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“New Perspectives for Research and Technology Organisations within the National Innovation System:
Experiences from Western Europe
with special reference to the transformation of RTO’s in East Germany

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1.) Introduction: The scope of the problem, definitions and typologies

This meeting here in Warsaw comes at the right time.

- Prime Minister Marek Belka has just announced a massive increase of the Polish R&D budget within the National Development Plan covering the period 2007-2013.[1]

  This is good news.

The topic to be discussed at this conference, that is to say finding ways and means to optimise the national Innovation system, is of increasing concern not only to Poland, but for varying reasons to other governments in Europe and in North America.

- Chancellor Gerhard Schröder has appointed Professor Bullinger, the President of the of the largest German RTO, i. e. the Fraunhofer Gesellschaft to chair a massive Innovation Campaign (*Partners for Innovation*) encompassing all straights of the German Innovation System
- President Jacques Chirac of France has announced earlier this month the launching of a multi-billion project to re-activate the French RTD system through new large scale missions
- In the United States, a "National Innovation Initiative" supported by 400 key individuals, including Corporate Chief Executives, Presidents of the Ivy League Universities, Directors of the large Biomedical Centres and the Heads of National Research Centres) has just presented a series of recommendations aiming at a better cooperation between Science and the Economy.[2]
- The 2004 OECD-Meeting of the Ministers for Science and Technology have reached the following conclusions:
  "Changing innovation processes and the evolution of the relative contribution made by the private and public sectors have emphasised the need for strong industry-science linkages. A well functioning interface between the innovation and science systems is more necessary than ever to reap the economic and social benefits from public and private investments in research, and ensure the vitality and quality of the science system…".[3]

These new initiatives have deeper roots: The last few years have seen within nationals contexts such as in Poland, within the EU and the OECD and within the leading Europe-wide operating non-governmental organisations a growing debate on the optimal role in society of the 'National Innovation System" with particular emphasis on the knowledge base funded by public sources.
In the centre of the interest has been the whole range of the so-called "Public Research Organisations (PRO)", i.e.

- Universities
- Research and Technology Organisations (RTO's)
- Other publicly funded bodies,

[1] The Chancellery of the Prime Minister, Speech by PM Marek Belka on 11. January 2005, Press Release 24.1.2005
[2] Schwägerl, Christian, Ökosystem Innovation – Die amerikanischen Wissenschaftsstrategen haben ähnliche Sorgen wie der Bundeskanzler, in: Frankfurter Allgemeine Zeitung, 25. January 2005
[3] Final Communiqué, Meeting of the OECD Committee for Scientific and Technological Policy and Ministerial Level: Science and Technology and Innovation for the 21st Century, Paris, 2004

all carrying out research and/or development work that is intended for broader application.

It is understood that our Warsaw meeting will focus mainly on the future role of RTO's in Poland. And yet, it would be a grave error, seeing the RTO's in isolation from the other partners in the Polish innovation system, i.e. Industry, Universities, PAN and other organisations contributing to the stock of scientific and technological knowledge in Poland.

By way of introduction I wish to quote one paragraph from a draft of the forthcoming "Handbook of Responsible Partnering", jointly prepared by

- the European University Association (EAU),
- the European Industrial Research Management Association (EIRMA)
- the European Association of Research and Technology Organisations (EARTO) and
- ProTon Europe, a pan-European Network of Knowledge Transfer Offices linked to Universities and PRO's

"*Europe's dense network of Public Research Organisations carries out work of generally world class standards. Traditionally, the knowledge creation capacity of institutes has been measured by the number and quality of publications that emerge. In this "Open Science Model", researchers collaborated closely, but often without regard to the wider benefits that this knowledge could provide. Today, and particularly in Europe, more attention is being given to the conversion of knowledge to achieve economic value and social benefits. The trend towards new patterns of innovation, highlights that it is possible to work more effectively, and that new opportunities emerge, which creates accompanying new demands."*[4]

Any attempt to define the term "RTO" as contributor to the national knowledge system in a way acceptable to all is difficult. A *wide* notion of RTO's will necessarily include universities and Academy Research institutes, whereas RTO's in the *narrow* sense refer to organisations outside the universities.[5]

2.) Innovation System: Knowledge Generation and Knowledge Transfer

The Business and Industry Advisory Committee to the OECD has made a statement to the OECD Ministerial Conference in January 2004 which puts the complex issue conveniently 'into a nutshell': *The quality of all our economies depends on their ability to acquire, protect, translate, combine and apply knowledge. This knowledge is needed to solve today's problems and to prepare the ground for solving tomorrow's. Without new knowledge and new combinations of knowledge, there will be no innovation."*[6]
Although all nations have the same objective when it comes to policy setting and organisation of science and technology, i.e. to optimise the generation, diffusion and application of knowledge to sustain the well being of the society, there are no two countries having adopted the same national Innovation System.[7]

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[4] EUA/ProTON Europe/EARTO/EIRMA, "Responsible Partnering" – Capitalising Upon Our Strengths in an World of Open Innovation: A Guide to Better Practises, Brussels/Paris, Version 1.0, January 2005, p.5
This report draws on the conclusions of a Conference Report "Effective Collaborative R&D and Knowledge Transfer, Brussels, 5-6 February 2004. The meeting was jointly organised by the 4 organisations and supported by the DG Research of the EU

[5] Farina, Claudio and Preissl, Brigitte, Research and Technology Organisations in National Systems of Innovation, German Institute for Economic Research (DIW), Discussion Paper No. 221, Berlin, July 2000

[6] BIAC, Promoting Better Public-Private Partnerships: Industry-University Relations, Paris, September 2003

[7] Herbert I. Fusfeld, former President of the Industrial Research Institute Inc. (IRI), Washington D.C., talks in this context about "the Technical Enterprise", Fusfeld, Herbert I., The Technical Enterprise: Present and Future Patterns, Ballinger Publishing Co., Cambridge, Mass., 1986

And yet, over the decades, intergovernmental organisations, such as UNESCO on a global scale, and more linked towards the special conditions of industrialised countries, OECD and with particular relevance for Europe, the European Union, have assisted member states in formulating and constantly adjusting their national science, technology and innovation policies.[8]
For countries such as Poland, belonging for more than 40 years to the Soviet led-COMECON, and in consequence having organised its national economic system as well as its science policy system, like all the other COMECON countries, similar to that of the Soviet Union, the transition to market economies and thus to a completely different style of generating knowledge and innovations came abrupt.
The transformation of the East German Science Sector in the years 1989-1991 was described in hindsight by the President at that time of the German Science Council, Professor Dagmar Schipanski, as follows: *"What might look today as a success story that has been achieved without any set-backs or difficulties, was in reality a painful, exhausting, and moving process por all people involved…".*[9]
The process of adjustment, as this debate at this meeting clearly demonstrate, is – not surprisingly – far from completed.

In spite of the trends of globalisation, Europeanisation, Internationalisation of Knowledge, the fact remains that science and technology policy efforts are still essentially geared towards **national** goals. On the other side, any national innovation concept must take into account that traditionally any results generated within '*the Republic of Science'* have a worldwide diffusion and contribute to the stock of knowledge of the world as a whole.
On the other side of the spectrum, multinational corporations which undertake the 'lions share' of industrial R&D are generating and transferring their technological knowledge from and into in many parts of the world.

a. The global dimension

The global dimension of any consideration concerning the responsibilities of RTO's has three distinct, but interrelated features: (1) Custodians of knowledge, (2) Providers of solutions to global problems (3) Players in global competition:

1. According to Joseph Stiglitz, Chief Economist of the World Bank, 'most knowledge is a *global public good*...".[10] Within the context of a revision of the Patent and Copyright Legislation in the EU and in the USA the issue of "*Global Commons"* in a global Science Society has given cause to controversy.
2. '*Global responsibility*': With increasing globalisation it has become increasingly more important to focus on partnerships and alliances to address global problems.[11] One

[8] Standke, Klaus-Heinrich, The Impact of International Organisations on National Science and Technology Policy and on Good Governance, European Institute for International Economic Relations, Potsdam University, Discussion Paper No. 104, Potsdam March 2003
[9] Schipanski, Dagmar, The Status of Scientific Research at Universities, Academies and Extra- University Institutes – Approaches and Transformations in Connection with German Unification, in: German-American Academic Council Foundation (Editor), Scientific Research in Universities, Academies, and Extra-University Institutions of Central Eastern European Countries, Germany and the USA – Approaches, Experiences, Perspectives; Proceedings of the Halle Symposium 1997, Bonn-Washington D.C. 1998, p.49
[10] Stiglitz, Joseph E., Knowledge as a global public good, in: Kaul, Inge et al. (Editors), Global Public Goods – International Cooperation in the 21st Century, Oxford University Press, New York – Oxford 1999, p.310
[11] Deutscher Bundestag (Editor), Globalisation of the World Economy (Globalisierung der Weltwirtschaft), Final Report of the Enquête Commission, (Chairman: Ernst-Ulrich von Weizsäcker), Leske + Budrich, Opladen 2002

recent initiative is the creation of the "Global Research Alliance (GRA)", formed by eight Knowledge Intensive Technology Organisations spread across the world.

3. Globalisation means also *global competition.* The globalisation of trade means that new products, processes and services often must compete from the start on world markets. Protected home markets are disappearing. In addition to the traditional competitors among nationals industries and national RTO's there are increasingly competitors operating globally. Multinational companies are not anymore predominantly of U.S. and of European origin, from Asia there are not only the large Japanese, Korean and Taiwan technologically leading world players, most recently China and India have entered the global competition.

b. The European dimension

Te European Union spends about 4% of its annual budget on the implementation of R&D policy. This amounts to 5% of the combined public input by member states. The budget of the current (sixth) EU Framework Programme on research is € 17.500 million. The objective of creating an *European Research Area* is the guiding ideology of the EU Commission and approved by the EU member states.
The so-called Lisbon strategy for growth and employment continues to be the cornerstone also of the new Barossa-Commission.[12]
As just pointed out in connection with the global dimension of R&D, many observers are casting doubts on this narrowly geographically confined concept and are warning about the building of an "R&D fortress Europe": *"ERA basically hinges on two arguments. First it is about integration. The idea that we should integrate all forces in Europe in each and every area of science in networks of excellence that can compete as a whole versus the United States, is a completely wrong idea.*
The second notion is behind ERA is subsidiarity and co-ordination. Integration should be based on whether it is necessary for producing top-quality science, and on the nature of science. Science means competition; integration comes in if you lack size, for example. If you, however, look at the size of the European research efforts, it is rather strange to think that integration is necessary…".[13]

Be this as it may, the EU framework Programme is aiming to orient the R&D efforts towards a set of commonly defined targets of European interest, it is deliberately attempting not only to forge intra-European Research teams but furthermore to foster collaboration within public-private partnerships involving private firms, universities, RTO's, i.e.the entire R&D machinery, in collaborative and multi-annual research actions.
To what extent the gradual interaction of national R&D policies and of R&D on the enterprise level might ultimately facilitate on the supranational level something which might be called a true European R&D policy is at present a question of speculative nature.[14]

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[12] Cf. Facing the challenge: The Lisbon strategy for growth and employment, Report from a High Level Group chaired by Wim Kok, Brussels, November 2004

[13] Tindemans, Peter, Competition instead of Integration, in: Stifterverband für die Deutsche Wissenschaft (Editor),
Weighed and Found Wanting? New Challenges for Research Policy in Germany and in Europe, Proceedings, Villa Hügel-Gespräch 2002, Essen 2003, p 42

[14] see also Welfens, Paul J.J., Auf dem Weg in eine europäische Informations- und Wissensgesellschaft: Probleme, Weichenstellungen, Politikoptionen, European Institute for International Economic Relations, University of Wuppertal, Discussion Paper No. 117, Wuppertal, January 2004, p.11

c. Main Focus: The national dimension

Science and Technology Policy is an important part of overall national policy designed to ensure safety and economic and social welfare.

The question must be asked, to what extent it would be both feasible and realistic to confine issues of Science and Technology, which are by definition of an international nature into a national context. Can we still assume geographic boundaries of the national systems or whether the process of globalisation (or Europeanisation) has erased them and innovation is now a global process? If this were so, national approaches would not make much sense.[15]

The R&D priorities set e.g. by the EU Framework Programmes are not necessarily the priorities which a country such as Poland would define in order to catch-up with the group of former EU-15 countries in Western Europe. And yet, Poland as a EU-25 member has to adjust its R&D efforts accordingly.

The same can be said about industrial R&D. In the case of Germany, for example, the latest available statistical data reveal for 2001 that 24,8% (= 8,0 Bill.€) of all industrial R&D in Germany was carried out by subsidiaries of foreign companies.
At the same time, German companies in 2001 carried out R%D in laboratories of their own subsidiaries in foreign countries in the value of 12 Bill. €.[16]

Any 'national' science and technology policy must take into account that an ever increasing part of the R&D budget is being spent outside the direct governmental influence .

d. The regional dimension

In all countries the R&D competence is unevenly spread. Usually in the capital region a high percentage of the given country's innovation potential is concentrated. The same is true in Poland. Furthermore, some geographic regions – usually, but not always, because of historic industrial concentrations – have specialised in certain technological fields.
As a consequence, at the national level there are so many differences between regional rates of performance, that regional disparities might be further aggravated by a national perspective on policies.[17]
The existence of a large R&D base in a given region or city becomes increasingly a decisive factor within the competition among regions. The presence of considerable innovation capacities is of particular importance to attract national or foreign investment. It becomes thus an import regional development factor:
A recent U.S. study reveals that 'skilled cities' are growing because they are becoming more economically productive (relative to less skilled cities). There is evidence that the skills-city growth connection occurs mainly in declining areas and occurs in a large part because skilled cities are better at adapting to economic shocks.[18]

[15] Farina, Claudio and Preissl, Brigitte, Research and Technology Organisations in National Systems of Innovation, op.cit., p.3
[16] F&E im globalen Umfeld: Zunahme der Verflechtung deutscher Unternehmen, Stifterverband für die Deutsche Wissenschaft, FuE Info 1/2004, pp 14-16
[17] Farina, Claudio and Preissl, Brigitte, RTO's …, op.cit., p. 3
[18] Glaeser, Edward L. and Saiz, Albert, The Rise of the Skilled City, NBER Working Paper No. w10191, Washington D.C., December 2003

3.) The main contributors to the national Sc&T knowledge base

The main actors contributing to the 'Knowledge base' of any given country are easily distinguished:

a. The private sector
    i. Knowledge intensive industrial companies
    ii. Knowledge intensive business services (Consulting companies)
b. Public funded institutions
    i. Universities and Technical Universities
    ii. RTO's
    iii. Academies of Sciences and of Engineering
c. Private-Public Partnerships

In some countries, such as Sweden, the main contributors to the national SC&T knowledge base are the universities, in others, they are technology-specific or industry-specific RTO's. Some of them are public or semi-public, others are private and/or subsidised through public funds. There is no obvious magic formula for an optimal mix of institutions. One common recent development should be stressed:
An increasing amount of the research carried out either by industrial firms or in public research institutions is now undertaken collaboratively. Not only are private firms forming strategic partnerships with the purpose of joint R&D, but increasingly these partnerships are also involving universities and RTO's.

4.) New patterns of cooperation within the Innovation System

The first European conference on RTO's took place in Brussels on 16/17 november 1993[19]. RTO's have joined forces

- on a *global* scale, i.e. through the World Association of Industrial and Technological Organisations (WAITRO), created under the auspices of UNIDO

- on a *European* scale, i.e. through the European Association of Research and Technology Organisations (EARTO). EARTO operates a directory and search tool, NEXUS, guiding interested parties to the technology
  Within EARTO an informal interest group, EuroTech, has been created.
  It consists of the Chief Executives of 13 large RTO's from 8 West European countries.

  or, the European Association of Contract Research Organisations (EACRO),

  or, the Federation of European Industrial Research Cooperative Research Organisation (feicro)

- on a *national* scale, i.e. through the Applied Industrial Research Trading Organisations (airto) of the United Kingdom

  or, for example in Poland, through the Technology Partners Consortium.

[19] Tiscar, J.R. (Editor), The future of research and technology organisations in Europe. Proceedings of the first European conference on RTO's, EIMS Publication No. EUR 15458, Brussels 1994

If the issue were to link the Polish RTO's as efficiently as possible with the West-European RTO networks, it is surprising that among the appr. 100 EARTO members, there is only one from Poland, i.e. the Technology Partners Consortium. Incidentally, EARTO will organise its 2005 Annual Convention in Poland, i.e. from 14-15. April in Warsaw.

The same has to be said about the membership in EIRMA. Among the appr. 150 member companies there is not one industrial enterprise from Poland, but we find again our friend Tomasz Kosmider and his colleagues from the Technology Partners Consortium.
EIRMA, created in 1966 under the auspices of the OECD in Paris has organised its first East-West-European dialogue between R&D managers on 20/21. October 2004 in Krakow. The meeting was attended by Delegates from research and technology organisations from 13 countries.[20]

There is no Polish member in EuroTech. without statutes and without a definite organisational structure,

5.) The funding of RTO's

To no one's surprise, even at the first European conference on RTO's in November 1993, one of the main findings reads as follows: "*Funding issues are of central concern to RTO's because public sector funding is being reduced in many countries and switched from core-funding to contract-base awards. At the same time RTO's face tougher attitudes from their traditional private sector supporters. As a consequence, RTO's need to solve the dilemma of how to maintain their "public duty" role in helping unsophisticated SME's and the dilemma of how to finance the renewal of their technology bases. Virtually all RTO's have to become market oriented using a variety of approaches to restructure their business…*".

What else is new?

Perhaps the Chairman might want to wish to insert this paragraph into the conclusions and recommendation of this Warsaw meeting?

The attached chart compares the income of four of the leading European RTO's, i.e.

- Fraunhofer Gesellschaft (Germany)
- TNO (Netherlands)
- VTT
- SINTEF (Norway)

According to their main source of income (Private contracts, Public contracts, National/International funding organisations (e.g. EU) and institutional funds.

[20] innovation, EIRMA Quarterly, Winter 2004: "The business environment in Eastern Europe": Do Poland and other former eastern European states offer a rich source of research and technology transfer capacity? Delegates from research and technology organisations in 13 countries met in October 2004 to find out and to learn how to put the capacity to good effect.
The meeting revealed the importance of awareness and trust to effective collaboration. The key issue is where to find the right partner. Once this has been recognized, steps can be taken to overcome the 'waiting-room mentality', where each partner waits for another to approach them first. This allows both parties to communicate their requirements and capabilities and so enables better match-making." www.eirma.asso.fr/eastern

6.) Special situation of RTO's in Transition countries:

- The case of Poland

At a meeting organised in Potsdam by the Council of Europe in January 1993 devoted to the Assessment of "Scientific Policy in the Service of a Greater Europe" *Jan Krzystof Frackwiak* described the situation of RTO's in Poland at that time as follows:
Over 400 institutes and over 800 basic units of schools of higher education are eligible to apply for statutory activity funding by KBN.
In 1992, there were altogether 858 applications – 82 from PAN institutes, 239 from R&D units, 537 from 'units' (mainly faculties) of higher education schools.
The results of classification and decisions on statutory activity funding were as follows:

"A": 28% of units, 73% of resources
"B": 32% of units, 23% of resources
"C": 25% of units, 4% of resources
"D": 15% of units, 0% of resources.

Depending on the result of the assessment ((a.) level of scientific specialisation, (b.) scientific value of a specific research plan, (c) expected results for practical operations) the highest funding goes to category "A", the lowest to category "C".
His description concludes: "As the links between science and economy are still not satisfactory in Poland, the KBN will seek institutional and financial support from the state in processes involving the implementation of research results, especially those concerning technology transfers."[21]

In 1997, *Marian Truszczynski,* PAN-VicePresident, mentioned 225 RTO's in Poland, out of which 69 belonged to category "A", 85 to category "B", 62 to "C" and 9 to "D". In his opinion, the RTO's are at varying levels: "To a very great extent, their work in involves a number of technical developments which cannot, strictly speaking, be equated with scientific activity. This is confirmed by the above-mentioned figures, indicating that almost 66% of these institutes belong to categories "B" and "C". All the same, it must be pointed out that quite a significant percentage, i.e. 30,67%, of the RTO's, especially national research institutes in the chemical, medical, and agricultural sciences, can be allocated to category "A" and, as regards the level of their scientific work, compare well with the Pan institutes and good university institutes."
His description concludes: "Collaboration on R&D between the institutes of PAN and the universities…on the one hand, and RTO's…on the other, is inadequate at present…".[22]

In 2000, *Richard Granger and Tomasz Kosmider,* after having evaluated a total of 50 RTO's reached *inter alia* the conclusions that "Industrial R&D institutes are the leaders and an example of independent transformation and adaptation to functioning under free-market conditions".[23]

[21] Standke, Klaus-Heinrich (Editor), Science and Technology Policy in the Service of a Greater Europe, Campus, Frankfurt/New York 1994, pp. 173/174
[22] Truszczynski, Marian, Scientific Research in Poland: Taking account of the establishments of Higher Education, the Institutes of the Polish Academy of Sciences (PAN) and the Research and Developments units, German-American Academic Council Foundation (Editor), Scientific Research un Universities, Academies, and Extra-University Institutions of Central Eastern European Countries, Germany and the USA – Approaches, Experiences, Perspectives, Bonn-Washington D.C. 1998, pp.115-117
[23] Granger, Richard and Kosmider, Tomasz, The Institute restructuring and training – overview and conclusions, in: Foundation for Polish Science (Editor), SCI-TECH II Programme, Proceedings of the final Conference, Warsaw 2000, p.62

In 2004, concerning the RTO's *Jan Kozlowski*, is reporting this: "…The relatively significant R&D potential contained in the in the industry or branch R&D units is rather disconnected from the wider economy. Continued state funding enables these institutes to carry out research without much regard for the needs of the end-user, whether consumers or firms. This is indicative of the continuing fragmentation of the R&D innovation system.[24]

1. The country, at present, as a matter of high priority has to look for and to find the optimal legal forms for 202 R&D governmental units existing in Poland to reduce their number and to improve their effectiveness. The following legal structures are considered as feasible:
   - State Research Institute
   - holdings
   - merging of several institutes
   - commercialisation, privatisation and restructuring into the Research Centres on the basis of new act on innovativeness
   - Consortiums and networking
   - merging into Academy of Science or into universities

The all mentioned above forms are allowed accordingly to the act on R&D Units or on the new act on innovativeness (currently being in Parliament).

2. The second problem is the structure of financing of R&D activity.
There is a need to change the existing relation: 70% - budget, 30% industry to the opposite, like in developed Western countries. This is a problem, which is related to incentives for enterprises, tax policy, development of financial banking support, the venture capital, seed capital and risk capital.

At the time being, only a few R&D units are involved in the privatisation process. According to the intention of our Ministry of Economy and Labour, which supervises 117 of 202 R&D units should undergo restructuring to the forms mentioned above.
In 202 R&D units there are working about 12.200 scientists (as full time job) which is 22% of all scientists engaged in R&D activity in Poland. The present governmental subvention for R&D sector is about 122 M € and their yearly incomes are about 500 M €.[25]

- **The case of East Germany, the former GDR**

Germany has spent in 2002 53,3 Bill.€ on R&D. East German Research Institutes outside the universities are obtaining 29,2% of all national funds, universities 21,6% of the R&D funds, and industrial research only 9,9%.

[24] Kozlowski, Jan, Poland: Restructuring S&T without radical transformation, in: Meske, Werner (Editor), From System Transformation to European Integration. Science and Technology in Central and Eastern Europe at the beginning of the 21st century, Lit Verlag, Münster 2004, p. 191, see also: Jablecka, J., Changes in the Management and Finance of the Research System in Poland: A survey of the Opinions of Grant Applications, in: Social Studies of Science Vol. 25, No. 4, 1995, pp.727-753

[25] Śmieszek, Zbigniew, Information provided at the EIRMA Conference "The Environment for Industrial Research and Technology Transfer in Eastern Europe", Krakow, 20-22 October 2004

Appr. one half million people (480.606) are employed in the German Innovation system, 55% of which are Researchers, 21,5% are Technicians and 23,5% other support staff.

307.257 are employed by the private sector, 101.443 by universities and 71.906 at Government funded institutes.

The Federal Government and the 16 Länder have devoted in 2002 16,3 Bill.€ to R&D.
29,7% of this amount went into the institutional financial support for Research organisations:
15 large research organisations (Helmholtz-Community) = 1,563 Bill.€ (31,9%)
German Research Association (DFG) = 1,261 Bill.€ (25,8%)
Max-Planck-Society (77 MP Institutes) = 0,935 Bill.€ (19,1%)
Leibniz Association (80 Institutes outside Universities) = 0,701 Bill.€ (14,3%)
Fraunhofer-Society (57 Institutes, Total Budget: 1,0 Bill.€) = 0,384 Bill.€ (8,0%)

- East Germany (including Berlin) has a population of 17,009 mill. inhabitants, this equals 20,6% of the country's population.
  For comparison: Poland = 38,600 mill. inhabitants
- The East German GDP at the time of German re-unification, i.e. in 1991 amounted to 11,0% of the accumulated GDP of Germany, in 2003 – in spite of massive West-East German transfers (more than 1.200 Bill. €) and access to EU structural funds – it did not climb higher than 14,8%.
  For comparison: GDP of East Germany = 292,2 Bill.€, Poland: =200,4 Bill.€ (2002)
- The share of East Germany in all German exports is only 5,8% (2002), 6,67% (2003)
- The unemployment rate of East Germany is with appr. 19% about twice as high as in West Germany. It is thus in the order of magnitude of the unemployment rate in Poland.

Even 15 years after the German reunification, the Federal Government is still reporting on all R&D related activities separately on the developments in West and East Germany. In spite of tremendous efforts to reach more or less the same standard in the country, there still remain marked differences in the R&D performance.

The East German share of the country's Innovation system is as follows:

From the national R&D expenditures:	2,8 Bill.€	= 14,4%
Research Institutes outside universities:		= 29,9%
Universities:		= 21,6%
Industrial Research institutes:		= 9,0%
R&D Personnel	80.662	= 16,8%
out which		
Research Institutes outside universities:	20.521	= 28,5%
Universities:	23.238	= 22,9%
Industrial Research institutes:	36.903	= 12,0%

Against these 'input' figures the share of the 'output' of the East German Innovation system if measured in terms of patent application is with 3.771, i.e. 7,2% of the German total of 52.650 applications in 2003 relatively poor.

What has happened? Did anything go wrong?

And which conclusions – if any - could possibly be drawn by other former COMECON countries from the experience of the transformation and modernisation of the East German R&D system?

In 1990 at the time of the German re-unification, there were in both parts of Germany some 560.000 people employed in Science and Technology. (For comparison: In 2004 the German Innovation System employs some 480.000 researchers and auxiliary staff).
The distribution among the main fields of occupation was as follows:

	German Democratic Republic 1989	Federal Republic of Germany 1987
Economic Sector	61,3 %	70,5 %
Government Sector	26,9 %	13,5%
Universities	11,8 %	16,0 %
Number of employees	140.565	419.205

Source: Renate Mayntz, Deutsche Forschung im Einigungsprozess, Campus, Frankfurt/New York 1994, p.40

There have been two parallel evaluation processes, both in the period 1990-1992; one dealt with the assessment of the scientific institutions of the former GDR Academy of Sciences and related institutes, the other with the institutes devoted to applied research for industrial purposes. It is the latter category which may be of interest to the present Polish situation.

From the appr. 80.000 researchers in industry or in RTO's employed in 1990, today some 22.000 are still in place.
The development can be seen from the following graph:

It is being reported that 17 to 22% of the R&D staff not retained in their previous position moved to West Germany or to foreign countries; 15 to 20% found employment outside the research sphere, some 10% have been re-trained for other professions, 10 to 15% became unemployed and some 15% took early retirement.[26]

As a general conclusion, it can be said, that most of the Researchers working in fields of natural sciences and engineering sciences at the GDR academy did not encounter great difficulties in finding new employments, whereas both the social scientist and those working in industrial R&D have found the reorganisation of the science scene difficult.

7.) New Challenges and New Perspectives for RTO's

a.) Research bought outside the firm

One of the first Working of EIRMA in Paris, almost 40 years ago, dealt with the issue of "external research". Research bought outside the firm accounted at that time for roughly 3% of total research. It was felt that the importance of this form of research was greater than the figure of 3 % might suggest. Certain of industry's needs in research could indeed be best met externally. Ways had to be identified so that industry could derive more benefit from the advantages that outside research undoubtedly offers.

[26] Kohn, Helmut, Externe Industrieforschung im Wettbewerb, Schriftenreihe H. 5, Verband Innovativer Unternehmen, Dresden Mai 2001, p.21

EIRMA identified in 1968 four main sources as suppliers of outside research:

1.) Universities and RTO's
2.) Research Associations
3.) Government Research Centres
4.) Independent Contract Research Institutes.

An identical list of R&D Suppliers was highlighted in 2003 by the European Research and Technology Organisations.[27]

The main reasons cited in the EIRMA report for going outside for research support are equally valid today:

1.) Exploratory work in new fields on the periphery of the company's major activities
2.) The purchase of special expertise or of time on expensive equipment whose permanent acquisition by the company could not be justified

Most of the experience reported to the group suggested that reasonable value is obtained from outside work, with the greatest benefits being derived from short, fairly well-defined projects operated under close technical liaison.[28]

It is important to recall that this EIRMA report was written at a time when the central laboratories of the large research-intensive industrial companies have had the greatest role in the process of knowledge-generating for the firm. The 60s and early 70s of the last century are thus being described as "the Golden Age of R&D labs". In the last decades, the situation has drastically changed: *"Partnering, strategic alliances, collaboration and co-operation are more and more used to produce, access and require new technology. Corporate researchers are becoming "hunters and gatherers" of technology rather than technology originators."*[29]

a.) Trends in Western Europe towards R&D Outsourcing

Although systematic figures at European level on trends in R&D outsourcing are not available, the European Research and Technology Organisations EACRO and feicro have attempted to gather for illustrative purposes some figures from several European countries:

"- France: R&D outsourcing has grown 2 ½ times faster than R&D spending in general
- Germany: The share spent on R&D purchased from third parties is oscillating around 10,1% to 13,0% of total R&D spending
- Italy: Comparing 1994 with 1991 shows an increase in R&D outsourcing expenditure of 12,5%
- Netherlands: Sectoral figures show over the period of 1990-1994 a particularly marked growth in outsourcing in the chemical industry (+ 24% over the four years) and especially in the food industry (+ 88%).
- Sweden: The most recent figures (1995) indicate that one third of R&D expenditures made by manufacturing industry goes to external R&D performers.

The overview concludes: *"The above figures are clearly imperfect evidence. Nevertheless, they all generally point towards an important and growing European market in R&D outsourcing by firms…*

The trends point to a growing corporate market in R&D outsourcing and technology acquisition. As the competitive pressure pressures on industry continues to increase, this market is likely to continue to grow. It represents a significant opportunity and challenge for the specialised RTO's, while governments, as R&D funders, need to review their programmes to ensure that they are in tune with the trends.

The report contains also a word of warning towards the RTO's:

[27] EACRO and feicro, The changing world of industrial R&D, Brussels 2003
[28] EIRMA, Research bought outside the Firm, Working Group Report No.2, Paris 1969, pp.21/22
[29] EACRO and feicro, op. cit., p.1

"To gain a position in this changing world will mean a different attitude for some RTO's: The focus must be increasingly on the needs of the client (as opposed to, for example, a research centre's skills). Given industry's favourable perception of the specialised industrial RTO's, they are generally in a good position to meet this challenge"[30]

RTO's can benefit from the changing attitudes of the knowledge-intensive industry towards the sources of innovation. Many corporations are outsourcing considerable parts of their R&D requirements to Universities (Rolls-Royce for example, undertakes practically its entire R&D through sub-contracts carried out by Universities in the UK and on the continent).

As demonstrated, in many countries a need is felt at the national level to analyse the innovation system as a whole. The RTO's in Poland, when adjusted to the new challenges of the country as a new member of the EU, can become an important pillar in this endeavour.

The new potential is shown below:

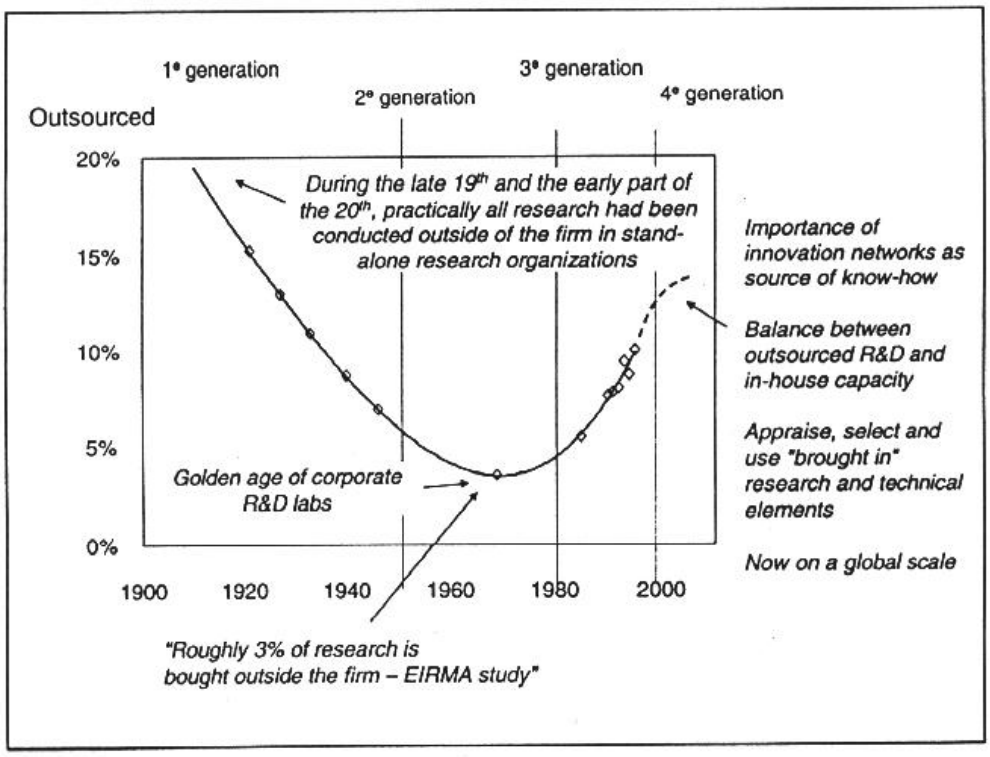

Figure 2: Changing patterns of industrial R&D outsourcing

Source: Conference presentation by Prof de Wit and references [8]

[30] EACRO and feicro, op.cit., p.2

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