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The Interplay between Science and Technology Policy and Industrial Research:
Key Success Factors for international Competitiveness and East-West European Integration

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"L'investissement dans la recherché est plus qu'une priorité.
C'est une condition de la croissance et de l'emploi.
C'est une exigence de survie dans la compétition internationale. »
Président Jacques Chirac
à l'occasion du 50[e] anniversaire du CERN,
Genève, 19.10.2004

I. From Monte Carlo to Krakow: The evolution of industrial R&D Management

II. 25 + 1: Science and Technology Policy concepts in the EU

III. The role of the new CEE member countries within the European Research Area

IV. The impact of the EU Framework Programmes on national R&D priority setting and on the "Europeanisation" of Research

V. Generating domestic R&D capacities, Licensing or importing technologies through Foreign Direct Investment

VI. The changing pattern of Industry–Science relationships

VII. Conclusions

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The Interplay between Science and Technology Policy and Industrial Research:

Key Success Factors for international Competitiveness and East-West European Integration

I. From Monte Carlo to Krakow: The evolution of industrial R&D Management

EIRMA's genesis can be traced back to an OECD sponsored conference, organised way back in 1965 in Monte Carlo. The conference stands as the first significant meeting of officers responsible for research in large private firms on both sides of the Atlantic. The Monte Carlo meeting was seen at that time as something of a **new departure.**

The conference put forward a proposal which led in the following year, that is to say in 1966 at the Château de Ménars near the Loire valley, under the auspices of the OECD to the creation of EIRMA, the *European Industrial Research Management Association.*[2]

On political grounds, the Third Ministerial Meeting on Science of OECD countries held in Paris on 11/12 March 1968, has also concluded that "*In the techniques of management, including the management of research, and of combined technological and market forecasting, the United States appears to have a significant lead. This is undoubtedly linked with the greater commitment to long-term planning, to the clear formulation of goals, both in business and in government (as far as national goals are concerned), and to the more rapid development and adopting of management technologies in general.*"[3]

Almost half a century later, here in Krakow, another '**new departure'** could possibly take place. A representative group of R&D executives of EIRMA member companies is reaching out to their colleagues in Central and Eastern Europe in order to explore and compare each other's knowledge and experience in industrial research. The Eastern enlargement of the EU may perhaps have as an immediate consequence the 'Eastern enlargement' of EIRMA.

The conference theme in Monte Carlo was "***The integration of Research Policy into the overall Policy of the Firm***".
Today I am attempting to explore with you ***"The Interplay between Science and Technology Policy and Industrial Research."***

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[2] Oger, Claude, General Report, European/North American Conference on Research Management, Monte Carlo, 22-24.2.1965, EIRMA Conference Papers Vol. I, Paris 1967
[3] OECD, Gaps in Technology, General Report, Paris 1968, p.25

When reverting to the meeting of the 'founding fathers' in Monte Carlo, it is surprising how many of the basic assumptions of that time are still valid today for any industrial research organisation:

- Basic mechanisms – innovation and company strategy
  A technologically based company exists to create, make and market useful products and services to satisfy the needs of its customers throughout the world.
  It is the opportunity to make a profit which provides the incentive to create, make and market such useful products and services.
- The inherent creativity of research
- Typology of firms
- Research financing mechanism
- The position of the research department in the firm
- The role of the research director[4]

In 1965 in Monte Carlo as in 2004 in Krakow it is true to dissert

- "that research is an extremely profitable investment" and
- "that the most constant concern of the firm is its own survival"

In almost forty years EIRMA has mobilised an estimated number of 15.000 to 18.000 key persons who are responsible for industrial research in the leading European technology-based corporations to meet, to exchange experience on the best methods of industrial R&D and innovation management. Over the years a most formidable stock of knowledge on the best methods of industrial research, development and innovation management has been developed.[5] Of equal importance, if not of even higher value, is the transdisciplinary European-wide network of personal contacts provided by EIRMA. In an article devoted to the Association's achievements the *Financial Times* had this to say: *"The best management development happens when experienced managers come together to learn from each other, to discuss common concerns and visit each other's companies*." (31 March 2004).
A look at the wide range of themes covered by EIRMA through the more than fifty major conferences organised in 30 cities in 19 different countries (see Annex) illustrates the evolution of "Industrial Research and Development Management" starting from "Integrating research policy into the general policy of the firm" in Monte Carlo in 1965 to "Increasing the Entrepreneurial Spirit of R&D" in Edinburgh in 2004 into a true 'real-life' Management Encyclopaedia. In addition are the 60+ EIRMA Working Groups and numerous "Top Management" sessions and 'Special-interest' Groups.

As an extension to the intra-European dialogue of research directors, a close network of contacts has been established with the American counterpart of EIRMA, the **Industrial Research Institute Inc. (I.R.I)** as well as with the **Japan Techno-**

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[4] Integrating research policy into the general policy of the firm, in: Oger, Claude, General Report, European/North American Conference on Research Management, Monte Carlo, op.cit.

[5] see EIRMA: The first 25 years. Highlights 1965-1990, Paris 1990

Economic Society (**JATES).** Similar R&D management organisations have been created in **Australia, in Canada and in the Republic of Korea.**

At the beginning of this meeting it should be stressed that the tragic circumstances of the division of Europe after WWII have up-till now not permitted that the Research Community in Central and East European countries could participate in the EIRMA mechanism. As part of the intended 'catching-up' policies of the CEE countries themselves as well as of the efforts undertaken by the EU, EIRMA's doors are wide open for those companies in Central and Eastern Europe which see in EIRMA an essential element for the construction of the European Research Area.

II. 25 + 1: Science and Technology Policy concepts in the EU

In the EU there are not two member states, which have identical Science and Technology policy concepts. This explains, *inter alia,* the remarkable differences of the involvement of the main actors, Research Institutes, Universities and Industry, within 25 member states in their participation in the EU Framework programmes.

The influence of the OECD in shaping and harmonising national Science and Technology policies cannot be overlooked. It was the OEEC, the Marshall Plan Organisation and predecessor of the OECD, which has created awareness for the need of national "Productivity" concepts for the reconstruction of post-war Western Europe.

'**Science Policy'** became subsequently '**Science and Technology Policy'** and ultimately '**Innovation Policy'**.[6]

All industrialised countries are constantly adjusting their Research System reflected in their specific Science and Technology machinery in order to meet the **changing societal needs** and in order to maintain, or as the case may be, to achieve **international competitiveness**. Each country has its more or less distinct STD structure to meet those challenges. Each country follows, in spite of all similarities, its own path. However, all countries have in common - and the new member states of the EU in Central and Eastern Europe are no exception to this general rule - that their science and technology policies can be considered in two broad categories:

1. Mechanisms by which science and technology can contribute to solutions of particular problems of **society and the economy,**
2. Mechanisms for strengthening the **infrastructure of science and technology.**

In the case of Poland – as well as in the case of the other new EU member states in Central and in Eastern Europe – another important dimension has to be added:

3. Mechanisms allowing simultaneously the necessary continued **profound transformation** of the national research system whilst at the same time providing the tools for the creation of a modern '***knowledge society'***.[7]

[6] cf. Standke, Klaus-Heinrich, The impact of International Organisations on National Science and Technology Policy and on Good Governance, discussion Paper 104, European Institute for International Economic Relations, University of Potsdam, March 2003
[7] cf. Standke, Klaus-Heinrich, The political context of the Reform Programme for the Science and Technology Sector of Poland, in: SCI-TECH II Programme, Proceedings of the Final Conference, Warsaw 2000, p.15

The OECD refers in this context to a phenomenon, which bears immediate relevance to the Science and Technology policy concepts of the CEE countries – and also to the representatives of the EIRMA member companies gathered at this Krakow seminar:
It is being stated that in many industrialised countries the globalisation of markets and the internationalisation of R&D have had relatively little effect on their national technology policies. And yet, because of the political circumstances of the economic transformation of the CEE's, it is evident that they are for the foreseeable future unable to develop the most important key technologies to compete internationally on their own. Therefore, for the Science and Technology decision makers in the CEE's it is of the outmost importance to negotiate with internationally operating industrial companies that through their investments the necessary embodied technological skills will be systematically mobilised for the benefit of both the foreign subsidiary as well as of that of the host country.

Today, more than in the early days of conceptualising Science and Technology Policies, it is known that not only the science and technology infrastructure is of relevance to the competitive situation of a given country, but of equal importance are the national education and training systems, the level of wages and their social costs, the degree of public regulations, the corporate taxation system and the exchange rates to foreign currencies.
In essence, two dimensions of Science and Technology policies are aiming to support the national innovation system can be distinguished:

- First, the public sector directly finances innovation activities, especially through R&D support, or provides support (such as venture capital) in areas that might otherwise be barriers to innovation. Support of SME's is in all countries high on the list of priorities.
- Second, the public sector supports a scientific-technological infrastructure on which industry can draw for innovative ideas and general research co-operation. This includes the government-funded research institutions as well as the university system.

As an extension to the governmental support of the national innovation system public funding of bilateral and multilateral R&D cooperation efforts must be mentioned here, the most substantial being the national financial contributions to the funding of the EU Framework programmes of research.

At this juncture it must be stressed that in spite of many years of cooperation within the EU, most public funding on R&D is geared towards national objectives. At a time of rising high-level unemployment there seems to be little enthusiasm by the EU countries for transferring scarce national R&D funds into an EU mechanism aiming to induce on an Union level economic growth and to fight unemployment. To the contrary, governments seem to prefer seeking national ways and means to strengthen the national competitive forces.

Eugene B. Skolnikoff, Professor emeritus at the MIT and for many years a member of the White House Office for Science and Technology, has been able to highlight this complex problem within one single sentence: "*The process that determines the policy of a nation toward collective action, however, continues to be entirely national* *in structure, giving representation to domestic interests in areas affected by the issue and only indirectly to foreign or international interests."*[8]

It is, therefore, not likely that the delegation of authority on key R&D issues from member states to the European Union will proceed very far once important interests of major states were adversely affected, nor will such a policy be seen as "desirable" by those who disagree with the values and decision processes that might dominate the EU. The ongoing debates on the ratification of the EU Constitution illustrates this conflict.

Such attitudes are surprising since it is known that the main benefit from the public allocation of funds into national R&D resources and thus into the national economies is progressively disappearing: "Not only the know-how produced in the national innovation system, but also other public investments, for instance in training and education, are increasingly swept into the stream of the international exchange of knowledge."[9]

Given the enormous amount spent by the individual EU member states on R&D, the sums allocated for common EU projects are still not more than of symbolic character. In addition, their volunteer nature within the Union-wide cooperation of the FP activities or within the cooperation mechanisms such as COST or EUREKA are demonstrating the limitations of such non-compulsory EU R&D cooperation. And yet, they seem to be of a higher importance to the participating smaller and medium sized countries of the former EU-15 and to the new CEE member states than to the larger EU countries. There are voices, pleading for an application of the EU principle of subsidiarity also for the field of R&D, i.e. only those issues should be dealt with through R&D EU actions that cannot be handled by member states on a national scale alone. It is thus felt that under the present political circumstances in Europe it would be unrealistic if one would be tempted to regard the priorities of the FP be as a nucleus for the priority setting within a European Science and Technology Policy.

The EU Commission, when calling for a "European Research Area", seems to be fully aware of this dilemma: "National research policy and Union policy overlap without forming a coherent role." The Commission warns therefore that the situation will not improve with enlargement: "It opens the prospect of a Europe of 25 or 30 countries which will not be able to cooperate with the methods used so far. This fragmentation, isolation and compartmentalisation of national research efforts and systems and the disparity of regulatory and administrative systems only serve to compound the impact of lower global investment in knowledge."[10] The Commission, therefore, wants to extent national research efforts with community-wide programmes and intends to provide financial incentives to those who do so. Doubts may be allowed to what extent such a laudable intention is realistic if one compares the annual amount of the national R&D budgets of the EU-25, i.e. 178,9 Bill.€ with the annual budget of the current 6th Framework Programme of the EU, i.e. 3,5 Bill.€.

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8 Skolnikoff, Eugene B., The elusive Transformation: Science and Technology and the Evolution of International Politics, Princeton 1993, p. 210/211

9 Reger, Guido, Changes in the R&D Strategies of transnational firms: Challenges for national Technology and Innovation Policy", in: OECD, New Rationale and Approaches in Technology and Innovation Policy, STI Review Nr.22, Paris 1998, p.257

10 European Commission, Communication 'Towards a European Research Area'

Andrew Dearing, the current EIRMA Secretary-General, has put it right when describing the wider context in which the national science and technology policy pattern of the EU-25 as well as the EU activities on the same field have to interact and hopefully converge: *"There is growing recognition that national and European initiatives are necessary to achieve the desired entrepreneurial approaches to innovation. Industry policy has been a taboo in European circles for some years, but has re-emerged within a new Commission communication '*Science and Technology, the key to Europe's future'. "[11]

III. The impact of the EU Framework Programmes on national R&D priority setting and on the "Europeanisation" of Research

The heads of states and governments of the EU have proclaimed at their summit in Lisbon in March 2000 that by the year 2010 the European Union should be elevated 'to the most competitive and dynamic knowledge-based economy in the world'. To this effect the member states should increase their average expenditure from presently almost 2,0% to 3,0% by the year 2010. Two thirds of the figure should come from the private sector (at present approximately 56%) and one-third from public funds.

The Commission realises that in view of the large discrepancies in national R&D spending, the overall objective of 3% cannot be reached individually by all current and future Member States, "*but they should all contribute to the effort. They should coordinate their efforts to create a joint dynamic for the growth of R&D investment throughout the Union."*

The European Union, as a supranational organisation, intends to influence the orientation of national science and technology policy setting through the "Framework" sequence of multi-year initiatives on Research and Development. However, since the European Framework funds are in the order of magnitude of roughly 5 or max. 6 % of the R&D public funds allocated in the 25 member states in their national budget, the impact of the European Union on the direction of the European research enterprise is rather modest – even when the necessary national co-financing of usually 50% is de-facto doubling this amount. What is hoped for, is a gradual increase in intra-European cooperation regarding the remaining 95% as well.

In addition to increased spending by governments and the private sector, the Commission proposed a set of fiscal measures, public support for risk capital, direct support measures and others in addition to a call for more friendly innovative economic environment allowing entrepreneurship and creativity to flourish better.

The Commission recalls a series of strong points which – pulled together - may ultimately form the European Research Area:

1. A stock of material resources and facilities optimised at the European level,
2. More coherent use of public instruments and resources,
3. A common system of scientific and technical reference for policy implementation,

[11] Dearing, Andrew, Research: risk and award, in: EIRMA Quarterly: Innovation, Autumn 2004, p.4
Science and Technology, the key to Europe's future, COM (2004) 353, 16.6.2004

4. More abundant and more mobile human resources,
5. A dynamic European landscape, open and attractive to researchers and investment,
6. An area of shared values.

As a conclusion, the Commission advocates: "*Openness is the key: Underlying all this are the concepts of sharing and exchange. Clearly, European researchers must learn to stop thinking of themselves as living and working in individual states and to be more open and communicative about the results of their work."*[12]

The Commission has outlined six objectives as key elements of the 'Lisbon strategy':

- "The first of these is to create European centres of excellence through collaboration between laboratories.
- The second objective objective is to create 'technology platforms', common research agendas, that are so well defined that they attract a critical mass of national and European resources from the public and the private sector. Proposed topics for these platforms include *energy, transport, mobile communications, embedded systems and nano-electronics.*
- The third objective is to stimulate the creativity of basic research through competition between teams at European level, by supporting competing research teams.
- The fourth objective is to make Europe more attractive to the best researchers, through better training and career development; greater efforts to encourage women into science; better knowledge transfer to less advanced regions and companies; and more international exchanges.

The report suggests two more objectives to underpin these ideas:

- The first is the creation of European research infrastructure, like the nano-electronics facility proposed under the European Growth initiative. Essential infrastructure and services such as dedicated communication networks, archives and databases, would be supported in the same way.
- The second supporting objective is to improve the international co-ordination of national research programmes, using money from the sixth Framework Programme as a lever."[13]

The EU Research Framework remains a domain of the largest countries of the Union. An interim evaluation of the 12.787 projects evaluated so far in the 6th FP[14] reveals that from the 2.228 projects retained and 2,356 bill.€ disbursed, more than 50 % of the funds went to Germany, France and the U.K. alone. If one adds Italy the figure stands by 60,6%:

[12] http://europa.eu.int/comm/research/growth/gcc/era.html

[13] European Commission, Communication „Science and technology, the key to Europe's future, Brussels, June 2004, cit. in: EIRMA Quarterly: Innovation, Autumn 2004, p.11

[14] as per 30. April 2004. Source: EU, Analysis prepared by Ministère délégué à la Recherche, Direction de la Technologie, Mission Affaires Européennes, Paris 18.8.2004

Germany: 519,3 mill.€, France: 347,5 mill.€, UK: 338,4 mill.€, Italy: 224,1 mill.€. The relatively small host country of the EU, i.e. Belgium, finds itself with 129,1 mill.€ before Spain on 5th position.

The Framework is seen as a 'major tool to support the creation of the European Research Area (ERA)'. It is subdivided into three main areas:

I. Integration and Reinforcement of the European Research Area
II. Structuring of the European Research Area
III. EURATOM

I. Integration and Reinforcement of the European Research Area:
   6.845 projects evaluated, 2.228 projects retained)
   - Life Sciences
   - Information Society
   - Nanotechnologies, material processes
   - Aeronautics and Space
   - Food Safety
   - Sustained Development
   - Citizens and governments
   - Sc&T Policies
   - SME's
   - International cooperation

II. Structuring of the European Research Area:
   5.880 projects evaluated, 986 projects retained
   - Research and Innovation
   - Human resources and mobility
   - Research Infrastructure
   - Science and Society

III. EURATOM:
   62 projects evaluated, 29 projects retained

The success rate of all 12.787 applications is on average 18,2%.
On the first position is Belgium (21,6%), followed by France (21,2%), the Netherlands (20,8%), Sweden (20,0%), UK (19,8%),Germany (19,2%), Denmark (19,2%).
The CEE's find themselves as far as their 'success rate' is concerned, in the last third of the 25 member states, i.e. between Hungary (16,6%) and Slovenia (13,4%).

Of interest is to note that the involvement of the 'main actors' in the national R&D community, i.e. Universities, Research Institutes and Industry, differs widely from country to country.

Life Sciences: Execution of the 117 retained projects in FP 6
(in %)

	Industry	University	R&D Institutes	Others
Germany	12,5%	38,9%	47,3%	
United Kingdom	7,9%	65,0%	24,6%	
France	11,2%	13,2%	71,6%	
Italy	3,7%	33,5%	52,2%	

Information Technology: Execution of the 227 retained projects in FP 6
(in %)

	Industry	University	R&D Institutes	Others
Germany	49,0%	24,6%	20,8%	
United Kingdom	37,8%	48,9%	2,5%	
France	61,9%	9,2%	16,3%	
Italy	36,4%	32,4%	18,5%	

There seems to be a sort of ‘division of labour’ among the larger European countries on the various fields covered by the Framework Programme. An analysis of the main FP areas shows the following pattern of specialisation, if one uses as measurement the given field on which the successful countries maintain the first position among all applications:

Germany

- Life Sciences
- Information Technology
- Nanotechnology
- Sustained Energy
- Transportation
- Citizens and Governments
- Science Policies
- Era-Net

France

- Aeronautics
- Space
- EURATOM
- International Cooperation

United Kingdom

- Food Safety
- Ecosystems
- Research and Innovation
- Science and Society

Perhaps a larger sample is needed over a longer period of time and involving all 25 EU member countries in order to draw some meaningful conclusions to what extent the evolution of the EU Framework Programmes are indeed representative for what one day may be called “European Research Area”. In any event, the number of participants within the FP projects – in FP 6 at mid-term: 116.548 proposed, and 21.207 retained – reaches so far only a tiny fraction of the European Research Community.

In his last Press Conference as President of the EU Commission, Romano Prodi, regarded the ‘Lisbon Strategy’ aiming by the year 2010 to bypass the United States

as the most growth-intensive economic region of the world by and large as a ‘failure’. He gave two reasons for his pessimistic judgement (1) the governments of the EU member states have so far not kept their commitments to increase gradually their R%D expenditures and (2) individual governments have block with their ‘veto’ decisions which would have benefited the European Economic Area as a whole.[15]
Earlier, the EU Commission’s President-designate, José Manuel Barroso of Portugal, underlined his strong commitment to the Lisbon agenda: *“We must reinvigorate the Lisbon strategy…I will personally chair a group of commissioners who will seek to boost the reform process and give new impetus to the economy…”.*[16]

IV. The contribution of the new CEE member countries to the European Research Area

Traditionally, ‘the lion’s share’ of the world’s scientific and technological community was concentrated in the countries of the OECD on one side and in the countries of the former COMECON on the other side.
When the Berlin wall collapsed in 1989 the number of Scientists and Engineers working in Research and Development were believed to have more or less the same order of magnitude in both the OECD countries and in the COMECON countries: 2,2 mill. in the West and 2,0 mill. in the East.[17]

The scientific and technological exchanges between East and West of Europe have fascinated even during the coldest days of the Cold War observers from both sides. The Conference on Security and Cooperation in Europe (CSCE) organised already in 1980 a special East-West Scientific Forum in Hamburg.

UNESCO together with a number of international organisations such as the OECD, EU, UNIDO, the Council of Europe, has convened in September 1990 a special meeting in the Reichstag Building in Berlin, just one week before the German re-unification, to arrange for a first East-West dialogue among eminent representatives of the science community from both sides of the abolished Iron Curtain to discuss the future role in a united Europe.[18]

The so-called Eastern Enlargement of the European Union on 1 May 2004 has added to the Union 65,9 mill. Citizens and has furthermore brought about an increase of the annual R&D expenditures of the EU-25 amounting to 3,2 bill.€:

Population and R&D expenditures in CEE countries (2001)

Country	Population (million)	R&D expenditures (in % of GDP)	R&D expenditures (million €)	
Czech Republic	10,2	1,3%	832	
Estonia	1,3	0,7%	49	

[15] Frankfurter Allgemeine Zeitung, Prodi: Wir sind für den Notfall bereit, 26.10.2004
[16] Europe plans for stronger research to meet the Lisbon criteria, in: EIRMA Quarterly Innovation, Autumn 2004, p.11
[17] Standke, Klaus-Heinrich (Editor), Science and Technology Policy in the Service of a Greater Europe, Frankfurt/New York 1993, p.14
[18] Standke, Klaus-Heinrich (Editor), Science and Technology for the Future of Europe – New Forms of Cooperation between East and West, UNESCO, Paris 1991

Hungary	10,1	0,8%	548	
Latria	1,3	0,4%	38	
Lithuania	2,3	0,7%	91	
Poland	38,2	0,7%	1.323	
Slovak Republic	5,4	0,7%	149	
Slovenia	2,0	1,5%	341	

Source: European Commission

The total R&D expenditures of the EU-25 are in the order of magnitude of 179 Bill.€ p.a.. The percentage of the eight new members of this total amount is appr. 1,9%.

What is, in essence, the impact of the planned ERA – if and when realised - to the countries in Central and Eastern Europe?

- The Commission intends to facilitate the integration of the basic research facilities of the countries in Central and Eastern Europe into the European research system. The Academies of Science and the Universities in CEE which are often of the highest calibre can benefit from such EU initiatives. The same can be said, for any form of pre-competitive research. Instruments are the EU-Framework Programmes, and mechanisms such as EUREKA, COST etc.
- The Commission has, however, little influence, if any, on industrial research and development activities. Industries choose their own partners '*à la carte.*' There are European consortia on specific fields with a limited number of partners, e.g. Airbus, EADS and others. There are furthermore many EU/US research arrangements within multination companies and on a bilateral basis. They do not necessarily fit into the concept of 'ERA'. The dilemma for the CEE's is, for the time being, that usually their industrial R&D base is not yet developed to a level which would allow them to be equal partners in such R&D consortia.

As far as the new CEE member states are concerned, the following conclusions on their R&D performance can be drawn:

1. Their expenditure on R&D is far below the EU-15 average (see tables below)
2. In most countries (only the 4 largest new EU members are shown) the ratio 'public funds' to 'industry funds' must be reversed from the present "2:1" to "1:2" as it is customary in most of the OECD countries.
3. The per capita amount spent on R&D, in particular in the largest new EU member state, i.e. Poland, is at present not more than 12% of the EU average.
4. To give another illustration: The R&D expenditure of all 8 CEE new member states with a total population of 66 million inhabitants is in the order of magnitude of the R&D expenditures of Berlin with a population of 3,4 million inhabitants, i.e. 3,3 Bill.€.
5. Even before the restructuring process of the science and technology infrastructure in Central and Eastern Europe has been completed, the number of Researchers per 1000 people employed is presently considerably lower than in the EU average:

Number of Researchers in selected CEE countries (2001)

	Full time equivalent	Per 1000 total employment
Czech Republic	14.987	…
Hungary	14.666	3,8
Poland	56.919	3,8
Slovak Republic	9.585	4,5
EU – 15 TOTAL	971.497	5,8

Source: OECD in Figures 2003

6. On the positive side it has to be noted that the new EU member states have made extraordinary efforts in the increase of their student population. Poland, for example, has quadrupled the number of university students since 1990 to presently 1,8 mill. (including some 500.000 students in private business schools). For comparison: France: 2,2 mill. enrolled university students and Germany: 2,0 mill.

Gross Domestic Expenditure on R&D (GERD) in 2001

	% of GDP	% financed by Government	% financed by Industry	Per capita at Current US-$
Czech Republic	1,30	43,6	52,5	197
Hungary	0,95	53,6	34,8	127
Poland	0,67	64,8	30,8	67
Slovak Republic	0,65	41,3	56,1	79
EU-15 average	*1,93*	*34,5*	*56,2*	*491*

Source: OECD in Figures 2003

V. Generating domestic R&D capacities, Licensing or importing technologies through Foreign Direct Investment

Successful competition in high-technology products and processes is seen as one of the prime determinants of the future economic status of nations. Obviously only the largest industrial countries can afford technological leadership on most, if not on all, essential fields. The process of globalisation and of European integration is increasingly blurring the picture of ownership of such technologies. A recent report reveals for example that 530.000 French and German citizens are working in companies with headquarters either in France or in Germany. Which production technology in this example is considered as French and which as German?
Small and medium sized countries are by definition relying on others for many essential products or on their manufacturing technology.

A completely new situation for industrialised countries has occurred, for which no model in the history of nations exists, when ten countries in Central and Eastern Europe with some 100 million inhabitants belonging for more than 40 years to a centrally planned economic system have joined – or as in the case of Bulgaria and Romania – are going to join the European Union.

The new EU member states of the EU in Central and Eastern Europe whilst having trade deficits in their exchange of manufacturing goods, have been able to attract considerable FDI's: For example, in their GDP some of the CEE member countries can account Direct Investment Inflows in the same percentage range as the notorious FDI 'heaven' Ireland (14,01 % in 2002): Czech Republic 16,49%, Slovak Republic 14,95%. Hungary for example, with a relatively low GERD (0,95% of the GDP) is reporting that a very high portion of the Hungarian exports are in the category 'High Technology'. The explanation is that a number of Western companies, such as BMW and Audi, have transferred a part of their production facilities – not heir R&D departments – to Hungary.

According to a recent survey by the Federation of Chambers of Commerce in Germany, almost one quarter of the German industrial enterprises are planning the outsourcing of some of their manufacturing plants to the CEE countries.[19] From other EU countries similar intentions have been reported.

Foreign industrial investors bring the latest manufacturing technologies and the equivalent know-how. They are willing to train the local labour force to bring them onto the standards of their needs. What they are usually not (or not yet?) transferring, however, are their R&D facilities. However, the first signals in this direction have been reported.

For the CEE's it is thus of the outmost importance to attract research centres of such foreign companies. The experience in Western countries shows that initially the tasks of industrial development departments of multinational companies with major investments abroad were limited to adapting product and process technologies from the home country to local production and market requirements. This was followed in a second phase towards strengthening R&D in foreign countries and thus extending the global competence portfolio. Likewise in the new EU member countries 'rising presence of multinational companies is associated with a larger role of ownership, specific technology advantages, and hence a rise in the level of technology intensity. Moreover, the higher the share of skilled labour, the higher the technology intensity.'[20]

It may come as a surprise that an analysis of recent export statistics of CEE countries matched with an analysis of the employees in the manufacturing industry in some of the new EU member states reveals that they have in spite of low-level domestic R&D efforts an above EU-15 average in the percentage of staff employed in the "HighTech" sector:

- Mainly because of FDI, the percentage of employees in the HighTech sector in the CEE countries (Czech Republic: 8,9%, Hungary: 8,5%, Slovak Republic: and Slovenia: 8,2%) are above the EU-15 average of 7,4%.

Linked herewith are the following consequences:

- In the case of Hungary, for example, 22,9% of the Hungarian exports fall into the category 'High-tech' (EU-15 average: 19,7%).The same can be said in particular about the automotive exports of Poland, the Czech Republic and the Slovak Republic. Since many of the suppliers of these Western car manufacturers follow the pattern of 'outsourcing' to CEE, such a trend may even accelerate in the years to come. As Polish economists described this development recently: *"Declining real wages and little or no pressure on*

[19] Frankfurter Allgemeine Zeitung, 15.10.2004, p.43

[20] Welfens, Paul JJ. Et al., EU Eastern Enlargement and Structural Change Specialisation Patterns in Accession Countries and Economic Dynamics in the Single Market, Discussion Paper # 116, European Economy and International Economic Relations, University of Wuppertal, May 2003, p.2

wages owing to high unemployment are factors that should keep costs down and exports competitive."[21] One might add, that furthermore the considerable high costs for R&D for the manufacturing of the CEE export goods in question were to the largest extent covered by the parent company in the West.

Other factors such as the competition on corporate tax levels, subsidies stemming from European Structural funds and in some countries favourable exchange rates are beneficial for the general cost level in Central and Eastern Europe.

VI. <u>The changing pattern of Industry–Science relationships</u>

In Western industrialised countries, as Herb Fusfeld, a former I.R.I.President has described, 'the competitive pressures on industry and the financial pressures on universities, added to the growing commonality of interest in many areas of science and technology, have set the stage for closer working relationships between these two dissimilar cultures."[22]

The former Soviet/East European University pattern was characterised by the concentration of basic research in publicly supported institutions (the Academies of Sciences) while the universities concentrated on teaching (with some research around individual professors). With the move to market economies in these countries, formally completed by the accession to the EU, this system has undergone major changes, with a marked weakening of the academies, and a strengthening of university-based research.[23]

For example, since 1997 the Polish Academy of Sciences (PAN) has ceased to be an institution of the government, but as in Western countries, has become a scientific organisation. PAN has some 80 institutes within which some 4.000 scientists are employed, among them appr. 800 professors.[24]

More complicated is the situation of the more than 200 independent research institutes with 26.400 employees, among them 5.200 scientists. Not belonging to either the PAN, nor to universities nor to industry, they have to demonstrate their 'raison d'être" within an increasingly competitive environment. Some of these institutes are represented here at this meeting. The Chairman of the Main Council of Research and Development Units of Poland, Zbigniew Smieszek, is ready to provide you with some inside information on the present stage of the intended transformation and/or privatisation of the Polish research units.

The co-hosts of this conference, Tomasz Kosmider, President of the Technology Partners Foundation and Vice-President Krzysztof Santarek, to which 10

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[21] Day, Matthew, Through the Roof. The increase in Polish exports has given credence to economic optimists. Even better, this time this is a boom that appears to be sustainable, in: Poland Monthly, No.32, October 2004, p.41

[22] Fusfeld, Herbert I., Industry's Future – Changing Patterns of Industrial Research, American Chemical Society, Washington, DC 1994, p.179

[23] OECD, University Research in Transition, STI Science, Technology, Industry, Paris 1998, p.19
see also: Benchmarking Industry-Science Relationships, Proceedings of the Joint German-OECD Conference held in Berlin, October 16-17, 2000, BMBF public, Bonn December 2000

[24] For further details see: Konrad Buschbeck, Die polnische Wissenschaftslandschaft. Orientierungen bei der Suche nach Kooperationspartnern für Forschung und Entwicklung, forthcoming article to be publish in: Internationale Hochschulnetzwerke – Journal für die Kooperation von Wirtschaft & Wissenschaft, ISSN 1614-0818

independent sectoral Research Institutions with a research staff of 1.000 people belong, will – no doubt – present to you an interesting view on the cooperation possibilities with their consortium.

Whereas government funds for scientific and technological research in the CEE countries have seemingly not obtained the political high importance which this sector deserves, the universities, including privately funded Higher Education Institutions, have often bypassed the growth in Western countries. It was already mentioned that in Poland alone the number of students increased from 410.000 in 1991 to 1.800.500 in 2002. In a parallel development the number of Doctoral degrees in Poland has increased from 1.600 in 1991 to 31.000 in 2002.
The Universities in the CEEC's are as in Western countries an important part of the Science System. In the desired closer Industry-University relationship there are no basic differences any more between East and West – with one, however major difference – the number and the size of private enterprises is still far behind.

For Western companies wishing to be more visibly present in Central and Eastern Europe, the cooperation with local universities and with independent industrial research institutes could become an important avenue.

All the rules known from such a cooperation in the West can be applied here with mutual benefit:

- 'Industry has no need or desire to direct the activities of university research. That would be paying for hands not for brains. A corporation does provide support for researchers that have chosen to pursue research in fields that relate to the scientific base of the company's business, and normally such support goes to individuals who made who made sufficient contributions in their field to attract industry support: *The individual has selected the field; the corporation selects the individual.'*[25]
- Ensuring appropriate intellectual property rights in the organisation and intensity of industry-science relationships
- Assisting in the commercialisation of jointly achieved R&D results
- Assisting in start-ups
- Licensing arrangements
- Assistance to inventors to market their ideas
- Organising Enterprises For a for a involving alumni and local business[26]

The relatively high number of university partners in EU Framework projects – as compared to private companies in the CEE countries – suggests that the readiness of universities in Central and Eastern Europe to enter into international ventures is promising. A similar effort should be carried out to foster Industry-University Partnerships in both directions.

[25] Fusfeld, Herbert I., Industry's Future – Changing Patterns of Industrial Research, op.cit., p.181
[26] cf. Gast, Alice P., Mechanisms to promote Technology Transfer at U.S. Universities – the case of MIT, presentation at Innovation Forum, Friedrich-Ebert-Foundation, Berlin, 30. September 2004

VII. Conclusions

As Heinz Hefter (formerly Dupont) keeps on reminding us, the purpose of industrial research and technology transfer is ultimately the **creation of wealth through innovation**.

To achieve this goal, he is suggesting that several requirements have to be met:

- the right investments in education and R&D
- the right policies to groom entrepreneurs
- risk financing and
- global reach

Hefter is right, but the question remains for the countries in Central and Eastern Europe how to reach these ideal targets.
For the new EU member countries crucial choices have to be made to make their 'catching-up' strategy successful:
What are 'right' investments and what are 'right' policies?
To which extent can the EU assist in the formulation of meaningful solutions for the CEE countries, since the EU experience is exclusively based on experience developed by Western mature market economies?
Welfens et al. are recalling in this context the « Gerschenkron-hypothesis » published as early as 1962 according to which the CEE countries could benefit from an "advantage of backwardness": Since the countries in question have, as shown, a low R&D-GDP ratio, rising government expenditures on research and development plus higher education is of the essence.[27]
Practically all CEE countries have during the last years heavily invested into Higher Education (Poland for example, has quadrupled its student body since 1991 and has presently almost the same number of students as Germany with a population more than twice than that of Poland) but no similar efforts were made to increase the R&D-GDP ratio. Instead, the modernization of their economies was to a large extent driven by high FDI activities which were coupled with the import of most modern technologies from abroad. In the long run, this 'short-cut' strategy cannot substitute for a solid own domestic R&D base in Central and Eastern Europe, but it is certainly accelerating the modernization process of the countries of the region. The next phase of the catching-up strategy – as the successful Asian 'tiger states' have ably demonstrated – may be devoted to adaptation or imitation. Finally, the CEE countries are expected – within the European Research Area – to become technological innovators on their own.
For the time being, their comparative advantage consists mainly in the mixture of low costs coupled with well educated human resources.

[27] Welfens, Paul J.J. et al., EU Eastern Enlargement and Structural Change, op.cit., Introduction

ANNEXE

EIRMA Conferences 1965-2004

Monte Carlo	Integrating research policy into the general policy of the firm	1965
Ménars	An association for research management in Europe	1966
Lund	Technological gap between Europe and the USA	1967
Paris	Technological progress and economic expansion	1967
Scheveningen	Industrial research and big science	1968
Paris	International patent co-operation	1968
Venice	Documentation and information in R&D	1969
Dublin	Relations between industry and the universities in Europe	1970
Lausanne	International cooperation in research and technology	1971
Paris	Changing emphasis in industrial R&D	1972
Stuttgart	Technological forecasting and long range planning	1972
Zurich	Industry and the constraints on growth	1973
Copenhagen	Industrial R&D and environmental protection	1973
Paris	European Industrial research faced with the energy crisis	1974
Brussels	R&D for industry of the future	1974
Edinburgh	Industry-government relations in R&D	1975
Paris	The responsibility of industrial research towards society	1976
Rotterdam	Planning for R&D	1977
Paris	Technology 88	1978
Florence	Industry's needs for basic R&D	1978
Helsinki	R&D in an energy and raw materials conscious era	1979
Paris	Impact of micro-electronics on R&D in European industry	1980
Munich	Informing and communicating on industrial R&D	1980
Stratford	Industrial R&D in the innovation process	1981
Paris	New materials science and engineering	1982
Gothenburg	R&D as an investment	1982
Interlaken	The role of industrial R&D in the 80s	1983
Brussels	Technological challenges to European industry today	1983
Cannes	Managing the human resource of industrial R&D today	1984
Paris	Towards a new technological base for industry in the 90s	1985
Scheveningen	Productivity and effectiveness of R&D	1986
Milan	Integrating R&D into the company	1986
Paris	Manufacturing systems of the future	1987
Madrid	Madrid: R&D, technology and corporate strategy	1988
Brussels	Industrial R&D and public policy	1989
Paris	Technology 99	1989
Berlin	Mastering the growth of scientific and technological information	1990
Paris	25 years of industrial R&D management in Europe	1991
London	Industrial R&D and the human resource	1992
Helsinki	Speeding up innovation	1993
Interlaken	Funding and financing industrial R&D	1994
Prague	Globalisation of R&D	1995

Paris	The bases for long-term planning	1995
Amsterdam	Quality R&D	1996
Venice	The evolution of industrial R&D	1997
Dresden	Business growth through dynamic R&D	1998
Lisbon	Information and communications technology in R&D	1999
Paris	Towards the next generation	2000
Paris	Scenarios for the future	2000
Stockholm	Delivering innovation and value	2001
Vienna	Innovation through collaboration	2002
Sorrento	Shaping the Future : Breakthrough Research and Innovation	2003
Edinburgh	Increasing the Entrepreneurial Spirit of R&D	2004
Copenhagen		2005
Berlin		2006