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The political context of the Reform Programme for the Science and Technology Sector of Poland
(Phare SCI-TECH II)

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Abstract

1. The Treaty of Rome, signed in 1957, has from its outset given special attention to the rules of competition. The European Council in Copenhagen in 1993 which set in motion the process of EU enlargement has thus reiterated a number of criteria (the so-called '*Copenhagen criteria')* which are asking the prospective new member states, such as Poland, in addition to meeting the obligations from the *'Acquis Communitaire'* to proof "*the existence of a functioning market economy and the capacity to withstand competitive pressures and market forces within the Union*". The evidence of the international competitive situation of Poland gives cause to grave concern.
2. The Treaty of Maastricht, signed in 1992, and reiterated by the Treaty of Amsterdam, signed in 1997, have put the international competitiveness of the EU in the centre of the RTD policy of the EU. All EU RTD measures have to serve this overall purpose. Although in recent years the Polish government has undertaken remarkable efforts for modernising and strengthening the RTD system, most of the indicators used for international comparisons of the national Research System are revealing, that Poland is seriously lagging behind not only in comparison with the EU-15 countries, but also in comparison with some of the other accession countries from Central and Eastern Europe.
3. Poland's R&D inputs – measured by R&D expenditure and by the number of R&D personnel – is still considerably smaller than the EU average. To raise gradually the present 0,78% GERD of Poland to the EU average of 1,7%, the annual Polish expenditures would ultimately have to be raised to ... US-$. In order to reach the ambitious target set by the European Council, getting Europe to be '*the most competitive and innovative region in the world by 2010'*, it has been proposed, that the European GERD should reach within the next decade at least 3,0 % of the GDP. If Poland would be in line with the other EU countries, to reach such a target, not even allowing for the likely further growth of the GDP, the Polish GERD will have in nominal terms to quadruple within ten years.
4. R&D investment is generally thought to be a necessary condition in fostering international Competition. Therefore, national RTD policies are based on the assumption of an automatic linear relationship whereas R&D efforts will be translated into technology output to create innovations in production that will increase competition and trade activities. Such a view would be too simplistic. Not only is the causal relationship difficult to establish. International comparisons show that not all countries need to be technological 'leaders' in order to be economically profitable and furthermore, '*quick fixes'* in redressing the RTD system are not possible. The urgently needed adjustments in the Research-Technology-Innovation system, as well as in the Human Resource Development, are of a medium term, if not long-term nature. In any event, they are calling for bold political decisions in giving considerably higher budget priorities to the RTD sector as well as reformulating the relationship between government, the scientific community and the private sector.
5. Poland will be in an enlarged EU the sixth-largest country. It will thus undoubtedly have to play a leading role in the necessary re-adjustments in the European RTD strategy. Being a late-comer in the EU has also certain advantages:
   The Polish policy-makers in preparing for Poland's future can benefit from 'best practises' in fthe attempts of other European countries to formulating their own modern RTD policy. Polish policy makers can also can also, from the outset, seize the opportunity in adjusting the Polish commitments towards the EU against the background of increasing

feelings of uneasiness at the recent European Council meetings concerning the appropriate way of an integrated Europenan RTD policy in order to meet the Lisbon targets.

6. The European Union, within the framework of the Phare Technical Assistance Programme, has provided specific support to the Polish Government, represented on behalf of the State Committee for Scientific Research (KBN) by the Foundation of Polish Science (FNP), through SCI-TECH II *"To reform and utilise Poland's science and technological development potential more effectively towards the economic development of the country, especially in the context of preparing the S/TD sector for EU membership, and supporting and strengthening Polish S/TD administration during preparations to the accession negotiations."* 44
   The immediate objectives of the programme – which provides in reality the elements for devicing a massive master-plan for the role RTD in Poland's furture - are:
   a.) To support the further development and implementation of a national science and technology policy, especially with regard to preparing accession negotiations; to prepare the sector for future Polish EU membership.
   b.) To support the development of institutional systems for technology support, advice and transfer to SME's and larger enterprises; to assist in the development of the science and technology information infrastructure.
   c.) To support increased interaction between basic and applied research, higher education, and enterprise sectors.
7. The SCI-TECH Programmes have proven to be useful and most unique instruments for Poland to set in motion the government's modernisation efforts - in particular with regard to reaching a new balance between state-funded and privatised RTD institutes. It would be unwise to bring the promising restructuring efforts and the opportunity for introducing an integraded RTD policy concept prematurely to an end.
   SCI-TECH should not be ended after the phasing-out of the respective Phare funding, but should be continued until the satisfactorily restructuring of the RTD machinery has been completed. In this context an independent Expert Panel set up by the EU to assessment the EU RTD Programmes (1995-1999) has concluded in July 2000 *"The EU needs to take appropriate steps to ensure that the transition is successful."* [1] Undoubtedly Poland can continue to count on the multilateral EU assistance as well as on bilateral support on the country's efforts to become a competent and competitive partner of the European Union.

Introduction

a.) *The ultimate objective: Building-up of 'Knowledge Society' in Poland*

This is a time when the national policy of Poland with regard to science and technology is a particular critical factor in many areas of national concern, and when it plays a definitive role in setting the future directions of Poland and in the country's adjustment to new pressures both domestic and foreign in view of Poland's forthcoming full membership in the EU. The Government of Poland is mindful of this necessity: *"Science should be treated as one of the most important fields of investment into the future; its development must be ahead of economic and social development."*[2]

In "The World Science Report of UNESCO", when analysing the situation in Central Europe it is being said: *"The process of transformation of Science in Central Europe is well*

[1] European Commission, Chairman's Introduction, Five-Years Assessment of the European Union Research and Technological Development Programmes, 1995-1999, Report of the Independent Expert Panel, Brussels July 2000, p.15
[2] Declaration of the Polish Government, November 1997, quoted in: Science in Poland, KBN, Warsaw 1999

advanced, although both the endogenous and exogenous barriers diminishing the efficiency of this process have proved greater than originally anticipated. The crucial decade 1996-2005 must see the construction of a new model of science in Central Europe – a model well related to that created by the European Union which, at the beginning of the next century will most probably incorporate the Central European countries as full members. The transformation of science in Central Europe is necessary not only for science itself – but as an essential factor in the transformation of the whole economy."[3]

The European Council meeting, held on 23/24 March 2000 in Lisbon, has put, for the first time, research and development (RTD) policy in the heart of development policies of the EU.
In similar terms, the European Council of Research Ministers when meeting on 15 June in Luxembourg emphasised the significant role played by research and development in generating economic growth, employment and social cohesion.

In today's global market environment knowledge has become a decisive weapon for competitive advantage. Managing this knowledge in effective ways is now seen as an absolute necessity, in fact it is regarded as a core competence. Both the government of Poland and the Polish industrial enterprises – in concertation with the scientific community of the country – should thus give highest importance to create the conditions enabling the creation of a competitive '*Knowledge Society'*.
Investment in knowledge has grown faster than the GDP in OECD countries since the middle of the 1980s. Based on a 1995 survey, the OECD is estimating that its value today, i.e. public spending on education, GERD and Software, is roughly equivalent to that of investment in equipment. If Business Training (about 1% of GDP), innovation (graphic design, for instance), some market research or private spending on education were to be included, the overall investment in knowledge would be considerably higher than 10% of the GDP.[4]

c.) SCI-TECH as key instrument for the preparation of Poland's EU accession

Poland is presently in the final stages of preparations for the accession to the European Union. Among the many aspects to be considered in this connection is the optimisation of the RTD system as a key factor on which primarily the international competitiveness of Poland depends. The European Union, within the framework of the Phare Technical Assistance Programme, has provided specific support to the Polish Government, represented on behalf of the State Committee for Scientific Research (KBN) by the Foundation of Polish Science (FNP), through the SCI-TECH Programme executed in the period 1992-1997 and continued under the SCI-TECH II Programme. The latter was intended *"To reform and utilise Poland's science and technological development potential more effectively towards the economic development of the country, especially in the context of preparing the S/TD sector for EU membership, and supporting and strengthening Polish S/TD administration during preparations to the accession negotiations."* 44

The immediate objectives of the programme were:

1. *To support the further development and implementation of a national science and technology policy, especially with regard to preparing accession negotiations; to prepare the sector for future Polish EU membership.*

[3] UNESCO, World Science Report 1996, Paris 1996, p.90/91
[4] Investment in knowledge, OECD in figures, 2000 edition, Paris, June 2000, p. 47

2. *To support the development of institutional systems for technology support, advice and transfer to SME's and larger enterprises; to assist in the development of the science and technology information infrastructure.*
3. *To support increased interaction between basic and applied research, higher education, and enterprise sectors.*

The Reform Programme for the Science and Technology Sector of Poland (SCI-TECH and SCI-TECH II) is the important international instruments for setting in motion the necessary new strategic thinking concept in Poland on RTD. The SCI-TECH effort amounting for both Programmes to appr. 10 Mio. Euro is by far without without any parallel in the other CEE accession countries.
SCI-TECH II is composed of three major interwoven programme elements:

1.) Science and Technology Policy
2.) Technological Infrastructure
3.) Links between Science & Technology, Education and Enterprises

The following considerations are aiming to outline the wider context in which SCI-TECH is to be seen and to suggest vital follow-up actions after the envisaged phasing-out of the Phare technical assistance.

I.) Significant features and particular concerns

1.) The potential of the RTD system of Poland: Facts and figures[5]

The Polish RTD system has been the subject of numerous studies and analytical report, among them should be cited the "White Paper: Poland – The European Union, Science and Technology" and the OECD Review of the National Science and Technology Polcy of Poland (1996). Poland figures as well in international comparisons published by the EU, OECD, ECE, UNESCO, UNIDO the World Bank and others. The KBN 'Science and Governmenet Series" should be mentioned in this context as well. The following two chapters are presenting some selected parameters which are important when comparing the RTD capacities of Poland and the international competitiveness of the Polish economy with other countries.

- Gross Domestic Expenditure on R&D (GERD): 0.78% (1998)
- GERD per Capita: 1997: 57 US-$, 1998: 60,9 US-$ (EU average 1995: 318,2 US-$)
- GERD by Source of Funding: 59,0% Government
  29,7% Business Enterprise
  8,2% Branch R&D Institutes of Academy of Sciences
  1,5% Foreign Resources
  1,6% Others
- Number of University Students: 1,231 Million [6] [7]

[5] As will all statistics, a certain margin of error has to be taken into account. In the case of Poland, it is being argued that the real amount of expenditure is underestimated. The data of the Central Statistical Office encompass only a part of R&D omitting apparently the expenditure from Ministry of National Defence Budget. In any case, these comparisons may be useful in indicating trends and orders of magnitude.
[6] KBN, Science in Poland, Warsaw 1999
[7] For comparison: 1990: 584.177 students at tertiary level, Chapter "Central Europe" by Kuklinski, Antoni and Kacprzynski, Bogdan, in: UNESCO, World Science Report 1996, Paris 1996, p.82

- Enrolment of Foreign Students: In a comparison of 24 OECD countries Poland ranks with 0,5% of Foreign Students in tertiary education of all students enrolled on the end of the list just before Korea (0,1%). Hungary: 2,6%, Czech Republic 1,9%. [8]
- The annual expenditure per student in tertiary education in 1997 was US-$ 4.264,--. This is the third-lowest figure from 23 OECD countries. Lower figures were reported from, Greece (3.990$), and from Turkey (2.397$). For comparison: Hungary: 5.430$) and Czech Republic: 5.351$). However, the total public expenditure of Poland on educational institutions was with 5,8% of the GDP higher than in 19 other OECD countries.[9]
- Some 75.000 scientists are government funded – among them are 45.000 post-doctoral research scientists
  - Out of which 39.000 are working in around 100 state universities
  - 36.000 people are working either in the 82 Institutes affiliated with the Academy of Sciences (8.000 scientists) or in the 255 public institutes and organisations (28.000 scientists)
- The private sector of Poland employs appr. 9.000 researchers in around 400 R&D units.[10] [11] Allowing for some country specifics, it can be said in general, that countries with the largest number of R&D personnel (e.g. Germany, France, U.K.) typically have the majority employed by industry, followed by higher education and the government sector. In Poland, however, the highest percentage of R&D staff is in higher education (55%) and in government sectors (22,6%). [12] According to the EIRMA R&D Spending Survey 1998, the average spending per industrial R&D employee in 1997 across all industry sectors was about 117.000 €uro.
- Poland ranks 20th in the world as far as scientific research is concerned.[13] [14]
- According to the Science Citation Index of the Institute for Scientific Information in Philadelphia Poland occupies with 33.903 publications and with a share of the world's scientific publications rank No. 18. In this position, Poland is far ahead of all other CEE countries. Hungary occupies the 30th rank and the Czech Republic the position No. 33
- The Co-authorship of scientific publications of EU Member States with Poland has dropped from 37% in 1985 to 22% in 1995[15]

2.) Benchmarking of Polish RTD and related parameters within the context of the EU and of the OECD

[8] Foreign Students, OECD in Figures, 2000 Edition, Paris, June 2000, p.83
[9] idem, p. 66
[10] Rokosz, Bogdan, A tradition of scientific openness, in: European Commission, RTD info Nr. 22, Supplement '99
[11] For the period before 1989 see Chapter "S&T manpower" in: Chapter 'Poland' by Glikman, P., in: Darvas, G. (Editor), Science and Technology in Eastern Europe, Harlow, Essex 1988
[12] OECD Main Science and Technology Indicators, Paris 1997
[13] Wiszniewski, Andrzej, Preface to "Polish Research Directory 1999", Warsaw 1999
[14] "Why the enterprise sector reduced so dramatically its demand for the domestic R&D? One clear reason was, that a part of the R&D expenditures from before the market break-through was not necessary at all and was seen by the enterprises as a "duty" rather (required by the government) than a real need. Secondly, the worsening financial situation of the forms did not allow for continuation of the high R&D expenditures. The state-owned firms (previously the main consumer of the domestic scientific services) started fighting for survival rather than investing in R&D. Thirdly, the imported technological progress, now easily available, appeared cheaper than financing the own research. Fourthly, the firms initially adjusted to the new market environment in an extensive way, by reducing the widespread misuse of the production factors (idle capacities, hidden unemployment) rather than by an attempt to raise productivity by upgrading the technology." Orlowski, Witold M., Knowledge Economy and knowledge-based growth: Some issues in a transition economy, in: Kuklinski, Antoni (Editor), The knowledge-based economy, KBN Science and Government Series, Warsaw 2000, p.91
[15] RASCI, Data Science Citation Index quoted in Second European Report on S&T Indicators 1997, op.cit.

- The 15 EU countries are spending at present on average 1,82% of their Gross Domestic Product on Research and Development (for comparison: USA 2,77%, Japan 2,91%, Korea 2.89%).
  According to KBN, Poland has spent in 1998 appr. 0,78% of the country's GDP on R&D.
  The OECD has estimated that the Gross Domestic Product of Poland in the year 1999, when using current exchange rates, amounted to 152,7 Bill.US-$. 0,78%, i.e. 1,19 Bill.US-$ have been spent on R&D. If Poland were to catch-up with the average percentage of the EU-15 countries, i.e. 1,82% of the GDP, Poland would have to earmark 2,78 Bill.US-$ for that purpose.
  The European Council of Ministers in March 2000 recommended that the relative size of the budgets allocated to science and technology should be comparable to other policy domains. The percentage of the GDP spent in the EU on public and private RTD should, therefore, rise over the next ten years to at least 3%. In order to reach for Poland such a target, it would mean – not allowing for any increase in the GDP - that the present annual expenditures for RTD must be *quadrupled*.
  KBN in the government position paper "Directions of National Innovation Policy till 2002" adopted by the Council of Ministers on 6th December 1999, when strongly advocating for an increase in the share of the state budget outlays on scientific research and development projects in the GDP has alerted the government on the present low RTD allocations: "*These circumstances make it increasingly difficult to maintain the research capacity of the scientific base and make it practically impossible for this base to be effectively involved in the development of new technologies, which would help to improve the competitiveness of the Polish economy.*" (p. 11)
- The percentage of the GDP spent on Gross Domestic Expenditure on R&D (GERD) is less significant than the indication for which purpose the GERD is being used. From all OECD countries and in comparison with all EU-15 countries the Polish government finances the highest percentage of the Business Enterprise Expenditure on R&D, i.e. 26,9% (1998). The average equivalent figure for the OECD is 10,2% and 9,2% for the EU-15. For comparison: Czech Republic: 8,2% and Hungary: 9,4%. The Polish industry is funding from its own resources 72,0% of their research (average OECD: 86,8%, EU-15: 81,9%).
- Poland accounts for 32 Researchers per 10.000 Labour force (Reference year: 1998). The average figure for the EU-15 countries is 50 and for the OECD countries 55.
- On a 1999 ranking of Internet hosts Poland occupies with 4,4 Internet hosts per 1000 persons, the third last position before Mexico (2,8) and Turkey (2,7). The OECD average is 47,3. Internet hosts provide data and services, such as web sites, to other computers.
- In a survey among 22 OECD countries on the number of mobile phones per 1.000 population, Poland ranks with 80 on the end of the list (EU average: 300)[16]
- With regard to the other 4 'Luxembourg' CEE accession countries (Czech Republic, Estonia, Hungary and Slovenia) Poland compares not well on the estimated number of *fax machines* per 1000 population: 1,43 (Cz: 6,79; Est: 8,84; Hu: 4,41; Slo: 8,89), on the estimated number of *Personal Computers* per 100 population: 3,62 (Cz: 6,79; Est: 0,67; Hu: 4,41; Slo: 4,78), and with *Telecommunication investment* per inhabitant: 23,0 US-$ (Cz: 103,1; Est: 44,6; Hu: 53,1; Slo: 71,4).[17]
- According to 1996 data the average period of invested capital rotation in the Polish economy reached 11.4 years (12.9 years in industry), while in EU member countries the

[16] OECD indicators on mobile communications (June 1999 data)
[17] ITU 1998, Network Wizards 1998 quoted in: Kuklinski, Antoni (Editor), The Knowledge-based Economy, KBN Science and Government Series No. 5, Warsaw 2000, pp.80-81

rate of machinery renewal is twice as fast as in Poland, with 6.5 years the average rotation period.[18]

- In the Global Competitiveness Report based on over 300 indicators, annually published by the World Economic Forum, Poland's competitive index among the 59 analysed countries has gradually deteriorated and puts Poland behind the Czech Republic and Hungary.[19]

3.) RTD related indicators measuring the position of Poland's international Competitiveness

The influence of the scientific and technological capabilities of industrialised countries on their international competitiveness, i.e. on trade in goods, movement of capital, flows of technology and movement of professional manpover, was for the first time the subject of a major investigation commissioned by the Ministers responsible for science and technology in the OECD Member countries in the late 60s.[20] [21] Since that time, the public debate about the nature and significance of the causes for the 'technological gaps' between competing countries has never ended. Most recently, the issue was in the center of the deliberations of the Lisbon summit of the European Council. More specifically, the question of the international competitiveness of the candidate countries from Central and Eastern Europe in comparison with the EU-15 countries became a major focus. KBN has stated in this context as first major specific objective of the innovation policy of Poland, among others, 'to improve the international competitiveness of the economy and bridging the technological gap between Poland and the highly developed countries'.[22]

The so-called "Copenhagen criteria" laying down the basic conditions for the CEE accession countries defined by the European Council in 1993, calling ***inter alia*** for the ability of the candidate countries to '***withstand competitive pressure'.*** How the international competitiveness of the candidate countries should be measured in order to allow their sactisfactorily EU membership has not been stipulated. *Wojciech Bienkowski* (Warsaw School of Economics) when studying the *"Competiveness of the Polish Economy on the Eve of Integration with the European Union"* has found not less than 40 definitions of 'Competitiveness'.[23] He retains as definition of the term 'competitiveness' "*the ability to survive under more and more stringent competion."* He correctly stresses the point that within the process of transformation the Polish government in order to increase the competitiveness of the economy it is not enough to analyse the classical instruments of competitiveness such as rate of growth and market shares. "It is necessary as well to concentrate on other issues such as structural adjustments, influence of foreign capital and increasing competition on quality and structure of goods and services, on export composition and terms of trade, on slow but systematic mental changes within society and managers, etc."[24] The cited series of OECD studies on the 'Gaps in Technology' have already highlighted that social attitudes reflected in

[18] Kotowicz-Jawor, J., Determinanty wewnettrzne dynamiki i structury handlu zagranicznego, in: Ekonomista No. 1-2 1999, Warszawa, p. 69, cited in: Bienkowski, Wojciech, Competiveness of the Polish Economy on the eve of integration with the European Union, World Economy Research Institute, Warsaw School of Economics, Working Papers No. 209, Warsaw May 2000, p.9

[19] Quoted by : Stepniak, Andrzej and Uminski, Stanislaw, Die Wirtschaftslage Polens vor dem Hintergrund ausgewählter Länder Mittel- und Osteuropas, in: Die Osterweiterung der Europäischen Union, Stellungnahme zum Bericht der Friedrich-Ebert-Stiftung, Regierungsbeauftragter für Verhandlungen über die Mitgliedschaft der Republik Polen in der EU (Hrsg.), Warschau, September 2000, p. 108

[20] Third Ministerial Meeting on Science of OECD countries, Gaps in Technology between Member countries, General Report CMS (68) 2, Paris 1968

[21] cf. also Standke, Klaus-Heinrich, Europäische Forschungspolitik im Wettbewerb – Industrielle Forschung und Entwicklung und internationale Wettbewerbsfähigkeit, Baden-Baden 1970

[22] KBN, Directions of national Innovation Policy till 2002, A government document adopted by the Council of Ministers at ist meeting on the 6th of December 1999, Warsaw, December 1999, p.10

[23] Bienkowski, Wojciech, op.cit., p.6

[24] Bienkowski, Wojciech, op.cit. p. 7

management, education and the propensity to innovate are to be seen as the fundamental cause of the technological gap. Others explain the superiority of certain countries in some industrial sectors by the large amount spent on research and development, not only by industry itself, but also by governments, as exemplified by expenditures for defence, space and other goals. The increasing 'price of entry' into modern technologies has also highlighted the disdvantages arising from the market, technological, economic and political fragmentation of Europe. The Eastern enlargement of the EU will also enlarge the European RTD potential as well as the European market. As it is being observed in the first 'Avis' by the European Commission, Poland's RTD potential is expected to contribute significantly to the overall RTD ressources of the EU. Three parameters of the methodology developed by scholars and ususally applied for international comparisons of the technological performance of countries, i.e. *Patent applications, Trade coverage ratio's (exports/imports) in 'high tech' and other industries as well as Poland's export market share in 'high tech' and other industries* are being briefly presented:

a.) Patent applications

The Report on Science and Technology Indicators reveals that on average, growth in GDP seems to co-evolve with growth in terms of patents per head.

One of the possible yard sticks to measure the scientific-technological performance of a country is the statistic of patents. The UNICE 'Benchmarking Report 2000' describes the role of Patents as international yardsticks as follows: "*Patenting activity differs widely between sectors and is, in part, influenced by national business cultures and practises as well as the cost and time needed to obtain a patent. However, it is an indicator of the extent to which companies have a positive culture towards innovation and first access to 'leading-edge' technologies"*. [25]Poland, when measured by the number of patent applications, has a relatively low number of inventions and patents. The OECD reported that in the year 1997 32.536 patents have been filed in Poland, of which 92,6% were from abroad. The equivalent numbers of the much smaller countries, Czech Republic and Hungary are in the same order of magnitude. Spain, for example, a country with a similar size as Poland, has registered in 1997 89.227 patent applications. In the OECD ranking of the 29 member states, Poland figures with 9 Patent applications (Resident and abroad) per 100.000 of total population before Portugal (8), Turkey (4) and Mexico (2) on the fourth-lowest position.

b.) Trade coverage ratio's (exports/imports) in 'high tech' and other industries

The Trade performance of countries, to which the European Council also alluded when defining the "Copenhagen Criteria" to be fulfilled , is seen as one of several parameters to judge the international competitiveness of a given country.

In its annual survey among member states on the ratios between exports and imports, the OECD has introduced for categories according to the technological content of the exported and important goods. In 1997 according to OECD statistics, the foreign trade of Poland has had the following ratios:

'High-tech' industries: *0,28*
'Medium high-tech' industries: *0,37*
'Medium low-tech' industries: *0,91*
'Low-tech' industries: *1,10*

An analysis shows that within the first two categories, i.e. the group of research intensive industries, Poland is in the same grouping of countries as Australia, Greece, Iceland, New Zealand, Portugal and Turkey. Hungary, for example, is already in the top group of high-tech

[25] UNICE, Stimulating Creativity and Innovation in Europe. The UNICE Benchmarking Report 2000, Brussels 2000

exporting countries (ratio: 1,03 in 'high-tech' and 0,83 in 'medium high-tech), whereas the Czech Republic has shown a ratio of 0,45 in 'high-tech and of 0,99 in 'medium high-tech'.

Allowing for the time-lag, the Polish trade coverage ratio's are reflecting the Investment composition of the Polish industry in earlier years. According to the UNIDO Global Industrial Development Report 1997, Poland has had in the reference year 1994 in comparison with selected other CEE accession countries to the EU (former Czechoslovakia, Hungary, Romania, Slovenia) the highest percentage of investment in low-technology industry, i.e. 66,9%. The accumulated figures for medium and for high technology industries in the same year have been for former Czechoslovakia 51,4%, for Hungary 37,6%, for Slovenia: 53,3% for Romania 20,0% as compared to Poland: 32,1%.
KBN has taken up this issue in a government document in December 1999 in highlighting "*The Polish products which remain competitive in our export to the EU countries are those delivered mainly by the sectors where labour-intensity is higher than the average as well as those which are based on hardly renewable resources (e.g. wood). As a result, our competitiveness fails to improve over time." (p.8)*

c.) Poland's export market share in 'high tech' and other industries

Formatiert: Nummerierung und Aufzählungszeichen

In all manufacturing industries Poland, with 3,5% of the population in the OECD area, has an export share of the OECD countries of 0,72% and in all 'high-tech' manufacturing industries of 0,21%. The other two CEE candidate countries, e.g. the Czech Republic and Hungary, which have each slightly more than 24% of the population of Poland, are contributing with 0,74% and 0,23% respectively 0,60% and 0,65% to the total OECD exports.

In a recently published joint study undertaken by the World Bank and by the Bertelsmann Foundation entitled "*Winners and Losers of EU Integration"* the critical issue of the competitiveness of the Polish industry has been analysed. *"...The free flow of goods within the Single Market (SM) will endanger firms that previously did not export or compete with imports. Even those selling on their local markets will feel the pressure because they will have to comply with EU technical norms (product and process related)....Fulfilling this condition will require investments in modern equipment. Those companies that do not upgrade their technology will find themselves losing...".*[26] The study referred to recent research undertaken by *W. M. Orlowski* of the European Institute in Lodz who found that Polish imports would grow faster than exports, worsening the trade balance between EU and the rest of the world by 4,1 billion US-$. This would require transfers of at least an equal amount of public and private capital from abroad. *Orlowski* also expressed concern that many industries that were leaders in the Polish economy so far would become uncompetitive in the medium term...[27]
In a study published in September 2000 *Stepniak* and *Uminski* are showing in a comparison of the Foreign Trade situation of the CEE's that the per capita export in Poland was in 1998 with 729 US-% less than one third of the comparable figures in the Czech Republic, Estonia, Slovenia and Hungary. The Polish exports expressed in percent of the GDP were in 1998 with 17,9% the lowest of all 7 analysed CEE's.[28]
The Foreign Trade balance of Poland showed for the last time a surplus (4,794 Bill.US-$) in the year 1990. Since then, year-by-year, the Polish foreign trade deficit has grown, reaching in

[26] Tang, Helena (Editor), Winners and Losers of EU Integration – Policy Issues for Central and Eastern Europe, The World Bank, Washington D.C. March 2000, p.173
[27] Orlowski, W.M., Uwarunkowania i skutki przystapienia Polski do unii celnej UE, Lodz 1997 queted in: Tang, Helena (Editor), op. cit., p. 173
[28] Stepniak, Andrzej and Uminski, Stanislaw, Die Wirtschaftslage Polens vor dem Hintergrund ausgewählter Länder Mittel- und Osteuropas, op. cit., pp. 101/103

1999 the figure of 21,174 Bill.US-$. Poland also has be far the highest trade deficit of all CEE countries (even after taking into account the different sizes of the economies in question).[29]
KBN in the government document "Directions of National Innovation Policy till 2002" has acknowledged this situation: "*A large deficit in the foreign trade balance is caused* inter alia by the low innovativeness of the Polish economy." (o.9).
The Economic Commission of Europe of the United Nations (ECE) in its 1999 'Economic Survey for Europe' concluded therefore: "*In Poland a loss of competitiveness (reflected in the appreciation of the real exchange rate) contributed to the deterioration of trade and current account balances (although exports remained buoyant for much of the year).*[30]

Even before the full admission of Poland into the EU, the manufacturing industry of Poland has already drastically reduced its share in the Polish GDP: The World Bank study, based on the Statistical Yearbook of Poland, has demonstrated that the industry has reduced annually from 34,0 % in 1992 to 25,8 % 1998 (in current prices) its share to the GDP of the country: "*One can presume that the sectors that lost their importance are the losers in the transformation and those that increased their importance are the winners. It is evident from the figures that industry kept reducing its share, while trade, financial services, and hotels and restaurants kept increasing their shares."*[31] It has to be stressed, however, that in the long run the position of Poland in the globalized economy depends first and foremost on the international competitiveness of the Polish industry. As pointed out by *Stepniak* and *Uminski* the growing deficit of the Polish Foreign Trade Balance presents in the long-term one of the greatest dangers for the stability of the economy of Poland.[32]
In the short run, however, the imports of technology intensive goods which include "*imbedded R&D*" (because of their high content of the results of R&D undertaken by other companies abroad), are a justified way of accelerating the process of modernising the Polish economy. The question is, how long such a process will last and how long it will take to transform the 'imported technological progress' into the countries own technological knowledge potential.

4.) Selected Issues of particular concern

Formatiert: Nummerierung und Aufzählungszeichen

Gelöscht: ¶

a.) Interaction of RTD policy with different other policy spheres

The recent five-year Assessment of the European Union Research and Technological Development Programmes (1995-1999) has highlighted that 'most of the measures to stimulate innovation lie outside the realm of RTD policy. Successful innovation is dependant upon a variety of financial, market, legal, fiscal, and cultural factors as well as scientific and technological one. Successful innovation policies have to embrace all these aspects and cannot be treated as mere extensions of RTD policy.'[33]
What has been proposed in the EU report of the Independent Expert Panel addressing the EU itself, is – even more so - true for the individual governments such as Poland: "Concerted action is required across the whole of the government to develop adequate innovation policies."[34] The ultimate target is the creation of consistent economic, social and educational policies to create an environment where local industry can benefit from the RTD activities.

[29] Friedrich-Ebert-Stiftung and European Union, EU-Monitoring report No. III, Warsaw 1999, p.21
[30] Economic Commission for Europe, Economic Survey of Europe, 1999 No. 1, Geneva 1999, p. 164
[31] Tang, Helena (Editor), op.cit., p. 171
[32] Stepniak, Andrzej and Uminski, Stanislaw, Die Wirtschaftslage Polens vor dem Hintergrund ausgewählter Länder Mittel- und Osteuropas, op. cit., p. 102
[33] European Commission, Five-Year Assessment of the European Union Research and Technological Development Programmes (1995-1999), Brussels July 2000, p. 16
[34] op. cit., p. 16

b.) Mobility of European researchers versus 'Brain drain'

As part of the efforts establishing a European Research Area (ERA) a policy of investing in human resources has been proposed. The EU experience reveals that in average not more than five percent of European nationals have worked in science outside their country of origin. According to *Mariano Gago* a precondition for establishing the ERA would be that in 20 years from now this figure would reach twenty percent. According to him, "*Member States could be persuaded to make a commitment to this, by setting a standard for researchers in the public sector that they cannot progress above a certain level unless they have spent a number of years working outside their country of origin. If we want to do this, we have to invest heavily in researchers at the age of mobility and invest heavily in post-doctoral programmes abroad."*[35] ERGEBNIS FEHLT

[3535] op. cit, p. 1

A failure to maintain strong research intensive industries will lead to a 'brain drain' of scientists and engineers to other nations and thereby weaken the the capacity to innovate.

c.) Industry-University relations

This issue is of particular convcern.

The – compared with average EU-15 countries – large share of scientific researchers in the education sector in Poland makes it particularly important to strengthen the relations between university and industry in general and with SME's in particular which usually do not have in-house reearch facilities or R&D staff.

The matter is frequently on the agenda of governments which have to fund the university system [32] and selected segments of research performed by industry likewise. [33] The basic question is always, how can universities and industry best capture the benefits of partnership while ensuring the broad diffusion of public knowledge?

Poland can gain from the experience gained elsewhere, in particular in the EU-15 countries and in the U.S.

d.) The role of defence R&D

Looking at the example of Western countries in general and of the U.S. in particular, *Herbert Fusfeld* observed, "*The strong and productive technical system, which has served the United States and the world of science and technology so well for over 40 years, has rested on a three-legged foundation: a unique research university system, an effective industrial research system, and a strong, well-funded defence R&D system."* [34] 54,1% of the U.S. governments appropriations for R&D have been allocated in 1997 for Defence R&D. (EU-average: 15,5% ranging from 0,4% (Belgium) to 39,5% (United Kingdom).

When analysing the role of the defence R&D in the CEE countries, the European Commission has underlined that the decline in R&D intensities and R&D personnel in the countries concerned is closely related to a sudden reduction in defence expenditure. According to the Commission a large proportion of national R&D efforts were previously devoted to defence applications. For most of the CEE economies, data on defence R&D expenditure during the period of economic transition is incomplete. Poland is one of the few of the 29 OECD countries (together with Hungary, Korea and Turkey) which has not disclosed the percentage of its Defence R&D in the OECD Statistics of Member Countries.

For Poland's future RTD strategy, the sensitive issue of defence research within the Gross Domestic Expenditures on R&D (GERD) presents two important challenges:

1.) Poland's ability as a new partner in NATO to participate fully in the Treaty will depend on the country's access to the modern military technology needed to implement NATO's doctrine and procedures.[35] The modernisation of the country's defence infrastructure should not rely only on imported military systems. A division of labour in the production of those systems with the other NATO countries will call for a innovative Polish defence R&D system.
2.) The 'spill-over' effects from military R&D into the civilian sector are important ***stimuli*** in particular for the modernisation of the High-tech industry. One can go even one step further. Experience not only in the NATO countries shows, it had always occurred that military R&D activities had deliberately be planned to assist industry. Defence R&D objectives and specifications have pushed the frontiers of science and technology and forced progress in high-technology fields that are critical to expanding commercial markets. Obvious examples are those industries which are an important supplier to defence notably aerospace, computers, and communications.[36] The intended Reform Programme for the Science and Technology Sector of Poland must surely take these two challenges into account.

31 Piasecki, Bogdan et al., Business Environment for Running SME's in Poland and the EU Countries, Polish Foundation for Small and Medium Enterprise Promotion and Development, Warsaw 1998, p. 123
32 OECD-Federal Ministry of Education and Research Conference "Benchmarking Industry-Science Relationships", Berlin 16-17.10.2000
33 e.g. EIRMA, Improving Industry-University Relations, Working Group Report No. 37, Paris 1988
34 Fusfeld, Herbert I., Industry's Future, Washington D.C. 1994, p. 139
35 cf. Kugler, Richard L., Enlarging NATO, National Defence Research Institute, RAND, Santa Monica 1996, p.245
36 Fusfeld, Herbert I., Industry's Future, op.cit., pp. 139 and 235
37 Hausner, Jerzy and Marody, Miroslawa (Editors), Three Polands: The Potential for and Barriers to Integration with the European Union, Warsaw 1999, p. 91/92

According to the Commission's Report on Science and Technology Indicators , spending on Defence R&D in the CEE countries has declined faster than the military production.
As far as Poland is concerned, a recent report by the Friedrich Ebert Stiftung and published with the financial support from the European Union came to the following conclusion: "*The defence sector is still in a very difficult financial situation and technological modernisation efforts are urgently needed. At present, however, the sector is suffering from a dearth of orders and – as a consequence – has no resources for modernisation.*" [37]

Being aware of this dilemma, KBN has proposed in the government paper "Directions of National Innovation Policy till 2002", adopted by the Council of Ministers in December 1999, to change the operational basis of R&D units supervised by the Minister of National Defence; bringing these units into the scope of general regulations applicable to R&D units. (p.13)

e.) SME's and RTD

Although more than 99,0% of the enterprises in the European Union belong into the category of 'SME', the EU reported, that in the period 1994 to 1998 only 14.500 SME's have participated in European research projects. To redress the situation, the EU has recently, therefore, explored how SME's without their own research facilities can use other organisations – such as universities and contract research organisations – to perform the

research for them, and still obtain funding under the EU's Framework Programme for Research and Technological Development.
In the same line, it is hardly surprising that only some 17% of the responses to the first round of calls for FP5 have come from SME's. In any event, only 10% of the total funds of the Framework Programme have been earmarked for SME's.
A survey among 2.500 enterprises of the German manufacturing sector reveals that during the last three years in average 40% of the sales of all enterprises can be related to product innovations, the equivalent figure for the SME's is only 30%.

As in all EU-15 countries, the adequate involvement of the SME's in the innovation process remains also in Poland difficult to achieve. The German Minister for Education and Research reports for example, that only 10% of the innovation-oriented SME's are co-operating with universities and only 6% with independent research institutes.
In the case of Poland it is being reported that, in general, very few SME's have formal connections with Academy Institutes and R&D units or with Academic institutions: "These sporadic contacts are due to financial weakness of both sides but also limited mutual understanding. Few SME's had contacts with foreign institutions also. Again, there is a 'size bonus'; many large and very large enterprises had formal links especially with R&D institutions and academic institutions then SME's." [38] The dilemma of the insufficient involvement of SME's in industrial R&D has – in spite of a multitude of efforts – remained unchanged and unresolved. The U.S. National Science Foundation has reported already in 1965 that the SME's in the United States expended only 5,2% of all industry funds used for R&D. [39]
The systematic involvement of SME's into the RTD-Innovation chain will remain in the years to come one of the biggest challenges for Poland.

f.) Regional and sub-regional disparities of the RTD potential in Poland

After the recent restructuring of the regions of Poland resulting in 16 administrative provinces (Voivodships) regional development issues will be high on the agenda of the government.
In an analysis of "Winners" and "Losers" in Poland as result of the process of EU integration *Karasinska-Fendler et al.* have found, that among the 16 provinces only those four of them (Mazowiecki (*i.e. Warsaw),* Slaskie (*i.e. Katowice),* Wielkopolski *(i.e. Poznán)* and Pomorski *(i.e. Gdansk),* which have traditionally been strong economic provinces in reaching at least the mean of the GDP per capita of Poland, have been able during the last years either to maintain their leading position or, in the case of the regions of Warsaw and Poznán, to increase their leading positions considerably (Poland=100 in 1997; Warsaw=151; Poznán= 108). They conclude that historically well-equipped regions will be the winners of integration and poorly equipped regions will be losers in the process. [39 a] The situation is being further aggravated by the fact that the same '*Locomotive*' regions are able to attract the lion's share in which a relatively high concentration of R&D institutes and higher education institutes does already exist.[39 b] The Ministry of Economy has communicated in July 2000 that 11,5% of the total amount of expenditures on innovation activity were spent in the Warsaw voivodeship, Bielsko-Biala (7%), and Lublin (4%), whilst the least innovative regions included the Biala Podlaska and Ciechanów voivodeships (0,3%).

As in practically all countries of the EU – with the exception of Germany - the scientific and technological potential of Poland is rather unevenly spread with a large concentration in and around the capital Warsaw. Warsaw has also the highest concentration of FDI in Poland.

According to *Weresa* foreign Capital is relatively rarely invested in high-unemployment regions: "The regions most attractive for foreign investors are usually those with the highest level of development, lowest unemployment rate and relatively good infrastructure, such as Warsaw, Poznan, Katowice, Bielsko-Bialo, Szczecin." 39cc

The question of regional disparities is of major concern to all EU countries. The Second European Report on S&T Indicators (ERSTI) has analysed the question: "*Can regions which lag behind in the S&T race catch up? If so, can S&T investment be translated into economic growth and job creation?"* The conclusions based on existing experience in other European countries can prove to be valuable assistance to Poland when using RTD as one of the devices to foster regional development.39 c
KBN in the government paper "Directions of National Innovation Policy till 2002" has underlined the need for structural measures fostering regional development. It has pledged 'supporting regional initiatives for the development of regional innovation systems' in line with the earlier Programme to support the development of regional institutions promoting the transfer of technology adopted by the Council of Ministers on 4 March 1997. According to KBN support will be provided 'to those undertaking and co-ordinating innovative activities which include in particular: Education and information, scientific research and development projects, transfer of technology, interfacing between designers and entrepreneurs, development of the enterprise sector.
Particular attention will be given to the objective of increasing the innvativeness of SME's.'(p. 14)

g.) The role of Foreign Direct Investment in modernising the Polish Industry

Since Poland, like the other CEEC's was until 1989 *de facto* cut-off from the mainstream of the scientific and technological developments in the OECD countries, one of the options for a quick 'catching-up' strategy would consist of accelerated Foreign Direct Investments under the assumption that the concerned foreign industrial companies would automatically contribute to the Polish science and technology base the most recent technological achievements. There is also the hope that foreign companies setting up subsidiaries in Poland will set-up their own Research Laboratories and will be recruiting Polish scientists and engineers for RTD. So far, the experience in some CEE countries is in this context not very positive. Ireland, in contrast, is being quoted by the EU as an example of how an effective Innovation Policy integrating foreign *know-how* is working: "Ireland's export of high-tech products was stimulated by the manufacturing investments of the multinationals. Today, Ireland's manufacturing plants are efficient and successful enough to perform their own R&D:" 39a
KBN has in its publication "Science in Poland" included detailed data on the Foreign Investment in Poland for the years 1989-1997. The fast growing annual increase on FDI in Poland reveals for 1997 that Poland was able to attract 20,587 Bill. US-$.
In 1991-1998 the gradually employment in companies with FDI has reached 7,1% (841.000) of total employment. FDI companies are characterised by a downward tendency in the average number of persons employed per foreign-owned enterprise. 39aa
The motivations of the foreign investors for their engagement are not easy to discern.
A survey among 500 German industrial companies, most of which have international operations, shows that mainly because of cheaper production costs 49% of them have been setting-up production facilities in Central and Eastern European Countries with the main purpose of supplying from their new production facility the German market. Only 26% have

38 Wisniewski, Wojciech, The role of R+D for Polish Industrial Enterprises, in: Kuklinski, Antoni (Editor), The knowledge-based Economy, op.cit., p.266
39 The Conference Board, R&D and Small-company Growth, New York 1968, p.6
39 a Karasinska-Fendler, Maria et al., in: Tang, Helena (Editor), Winners and Losers of EU Integration, The case of Poland, World Bank, Washington D.C. 2000, p. 181
39aa Weresa, Marzenna A., Foreign Direct Investment and the Development of the Polish Economy, p. 18

39 b Karasinska-Fendler, Maria et al., Figures on Regional Dispersion of Companies with Foreign Capital in Poland in June 1995, op.cit., p. 180, cf. also: Polen: Standorte im Wandel, OST-WEST CONTACT No. 6/2000, pp.14-16
39cc Weresa, Marzenna A., Foreign Direct Investment and the Development of the Polish Economy, p. 19
39 c ERSTI, op.cit., pp.

indicated that the main target of their entrepreneurial engagement is the home market of their host country. In Western Europe this ratio is just reversed: 46% have indicated that their main target is the host country, whereas 27% have mentioned that the new production facility will mainly supply the German market.40 *A. Nicholls* warned in this context about the dangers of an economy "split down in the middle": "*Some of the foreign-owned companies are making high value-added stuff for export. But locally owned companies are starved of investment and equipment, and competing solely on the basis of low wages.".*41

Of particular interest is the question whether the branches attractive for foreign investors are import-substituting or rather export-oriented, and to find out their technological sophistication.

The recent study by *Weresa* on "Foreign Direct Investment and the Development of the Polish Economy" is shedding some light on this issue. Foreign Direct Investment is mainly taking place in industries where Poland has already comparative advantages in foreign trade. Only one of the four industrial branches absorbing the bulk of foreign investments, i.e. the chemical industry, is a sector in which Poland has a comparative disadvantage in foreign trade. *"Moreover, the the share of FDI companies in Poland's exports of comparatively advantageous goods is relatively large: 52,8% in export of food products, 50,8% in export of wood and paper products, 47,6% in export of textiles and 39,6% in exports of metal products. Furthermore, the labour-intensive products are releatively important for FDI companies's overall export manaufacturing, accounting for more than ist half."* 41a

The findings by Weresa confirm furthermore that the

- productivity of capital for FDI firms (net profit related to working capital) is nearly two times higher than that for all Polish firms.
- Although there is a significant nominal increase of FDI into Poland, the ratio FDI inflow to GDP has remained stagnant at the level of 3% since 1995. The same can be observed for the share of FDI in the total investments of the Polish industry, it remained stable at a ratio of 17-18%
- Up till now the FDI is apparently not contributing substantially to the RTD based industrial development of Poland. In contrast, the foreign capital and technological know-how imports through FDI have assisted to modernise the sectors of more traditional industries of Poland. Consequently, exports of FDI companies have had a considerable higher than average share in Polish exports. KBN reached the same conclusions: "*Direct foreign investments are not highly innovative but still more innovative than those in domestic enterprises. Foreign capital is invested mainly in the food, household chemistry and motor industries, while avoiding the so-called high-technology industries which involve a high investment risk."(KBN directions of national Innovation Policy, p.9)*

II.) The EU as partner in RTD policy-making and in RTD

1.) Changing emphasis on EU assistance in R&D

Only four percent of European research funding are being allocated at EU level. The annual disbursements of the EU for research, covering all areas of scientific endeavour, are amounting to 3,5 billion €uro/year. (For comparison: This amount equals the average 1-year R&D expenditures of only two large industrial groups, i.e Philips (Netherlands) and Bayer (Germany). But it is not this relative modest level of the European RTD funding which makes it meaningful. As *Philippe Busquin,* the European Commissioner for Research has put it: *"The Commission gives added value for research, but it must not substitute for the efforts of individual Member States. This is the principle of subsidiarity. The Commission's role is to bring the different levels together, encouraging people to work together."*42 It is not always well understood that what the EU RTD activities – in contrast to national S&T policy actions - are meant for is the focus on *international* technology transfer in the form of RTD collaboration. Not more, and not less.

41a Weresa, Marzenna A., Foreign Direct Investment and the Development of the Polish Economy, Working Papers No. 210, World Economy Research Institute, Warsaw School of Economics, Warsaw May 2000, p.13

The opinions on the real relevance of the EU Framework Programmes are divided. An objective assessment of a primarily politically motivated initiative is not easy. It is, therefore, quite an achievement that three years after the publication of the so-called Davignon report also assessing by a panel of independent experts the EU RTD Framework Programmes another report of an independent panel chaired by *Joan Majó* of Spain proposed some far-reaching changes in the orientation of the EU's future RTD activities. *Antoni Kuklinski,* when referring to the earlier Davignon Report formulated under the heading "*The glory and misery of the Five Framework Programmes"* the following pertinent observations:
"The (Davignon) Report is concentrating on the institutional pattern of the European RTD, while two factors are not analysed in the report:
a.) the extremely modest scale of the Framework Programmes in comparison with the scale of the Common Agricultural Policy. The Framework Programmes are just too small to create a real big push on the European and the global scene,
b.) the substantive composition of the consecutive Framework Programmes.
In the final analysis, the Framework Programmes are a relatively weak actor on the European scene which is dominated by the growing deficit of the European Union in the balance of trade in the field of high technology products." 43

"There are also significant differences of opinion within the science and technology community at large concerning the importance of EU RTD programmes vis-à-vis national efforts. In particular, the EU RTD Programmes are seen to be more oriented towards

39 a European Commission, ERSTI Report, op.cit., p.195
40 Institut der Deutschen Wirtschaft, Globalisierungstendenzen der deutschen Wirtschaft, Köln 1999, p. 23
41 Nicholl, A.
42 Busquin, Philippe
43 Kuklinski, Antoni, Maximizing Return on Investment: An European RTD Challenge, in: Kuklinski, Antoni (Editor) The Knowledge-based Economy, KBN Science and Government Series, Vol. 5, Warsaw 2000, p.36

application, technology and implementation, and such shift of emphasis is still causing considerable debate amongst Polish science and technology policy makers."45 ADL
The EU itself is recognising that such a debate is indeed fully justified. The authors of the Second European Report on S&T Indicators (ERSTI), published by the Commission in December 1997 find that the Framework Programme "*contributes only a fraction of over-all RTD spending...direct impact on technology creation should not be over-estimated.* 46

Another important point of debate is, to which extent the priorities of the European Research Framework - developed over decades in Western Europe as an 'add-on' of intra-European RTD co-operation to the ultimately still national R&D efforts - are answering the particular needs of the CEE countries. The profound transformation of their economies and of their RTD machinery confronts them for years to come with very different problems as compared to the well-established RTD community of the EU-15 countries. It is, therefore, to be highly welcomed that the Independent Expert Panel set up by the EU to assess the European RTD programmes during the last five years has recommended in July 2000, that the design of the Sixth Framework Programme should not only increase the scope in line with the need to meet the Lisbon goals but also to meet "***the demands of enlargement".*** The indication by the new EU Director-General for Research *Achilles Mitsos* that *"the Sixth Framework Programme is unlikely to get very much more money than the Fifth Framework Programme"* is in particular for the accession countries bad news. Since the EU membership is expected to grow considerably latest during the period covered by FP-6 and since the CEE's, although being full participating members at the FP-5, have yet to gain experience getting fully the expected returns, the expected ceiling of the FP-6 will be most probably to their disadvantage when competing with the established EU-15 members for the same amount of funding.

Meanwhile, the Commission itself is more and more realising that the EU Framework Programme alone 'will not be enough' to serve the goals set in the March 2000 meeting of the EU Council of transforming the Union into *"the most competitive and dynamic knowledge-based economy in the world."* The Heads of Government have been called to reconsider the priority attached to science, technology and innovation. It has been acknowledged that these activities are critical to the development of the knowledge-based society envisaged at Lisbon.

2.) Benchmarking of national science and technology policies within the EU

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 the international competitiveness.
Furthermore, there are not two countries adopting the same scientific and technological approach to meet those challenges. Each country has its more or less distinct organisational STD structure and each country follows in spite off all similarities its own path. However, all developed countries have in common – and Poland is 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.*

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45
46 RTD Info Feb 99, p 9
46 a, Commission acts on expert advice, in: CORDIS focus, No. 158, 25.9.2000, p. 3

In the case of Poland – as well as for the other EU accession countries from Central and Eastern Europe – another important dimension has to be added:

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

The Commission intends to introduce drastic re-orientations in the European approach towards RTD. "National research policy and Union policy overlap without forming a coherent role" says a Communication from the Commission "*Towards a European Research Area (ERA)"*, which warns 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." [47]
Since national science and technology policies within the EU countries are too divided, the European Commission endeavours as part of the new ERA initiatives to create a mechanism through agreed measurable 'yardsticks' which would allow a systematic comparison of such policies and their effects , and reviewing the results of benchmarking will be effective. *"Benchmarking has proved to be successful by naming and shaming those who are not complying. It worked for the single currency, so why not for the ERA" (Philippe Busquin)*[47 a]

3.) "European Research Area" *versus* National competitiveness

At the Feira summit of the EU marking the conclusion of the Portuguese presidency, the so-called Lisbon strategy for strengthening the employment situation in the present knowledge-based economy of the EU was reaffirmed. The EU heads of state were apparently [47]
"particularly enthusiastic" about proposed measures to draw up criteria for benchmarking research policies and mapping scientific and technological excellence, undertaking to network national and European research programmes and the high-speed network connecting research institutes. Against this new initiative *Mariano Gago*, the Portuguese Minister for Science and Technology in his capacity as president of the Research Council expressed strong caution. He did not support the target proposed by Research Commissioner *Philippe Busquin* of opening at least 30% of national research programmes to researchers from other countries, and argued that would give rise to difficulties in the short term: *"I am very convinced that putting national programmes together is very complex. It leads to problems of equilibrium and of funding, so we need to devise ways of creating confidence in national governments so that they know they won't be disadvantaged...*
We have to look at what is achievable. Opening up national programmes is only one part of the deal. What we need to do is not just open up plans, but also to devise common programmes."[48] On another occasion he was even more outspoken: *"I have looked very briefly into the debates of the last ten years of European Summits. I have asked some of my collegues who have been debating politics for several years but they do not recall one single important decision on science in the last decade in Europe, not one single report or decision. The main decisions have been taken at national level."*[48a] The former French Research Minister *Hubert Curien* supported this position: *"...The politics which are discussed in Brussels are essentially the politics with the Brussels money and not general policy(on RTD in Europe) which is much more important."* [48 b]
It remains paradox, however, that the laudable EU efforts to create an "European Research Area" are taking place at a time in which on one side the globalisation takes an ever increasing speed and on the other side, one cannot fail to notice that in spite of the EU integration efforts under the threat of a high-level unemployment national and regional competition among the EU-15 countries is increasing. For this reason generally agreement can

Gelöscht: , *José*

be reached on one fundamental point: "*The European Union cannot be competitive in the field of technology and innovation if it continues with 15+1 different policies for RTD.*" [48c] When creating an "European Research Area" with the particular emphasis to improve the European competitive situation with the US, one has also to take into consideration that e.g. in Germany 17 % of the industrial Research staff works in foreign subsidiaries, about half of them are of U.S. origin. 20% of all German industrial R&D efforts are being undertaken outside the country. [48d]

Gelöscht: a

4.) EU position on RTD in accession negotiations

The remarkable Polish catch-up efforts on the field of RTD have not remained unnoticed. The European Union, in its Second European Report on S&T Indicators 1997 has singled out Poland in all CEEC's as follows: "*Nonetheless some countries such as Poland, have stabilised their science and technological systems and are now starting to develop new patterns of growth and interaction.*" [59]
Furthermore, the Commission in its initial "Opinion on Poland's Application for Membership in the European Union" ('Avis') has stated in the Concluding Remarks concerning the Chapter "Research and Technological Development" on page 54: *"In the perspective of accession no major problems are expected in this field. Accession would be of mutual benefit."*
In the same 'Opinion' (para 2.2) the Commission has, however, has reiterated the "Copenhagen criteria' to be satisfied by Poland before granting full membership with specific reference to Poland's ability to cope with competitive pressure and market forces within the Union. (see below).

"In the perspective of accession (of Poland), *no major problems are expected in this field (ST/D structures and resources).* However, the Commission also pointed out that "*...it is necessary (for Poland) to improve the level of innovativeness in the economy generally and in industry in particular, and to enforce the links of research institutes with industry and SME's."*[49]

a.) One plus ten chapters in the 'Acquis Communitaire'

Although from the 31 chapters to be negotiated between the EU Commission and the CEE accession countries only one, chapter 17, is dealing specifically with RTD, at least 11 other chapters are directly or indirectly related to this central issue: "*Common agricultural policy"* (7), "*Energy"* (14), "*Industrial Policy"* (15), "*Small and medium-sized Enterprises*" (16), "*Education and Training"* (18), "*Telecommunications"* (19), "*Culture and Audio-visual policy"* (20), "*Regional Policy"* (21), "*Environment"* (22), "*External Relations"* (27) and "*Common foreign and security policy*" (27). The need for an overall strategy for Europe, articulated at the level of the EU and supported by all the Members States – and, one might add – all accession countries as well – was for the first time clearly articulated at the European Council meeting in Lisbon.
In connection with the creation of the proposed European Research Area, the Commission is advocating that RTD policy must be linked with policies in other spheres, especially education and innovation.
Looking at the RTD situation in the CEE countries, the Second European Report on S&T Indicators, published in December 1997, reached the conclusion: "*RTD activities taking place (in the accession countries) do not yet match the needs of modern economies. In general, the candidate countries do not give any great priority to R&D, in spite of the fact they have a plethora of researchers; they also lack research laboratories in private industry*." "*The RTD*

intensity of the CCE countries has fallen to the level of the less developed of the EU-15 countries" 49 a

Two and a half years later, the independent expert panel set-up by the EU to evaluate the Framework Programme has stated in June 2000 in even stronger terms: *"The situation concerning science, technology and innovation in many Central and Eastern European countries is perilous....and many countries are now waiting for the EU to take the lead in elaborating an effective RTD strategy which can serve their needs and take advantage of the scientific and technological talent emerging from their educational systems..."* 50

The positive assessment of the Polish RTD sector when screening chapter 17 "Science and Research" of the EU list of 31 chapters for accession negotiation could be dangerously misleading, if this encouraging signal would be construed as message that that Polish RTD sector is already competitive in comparison with the EU-15 average. What has been achieved by Poland in this context, and this is the fruit of a considerable Polish efforts, is the notion conveyed by the Commission that the formal conditions of the "*acquis communitaire"* on the field of RTD have been met by Poland. In essence, the '*acquis*' relates to the conformity of the legislation, rules and regulations in vigour, it does not express an opinion on the substance of the matter. The chapter has been, therefore, provisionally been closed until the final stage of the accession negotiations. Without any doubt this favourable interim result will permit the Commission to make on the field of the Polish RTD a positive recommendation to the Council for the necessary final "common position" of the Union. It does, however, not say that Poland is already able to meet one of the most important overall accession criteria adopted in Copenhagen, that is to say Poland's repeatedly mentioned capacity to cope with competitive pressure and market forces within the Union. Poland's competitiveness will depend to a large extent on the functioning of its RTD and innovation abilities. Industrial RTD is the most powerful means for improving innovation and competitiveness, and to support technology transfer.

b.) Copenhagen criteria: Withstanding competitive pressures

Even when Poland will have adopted and implemented the whole package of legal adjustments known as the "*Acquis communitaire"* , there are in addition a number of over-all criteria which accession countries must meet in order to qualify for EU membership.

These criteria for accession ('*Copenhagen criteria'*) have been defined as early as at the Copenhagen European Council in June 1993. In the three groups of criteria (political, economic and other criteria: The obligations of membership), the second (economic) group calls for "*the existence of a functioning market economy and the capacity to withstand competitive pressures and market forces within the Union*".

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48a
48 b Curien, Hubert, European Science Foundation Briefing No. 6, February 2000, p. 10
48 c
48 d Bundesministerium für Bildung und Forschung, Zur technologischen Leistungsfähigkeit Deutschlands 1999, op.cit., pp. 50/51
49
49 a European Commission, Second European Report on S&T Indicators, Brussels December 1997, p. 418
50 EU 5 years p. 15

As "significant factors" for the required competitiveness explicit reference is made, *inter alia,* to human and physical capital, i.e. infrastructure (in particular telecommunications), education and research; the extent to which government influences competitiveness,

support for SME's and the proportion of small firms in the economy and finally, the volume and nature of goods already being traded with Member States.

The obligation stiputeld in the 'Copenhagen criteria', namely the ability of the accession countries to meet the pressure of competition and of the market forces within the Union, does not always obtain the political attention which is called for.

A variety of factors determine the economic competitiveness in international markets. Many of them are beyond the direct reach of science and technology – for example as the recent development of the €uro/US-$ ratio has evidenced – exchange rates.[50a] But today there is no doubt about the importance of the role of science and technology in economic competitiveness. There is, furthermore, no doubt about the fact that modern technology is built on a base of scientific and engineering knowledge. Not surprisingly, the same high priority notion of competition pressures between countries has been reported by industry. According to EIRMA's 'R&D Spending Survey 1998' reflecting the views of a representative sample of about 1/3 of total business R&D spending in the European Union, '*Competitive pressure'* is seen as the single most important innovation driver.

Concerning Poland, within the World Bank study "Winners and Losers of EU Integration" *Karasinska-Fendler et al.* have expressed their fear that "*The free flow of goods within the Single Market will endanger firms that previously did not export or compete with imports. Even those selling on their local markets will feel the pressure because they will have to comply with EU technical norms (product and process-related)...Fulfilling this condition will require investments in modern equipment. Those companies that do not upgrade their technology will find themselves losing...".*[50 a]

According to *Orlowski* many industries that were leaders in the Polish economy would become uncompetitive in the medium term. Among the potential losers in the process of Poland's EU integration he found were '*manufacturers of office equipment, tobacco products, vehicles, textiles, leather goods, and metal products.* More growth opportunities would occur in the *manufacturing of furniture, clothing, wood, TV equipment, and electrical machinery."* He concluded that some losers in integration possibly can stay afloat, however, by selling their products (such as automobiles and office equipment) on the growing domestic market.[50 b]

In this context, a closer look at the economic development of East Germany seems to be worthwhile. The restructuring of the industry under competitive pressures has led to the situation that the share of the "Neue Länder" in R&D intensive products was in 1998 only

50 a cf. Mróz, Marci, Competitiveness as an objective of Monetary Policy: The case of Poland, Working Papers No. 196, World Economy Institute, Warsaw School of Economics, Warsaw June 1999

4,0% of all German exports. The "Innovation base" of East Germany is in spite of some improvements still too small to produce innovative internationally competitive products: In 1997 there have been only 25.100 Researchers in East Germany as compared with 261.200 researchers in West Germany. In the private sector 56 researchers per 10.000 employees have worked in East Germany and 122 in West Germany. 68 patents have been filed per 100.000 employees in East Germany as compared with 206 in West Germany. [50c]

III.) Modalities of RTD cooperation with the EU

Polish Co-operation in EU programmes has started in 1992: Poland has signed in 1992 (ratified in 1994) the "European Agreement Eastblishing an Association between the Republic of Poland and the European Union". In this agreement (Art. 75/76 and other related

paragraphs) several forms of cooperation between the EU and Poland's S/TD sector have been assured.
According to KBN, more than 160 Polish research teams have participated in EU programmes, as the result of the PECO '93 and PECO '94 actions. Furthermore, over 300 Polish institutions were engaged in the implementation of joint projects within the framework of COPERNICUS '92/93 and COPERNICUS '94. Poland is also an active partner in scientific projects organised by NATO.[35] The country is a member of the European Science Foundation (ESF) and is also seen as one of the overproportionally active member of CERN.

a.) Framework Programme for Research and Technological Development

Poland has already participated in five of the specific programmes of the EU's Third Framework Programme (1990-1994): *Environment, Biomedical and Health Research, Non-nuclear Energy, Nuclear Fission Safety, Human Capital and Mobility*.

In the Fourth Framework Programme (1994-1998) Poland was able to participate on a project-by-project basis practically in all specific programmes.

In 1999 Poland became a full member of the Fifth Framework Programme (FP-5). The other nine CEE countries are participating as well in FP-5. When analysing this new development the Magazine "Business Central Europe" concluded: "*The decision means that Central European researchers have the chance to compete for 15 Bill. Euro in research funding for the next four years. As importantly, they have the chance to collaborate with EU researchers and industry on multinational projects.*
The trouble is, that to join the scheme, the ten countries have to pay contributions into it – which could total up to more than 1 Bill. Euro over four years." Even for relatively advanced countries like Poland it is unlikely that they will win enough funding in the first two years 'to get their money back'. Countries like Romania, it is felt, which are even worse prepared to compete for grants, will almost certainly make a huge loss on the venture... *"And that means that for at least two years, these countries' miserly R&D budgets will get smaller still."* It is being reported that some Polish scientists were virulently opposed to joining the EU scheme, arguing that it would take money away from the few scientists that still have funding.[51]

The EU has commissioned a study analysing the RTD strategies of the top 500 European Industrial Companies and their participation in the Framework Programme and in EUREKA[52]
The study revealed that both Framework programme and Eureka funding contribute relatively little to the R&D budget of the companies involved: Only 4% of the R&D total budget comes through projects in international schemes. Furthermore, a majority of the companies interviewed would have launched their projects even if not funded by the EU or by the EUREKA label.[53]
The study also showed that "*Since the Framework Programme deals with products or processes still in their pre-competitive stage, these companies are not reluctant to use these resources for research activities in core technologies. The EUREKA initiative label, on the other hand, tend to be more concentrated on peripheral technologies".* It is also interesting to note that the Framework programme is often seen as a way of risk-haring and of financing more prospective projects. Less prospective projects tend to be financed internally.[54]
The study, published in 1996, showed already, what has been confirmed four years later, by

50a Karasinska-Fendler, Maria et al., in: Tang, Helena (Editor), Winners and Losers in EU Integration, op. cit., p.173
50b Orlowski, Witold M., Uwarunkowania i skutki przystapienia Polski do unii celnej UE, Lodz 1997 quoted in: Karasinska-Fendler, Maria et al., in: Tang, Helena (Editor), Winners and Losers in EU Integration, op. cit., pp. 173/174

50c Bundesministerium für Bildung und Forschung, Zur technologischen Leistungsfähigkeit Deutschlands 1999, Bonn January 2000, pp. 41, 45
51 ADL
52 STUDY EUR 1724

the responses to a questionnaire sent by the European Commission to 2.275 participants in the Third and Fourth Framework panel, to evaluate the Framework programme: 65% thought that the whole application process was too slow and/or costly, even when 70% outweighed the costs (72% of academic and 62% of industrial partners.) 55 In the 1996 Survey the companies interviewed, see as an obstacle for participation in the Framework programme the costly bidding process and the low success rate for bidding companies. Furthermore, the Industrial Property Rights problems are a major sticking point concerning the participation in the Framework programme.
The companies interviewed express criticisms or offer suggestions mainly about the selection process and the constraints in the definition of projects for the Framework programme, and the partnership requirements for the two European schemes.
Most critical of the Framework Programme has been *Mr. José Mario Gago* Portuguese Minister for Research. In his key-note speech at the Special session commerorating the 25th anniversary of the European Science Foundation on 23.9.1999 he said: *"The European Council of Ministers for Research does not decide anything relevant for European science policy. It decides unimportant matters about a particular instrument which is called the research framework programme."55 a*

b.) COST

European Co-operation in the field of Scientific and Technological Research (COST) was set up by a Ministerial Conference in 1971, attended by the Ministers of Science and Technology from 19 countries. COST has been established to create a framework for scientific and technical co-operation between member countries, which should allow the co-ordination of national research on a European level. COST actions focus an basic and pre-competitive research, as well as on activities that generate public utility.56
Already in the year 1991 Poland has been admitted to COST as a full member.
The EU has reported in its Second Report on S&T Indicators 1997 (ERSTI) on a country-by-country basis the level of co-operation between COST countries Cross participation's the following numbers for four of the Central and East European Accession countries: Czech Republic 1.018 activities, Hungary: 1.418, Slovakia 611 and Poland 693.57 ERSTI makes reference to some criticisms that the outreach of COST has been limited and that it has not incorporated as wide a range of participants as it should have done....Apparently its present administrative structure will be unlikely to cope with further expansion as new member countries and Actions are added.

c.) EUREKA

EUREKA, launched in 1985, is a European-wide initiative for industrially-oriented collaborative science and technology research, without central funding. The objective of EUREKA is to raise the competitiveness of European industry through closer co-operation among enterprises and research institutes in the field of advanced technologies. As compared to the EU Framework Programmes ("*top down*") EUREKA is labelled by the EU as a "*bottom* up" scheme.
In recent years, EUREKA seems to have lost some of the initiative's earlier support. The numbers of projects submitted has fallen down, the projects are smaller and there are fewer
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55 a Gago, José Mariano, The future of European Science and Technology Policy, European Science Foundation Policy Briefing No.6, February 2000, p.5
56
57 p. 594
strategic projects. The funding from member states, down from €UR 550 million in 1993 was reported to be only 309 million in 1998.
The experts are divided on the significance of this trend: is it a fundamental decline reflecting a lack of interest in the EUREKA concept or is it a more specific cyclical phenomenon, one which may prove short-lived? A group of experts, called by the Commission, has presented four scenarios, reaching from pure and simple cessation to the launch of a second EUREKA designed to co-ordinate the innovation policies of member states.[58] ERSTI p 592

IV. Achievements of SCI-TECH
1.) General assessment
Zoltowski:
The SCI-TECH II Programme strongly contributed to the further development and to the modernisation of Poland's National and Regional Innovation systems. It has also contributed in the stabilisation of the Polish RTD potential.
The impact of this Programme was particularly felt after the introduction of country administration reforms, especially delegating responsibility to the regional self-governments for RTD and Innovation development.
The Programme has furthermore introduced model networks of regional institutions as elements of regional innovation sub-systems.

Before starting SCI-TECH II it was assumed that the sustained growth of the Polish economy experienced through the last few years will generate an economic demand from the enterprise sector for scientific and technological research with a European dimension. It is too early to conclude that this ambitious target is indeed already within reach. A number of reforms, especially the reform of country administration, was introduced during the planning phase of the SCI-TECH II Programme.

The findings gained and the experience available through SCI-TECH furnish sufficient strong evidence to continue the permanently necessary adjustments of the Polish Science and Technology Policy through the concerted efforts which have already started.
Projects conducted within the SCI-TECH Programmes have provided the tools and mechanisms for this process.

Under these Programmes – and particularly, the *Restructuring scheme for Institutes* and *Institute restructuring and training*, as well as *Pre-accession strategy* projects – the Institutes have already undertaken a number of initiatives that have led to their considerable streamlining. A massive restructuring effort has taken place, with particular emphasis on the training of R&D staff.

Industry in Poland – as apparently in any other of the Central and East European countries – is
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often seen as basically uninterested in getting engaged in-house-RTD. Confronted with the choice to undertake time- and money consuming Research and Development efforts for which no guarantee of success can be given, industry tends to favour the option to buy ready-available technical solutions "off the shelf". "*It is not new technology which industry shuns, but rather the investment to create it." 60* ***(X ADL S. 11)*** The UNESCO World Science Report is also highlighting the reluctance of the new private entrepreneurship to promote research and development. 61 The negative attitude was aggravated by the fact 'that staff cuts were particularly severe in industrial R&D in the CEE countries over a period when the proportion of R&D personnel engaged in entrepreneurial sectors in the countries of the OECD itself increased by an average of 5 points.' 62 A survey among 200 Polish industrial enterprises – undertaken with a KBN grant – covering the period 1990-1997 disclosed that "only a very small number of firms saw higher spending on R&D as a priority. In fact, most enterprises have cut back on R&D, which in the long term may prevent them from radically improving their market position and introducing new technologies. The research covered large enterprises, i.e., those with the greatest potential and best conditions for developing their own R&D base, but clearly R&D remains a fairly neglected area, especially in the case of state enterprises." 63

In this alarming picture belongs also the fact, that in the European Industrial Research Management Association (EIRMA), which was created under the auspices of the OECD as one of the mechanisms to bridge the "technological gap" between Europe and the U.S. among the more than 170 research intensive industrial corporation from 20 European countries, there are recently Hungarian, Czech, Croatian and Slovenian companies, but not one from Poland.

b.) Balance between state-funded and Privatised RTD Institutes

The SCI-TECH Programmes have attempted to assist in the KBN's numerous attempts to create a higher awareness about the importance of intensified massive efforts by all concerned actors, government, the scientific community and industry likewise, to redress the present unsatisfactorily RTD position of Poland. European-wide schemes like the FP-5 and European-supported assistance programmes like the SCI-TECH initiatives are meant to be mutually reinforcing each other. In an article with the provoking title "*Central Europe's R&D spending is a joke. Can the EU help?"* published by "Business Central Europe" the conclusion was reached that a pre-condition to make the external European support meaningful, more is needed that the willingness of the governments of the CEE countries to cooperate seriously: *"But that will only happen if both scientists and companies get together to take the opportunities on offer. Otherwise, Central Europe will end up with even less R&D funding, and an even lower chance of developing competitive industries."* 64

It is important to continue all efforts changing the attitudes of the Polish RTD sector which tends to look rather for ready-made solutions than for tools and mechanisms, such as those

developed within SCI-TECH projects whose implementation and continual use would enable it to follow the appropriate restructuring path, which in turn would make it less dependent on State financial support and ensure its greater contribution to Polish RTD development.

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61 UNESCO 1996 p.89.
62(UNESCO 1998 p.112)

63 Three Polands, p. 110
64*(p.19)*

Two trends among the Polish Institutes have emerged:

- Towards stability (by transformation into a proposed "State Institute", which would receive for a large proportion of its budget guaranteed permanent funding,
- Towards attaining independence through privatisation, although with the possibility to obtain some limited government funding for certain statutory activities.

Although it can be argued that from the point of view of the national budget, a speedy privatisation of the majority of the Polish R&D institutes may have the greatest advantages, caution must be observed towards any simplistic formula. The example of all Western industrialised countries demonstrates that the state is well advised in keeping direct influence on R&D institutes on fields of strategic interest to the country. Market forces alone are unable to safeguard issues of long-term interest to the economy. The same has to be said to the multitude of SME's which are usually unable to undertake innovative R&D on their own. If one leaves in the case of Poland the modernisation to the economy to the import of the latest state-of-the-art technology to foreign-based multinational companies, the R&D underlying the development of such technologies is usually undertaken at the headquarters of the companies concerned. It is vital for the future orientation of the Polish economy that key fields of modern technologies are being developed with the active involvement of Polish researchers.

Existing evidence suggests therefore that in view of the lengthy privatisation process with its many uncertainties, as well as in view of the still lacking managerial skills, that the above mentioned "stability option" has many advantages. Its implementation is relatively simple and uncomplicated. It requires, however, some straightforward administrative decisions.

The hasty privatisation of R&D institutes as evidenced e.g. by the experience in the East German Länder bears the danger that institutes with embodied know-how and research skills vital to the economy as a whole may disappear because the present market demands may not support the survival of such institutes leading to long-term negative effects for the innovation process of the sectors in question.

The 'stability option', i.e. the consolidation of the concerned institutes with the necessary clustering of groupings of institutes, in both research lines as well as in a geographic dimension could provide a seedbed for the exchange of new ideas. Not only does physical proximity tend to facilitate the transmission of knowledge, but it also enhances the development of institutions and makes them more effective.
Networking within this option will be of the essence. Formal and informal links between institutes, including subcontracting relationships facilitate both increased economic specialisation to the institutes as well as superior access to knowledge. The networking will furthermore facilitate the intended acceleration of the regional development within Poland. Last but not least, it is also the ideal vehicle for the Europeanisation of the Polish R&D infrastructure.

c.) Internal Restructuring and external Consolidation

Regardless of the various administrative initiatives to be taken, the process of Institute consolidation has been going on for years. It is a deliberate bottom-up process that involves practically all Polish Institutes albeit to varying degrees. The understanding of the process is crucial to the appropriate evaluation of the Institutes role and functioning.

The starting line for the assessment of the gradual development is the fact that all Institutes have presently already reached an important stage of their consolidation process. This positive development can been evidenced by:

- The internal restructuring performed thus far,
- The establishment of formal and informal contacts and structures serving a cluster of Institutes or most of them.

The Institutes are being practically permanently monitored. Continuously they undergo periodic reviews, analyses, evaluations, audits etc. As a consequence, KBN, the Ministry of Economy and other relevant Ministries are in a position to have an excellent first-hand knowledge of the Institutes potential and capabilities. In practically all cases the existing evidence allows very positive conclusions. National as well as international expert teams which have monitored the restructuring process of the Institutes are supporting this evidence, particularly based on the work conducted within the project mentioned above.

Both *"Internal" restructuring* as well as *"External" consolidation* of the Institutes must be undertaken at the same time.

"Internal" restructuring has meant in practical all cases some inevitable reductions in the size of the Institute and its R&D and supporting staff. It has also meant an increased concentration and thus specialisation. The R&D staff have significantly increased their market awareness. As a result, it is possible to demonstrate that several Institutes have risen to play the role of innovation leaders and have been able to improve their links not only within the Research Community but, even more important, between Research and Industry.
It is also encouraging to note, that the Institutes have been increasingly been able to stimulate R&D demand, particularly among SME's, for which R&D providers constitute practically the only chance for market survival. At this point, it should be noted that within the EU-15 countries in spite of huge efforts by their governments and by the Commission, the SME's remain the most difficult target group for effective Technology Transfer and Development. It has been reported that the SME's are usually not in a position to participate adequately in the FP-5. Special mechanisms are being called for to find solutions to this everywhere felt dilemma.

"External" consolidation – in some cases coupled with combination and mergers of the activities of Institutes – went hand-in-hand with the mentioned process of *"Internal" restructuring*. This process is motivated by the conviction of the potential and need for increasing the Institutes independence, expressed also in the efforts leading to privatisation. Unlike the "Internal" restructuring, the "external" consolidation is a process which is still far from completion. All Institutes, and this is a healthy sign, are at present at the stage in searching for appropriate consolidation options and alternatives. After their internal restructuring and faced by constantly changing market conditions and increased national and international competition they find themselves in situations which until recently have been very unfamiliar for the Scientific Community: Strategic considerations by the new owners, threats posed by various groups attempting to obtain funds currently allocated to the Institutes, attempts to commercialise the Institutes grounds without regard to the Institutes "Raison d'être" etc.

To summarise, it can be stated that the SCI-TECH efforts, encouraged by the Polish authorities, have achieved the following remarkable results:

- Acquisition of knowledge on the available Institute restructuring alternatives
- Assessment of the *"pro's"* and *"con's"* of individual restructuring options for each institute,
- Definition of the framework allowing the choice of options,
- Establishment of Institute associations for the realisation of the retained option

The above mentioned stage of consolidation of the Institutes has been achieved in essence through indirect action on the Institutes. Those indirect actions consisted to a large extent in the application of appropriate financial support policy, i.e. in practical terms in a gradual reduction of the state budget allocations – which currently amounts in average to approx. 20%-30% of the Institute's operating costs – and of stimulating the Institutes to raise their managerial skills, particularly in the areas of sales and marketing as well as in the development stronger customer relations; furthermore the need is increasingly felt by the Institutes to be more active involved in the participation in various national and international funding and cofinancing projects and programmes.

If one has to single out the most significant positive effect of this approach, the intensification of the Institutes "grass-roots" initiatives coupled, in many cases, with a considerable improvement of their financial condition can be highlighted.

All-in-all, it is justified to say, that the SCI-TECH activities have been able within the time-span of only a few years to obtain encouraging results. What seems to be called for is the systematic application of the methods developed and the utilisation of the tools which have been made available. The reform of the science and technology development of Poland is far from being completed after the formal completion of the SCI-TECH projects. As seen in all other industrialised countries, the reform and the adjustment of the STD infrastructure is a permanent process to which no 'sunset-clause' can be applied.
As next important step after the expected phasing-out of the EU PHARE assistance in form of the SCI-TECH Programmes a systematic nation-wide approach will be needed to support the implementation process of tools and mechanisms developed through the SCI-TECH Programmes into Poland's Science and technology machinery, enabling the country's economy to meet the forthcoming challenges of the increased international and global competition.

IV. Conclusions and Recommendations for further action

- In his analysis "Poland: Economic performance 1989-99 and Prospects for the Future" *Rapacki* reached the conclusion *"The data presented here suggest that some major threats exist to sustainable long-term growith in Poland. They are embedded in the limited ability of the Polish economy to encourage the indigenous R&D effort, to develop ist science and technology base and to generate new knowledge and technological innovations. This may impede the further growth of productive and allocative efficiency and by the same token adversely effect the competitive position of Polish firms in the global environment." XXXYYY*
- The EU funding for RTD will in future take place in other forms. After completion of the SCI-TECH II project, the Phare programme as such will not provide anymore technical assistance for RTD issues. Instead, the co-financing for projects within the Framework Programme will become the 'normal' EU RTD funding instrument. Funding from the Structural Fund and from the Cohesion Fund – if and to which extent Poland will be allowed to have access to these Funds – may under certain conditions be used for that

purpose. The budget estimates of the Ministry for Finance on which the Ministry of Economy has based its Innovation Programme (approved by the Council of Ministers on 11 July 2000) until the year 2006, are counting on massive EU funding: *"Until the year 2002, expenditure of the Programme is estimated at 5% of the whole National Development Plan. In the period of 2003-2006, this share of expenditure increases to 15%. The estimation is presented in two variants*: *minimum (50% share of domestic resources in the EU Structural Funds and the Cohesion Fund resources) and maximum (70% share)." P. 37*

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- KBN has presented in December 1999 a government document "Directions of national Innovation Policy till 2002" analysing thoroughly the competitiveness of the Polish Economy. The report says: "*The essential factor determining the international competitiveness of the economy is its innovativeness. The relatively low innovativeness of the Polish economy is a major barrier to the development of the country..." XXXYYYZZZ*
- The Ministry of Economy, when presenting in July 2000 the Programme "*Increasing the Innovativeness of the Polish Economy until the years 2006"observed*: The above analysis and international lead to the conclusion that the Polish economy performs at a relatively low level of innovation...The mechanisms for facilitating innovative activities are poorly developed in Poland. Particular shortcomings are notable in the area of cultivating attitudes promoting innovation among youth and among entrepreneurs. This situation is not conducive to Poland's economy achieving a high level of competitiveness."XXXZZZ
- In view of the increasing importance to deal adequately with the '*Copenhagen criteria'* referring to Poland's capacity to cope with competitive pressure and market forces within the Union, the creation of a 'Competitiveness Council', similar to that of the US, may be worthwhile to be considered for Poland. KBN may also wish to consider the publication of an annual report assessing the scientific and technological capacity of Poland. Such a report is being issued on an annual basis by the German Federal Ministry for Education and Research ""*Zur technologischen Leistungsfähigkeit Deutschlands."*
- For the larger Polish enterprises, membership of the European Industrial Research Management Association (EIRMA) should be sought. EIRMA was created in 1966 under the auspices of the OECD in order to bridge partly the "technological gap" between the US and Western Europe. Today, it provides an important forum for representatives of most of the major European companies to exchange ideas and information on best practises in industrial research management. Among the more than 170 members from 20 European countries, there are meanwhile companies from other CEE countries, but none from Poland.
- A 'Polish Industrial Research Management Association' (PIRMA) should be envisaged, similar to the pan-European EIRMA above. This could provide a national forum for exchanging best practices in R&D management, open to Polish industrial firms from all research intensive industrial branches as well as for independent research institutes, including those not able to participate in EIRMA.
- Training in the management of technology should be expanded. This program should focus in the near terms of the needs of SME's, with particular attention to entrepreneurship and the capabilities for managing SME's. In the longer term, this program can include projects such as the development of new Polish textbooks and the launching of a special Journal for the Polish speaking RTD community, in cooperation with others (e.g. "R&D Management" (Oxford – Manchester), or "International Journal for Technology Management" (Geneva). The establishment of special-purpose seminars specified by industry and in co-operation with the Technical Universities of Poland and

perhaps sponsored by the above proposed Polish Industrial Research Management Association (PIRMA) should also be envisaged.

- Improvement of University-Industry Relationships. The principal approach of such a program is to develop criteria for determining, and then improving, the effectiveness of university-industry relationships. The proposed program will be based upon the needs and objectives of industry, but modified to account for the resources and nature of university research.
- Organisation of an annual High-level International Science and Technology Conference to stimulate Investment by Industry in Innovation and to attract Foreign Investment. The objective is to develop an awareness of the need and opportunities for firms in Poland – domestic and international, to invest more in generating innovations within Poland. Such a Conference series could be organised, for example, in cooperation with the International Academy Schloss Baruth, to which among others, in their personal capacity senior officials from international governmental and financial institutions dealing with RTD issues belong as well as the chief executives from EIRMA and of its American, Japanese and Korean equivalent belong. The proposed conference series would bring together senior industry executives from Poland and from other OECD countries, as well as key government leaders. Industry speakers should provide role models of successful models in innovation including start-up models for young entrepreneurs in the 'new economy'. The pressures of entering into competitive EU and world trade would be stressed, and tied to the KBN efforts to launch government policies that can strengthen the competitive position of the Polish industry.XXX The above recommendations have been reiterated from a similar proposal made on 9.9.1998 by Arthur D. Little as part of the Pre-Accession Strategy support for Poland (Project PL9611/98/01-01.2), pp.14-15
- It is a necessity to induce Polish firms to increase their own R&D activities. Special incentives, such as the creation of a system of tax reductions for R&D and innovation efforts should be introduced.
- High attention should be given to raise massively the number of Internet hosts in Poland. The present situation which prevents many groups in Poland from having equal access to the educational and technological tools of the Knowledge Economy is hampering the European efforts to bring policies for the Information Society and the European Research Area together.
- Undoubtedly, one of the most important assets of the CEEC's are their Human Resources. The increase of numbers of students in the tertiary sector in Poland is particularly impressive. However, the "World Competitiveness Yearbook 1998" has observed that Poland's system in higher education is apparently not well geared to meet the demands of the private sector. In particular, doubts were expressed on the availability of sufficiently well trained engineers.[65]"The monitoring, explanation and guidance of the emergence of the new model of science in Central Europe are creating an urgent need for large-scale empirical comparative studies to analyse the whole process in a rigorous methodological. In these studies, not only will be the general features of the transformation process in Central Europe be properly defined but also the specific characteristics of each country." [66]

XXXYYY Rapacki, Ryszard, Poland: Economic Performance 1989-99 and Prospects for the Future, Working Papers No. 207, World Economy Research Institute, Warsaw School of Economics, Warsaw January 2000, p. 19

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65 International Institute for Management Development, Lausanne 1998

66 UNESCO World Science Report, Paris 1996 p.90

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