RESEARCH REPORT

Transition in Central-European RTDI systems
RECORD (Recognising Central and Eastern European Centres of RTD) project, EC STRATA support scheme

by

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Methods and goals of the project

Observations of statistics, measuring the use of knowledge in the European Union, reflect a significant back lag compared to the USA and Japan even though science, research and PhD are of global standards. This phenomenon became known as "European Paradox" in *EC* [1995]. In Central and Eastern

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Europe this paradox – as proven by several research projects[3] – is even more radically present than in the EU. The "Soviet" traditions[4] of segregation of the research sector and of the real economy are still present today and have dramatic impacts. While there are really significant publications in several scientific fields, and in some cases even better than before the transformation (or in some EU member states), these hardly affect the economies. Though the technological level of products and services is less than desirable in numerous fields (sectors and companies), the utilization of national R&D results is also weak compared to the EU. The radical decrease in the number of patents – which was low even before the transformation – has not stopped yet (see figure 1).[5] The fundamental cause of this phenomenon is the slow knowledge flow, the moderate diffusion of innovation and the weakness of relations between "science" and "industry" (as the social network transferring knowledge – e.g. the "ba" described by *Nonaka – Takeuchi* [1998] – would be fundamental for the creation and utilization of new knowledge).

Because of the situation described above, we have requested and received EC assistance to review this topic. In the framework of the RECORD project[6] financed by the EC between 2002 and 2005, researchers from nine countries[7] analysed the performance of RTDI institution – research institutes, universities and corporate research units – of the newly associated countries. First, the suitable method of benchmarking has been elaborated (see *RECORD Manual* [2004]). Later, during a smaller, mainly quantitative survey examining approximately 150 research institutions – chosen by national experts based on their excellence – their characteristics were reviewed. Finally about 20 detailed case studies were selected (based on a common outline) for the purpose of in-depth analysis (see the *RECORD Map* [2004]).

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[3] This back lag has been widely known for decades. The first examination of this topic with a tools however (as far as we are concerned) was performed by *Ray* [1991]. By that time, the researchers of the region have already discussed the topic (e.g. *Papanek* [1991]).

[4] In the past decade several research projects have shown and criticized the "Eastern" European traditions of the rigid separation of research, education and the producing sector (industry). See e.g. section 2 of the volume *Dévai – Papanek – Borsi* [2002] entitled „Examples of Evaluating R&D in the Candidate Countries" or the article of *Kutlaca* [2002].

[5] The economic effects of this phenomenon are sometimes discussed by Hungarian authors as the "double back lag".

[6] You may find its main findings in the RECORD Manual [2004] and the RECORD Map [2004] volumes, and the www.record-network.net webpage.

[7] From Central Europe the researchers of the Czech Republic, Hungary, Malta, Poland, Slovak Republic and Slovenia took part in the project. It was also supported by Austrian, Irish and English researchers.

Figure 1- Comparing Factors of national competitiveness
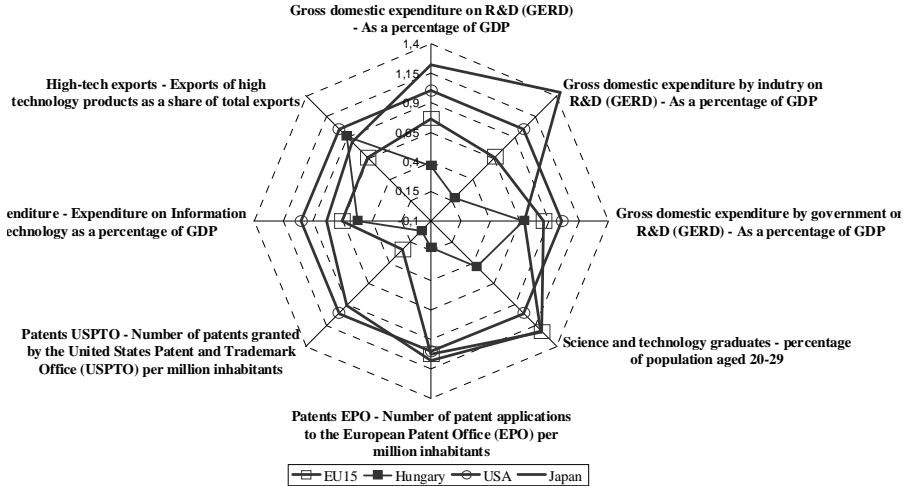
Source: Authors' calculations, based on EUROSTAT data

The project analysed how the innovative efforts of research institutes, universities and corporate research units contribute to the generation and utilisation (application and diffusion) of national innovative knowledge. However we did not focus on scientific output measured by publications, but on the capability[8] of knowledge generation to create "value added", and on the success of the business sector – the unique outcome of the conversion to market economy. Those institutions were considered excellent and met the following criteria: their size reached the competitive minimum, their performance resulted in marketable innovation(s), and their research results have proven to be commercialized. So the surveys could really outline the significant characteristics of the transition process, as they focused on one of the core processes of transition. The study concentrated on whether the wider application of R&D results and the acceleration of the diffusion of innovations

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[8] The criteria of the successful development of a market economy and its competitiveness – based on *Porter* [1990] – are evaluated on the basis of its GDP producing capability.

could be or were the driving forces of the economic development of Central Europe (and Europe[9]) constructing its knowledge-based economy.

Differentiated trajectories

An important conclusion of the RECORD project is that nowadays, the separation of "science" and "practice" is no longer a common feature in Central Europe, as there are internationally competitive R&D institutions (commercializing their R&D results and producing significant profit). So, in some sectors of RTDI the progress of transition is significant. As Table 1 shows below, larger research institutions accomplishing major innovation(s) using their knowledge, and commercializing their R&D results on the global market can be found in every country of the region. These institutions were named RECORD *international* centres of excellence. There are also significant RTDI institutions (named RECORD *national* centres of excellence), which developed to be regional centres of "industrial" networks. In the framework of the project, confined technology niches have also been discovered which are undoubtedly internationally competitive.

Table 1
Supposed excellence of the RTDI institutions surveyed* in the RECORD project

Country	International centres of excellence	National	Other RTDI institutions**	Total
Czech Republic	14	24	6	44
Hungary	8	6	11	25
Malta	5	10	6	21
Poland	8	5	12	25
Slovakia	3	5	2	10
Slovenia	8	5	15	28
Total	**46**	**55**	**52**	**153**

* The "sample" of excellent national RTDI institutions was constructed by national experts.
** There are 2-3 institutions specialized on niches in this group too.
Source: RECORD Map

The research results also highlight that the progress of transition in the RTDI sector of the region is by far not balanced. Several publications have already drawn the attention to the fact, that differences are not insignificant between

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[9] On the views of the EC, see e.g.: *Kok* [2004], pp. 6, 11-17.

these countries.[10] We found that differences inside a given country are larger than between countries. We strove for extending our sample to all institutions considered as excellent, however the proportion of RECORD centres of excellence seems rather low – at most a few percent of the RTDI institutions operating in the region – based on the data above. The performance of a large number of RTDI institutions (especially of the magnitude of newly founded university research institutes employing 0-1 persons FTE) was ranked even lower. In other words we drew the conclusion that transition processes progressed rather slowly in the past 15 years in several sectors of the Central European R&D sector falling behind the top performers. The European integration of the Central European R&D sector is on average slower than the economic integration.

The project gathered specific experience – even characteristic extended beyond the Central European RTDI sector – on the features (and also the causes) of performance differentiation. It has been stated, that the performance of Central European RTDI institutions varies largely on groups based on ownership, scientific field and regional distribution. This is especially important to notice, because convergence derived from the synergies of globalisation (e.g. spreading of entrepreneurial universities, research-based spin-offs) would rather be expected instead of differentiation.

It is specific to benchmarks of R&D capacities, leadership disciplines, human resource management methods, innovative performance, "industrial" relations, financial resources, etc. (listed during the project) that a rather different level of value added is produced in all three traditional segments – public research institutes, universities and corporate R&D departments – of the surveyed research institutions. These three institutional groups all achieved a different development path: they operate under different circumstances, follow different strategies, and there are extreme differences in their relation to politics.

- According to our experience transition in the corporate sector reached an end. Because of privatization, demolition or liquidation of the mother institutions, the majority of previously governmental research institutions faced great difficulties. RTDI activities have been halted, reduced, or even restarted by some foreign owners (GE, Volkswagen, etc.). Nowadays however, some "old-new" research institutions of world standard have again reached globally important results. Some private, small or medium size RTDI firms are also very successful, either spinning out from the

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[10] E.g. *Csaba* [2005] (pp. 19 and 25-37) stressed lately, that the economic situations in the region are very diverse despite the common communist past.

mother institution, or having been founded independently.[11] In this sector (just like in most of the business sectors) there are also market requirements. The effect of demand is strong, profit-requirements cannot be omitted either, and modern techniques of handling IPRs are spreading too. The practical use of R&D results is relatively fast, and the return of investments can often also be predicted. Sometimes however progress is strongly halted by regional boundaries of entrepreneurial opportunities (such as lack of capital, usual violation of the rules of competition, and unpredictable government's behaviour). [12]

Based on a case study e.g. the lighting research laboratory of General Electric Hungary has been considered as an international centre of excellence right away, as its research results of high scientific level are applied globally in all factories of the global firm.[13] The high scientific level of some long traditional universities and academic research institutions of the regions was registered. Furthermore we highly evaluated two entities in our sample: the performance of two spin-offs following niche strategies – the Hungarian ComGenex Co. selling its products almost completely on the global market, in the field of combinatorial molecular chemistry and the Polis Vigo Systems Ltd. developing and exporting opto-electronic devices.[14]

- In several research institutes of governmental research institutions – *especially in the research network of the Academy* – high-level scientific results are born nowadays too. There are some, which work according to market principles in many respects. However, the majority of these institutions – despite the leaning effect of the lack of sources through transformation crisis – managed to keep their positions (very diverse in different countries) and are still not market oriented. The main goal of the majority of researchers is publication. The examination of the research demand of the national economy or "industry", and the strive for the commercialization of acquired knowledge is scarce, so the national use of research results is slow or even falls off (and in some cases diffusion abroad is faster than inland). The latter opportunities are supported by the

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[11] Similar statements have been made previously by X. Richet. See: *Guerraoui – Richet* [2001], p. 23.
[12] Many experts favouring a shock therapy thought, that institutions of control guaranteeing the development of an efficient market after the rapid creation of private property (such as privatisation) would evolve automatically. However *North* [1998] questioned these hopes, as the difficulties of law enforcement in Central and Eastern Europe have proven to be rather strong.
[13] *Borsi – Papanek – Papaioannou* [2003], pp. 179-181.
[14] *RECORD Map*, pp. 53-64, 113-120

institutional background which is often in close contact with politics, and requests / receives significant subsidies.

> The Centre for Molecular and Genetic Biotechnology of the Czech Academy of Sciences is an example of academic institutes following a market economy scheme. Its aim is to accomplish biotechnology research, the promotion of the application and education of research results, and the founding of spin-offs. Its member institutions acquired a high prestige, and their incomes from their innovations are as high as millions of Euros (*RECORD Map*, pp. 34-43). The Slovenian National Institute of Chemistry **is** also having academic roots supporting the production of several companies in pharmaceutical, colour, food, etc production industries accomplishes high level research and contributes largely to the national GDP as well as the living standard of the population (*RECORD Map*, pp. 142-153). The research units of some examined educational institutions however still receive financial support primarily through the normative institution-financing system of governments, and sometimes even consider the commercialization of their research results to be in vein.

- A large number of RTDI institutions**,** previously specialized almost only on education, were born in the *higher educational sector.* When the principles of the entrepreneurial university are accommodated by their management, their economic performance can become significant and the number of spin-offs is also growing slowly. Most of these are however small, often employs only 1 person FTE, and does not have a significant performance. The only explanation of the existence of some of them is the fact, that the "firms" receive central resources – based on the number of students educated in the mother institution. Some other institutions acquired a status similar to the one of the academic institutions (only aims at scientific performance, strong governmental connections, etc.).

There are also large differences in the distribution of RECORD centres of excellence according to scientific fields and geographical regions. We shall discuss this problem later on.

We already wish to stress here, that according to our experience, the segregation of the Central European RTDI sector described above (as well as the benchmarking technique) characterises the transformation processes in other sectors of the examined economies too. This differentiation is however

sometimes a source of severe difficulties, and largely lowers efficiency.[15] In sectors, where the previous circumstances are kept, the slow knowledge flow sets technology development and the spread of social innovation – and so the catching up – back even stronger.[16] So it is inevitable to take this diversity into consideration both when examining the situation of economies (setting up the diagnosis) as well as the elaboration of the therapy when formulating the – e.g. economic political – suggestions.

> As Malta also joined the EU in 2004, we had the possibility of reviewing the practice of a small, but modern entrepreneurial university (University of Malta), which searched for "industrial" problems and commercialized its results (*RECORD Map*, pp. 74-81). It could also be stated, that the Faculty of Cybernetics of the Czech University of Technology also promoted the practical application of its research results by supporting a wide range of industrial connections (*RECORD Map*, pp. 25-34). Some Eastern European universities – breaking the traditions pursued by others – also strive for such a role. However we could also find institutions of higher education rigidly rejecting such changes.

The best practices

The RECORD project had the basic role of discovering and analysing the "best" practice of the RTDI institutions (the so called *RECORD centres of excellence*). Indeed, literature only exceptionally handles the question how the R&D sector of the region can integrate the European Research Era apart from a few statistics related to the Framework Programmes (see e.g.: *Schuch* [2004])]). So, it would be desirable to get informed about the catching up opportunities of the research institutions in the region.

The mapping of benchmarks pointed out first of all, that even some Central European research institutions considered competitive could only account for the factors resulting in the creation of their innovative knowledge. It turned out to be rather useful to discover business opportunities, we informed a wide range of RTDI institutions the in depth institutional analysis of the processes of

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[15] On the importance of economic cooperation see e.g.: *Plunket – Voisin – Bellon* [2001].

[16] The role of innovation in the development of national economies is acknowledged by most of the publications of the past 50 years (e.g.: *Nelson – Winter* [1982], *Dosi* [2000] etc.). The key importance of social - especially management – innovation is highlighted by *Drucker* [1985].

knowledge utilization and diffusion. It was also recommended to institutions promoting the progress of transforming Central European economies (the improvement of their competitiveness) – or of some of their spheres – operating in different sectors.

It seems that RTDI institutions with excellent results during the survey, could establish the technical background necessary for their competitiveness, including the financing of major investments (knowing that the catching up process needs financial resources and the lack of capital is a major break on progress). What is more, they do not feel important to indicate decades of back lag in the field of info-communications either.

The most important (but hardly surprising[17]) experience of the RECORD benchmarking is that *human factors*, innovative researchers and charismatic leaders supporting their work are the most important factors of success in Central European RTDI institutions. Their selection was made possible based on equal possibilities (selection of leaders without considering political notions, respect of knowledge, and open career opportunities for young researchers and women) in most of the high performing communities. We also found that opportunities of success were reduced significantly by appointing untalented management over a talented community – following the traditions of the region – or the managers are forced to work with no talented employees.

Case studies in two smaller research institutes (ComGenex and Vigo Systems) both highlighted that these firms would probably not even exist without the charismatic leader founding them, and would never have turned successful. However researchers providing information evaluated the role of talented managers high in several larger institutions as well.

A further important result of the project is that modern management as well as human resource management methods are widely applied in the surveyed institutions – and applied even more within successful institutions. So it can be very successful and recommended for managers to reconsider the traditional approach of the missions of their companies (as it is important not to set the accomplishment of scientific results, but their utilizations as a goal regarding business success). Strategy development is also spreading. Project management is also often applied. There is career management in many institutions; several ones help the initial accommodation of their new employees, education, conference participation, and training of their present employees. Almost every

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[17] This statement is stressed strongly in the literature. See e.g.: *Collins* [2001].

institution promotes mobility and researcher experience exchange, etc. There are no prohibited research topics. So we can conclude that they do not need methodological assistance.

Being familiar with the mother institution, it is not surprising, that General Electric Hungary employs high-level methods of HR management as well. This is also natural in the highest-level universities, academic research institutions of the region. However it is remarkable, that some institutions far from been successful in terms of business also follow the same practice.

The surveys have shown *network industrial relations* to be a rather successful method of business excellence. It is not surprising that the best small corporate research institutions[18] tend to build up relations with the small and medium sized enterprise sector. Such activities are also identified in the best regional centres. Indeed, international experiences[19] found industry-research co-operations to be extremely successful if organized in networks like regional clusters. However this process has hardly even started in Central Europe.

It is probable, that e.g. the corporate sphere evolved around the Centre for Molecular and Genetic Biotechnology of the Czech Academy of Sciences, or the Hungarian Cereal Research Non-Profit Company, are predecessors of such a cluster (RECORD Map, pp. 34-43, and 65-72).

The "academic" approach expressing the outstanding importance of basic research is still widely spread. Practical application and consumer needs often are not considered important, nor is knowledge exchanged between research institutions and production, etc. Patenting is obviously neglected in almost all Central European research institution, which clearly points out the exceptional nature of "market influencing" efforts aiming at the dissemination of scientific results (according to further experiences on the project, knowledge dissemination does not necessarily accelerate the publication of research results.) A reason appears to be that corporate demand for R&D is weak – except for some large multinational companies and some knowledge intensive public services (e.g.: nuclear plants) .

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[18] This practice concentrating on intra-company relations experienced in the largest global companies – necessarily consisting of numerous small entities – hardly contradicts to our conclusions.

[19] According to *Rush – Hobday – Bessant – Arnold* [1996], most of the resources in the best research institutions in the world come from revenues generated by high level services (consulting, expertise, testing, etc.) based on knowledge.

Entrepreneurial universities mentioned above – such as the Faculty of Material Sciences and Engineering of the Technical University of Warsaw (*RECORD Map*, pp. 92-102) etc. – e.g. often discovered research tasks by surveying practical needs. They often learned (and made scientific conclusions) from the experiences of their industrial partners. But these relations also helped out largely in the diffusion of scientific results.

Some "external" factors of success (independent form researchers) of RTDI institutions have also proven to be important. It seems that institutions considered as successful concentrate on a few fields of sciences: engineering, chemistry, physics, biology, medicine and IT. In other fields of science – e.g. in some light industries, catering and especially tourist services – however there are hardly any excellent research organizations (or even research projects) found. This implies, that RTDI specialized in these fields has a chance for success. We could also conclude that managers can support the development of their institutions by keeping good contact with the government.

Finally, it seems that some human factors (e.g. charismatic leaders) and commitment to the market economy principles and practice[20] as well as the development of institutions[21] enforcing them, are crucial factors of transition.

Future scenarios

On one hand, based on the facts described above, on the other hand based on international experiences of the development of the RTDI sector, the RECORD project attempted to conclude with some statements about the future of Central European RTDI institutions.

Our starting point is that more or less various scenarios of transition can be determined depending on the economic and political environment of the processes[22] and different development paths cannot be excluded in some countries of the region.

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[20] Three characteristic groups of this sector are the untrained, mostly unemployed labour "reserve", the aged intellectuals speaking no foreign languages, and some groups from the earlier political elite who were able to take advantage of their social networks during the privatisation.
[21] So, we agree with the conclusion of *de Soto* [2001] saying, that nowadays the most important prerequisite of economic development is probably the existence of general and fair institutions, which are the foundation of the market economy.
[22] Though scenarios can also be prepared on different versions of the global economic situation, in the following we only examine factors, which can be influenced by Central Europe.

Discovering the possibilities of the promotion of transition processes (and drawing the possible policy conclusions) was one of the important tasks of the RECORD project. We formulated two groups of recommendations concerning *regional* development and *government* economic policy.

1/ The results have shown that the promotion of regional development is crucial with respect to the future of the RTDI sector. The spatial distribution of RECORD centres is not balanced, most of them are in the capital cities of the surveyed countries. A larger area from Gdansk to Budapest, through Prague and Bratislava, is known as the "red" boomerang. [23] At the same time however, there are hardly any research units in many of the regions in the area. We found that there are only 2-3 international and some national (in other words minor) centres of excellence in the regions Prague, Central Hungary, Mazowieckie (around Warsaw), Bratislava and Slovenia out of the 36 regions of Central Europe.

The described geographical characteristics also set the direction for the innovation policy. Some regional connections become the key factors of the generation and diffusion of innovative "knowledge". These connections are linked to the cooperative work of research institutions settled in the region and the SMEs, the knowledge flow between them, and the creation of clusters. **As** experienced in the Silicone Valley or in the industrial area of Northern Italy, the network of (small and medium sized) enterprises offer an excellent social environment – a so called "ba" – for the creation of new innovative knowledge as well.

2/ A stronger economic political support of RTDI processes would be important. According to some international experiences the development of education can be, in the long run, the key of success of the innovative process. Therefore, it would be dangerous if governments try to save money on graduate or post-graduate education (e.g. limiting possibilities to attend primary education or determining a wage level inspiring good teachers, professors to leave the education sector, etc.).

Also the underdevelopment of management practices in Central Europe may hide potential reserves for economic policy to help innovation. Among the government owned RTDI institutions, the development of market economy can be promoted by e.g. the appointment of managers with specialized knowledge

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[23] See: *Gorzelak* [1996] regarding the phrase.

and managerial skills, institutional financing systems considering market performance, etc.

At the same time, *governmental subsidies* have quite a different role in financing excellent research institutions in the surveyed countries (perhaps somewhat more in the Slovak Republic and Poland, and less in Hungary). We could state, that the system of "proposing" for resources in the majority of countries in the region, and regular post-control in the Czech Republic and Poland largely contribute to the effectiveness of these subsidies. However we also found it obvious, that there is no technique, which could stop some subsidised institutions to feel the needs of the business sector to be of secondary importance, or not to let lobbying institutions receive subsidies regardless of their performance. So we do not think that governmental subsidies are the most important promoters of progress either.

In general, national economic policies should be made more entrepreneurial and innovation friendly. We remind however the proposition of M. *Olson* [1982], according to which market participants and governmental actors have different approaches of the economic policy to be followed. Some sociological surveys (e.g. *Kornai – Rothstein – Rose – Ackeman* [2004]) emphasize that most post-socialist societies do not have the necessary social capital, to elaborate an economic policy, favourable to the whole community.[24] So, only efficient assistance from the EU can result in progress in this field.

We also have to recognize, that some of the tasks described above are not parts of the European, but of the best *global* practice. This is especially true for R&D – e.g. the deployment of a larger part of research projects in companies, the spread of entrepreneurial universities, the growing role of regional clusters of SMEs in innovation, etc. The integration of Central Europe needs to pay special attention regarding these questions. Neither the EU, nor the accession countries can forget that a common goal in this case is the accomplishment of tasks implying the implementation of changes in the member states as well. That is the elaboration of a common future instead of transferring the present EU practice.

From all this, various future scenarios can be drawn for the RTDI institutions and national economies of the newly associated counties. Namely:

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[24] Perhaps it is no coincidence, that the leaders of transition in Central Europe are Estonia and Slovenia – two countries, which have not inherited a governmental apparatus from the command economy era.
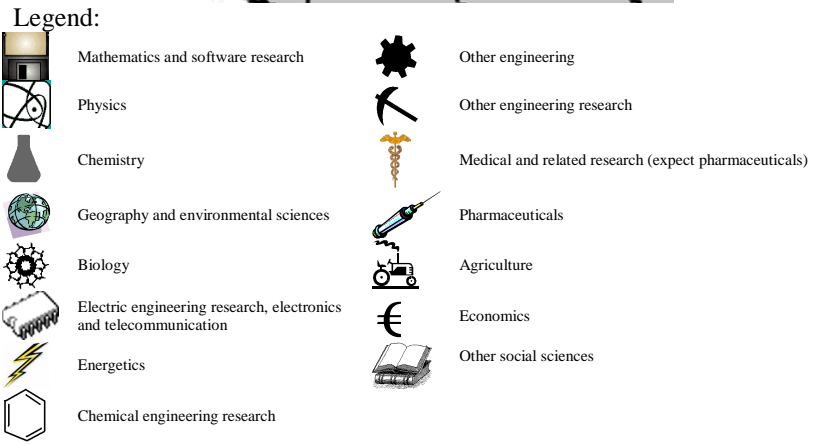
The preservation and further improvement of effectiveness and competitiveness can be expected from those institutions, which are operating as (mostly privatized or newly founded) corporations. So this sector is expected to catch up relatively rapidly.

– The future of RTDI institutions (networks) remaining in governmental hands – despite their high scientific levels in a wide range of fields – can be considered more insecure. Two alternative development paths can be drawn for these institutions (and their management). Some have already started adopting market economy model(s), and strive for the economic application of their knowledge, and aim to achieve financial resources available in this manner. The business success of the EU integration of (at least the majority of these) institutions capable of showing such progress can be predicted. However a darker prediction can be given for those institutions not considering market economy requirements and solely relying on governmental subsidies. This kind of institutions runs for the achievement of EU resources with a disadvantage, and can expect that tax payers will be less and less willing to finance R&D showing no return for the community as well. So their marginalization is hardly inevitable (because of the emigration of their young and talented colleagues abroad or to other institutions, etc.)
– A favourable prediction can be given where the development of regions has accelerated (real centres were formed, where the regional institutional background has strengthened, the directions of regional specialization have been clarified, and the clusters representing this specialization have been formed, and so several RTDI institution turned competitive, etc.) – and a really entrepreneurial friendly economic policy is established. In the past decades several countries with these characteristics (e.g.: Finland and Ireland) succeeded in both the integration of their RTDI sectors to the ERA as well as in the catching up of their economies.
– Those Central European economies, where the previous practice can only slowly be altered, have explicitly unfavourable chances. In countries maintaining their low level of technology and efficiency, even the present position of the producers can be endangered by competition from the Far East. So these societies shall draw the dynamism of the EU back, unless the Community effectively supports their social transition.

It is not questionable that the future scientific and economic centre of the EU will still be in Western Europe. The – slow – widening of the ERA network is expected towards Berlin-Prague and in the direction of Vienna, Bratislava and Budapest based on the experiences of the RECORD project (and the theories of

other authors, like the "red octopus" by *Meer* [1998]). The Austrian and northern Italian connections of Slovenia are also promising. We can only hope that the eastern widening of the ERA will be a parallel process to the economic catching up of this region.

Figure 2
Location of RTDI institutions surveyed in the RECORD project

Legend:

	Mathematics and software research		Other engineering
	Physics		Other engineering research
	Chemistry		Medical and related research (expect pharmaceuticals)
	Geography and environmental sciences		Pharmaceuticals
	Biology		Agriculture
	Electric engineering research, electronics and telecommunication		Economics
	Energetics		Other social sciences
	Chemical engineering research		

Source: RECORD Map [2004].

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