, because the data in the National Bank of Hungary and the trade statistics are not detailed enough for the production of this indicator, although the development of a suitable data stock has been under way since the second half of the 1990s.[9]

In addition to the input and output indicators, indicators pertaining to *impacts and cooperation,* knowledge and technology development are gaining importance.

◗ Although Hungarian statistics has no long time series, it possesses the basic indicators of innovation. The *rate of innovative enterprises* among enterprises run through foreign capital investment can only be roughly estimated. Data quality is considerably improving after the survey has been made mandatory and the respondents' routine has been developed. Until now data broken down by the regions were not available, but in order to meet the information demand that is perceptibly getting stronger both on international and domestic level, innovation data for 2006 will be producible in a regional breakdown, too.

◗ Depending on the analysed *correlation, cooperation, results and knowledge propagation* may also have indicators:

- number of spin-off enterprises in close relationship with the research institutions and the universities,
- revenues of research institutions and universities from licences,
- research agreements between the research institutions and corporations,
- research and development activities are internationalising due to the increasing number and importance of multinational companies. Similarly to other countries, Hungary has no accurate information *on the R+D data of the foreign subsidiaries of Hungarian enterprises,* or about the *R+D activities of foreign companies performed in Hungary.* The publication, which also contains the OECD methodology, provides a proper basis for the measurement of the internationalisation of R+D. (OECD, 2002) The collection of the necessary information requires not only the survey of R+D activities, but also cooperation with the national banks and national accounts. The Hungarian R+D statistics currently groups enterprises according to owners only (mostly nationally owned, mostly foreign-owned, mostly state-owned, mostly local government owned),
- in addition to, or occasionally instead of categorisation based on the major field of activity, the introduction of *the categorisation of enterprises according to product area* is also on the agenda. Detailed analyses can less and less frequently be prepared without knowing in which sector of the national economy the enterprises' research activities are utilised. This means that we would need a categorisation that focuses on the field of utilisation instead of the field of production. In the classic R+D statistics, research and development expenditures are accounted according to the TEÁOR (NACE) categorisation based on the main activity of the research place. For years, the OECD has also been collecting data that classify enterprises according to the type of product, and it also monitors *in which product field the research performed by the companies is utilised.* On the basis of such information we could provide information on the market of the R+D activity and innovations

based thereon. Hungary has so far broken down sector No. 73 in this manner, but has no such information in the other sectors. However, preparations have been started to allow for the categorisation of the R+D expenditures of the other sectors according to product type, too. Pilot data gathering is expected to start in 2008.

Professional work carried out in the international statistical organisations shows *further need for information,* for which the Hungarian statistical services must prepare.

◗ Data are available neither about the R+D activities of the foreign subsidiaries of Hungarian enterprises, nor about the R+D activities of foreign enterprises outsourced to Hungary.

◗ The management of immaterial assets produced by R+D activities has not been solved within the System of National Accounts.

Immaterial assets (intellectual capital) produced by R+D activities are not identical with the R+D expenditures, they require separate evaluation, which must be performed in conjunction with the revision of the System of National Accounts.

The need for information pertaining to the new, so called *"positioning"* indicators is known, but there is no established indicator that would show

- how efficiently foreign investors contribute to knowledge creation and knowledge propagation in the host country,
- whether research performed by Hungarian companies abroad fosters the exploitation of the international knowledge stocks,
- the volume, durability and efficiency of *international research joint ventures,*
- the nature and extent of the third mission (economic and social ties) of the universities, as well as its impact on education and basic research.

The industry has been considerably restructured all over the world. The adaptability, as well as the efficiency and flexibility of the companies have improved on international level, which has contributed to their competitiveness. The global innovation strategy of the companies has become stronger in the past ten years. Research and development, as well as the internationalisation of marketing and sales activities came into the spotlight during the restructuring of their operation. In connection with the internationalisation of R+D we can differentiate three major types:

- *foreign direct capital investment,* through which foreign enterprises also invest in the national knowledge capital;
- *fusions and acquisitions,* which companies apply in order to gain access to the R+D resources and expertise of other companies;
- *international research joint ventures,* which allow the cooperating companies to unite their resources in the field of R+D, but remain independent in the other fields of business.

Within the field of *foreign direct capital investments* the OECD differentiates several forms of the internationalisation of R+D, namely:

- establishment (or re-establishment) of R+D laboratories;
- foreign acquisition of R+D laboratories;
- outsourcing R+D to a foreign subcontractor,
- R+D as the provision of business services.

Indicators of the volume of foreign contributions to domestic investments into knowledge:

- *size and dynamics of foreign R+D expenditures* in the country,
- the ratio of R+D expenditures of foreign enterprises to all *R+D expenditures,* and to the increment in R+D expenditures.

In addition to the input and output indicators the indicators of impact, cooperation, knowledge and technology dissemination/propagation are gaining importance.

NEED FOR COOPERATION FOR BETTER INFORMATION

We can orient ourselves in the operation and performance of the innovation system by linking several branches of statistics, STI and economic statistics, as well as STI and education and human resource statistics. The relationship between R+D statistics and economic statistics implies problems due to their different logical structure and development history, among other things. For decades, analysts showed no interest in this relationship and information that could be exploited through it.

It is not merely a domestic problem that the methodology for the inclusion of *R+D expenditures in the System of National Accounts* does not exist yet. Experts find this important, and have been experimenting with the balance based accounting of R+D expenditures for years. According to the standpoint that has emerged as a result of international work, all or part of the R+D outputs should be treated as assets having an estimated market value, and the Frascati definitions should be used at the National Accounts, too. International workgroups are working on the development of exact methodological guidelines, which the HCSO is continuously monitoring in preparation for the solution of the task.[10]

R+D, demographic and labour market statistics

The measurement *of the mobility and migration of researchers and developers* is the common area of R+D, demographic, migration and labour market statistics. The analysis of the mobility of researchers has been an area of research in human resource statistics, but it lacks any organisational framework. Surveys are carried out at different places, independent of each other, for different purposes, in part upon Hungarian, and in part upon international initiatives. (The HCSO does not collect data on the mobility of researchers.) Certain indicators can be produced from the data of human resource surveys and the census. For example, it can be determined from the census data what percentage of the population has a higher education degree in natural sciences, technology (natural sciences, engineering sciences, medical sciences and agricultural sciences, ISCED 5, 6). The human resource survey also shows how many people in the scientific and technological employment category have such a degree.

The number and ratio of higher education degree holders can also be investigated *among the unemployed.*

Despite continuous restructuring and development, the implementation of R+D data gathering has *three neuralgic points.*

❶ There is no comprehensive register about enterprises engaged in R+D activities.[11]

❷ Due to the interdisciplinary nature of STI statistics, there is a need for broad cooperation among the different fields of special statistics, as well as among the experts of the statistical services and the new, quickly developing fields of science (e.g.: biotechnology, nanotechnology). However, this cooperation is not satisfactory, its development is slow.

❸ The usability of data collected in the different institutions of public administration for statistical purposes is limited due to regulatory problems and institutional independence.

WHAT COULD WE LEARN FROM THE LARGEST FUNDER OF STI, I.E. FROM PUBLIC FINANCES?

The largest potential data sources for STI statistics are the statements of public finances and its subsystems, as well as the tax returns.

It is worth examining the research and devel-

opment expenditures of the country from two approaches:

- according to users (entities engaged in R+D activities) and
- according to funders (entities funding R+D activities).

With the help of statistical R+D surveys we can form a picture about *entities engaged in R+D activities* (enterprises, universities, research institutes), including, among other, the funding sources of R+D expenditures, including the share of public finance funds.

From the other, f*unding approach*, the statements containing the decisions of fund owners reveal how much funds the different owners earmarked for R+D objectives in their plans (public finance), and how much money they actually spent on funding (all fund owners).

In countries in which data can be gathered from both sources, some difference can always be found between the consolidated data obtained from the users and funders. If this difference is too big, it may refer to the shortcomings of accounting, but it may also indicate that there are operational disturbances in the national innovation system, and only part of the funding resources are actually delivered to those engaged in R+D activities. This latter explains why the information must be examined from two approaches.

In Hungary information from funders, including one of the largest fund owners, i.e. the state is fragmented, although in the past decade nearly two thirds of R+D activities have been funded by the state through public finances. The R+D expenditures of public finances can be identified in the state budget on the basis of R+D appropriations. Currently, the legal appropriations of the state budget are not classified functionally, wherefore the different items of R+D expenditures cannot be unanimously identified according to functions.

There are significant differences between the *R+D appropriations of Hungarian public finances,* and the statistical data obtained from entities engaged in R+D activities and the statistics on R+D expenditures supplementing the latter with data from a few public finance subsystems.[12]

The reasons behind the differences in R+D funding data obtained from different sources

- In the functional classification of the budget the expenditures are categorised according to function until the breakdown of the legal title number (for the time being only for background calculations). Within legal titles that are not classified as R+D functions, expenditures actually planned to be spent or spent on R+D purposes could only be gathered from the financial management data of the chapters. However, the ministries do not produce databases for this purpose, i.e. the expenditure data are not processed according to their actual functional content. Thus, for instance, most ministries have no information on R+D expenditures planned to be spent or spent during the implementation of field management tasks, as well as the foundation thereof from the aspect of research and development.
- The major item in the discrepancy between the state budget and R+D statistics is R+D expenditure accounted as educational functional appropriation in higher education R+D statistics.
- The budget documents do not reveal what data actually pertain to the R+D function, and what data pertain to other functions in the appropriations of institutions or groups of institutions that are fully or partially engaged in research.
- For the lack of appropriations divided according to detailed functions one can only estimate what portion of R+D expenditures presented in the central budget serves the pur-

poses of institution financing, and what portion is used for financing actual R+D tasks. Within the larger items, the support appropriation of the Hungarian Scientific Research Fund (OTKA), as well as the budget subsidy to the Research and Technology Innovation Fund are obviously used for task financing. The fund itself – being a separate state monetary fund, a subsystem of public finances – is designed to be used in full for task financing, save for the portion that is re-allocated to Hungary's National Office for Research and Technology pursuant to an amendment of law.

The methodological problems of the public finance system from the viewpoint of the preparation of STI decisions

◗ The problem of comparability is that in budgeting the functional classification and identification of appropriations appear differently in the different years. Therefore, it is difficult to judge whether it is the support objectives that have changed, or only their place and method of registration. The balance of the central budget was first published in a functional structure in the annex to the budget act for year 2000, and this type of structuring was used until the budget act for 2003 inclusive. In these years the function codes assigned to the different legal titles were also indicated next to the budgetary appropriations. Since 2004, the functionally structured balance has been included *in the annex to the explanation of the act,* and not in the annex to the budget act.[13] Since that year not even the functional codes have been indicated next to the appropriations. (For more details see: Báger, Goldperger and Varga, 2005)

◗ Functional classification has become obsolete: within the main function 'state operational functions' the consolidated R+D appropriations appear within the functional group titled 'general community services' in the following grouping:

- F01. d Basic research
- F01. e Technological development

The methodological problem of presenting the R+D appropriations in the state budget is that the functional classification referred to above is inaccurate both in economic and science policy terms. It does not contain the category of *applied research,* however it uses the inappropriately defined concept of *technological development.*

Almost all R+D appropriations of the central budget are listed under F01.d Basic research, while at least 40% of the topics researched at research places funded from the budget is considered as applied rather than basic research.

The function group F01. e Technological development is listed in the original UN methodology under the title *experimental research,* which corresponds to the category of "experimental development" as defined in the Frascati Manual in the international practice, including the Hungarian statistics. The function "technological development" is not an inaccurate translation, but the survival of the definition used (with a different content) until the adaptation of the above mentioned UNESCO methodology to the practice of Hungarian statistics. Especially because of the change in content, the use of the definition 'technological development' is unnecessary and confusing in the functional classification of the state budget.

Functional classification was introduced in Hungarian budgeting in 2000, it is based on the methodology of international organisations issued 20 years ago, and does not take into account changes that occurred at the turn of the millennium.[14] The UN, in cooperation with the OECD, issued a new COFOG recommendation (Classification of the Functions of the Government) in 2000 for the *classifica-*

tion of government objectives.[15] The new recommendation is less deeply structured, wherefore it contains more easily applicable classification. According to the content of the definition, general community services include *basic research, applied research and experimental development, too.* It regards applied research and experimental development as a coherent functional class, and as such it defines it both as general community services and specific R+D activities serving the objectives of the individual divisions.

In each R+D functional class consistently two parallel activities, and related cash flows are defined. One legal title covers the management and operation of government agencies performing R+D activities (according to its content this would be the governmental overheads of the R+D activities), while the other legal title covers donations, credits and supports to non governmental organisations (such as research institutions and universities) for R+D activities.

The problem of the classification of R+D activities funded from public finances could be solved if the functional categorisation of expenditures and the presentation thereof would receive greater attention in state budgeting, according to the new international methodology in force. The thorough development and clear presentation of the functional classification of the state budget for the legislation and the citizens is not a secondary technical issue, but a basic requirement of democracy. In relation to the state budget it is not important for the society how much money is allocated for the different ministries or budgetary organisations. Rather, it wants to see community resources allocated to cover social needs represented by the governmental functions, and how such resources are utilised.

◗ There is no policy reconciliation about the assignment of the budgetary appropriations to the different function codes, or about the account thereof under the different function codes. Instead, it reflects the opinion of a small group of civil servants responsible for budgeting.

◗ *The classification of governmental R+D expenditures according to social and economic objectives* has not been established yet. The difficulties pertaining to the accessibility of public finance funds that really serve research and development objectives indicate that within the government there is no policy coordination regarding the objectives and directions of research and development, although this is also required by an EU decision.[16] Based on the decision of the Council of Europe, Hungary should have supplied such data since 2004, i.e. since Hungary's accession to the EU. However, for the lack of relevant financial registration and data supply this was not possible, wherefore Hungary requested derogation from compliance with this requirement for 2004. In the meantime the first attempt was made to collect GBARORD data for 2005. Despite this fact we still cannot call this system an established one.[17] According to the established international practice, it is the finance ministries' task to produce national economy-level data on governmental R+D expenditures (GBAORD) and the breakdown thereof according to the 13 agreed social and economic objectives. Such data would also be supplied by the Finance Ministry based on information about the chapters and separate state monetary funds. In addition to the EU requirement, it is a fundamental interest of Hungary to know ex *ante* and ex *post* how much money the budget earmarks for different social and economic objectives that serve R+D expenditures spent on or allocated to the development of environmental protection, healthcare, agriculture and national defence. In brief, functional classification showing the real proportions of governmental R+D expenditures is also important for the domestic decision-makers and for the provision of information to the society.

R+D information obtainable from the data of the tax authority

The tax system plays a major role in the encouragement of R+D and innovation activities. Tax allowances embody a special form of public funding, when the society gives up part of its revenues for the realisation of a certain objective. The significance of the tax allowance encouraging R+D activities is indicated by the fact that in former years the actual amount of tax saving that companies could reach based on the regulation totalled a few billions of forints. As a result of the extended discounts, tax savings in 2004 almost quadrupled compared to the previous year, and reached HUF 19 billion.[18] There is no regular data supply on the value of the tax impact of the allowance.

It is not known on a regular basis in what economic sector and to what extent this amount can be found, and nor is it known what R+D activities it fosters, and to what extent it assists small and large companies. However, by the targeted processing of the data stock accumulated in APEH's (Hungarian Tax and Financial Control Administration) database and the data stock collected for tax registration (data accumulating for the STI statistics), information can be obtained about the research and development activities of enterprises and the accounted costs thereof. This information serves the purposes of economic analysis, it may provide information on the rate of support provided by tax policy tools, as well as the restructuring impacts thereof, and may be compared with statistical data while keeping differences in mind, which contributes to the enhancement of the quality of data stock in both databases.

The following R+D information can be obtained from the *database of APEH.*

◗ In pursuance of Item t of Section 7 (1), as well as Sections 7 (17) and (18) of Act LXXXI of 1996 on corporate tax and dividend

- number of enterprises accounting tax base reduction,
- amount of direct R+D costs reducing pre-tax profits broken down by sectors, size categories and ownership categories.

◗ Pursuant to Item t of Section 7 (1) of the cited act (tax base reduction by 100% of the direct costs of research and development), and pursuant to Section 7 (17), it is possible to show separately the 300% tax base reduction effected by enterprises operating on the territory of higher education institutions and academic research places.

From the data of medium-size and large enterprises that *file contribution returns Pursuant to Act XC of 2003 on the Research and Technology Innovation Fund* one can obtain information on:

- the gross contribution payment obligation of this group of companies,
- the amount of items that reduce this obligation (direct costs of research and development performed within the organisation),
- the costs of research and development activities ordered from budgetary and public benefit research places, and
- the amount of actually paid net contributions broken down by sectors, size categories and ownership categories.

There is no regular, public data supply about the results of the analysis of contribution payment.

By utilising this database for statistical purposes, the domestic STI information system could be significantly improved without putting another burden on data suppliers.

CONCLUSION

Based on the brief and not all-inclusive review of the STI information system, this article is designed to draw attention to a few problems

of the Hungarian system that can be solved in the relatively short run.

Since the publication of the study that served as a basis for this article, decisions have been made for the solution of two priority problems. One of the decisions affect the establishment of an up-to-date register of all organisations engaged in R+D activities (enterprises, divisions of higher education institutions involved in R+D activities, as well as non-profit organisations), which has been a long-standing shortcoming and has deteriorated the quality of information. The other decision affects the conditions for the broader utilisation of information. The latter may also contribute to quality improvement and the development of indicators, if the individual or micro aggregated data become accessible for a broader range of researchers and analysts. Therefore, it is important to *examine what measures could be used to foster the broader utilisation of the data (including individual data, too) for analyses, in compliance with the act on data protection. The implementation of these decisions also requires the availability of the necessary funds.*

In relation to STI, public administration is occasionally engaged in parallel information gathering. The elimination of parallelisms may free up resources to fund the collection of currently missing data, and at the same time it meets the various data requirements of the public administration subsystems.

For the production of science and technology indicators, another cost efficient data source can be the utilisation of data generated (accumulated) in the different public administration subsystems. By processing these raw data one may obtain indicators producible without any data recording. This is why it is important that information accumulating at the various public administration organisations should be transferred to the HCSO (and/or the observatory) on a mandatory basis once a year, in a format suitable for statistical processes by a given deadline. [All institutions disbursing budgetary funds for the purposes of R+D shall be mandated to report the beneficiaries' names (except for natural persons) to the HCSO annually, indicating the legal title next to the amount paid to them.]

The improvement of the quality and reliability of data and indicators ranks high on the task list of the profession. For this purpose *the data supply discipline must also be strengthened by means of administrative tools.* In addition, professional causes that reduce the reliability of STI data and indicators have to be eliminated. The maintenance and expansion of the special knowledge of data producers and users also need to be solved, which can considerably contribute to the operation of the information system enhancing the work of the decision-makers, and to the provision of information to the general public at a higher standard. This could be implemented by incorporating the user level knowledge of STI indicators into the exam requirements of certain jobs (civil servants, economic and scientific journalists) and training programmes (courses of professional associations, master and PhD courses). It is equally important to invest in the research of this topic in Hungary, and to actively participate in international organisations. It is indispensable to reconsider the information provision activity in relation to the data with the involvement of the media.

We believe that several questions of development concern not only the affected public administration players, but also the broader professional public. Therefore, we believe that the appropriate form of participation must be found. *A platform for STI indicators can be established.* Within this framework one could also discuss ideas pertaining to the model of the production of GBAORD data. We could devise a system that would not put extra burdens on data suppliers, but would yield a considerable amount of additional information for

policy makers. *Within the framework of public finance planning and reporting the consistent application of the modern classification system of governmental functions, and the continuation of the first steps taken for the accounting of research and development funds according to social and economic objectives are necessary to make the priorities of the science and technology policy of the national economy known.*

We find it important to reconsider the current structure in order to enhance the quality of the STI information system, which involves multiple actors, yet implies deficiencies. There can be several solutions; in the international practice one successful model is represented by the STI monitoring stations (observatories). It is reasonable to have a study prepared about the feasibility of the different solutions in Hungary, and decide about implementation at governmental or parliamentary level.

Within the platform, the different opinions can be discussed with a view to defining the development priorities. The operation of the platform itself may significantly improve information generation in harmony with the users' needs.

This article did not deal with the issues of new indicators that are in the experimental stage at international level, too (e.g. the impact of the international mobility of people employed in science or nanotechnology on the flow of knowledge, or the impact of globalisation on changes in the structure of R+D and innovation activities). We did not touch upon the question how Hungary could use the valuable data stock that can be reached through the observatory system of the European Research Area. All these questions may form the topic of further research, articles and the proposed platform.

NOTES

[1] This article is based on a study prepared for the Science and Technology Policy, and Competitiveness Advisory Board (4T). The authors would like to thank dr. György Varga, the coordinator of the subject on behalf of 4T, Pál Tamás and Tibor Vámos opponents, as well as László Somlyódi for their valuable comments on the study. A special thank goes to the contributors to the debate organised at Pénzügykutató Zrt. (Financial Research Plc.) and the Budapest University of Technology and Economics for their remarks that inspired the writing of this article.

[2] Hungary became a full member of the OECD in 1996, and that of the European Union in 2004. Both events played an important role in the changes that occurred to the Science and Technology System and its information system, too.

[3] The modernisation of the OECD's classification system according to scientific fields is under way in accordance with the development of science and the emergence of new scientific fields (e.g.: biotechnology, nanotechnology).

[4] Indicators that are based on methodologies that have been internationally harmonised and adopted by the OECD member states are called Frascati-type indicators, since their methodological description can be found in reference books forming part of the Frascati Manuals. (OECD, 2002, page 16)

[5] Commission Regulation No. 753/2004/EC (22 April 2004) implementing Decision No. 608/2003/EC of the European Parliament and of the Council as regards statistics on science and technology, Commission Regulation No. 1450/2004/EC (13 August 2004) implementing Decision No. 1608/2004/EC of the European Parliament and of the Council concerning the production and development of Community statistics on innovation

[6] A majority of data that are missing from this group should come from the system of public finances, wherefore data that are related to R+D and innovation funding from public funds, and are hidden in the system of public finances, as well as the producibility for statistical purposes are discussed separately in the next section.

[7] In data acquisitions carried out so far international resources were treated as a homogeneous group. The HCSO modified the questionnaires in 2006, and since then foreign resources have been broken down, wherefore this information will be available in the years to come.

[8] The most renowned journal in scientometrics (Scientometrics) is issued in Hungary. In a country that has excellent professional competence in the production of indicators it would be important to produce a more informative version of the current narrow indicators for the measurement of scientific performance.

[9] In addition to the narrow measurement of the technological balance of payment some countries are paying attention to the measurement of "intellectual capital". This group of indicators provides a comprehensive picture not only on the macroeconomic information, but also on the micro-sector, including the intellectual capital of the universities.

[10] Adaptation would naturally be easier if international efforts were not only monitored, but either the HCSO or Hungarian researchers were actively involved in them.

[11] The long-standing problem of the missing register, which adversely affects the quality of statistics, has moved towards a solution, in part due to the study prepared for 4T. Section 14 of the action plan published as the annex to the medium term science, technology and innovation policy strategy approved by Government Decree 1023/2007. (IV. 5.) stipulates the further development of the system of R+D and innovation statistics, including the establishment and maintenance of a comprehensive register on organisations engaged in R+D activities.

[12] The comparison of the R+D statistics for 2004 and the final accounts (the annex of the general explanation of the bill) shows that R+D functional expenditures in the budget accounted for less than 85% of state R+D resources. In former years the difference was considerably larger.

[13] Functional tables that can be found in the annexes to the general explanation of the act:
- The functional balance sheet of the central budget (cash-based approach)
- The consolidated functional balance sheet of the central budget (cash-based approach)
- Central budgetary appropriations broken down by functions
- The functional balance sheet of public finances (cash-based approach)
- The consolidated functional balance sheet of public finances (cash-based approach)

[14] Classification of the Functions of the Government (COFOG). United Nations, Statistical Papers, Series M, No. 70 (New York 1980)

[15] Classification of Expenditure According to Purpose. United Nations, Department of Economic and Social Affairs, Statistics Division, Statistical Papers, Series M, No. 84 (New York, 2000)

[16] Decision No. 1608/2003/EC of the European Parliament and of the Council as regards statistics on science and technology. Within the statistical data supply obligation to be met by certain deadlines and on a regular basis by the member states this decision also separately names the budget appropriations earmarked for research and development activities (GBAORD).

[17] The Finance Ministry prepared a proposal in 2006, which indicates the intention to perform the task. If the ideas described in the proposal come true, plenty of items will disappear from the list of information shortcomings. In February 2006, the Ministry of Finance initiated the collection of information from the data suppliers regarding R+D expenditures spent from the central budget and the separate monetary state funds in 2005, as well as the classification of said information according to social and economic objectives.

[18] Report for the Science and Technology Policy Council (TTPK) on the research, development and innovation appropriations of the state budget for 2006. Ministry of Finance, 2006

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