III. ACADEMIA–INDUSTRY–GOVERNMENT INTERACTION: A CASE STUDY IN POLAND

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3.1 Introduction

Poland has undergone many changes since the early 1990s. The process of transition from a centrally planned economy, the main purpose of which was to introduce free-market forces into the national economy, began with radical socio-economic reforms. Today, after 15 years of building market institutions, Poland's experiences with economic and institutional change can be assessed. Successful achievements can be noted in several fields, such as the liberalization of the economic system, the creation of a market institutional structure, and macroeconomic stability. The educational system has also undergone many transformations. Many private schools and universities have been created since the mid-1990s, giving a large number of young people access to tertiary education.

The prospect of European Union (EU) membership in 2004 forced Poland's policy-makers to pay more attention to issues of national competitiveness and innovativeness. In the last decade, a significant number of policy documents influencing the development of innovation in Poland have been developed. In addition, regional governments have been encouraged to build regional innovation systems by creating and carrying out innovation strategies in which the promotion of academia–industry interaction is one of the most important issues.

Responsibilities for innovation policy in Poland have been divided among three ministries: the Ministry of Scientific Research and Information Technology (MNiI), Ministry of Economy and Labour (MGiP), and Ministry of Education and Sports (MENiS). This division of responsibilities is seen as the main drawback of the Polish national innovation system.

Academia–industry interaction is influenced not only by national policy and government actions, but also by the specific characteristics

of the higher education and business sectors in Poland. It is important to note that most universities in Poland's higher education sector focus only on teaching; very few institutions dedicated to research exist. If research activity is undertaken, it is mainly basic research with little or no regard for possible future business applications. Institutions of higher learning in Poland are therefore rarely seen by enterprises as cooperation partners.

As for Poland's business sector, well over 90 per cent of enterprises belong to the small and medium enterprise (SME) category. Research has shown that one of the biggest problems faced by SMEs in Poland is the lack of adequate financial resources for conducting innovation activities. This is considered the main reason for their reluctance to participate in costly in-house research and development activities.

The above are the main issues that have prompted discussions about how academia–industry cooperation can increase the innovative nature of the Polish economy. It is widely recognized that academia–industry interaction should form the central part of national and regional innovation systems in Poland. This study will present past and recent developments in national policy regarding academia–industry interaction, as well as assessing their possible contribution to the economic development of the country.

3.2 Poland's economic system and policy

Economic structure

According to the number of registered enterprises, Poland's economic structure is dominated by wholesale and retail trade, repair of motor vehicles, motorcycles, and personal and household goods (33.4 per cent of registered economic units); real estate, renting and business activities (15.6 per cent); manufacturing (10.6 per cent – 10.8 per cent together with other industrial sectors); and building and construction (10 per cent). A total of 2,259,796 enterprises (73.34 per cent) registered in June 2004 dealt with trade, transport, or other market services.

In recent years, market services have also generated the most economic growth as indicated by gross domestic product (GDP) and gross value added, as shown in *Table 3.1*. This sector has also been the most stable area of the Polish economy, registering constant growth

over the past decade. Its influence on the national economy was especially apparent in the period 2001–2002, when Poland experienced an economic slowdown due to the sector's weaker dynamics (see MGiP, 2004*b*: 53).

Table 3.1 Dynamics of gross domestic product and gross value added in 2000–2005 (average prices compared with the previous year, previous year = 100%)

Year	2000	2001	2002	2003	2004	Q1 2005
Gross domestic product	104.0	101.0	101.4	103.8	105.4	102.1
Gross value added	103.7	101.1	101.3	103.7	105.1	102.2
– Industry	106.5	99.7	99.8	106.3	109.7	105.3
– Construction	100.0	92.1	93.2	97.1	98.7	102.5
– Market services	104.2	102.8	103.7	103.6	104.5	102.1

Source: Central Statistical Office (GUS) data: www.stat.gov.pl

The acceleration of economic growth in 2003 was determined by the positive influence of both industry and market services, while construction remained a hindering element (this had been the case since the third quarter of 2000). Before and after joining the EU, in 2003–2004, Poland experienced considerable GDP growth rates. However, the economy seems to have been slowing down since the beginning of 2005.

The majority of the enterprise sector in Poland (95.2 per cent of all enterprises registered in June 2004) consists of micro-firms employing nine or fewer people. Small enterprises with 10 to 49 employees account for 3.9 per cent, while medium-sized firms with between 50 and 250 employees account for only 0.8 per cent of the total number of firms. This means that the SME sector in Poland consists of 99.86 per cent of the total number of registered enterprises. Large enterprises employing 250 people or more represent only 0.14 per cent of the whole enterprise sector in Poland.

The largest group of micro-enterprises (34.2 per cent) are registered in wholesale and retail trade, repair of motor vehicles, motorcycles, and personal and household goods. SMEs as well as large enterprises employing 250 people or more are mainly involved in manufacturing

activities (21.9 per cent of small enterprises, 27.1 per cent of medium enterprises, and 35.7 per cent of large enterprises).

Increasing privatization means that 93 per cent of the Polish enterprise sector is composed of private firms. However, the private enterprise sector is showing a downward trend in the number of firms, while the public sector is growing. This is also true of public medium and large enterprises; again, this is mainly due to the privatization process. It is micro-firms that are mainly responsible for the registered drop in the number of private enterprises (GUS, 2007).

The use of technology in the form of automation equipment increases with the size of the enterprise. In 2003, only 16 per cent of medium firms employing 50 to 249 people used computers to control and regulate technological processes, while in the case of large enterprises with 250 to 499 employees, computers were used by 39.3 per cent, and in those with more than 500 employees, by 57.4 per cent (GUS, 2003: 122).

A total of 5,923 surveyed Polish firms used a local area network (LAN), 7,696 used the Internet, and 5,943 had their own websites (GUS, 2003: 125).

According to the third Community Innovation Survey data (covering the years 1998–2000), only 6.7 per cent of all surveyed enterprises were engaged in research and development (R&D) activities, as shown in *Table 3.2*. Mining and quarrying companies turned out to be the most active in R&D activities – almost 13 per cent of them conducted R&D, of which 42 per cent did so on a regular basis. Foreign-owned firms accounted for 8.6 per cent of all surveyed firms and mixed ownership firms for 3.7 per cent. Almost one fifth (19.5 per cent) of foreign-owned firms carried out R&D activities, compared with nearly half (48.7 per cent) of mixed ownership firms (KOITA, 2002: 27, 42).

As in other countries, small and medium-sized firms in Poland are statistically the least active in R&D activities. In the period 1998–2000, only 3.4 per cent of SMEs were engaged in R&D, of which only 29 per cent did so on a regular basis. In comparison, 10 per cent of medium and 28.6 per cent of large enterprises conducted R&D

activities, of which 40 per cent of medium and 60 per cent of large firms did so on a regular basis.

Table 3.2 Engagement of Polish enterprises in R&D in the years 1998–2000

Enterprises		Engaged in R&D	Engaged in R&D on regular basis	Engaged in R&D occasionally
Total enterprises	number	1,885	796	1,089
	%	6.7	2.8	3.9
Mining and quarrying	number	19	8	11
	%	12.9	5.4	7.5
Manufacturing	number	1,833	775	1,057
	%	6.7	2.9	3.9
Recycling	number	3	2	1
	%	2.2	1.4	0.7
Electricity, gas and water supply	number	29	10	19
	%	5.1	1.8	3.4

Source: Central Statistical Office of Poland (GUS), www.stat.gov.pl
Note: Percentage figures have been rounded off.

The relatively small number of Polish enterprises conducting R&D activities makes for low numbers of patent applications. Among the firms surveyed in 1998–2000, only 0.8 per cent of small and 4 per cent of medium and large firms applied for a patent (KOITA, 2002: 116). Moreover, research conducted by Poland's Central Statistical Office (GUS) indicated that Polish enterprises' innovation activity had deteriorated during the period covered by three consecutive Community Innovation Surveys (1992–2000) and that the gap between the Polish economy and that of the rest of the EU had increased. In 1992, the percentage of innovative companies active in Poland was estimated to be about 62 per cent. In the years 1994–1996 this number decreased to 37.6 per cent. It fell to 26.4 per cent in the period 1997–1999 and reached 16.9 per cent in 1998–2000 (Niedbalska 1999: 265; KOITA, 2002: 41, 49).

National and regional policies for economic growth and development

Historical perspective on the role of the state in the economic sector

Prior to 1989, the Polish economy was centrally planned. The two main characteristics of a centrally planned economy are state ownership of the means of production and the non-market allocation of economic resources.

In the case of Poland, state ownership of the means of production was mainly associated with capital goods, less so with land, and to an even lesser extent with labour. However, even with regards to labour, the state used various administrative regulations and control mechanisms. This resulted in considerable 'nationalization' of production (for example limiting school admissions, employment, and so-called work orders for graduates).

As far as land ownership was concerned, in the majority of socialist countries the cooperative system formally predominated. In Poland, however, private ownership prevailed. Nevertheless, both of these forms of land ownership were set in a specific context. They functioned in a non-market and strongly bureaucratized environment. Large and extremely monopolized state enterprises were the main, and often the only, suppliers of indispensable production goods and raw materials, as well as the recipients of finished products both for the production cooperatives and for individual agricultural farms. The state also limited land sale and purchase on a wide scale.

In Poland, even before 1989, the private sector's main area of activity was agriculture, in addition to services and retail trade. As in the case of land ownership, the environment in which private firms functioned was very specific due to the vast influence of the state on the economy.

The principal features of the Polish centrally planned economy and the role of the state in the economic sector can be summarized as follows:

- centralized management of the economy and planning;

- command character of the system (central bureaucracy imposed general aims, detailed tasks, and administrative assigning of production factors including financial resources of firms and economic organizations);
- administrative regulation of product prices and production factors;
- management subordination of firms and economic organizations to state-party bureaucracy;
- centralization of authority to create and reorganize individual economic units (equivalent to prohibiting management from undertaking this type of activity);
- almost total lack of competition between individual economic entities;
- lack of commercial financial institutions;
- large degree of isolation of the economy and enterprises from the processes and phenomena predominant in the world economy; and enterprises functioning with so-called 'soft' budget limitations (regulation and funding of economic activity by the state, which covered its losses and did not allow bankruptcy, administratively established prices and a lack of commercial financial institutions), which resulted in reluctance to act according to principles of efficiency.

The state was the dominant economic entity in the centrally planned economy. The government defined the range of activities of other economic entities as well as the extent to which these were autonomous, and established prices and various other 'market parameters'. It also influenced choices made in the economic sector, especially those of a non-economic character. Under these conditions, enterprises were virtually devoid of economic independence. They were therefore unable to apply the rules of rationality and efficiency to their economic activity.

The first non-communist government in the post-war history of Poland adopted the Balcerowicz Plan in September 1989. This was an economic programme designed to stabilize the economy, in particular to balance the market and reduce high inflation as well as to introduce a fundamental transformation of the socio-economic system, which included the privatization of the economy. During this period, the role of the government was very specific. It aimed to introduce a market economy through centrally planned actions.

Nowadays, the role of the government in the economic sector is limited to dealing with the industrial sector's most pressing problems (*Section 3.2*), continuing the privatization process of state-owned firms, and creating various economic and non-economic incentive programmes in order to support the development of the private enterprise sector.

Regional industrial development policies

In the context of Poland, it is more appropriate to examine sectoral industrial development policies than regional ones, although some of them are indeed specific to the country's regions where a given industry is located. Regional authorities seldom engage in building their own sector-specific industrial development policies. *Table 3.3* presents an overview of the main industrial development policy papers issued in Poland in recent years.

A number of industrial development policies concerning, for example, restructuring programmes and strategies, have either been implemented, or have been formulated but are still awaiting implementation in Poland. They concern a number of industrial sectors: hard coal mining, iron and steel, defence, electronics, wood processing, chemicals, pharmaceuticals, light and cellulose-paper, as well as the electric energy and oil sectors.

The most problematic sector in the Polish economy is hard coal mining. Reforms of this sector started in the 1990s. Since then, the government has adopted a number of policies, the most recent ones detailed in the paper titled *Restructuring of the hard coal mining sector: 2004–2006* and *Strategy: 2007–2010* (Council of Ministers, 2004*a*, 2004*c*). In general, the aim of these policies was to enhance the economic effectiveness of this sector's business entities, so that they would be able to finance upgrades and capital expenditure projects with their own funds. Policy-makers also had in mind improving the economic effectiveness of the industry's exports and reducing employment in order to match production capacity, which in turn should match market demand. As a result of the implementation of these reforms and programmes, it is hoped that mining entities will not have to rely on any public assistance, which is forbidden by international treaties. Currently, this is practically impossible.

Table 3.3 Main industrial policy papers issued in Poland (1999–2005)

Title	Date of approval of publication	Regions concerned
Restructuring the hard coal mining sector: 2004–2006 and strategy for the period 2007–2010	27 April 2004	Upper Silesia, Lower Silesia, Lublin Region
Activities of the Treasury with regards to the realization of restructuring and privatization programmes in the pharmaceutical sector	26 November 2003	not region-specific
Strategy for light industry: 2000–2007	24 October 2000 changed 2 September 2003	not region-specific
Strategy for the wood processing industry up to 2006	19 August 2003	not region-specific, although it concerns mostly the northern and eastern regions of Poland
Strategic aims for the cellulose paper industry in Poland – perspective up to 2007	23 June 2003	not region-specific
Restructuring and development of the iron and steel industry in Poland up to 2006	25 March 2003	Upper Silesia, Lower Silesia, Mazovia region
Treasury ownership policy realization programme for the electric energy sector	28 January 2003	not region-specific
Strategy for electronic industry up to 2010	December 2002	not region-specific
Strategy for the pharmaceutical industry up to 2005	1 October 2002	not region-specific
Restructuring and privatization programme of the oil sector	24 September 2002	not region-specific
Strategy for the chemical industry in Poland up to 2010	4 June 2002	not region-specific
Evaluation of the realization and corrections to the directions of energy policy in Poland up to 2020	2 April 2002	not region-specific
Integrated schedule of the privatization of the electro-energy sector and the introduction of the electric energy market	16 May 2000 actualization 19 June 2001	not region-specific
Restructuring programme of the defence sector and support for the technological modernization of the Army of the Republic of Poland	9 February 1999	not region-specific

Source: Authors.

The conclusion arising from the above overview of recent industrial policy documents is that the process of economic transformation in Poland is far from finished. There are still numerous problems that must be confronted in order for the domestic economy to be able to compete internationally on different product markets. It is also apparent that central

government, rather than regional government, is formulating industrial policy. Regional authorities' role is limited to tackling emerging social problems connected with restructuring and employment reduction in the industries concerned.

Technological and human resource development policies

Formulation of technological development policy remains mostly in the hands of the Ministry of Scientific Research and Information Technology (MNiI, formerly the State Committee for Scientific Research – KBN). In recent years, the ministry has issued a number of policy documents. Policy documents have also been published relating to the growth of Poland's innovation activity, issued mainly by the Ministry of Economy and Labour and its predecessors. An overview of technological development and innovation policy documents can be found in *Table 3.4*.

Table 3.4 Main technological development documents in Poland (1999–2005)

Document title	Date of approval of publication	Organization responsible (ministry, etc.)
Directions of state scientific, science-technology and innovation policy through 2020	December 2004	Ministry of Scientific Research and Information Technology
Strategy for increasing R&D investment in order to achieve Lisbon Strategy Goals	March 2004	Ministry of Scientific Research and Information Technology in cooperation with Ministry of Economy and Labour
Proposed directions of science and technology development in Poland until 2013	2003	Ministry of Scientific Research and Information Technology
Directions of innovation policy until 2002	1999	former Ministry of Economy
Increasing innovation in Poland's economy through 2006	11 July 2000	former Ministry of Economy, Labour and Social Policy
Aims and directions of the information society	28 November 2000	former State Committee for Scientific Research and former Ministry of Posts and Telecommunication
e-Poland – Action plan for the development of an information society in Poland	11 September 2001	former State Committee for Scientific Research and former Ministry of Posts and Telecommunication

Source: Authors.

In the documents titled *Strategy for increasing R&D investment in order to achieve Lisbon Strategy Goals* (Council of Ministers, 2004*b*) and *Directions of scientific, science-technology and innovation policy of the state until 2020* (MGiP, 2004*a*), the Ministry of Scientific Research and Information Technology (MSRIT) set out the most important actions to be undertaken in Poland regarding the science and R&D sectors. These are:

- increasing public funding for science as well as enhancement of its efficiency;
- indicating directions and priorities of Polish science development;
- initiating systemic, organizational, and legal changes enabling effective implementation of scientific, science-technology, and innovation policy, as well as supporting the growth of R&D financing from sources outside the state budget;
- developing international cooperation, particularly in the framework of the EU; and
- making the promotion of science a priority.

The document also underlines the need to continue the Foresight Programme initiated in 2003. The main objective of this programme is to indicate the future of the development of science and technology in Poland. The results of the Foresight Programme's research are intended to verify the chosen research priorities, and will indicate in a more precise manner the path of scientific development in the country. Concentration of the scarce public funds on chosen research priorities is intended to help increase efficiency in spending.

The proposed directions of science and technology development in Poland through 2013 were defined in another document issued by the MNiI (MSRIT, 2003). Policy-makers understand that efficiency in the use of budgetary R&D funds is extremely important considering their scarcity. Applying funding priorities is necessary according to the influence of a given research area on the future development of the economy. The document proposes three priorities in line with those proposed in the EU's Sixth Framework Programme: 'Info', 'Techno', and 'Bio'. 'Info' includes software engineering, knowledge and decision-making support, intelligent networks, telecommunications, and new generation tele-information networks and optoelectronics. 'Techno'

includes new materials and technologies, nanotechnologies, design of specialized systems, and mechatronics (mechanical and electronics engineering). 'Bio' includes biotechnology and bio-engineering, organic food production methods and environmental protection, as well as new medical products and technologies.

After taking into account the specific situation of the Polish R&D sector, an additional strategic thematic area was chosen. This was called 'Basics', and included the computer sciences, creation of scientific information bases, solid body physics, and chemistry.

In both documents, the need to increase state funding for R&D was underlined in compliance with the Lisbon Strategy. Three stages of a successive increase in R&D expenditure are planned.

During the first stage (2004–2006), science expenditure were expected to reach 1.5 per cent of GDP by 2006, of which 0.6 per cent came from the state budget.

The second stage (2006–2010) is called Following the Lisbon Strategy. Two variants are to be taken into account during this stage. The first foresees the achievement of the Lisbon Strategy goals in 2010 – 3 per cent of GDP spent on R&D, of which 1 per cent is from the state budget. The second variant foresees exceeding the present average value of R&D financing in the EU-15 and achievement of the level of 2.2 per cent of GDP on R&D expenditure, of which 0.8 per cent is from the state budget.

The third stage (2010–2013) will be a continuation of the goals set by the Lisbon Strategy. It is understood that the state of the budget would not permit Poland to achieve the Lisbon Strategy goals by 2010. In such a case, the level of 3 per cent of GDP on research and development will be achieved by 2013.

Directions for Polish technological policy can also be found in documents relating to innovation as well as the regional policy of the country.

In 1999, a document titled *Directions of innovation policy through to 2002* was issued by the former Ministry of Economy, and in 2000 a government programme entitled *Growth of innovativeness of the*

Polish economy until 2006 (Council of Ministers, 2000*a*) was accepted by the Council of Ministers. Both documents underline the need to establish conditions for increasing the speed of creation and absorption of innovation practices concerning products and processing, as well as management and organization strategies in order to increase the Polish economy's competitiveness.

The problem of new technology development and adoption was also underlined in such policy documents as the National Development Plan (NDP 2004–2006) and National Development Plan (NDP 2007–2013) (Council of Ministers, 2003*c*; 2005). During the period 2004–2006, projects related to new technologies and innovation implementation were carried out within the Sectoral Operational Programme – Growth of the Competitiveness of Enterprises (SOP–GCE).

The NDP 2007–2013 aims to support actions related to the creation of Aviation Valley, a series of technologically advanced aviation industry development centres. The project related to the creation of Aviation Valley in the years 2007–2013 will be carried out within the Operational Programme – Territorial Cohesion and Competitiveness of Regions.

Another important direction for technology development in Poland is the creation of its information society. Since 2000, two policy documents have been issued on this matter: *Aims and directions of the information society*, and *E-Poland: Action plan for the development of an information society in Poland* by the former State Committee for Scientific Research and former Ministry of Post and Telecommunication (KBN, 2000; 2001).

The issue of the creation of an information society was also discussed in the regional policy document entitled *National strategy for regional development for the years 2001–2006* (NSRD 2001–2006) (Council of Ministers, 2000*c*). It is essential to the strategic objective of infrastructure modernization and development, central to the strengthening of regional competitiveness. Full implementation of the projects related to the building of a regional information society will allow for the realization of another strategic aim of the NSRD 2001–2006: the restructuring of the regional economic base and creation of conditions for its diversification. Projects related to the creation of a regional information technology infrastructure from

2004 to 2006 were carried out within the framework of the Integrated Operational Programme of Regional Development (IOPRD).

Today, discussions concerning the creation of a knowledge-based society are conducted at the national level. The Draft National Development Plan for the years 2007–2013 and National Strategy of Regional Development for the years 2007–2015 take into account the need to promote the creation of a knowledge-based society in Poland by building a system and culture of lifelong learning, increasing the use of e-learning, encouraging widespread access to tertiary education, giving support to local institutions of educational nature, libraries and archives, and fostering close cooperation between education, training, and labour market institutions (on every organizational level) in order to adapt education and training offers to projected labour market needs.

3.3 Overview of Poland's national innovation system

Poland's higher education system

In the 2003/2004, 274 private and 126 public higher education institutions (HEIs) operated in Poland. The Ministry of National Education and Sport supervises most public HEIs, including (GUS, 2004*b*; Ministry of National Education, n.d.):

- universities (17),
- polytechnics (18),
- economic academies (5),
- higher pedagogical schools (7),
- agricultural academies (9),
- physical education academies (6),
- state higher schools of vocational education (30),
- theological schools (7),
- medical academies (13), and
- fine arts schools (14).

In addition, the Ministries of National Defence and Internal Affairs supervise ten other HEIs.

Public HEIs train specialists in many areas. Universities provide tertiary education principally in the natural and social sciences. Polytechnics are mainly responsible for technical education and

providing the economy with engineers. In the 2003/2004, over 70 per cent of all tertiary-level students were enrolled in public HEIs.

The share of the population with tertiary education has increased constantly since the beginning of the 1990s. According to OECD data, 13 per cent of the population aged 45–54 years has a tertiary degree, as does 20 per cent of the population aged 25–34 years (OECD, 2006*a*). This is the result of growing demand for tertiary education and higher student enrolment rates (*Table 3.5*).

Table 3.5 Participation rates in tertiary education in Poland

	1990–1991	1995–1996	2000–2001	2001–2002	2002–2003*
No. of students (in 000s)	403.8	794.6	1,584.8	1,718.7	1,800.5
Participation rate in %					
Net	9.8	17.2	30.6	32.7	35.0
Gross**	12.9	22.3	40.7	43.6	46.2

Source: Goldberg, 2004: 63.

* Data for 2002/2003 is based on National Census Data.

** Note: The gross participation rate is based on the number of students, regardless of age, enrolled at a given level of education divided by the total population that corresponds to the age group specified for that level.
The net participation rate is based on the number of students in a specified age group (corresponding to legislated standards) enrolled at a given level of education, divided by the total population in the same age group.

In response to this growing demand, private higher education institutions have been created since 1991. At the beginning of the 2003/2004, there were 274 non-public HEIs providing education for 29.4 per cent of all students. Unlike public higher education institutions, only about 25 per cent of private schools have been legally granted the right to award master's degrees.

Most private HEIs specialize in educating economists, managers, financial experts, bankers, and sociologists. The technical sciences are covered to a far lesser extent. However, students in many private HEIs acquire skills in commercializing new technologies, innovation management, seeking resources of innovation financing, and establishing innovative companies.

In 1998, higher vocational education schools began to operate. Education in these institutions lasts six semesters, and graduates are awarded bachelor's or engineering degrees. In the 2003/2004, 166,800 students were enrolled in 151 higher vocational education schools.

Table 3.6 presents an overview of the number of students enrolled in different courses of studies as well as the number of graduates in the 2003/2004.

Table 3.6 Students and graduates according to the course of studies*

Higher education institutions	Students (2003/2004)	Graduates (2002/2003)
Total (000s)	1,858.7	366.1
Including (in %):	100	100
Pedagogical	11.3	14.3
Arts	1.1	0.8
Humanities (including theology)	7.8	7.4
Social sciences	13.0	14.4
Journalism and information	0.7	0.6
Economic and administration	23.2	32.3
Law	3.1	2.4
Biological (including biology, botanics, biochemistry, toxicology, genetics, zoology)	1.8	1.6
Physical (including astronomy, physics, chemistry, geology)	0.9	0.8
Mathematics and statistics	0.9	0.8
Information technology	2.9	1.6
Engineering and technical	9.2	6.4
Production and processing	1.7	1.4
Architecture and construction	2.9	1.7
Agricultural, forestry, and fishery	1.9	1.7
Veterinary	0.2	0.1
Medical	3.0	2.1
Services for citizens	1.5	1.5
Transport services	0.8	0.6
Environmental protection	3.0	2.6
Safety protection	0.2	0.3
All other specialities	9.0	4.6

Source: Central Statistical Office (GUS), 2004*b*: XXII.
* According to the International Standard Classification of Education (ISCED 97).

Enrolment rates show that the most popular courses of studies are economics and administration (23.3 per cent of all students in the 2003/2004), sociology and other social sciences (13 per cent) and

pedagogy (11.3 per cent). Engineering and technical sciences come in fourth place, with 9.2 per cent of all students.

Most graduates of the 2002/2003 completed courses in economics and administration (32.3 per cent), sociology and other social sciences (14.4 per cent), and pedagogy (14.3 per cent). The engineering and technical sciences came in fifth place, with 6.4 per cent of all students, preceded by the humanities (7.4 per cent).

Private HEIs are mainly teaching organizations; they conduct research and scientific activities to a far lesser extent than their public counterparts (*Table 3.7*). Polytechnics, universities, and medical academies are responsible for over 80 per cent of R&D spending in the entire higher education sector. Their share of R&D spending is twice as important as their share in the total number of higher education institutions and almost 20 per cent greater than their share in total employment in the sector. Only 21 of over 300 higher private schools perform R&D activities – with their share in total R&D spending representing only about 1 per cent.

Table 3.7 R&D in higher education institutions (2001)

Higher education institutions	Number of units	Structure (%)	R&D spending (%)	Employment (%)
Polytechnics	17	14.29	38.21	23.79
Universities	18	15.13	29.64	31.66
Medical academies	13	10.92	13.87	13.37
Agricultural academies	7	5.88	7.65	7.56
Schools of Ministries of National Defence and Internal Affairs	11	9.24	6.64	5.67
Economic academies	5	4.20	1.63	4.25
Higher pedagogical schools	7	5.88	0.70	3.97
Physical education academies	8	5.04	0.47	2.73
Higher art schools	14	11.76	0.25	2.65
Higher private schools	21	17.65	0.95	4.36
Total	121	100	100	100

Source: Rejn, 2003: 140.

The largest proportion of R&D funds was spent on technical sciences (38.8 per cent of total R&D expenditure by HEIs in the country), medical sciences (14 per cent), and mathematics and physics-related

sciences (8.5 per cent). Research support activities are financed mainly in the technical, chemical, and biological sciences (Rejn, 2003: 143).

According to the proportion of money spent on production and services, R&D activities are mainly conducted by HEI departments that cover the technical and medical sciences as well as philosophy and sociology. According to the same measure, implementation activities take place almost entirely in technical sciences departments (98.7 per cent of all spending on implementation in HEIs in the country) (Rejn, 2003: 143).

Institutional organization of policy formulation

The prospect of joining the EU in 2004 forced Polish policy-makers to pay more attention to national competitiveness and innovation. Innovation came to the fore of the policy debate in 1999 with the publication of the document *Directions of innovation policy until 2002*. However, the institutional organization of Poland's national innovation system still has numerous drawbacks. At present, there seem to be no coordination mechanisms or joint strategic policy developments between the various government ministries responsible, directly or indirectly, for innovation policy. Indeed, responsibility for developing and promoting various aspects of innovation policy in Poland remains dispersed between the Ministry of Scientific Research and Information Technology (MNiI), the Ministry of Economy and Labour (MGiP), and the Ministry of National Education and Sport (MENiS) (*Figure 3.1*).

Ministry of Scientific Research and Information Technology (MNiI)

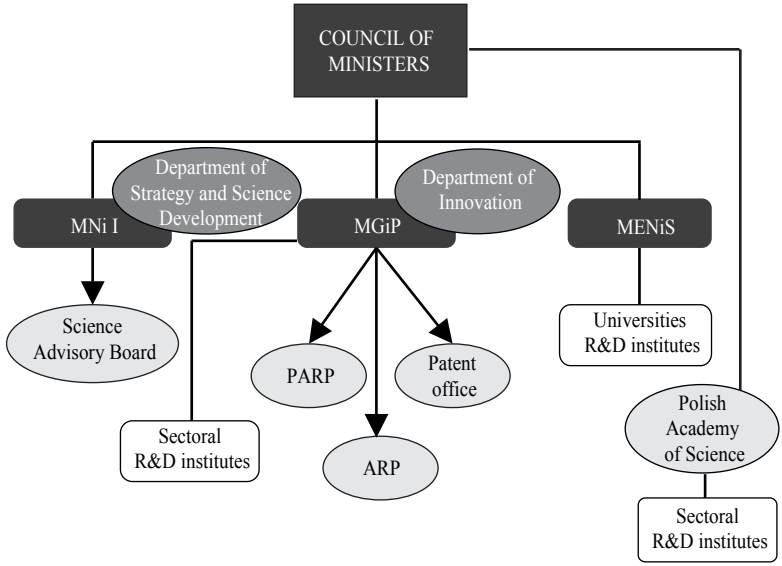
Formerly called the State Committee for Scientific Research (KBN), MNiI was created in April 2003. KBN was a governmental body set up in 1991 as the supreme authority on state policy in the areas of science and technology.

The main tasks of the Ministry are to:

- develop the state's science policy, including proposals for legal instruments to be issued by the parliament as well as actions to be initiated by the government;

- provide direction for scientific research and development, particularly important for science, culture, social development and the national economy, and conclude and carry out inter-governmental agreements on scientific and technical cooperation;
- distribute funds allocated each year for R&D, then supervise and evaluate the progress of the sponsored R&D (European Trend Chart, 2005: 8–11; MSRIT, n.d.).

Figure 3.1 Institutional organization of Poland's national innovation system



Source: European Trend Chart on Innovation (2005: 7), and information from Ministry of Scientific Research and Information Technology and Ministry of Economy and Labour websites (www.mnii.gov.pl, www.mgip.gov.pl).

MNiI consists of 14 departments. The formulation and implementation of innovation policy is dispersed between several of the Ministry's departments. However, the Department of Strategy and Science Development plays a primary role in this matter.

Within MNiI's organizational structure, there is also an advisory body to the minister – the Science Advisory Board, created in October

2004. The board is responsible for performing tasks that were formerly the responsibility of the State Committee for Scientific Research. These tasks mainly concern the distribution of funds among institutions and research teams and monitoring their spending (MSRIT, n.d.). The Science Advisory Board has the authority to supervise and assess the R&D activities performed by various organizations.

Ministry of Economy and Labour (MGiP)

MGiP consists of 32 departments (MGiP, n.d.). The Department of Economic Competitiveness, Department of Industrial Policy, Department of Entrepreneurship Development, and Department of Regional Policy deal with interrelated innovation policy issues. The Department of Innovation, on the other hand, focuses solely on innovation and knowledge-based society (KBS) policy as well as systemic and ownership changes in R&D units.

The Department of Innovation was created in March 2003 as a result of the internal reorganization of the former Ministry of Economy. Formerly the Department of Economic Strategy (Innovation Division), this body played a major role in formulating innovation strategies in Poland. Its work led to the adoption of a key document on innovation, *Growth of innovativeness of the Polish economy until 2006*, by the Council of Ministers on 11 July 2000 (Council of Ministers, 2000*a*).

The Department of Innovation's main tasks include:

- creating strategic programmes promoting enhanced economic innovation,
- supporting infrastructure favourable to the uptake of innovation in the framework of the National Development Plan,
- identifying barriers to innovation growth and analysing the effectiveness and efficiency of instruments supporting innovation development,
- cooperating with regional authorities in the field of innovation policy,
- creating systemic mechanisms to support the commercialization of technology and innovation,
- improving instruments supporting the creation of high-tech companies,

- cooperating with international and national organizations in the field of innovation stimulation,
- undertaking actions with a view to improving industry–science relations,
- monitoring R&D organizations,
- managing the implementation of projects prepared using EU structural funds and relating to the Department's activities (MGiP, 2005).

The Department of Innovation unofficially plays the role of an intermediary between the departments of different ministries responsible for the formulation of innovation policy.

Ministry of National Education and Sports (MENiS)

MENiS's role in the national innovation system is limited to providing direction for the development of education policy in Poland. The Ministry is responsible for the development of education and training systems in the country. It sets guidelines as to the thematic content of different courses of studies. The Ministry supervises state and private school institutions and a number of other scientific institutions and foundations. All state universities depend directly on the Ministry.

In order to ensure the quality and efficiency of higher education in Poland, the State Accreditation Committee (PKA) was created within MENiS in 2002. The committee plays an advisory role on the creation of new HEIs and on new courses of studies at existing HEIs, as well as on the evaluation of training quality

Aside from the ministries, four government agencies play an important role in Poland's national innovation system: the Polish Agency for Enterprise Development (PARP), the Industrial Development Agency (ARP), the Patent Office of the Republic of Poland, and the Polish Academy of Sciences (PAN).

Polish Agency for Enterprise Development (PARP)

PARP is a government agency that reports to the Minister of the Economy and Labour. PARP manages the EU and state budgetary funds intended for enterprise and human resource development, in particular small and medium-sized enterprises.

PARP is responsible for analysing the SME sector and publishing the results. It has also set up various programmes for SMEs, which can be divided into direct and indirect assistance initiatives as follows:

- Direct assistance:
  - subsidies for investments
  - information and advisory services
  - Bank of Technologies and Products[9]
  - Club of Innovating Enterprises.
- Indirect assistance:
  - financial aid to institutions financing SMEs
  - regional Financing Institutions (RIFs)
  - consultation points
  - support to new and existing technology parks, technology incubators, and technology transfer centres.

In 1996, PARP set up the National Network of Services for SMEs (KSU). By 2004 this network consisted of over 180 institutions, mainly PARP 'Consultation Points', created to offer SMEs high-quality services for their business development (including R&D). Institutions must undergo a special 'quality control' accreditation procedure in order to obtain the status of a KSU member institution.

In recent years, the National Network of Innovation (KSI) was created within the KSU network. KSI institutions are meant to provide advisory services in the field of innovation (patent regulations, technology transfer agreements, R&D cooperation agreements, etc.). The idea for the KSI network is based on the EU Framework Programme's Innovation Relay Centres (IRCs). However, KSI gives support to Polish firms wishing to develop domestic technologies; there is no international dimension to the KSI network, since the IRC institutions provide such services (for more information see *Section 3.3*).

Industrial Development Agency (ARP)

ARP was created as a National Treasury company in 1991. Its main tasks are:

9. Database similar to Innovation Relay Centres' database but offers data mainly from the Polish R&D sector.

- providing support for restructuring Polish firms and their adjustment to the requirements of international competitiveness, and
- creating initiatives aimed at the development of economic infrastructure.

ARP provides support mainly for large enterprises in stagnant sectors or for companies considered important from the point of view of the labour market. It also assists in implementing innovation and technology transfer policy. The role of ARP in Poland's national innovation system has grown, and the agency is now responsible for establishing industrial parks and supporting technology incubators that favour the creation of innovative enterprises.

At the beginning of 2002, the Industrial Development Agency supported by the Ministry of Economy established Innovation Centre FIRE, which was modelled on the Inno-Centre in Quebec (Canada). The FIRE Foundation began operations in late 2002 and is located in Warsaw.

The Patent Office of the Republic of Poland

The Patent Office of Poland was created in 1918. Its role in the national innovation system is quite obvious – it is the sole office that grants patents for inventions, utility models, and designs and registering of trademarks and semiconductor topographies.

The main tasks of the office include:

- granting legal protection for industrial property,
- gathering and distributing documentation and patent literature, and
- co-creating and popularizing of the rules of industrial property protection.

The Patent Office of Poland has also set up a network of Regional Centres of Patent Information. These centres are located in the country's biggest cities, usually in higher education technical institutions such as polytechnics.

Polish Academy of Sciences (PAN)

PAN was established in 1951. At that time, it played the role later fulfilled by the Ministry of Science or KBN. In 1997 the Academy obtained

the status of 'state scientific institution'. This means that the role of the PAN in the Polish national economic system changed from that of a ministerial-type institution to that of a purely scientific organization, conducting nationally renowned basic research.

At present, the Academy consists of 81 organizational units – 58 institutes and 23 research centres – carrying out mainly basic research. Altogether, it employs 6,934 people (4,646 of whom are directly involved in research activity).

The PAN is divided into seven sections corresponding to different scientific fields:

1. social sciences,
2. biological sciences,
3. mathematical, physical and chemical sciences,
4. technical sciences,
5. agricultural, forestry and veterinary sciences,
6. medical sciences, and
7. earth sciences and mining sciences.

Under the existing legislation, there is no coordination mechanism related to innovation policy in Poland. However, the Department of Innovation at MGiP seeks to play the role of unofficial coordinator, recognizing it as necessary. Depending on the actual situation and particular needs, meetings on innovation matters are organized at the level of under-secretaries of state. On average such meetings take place once every two months. Thus, the nature of innovation policy-making coordination in Poland can be characterized as 'ad hoc' (European Trend Chart, 2005: 5).

The R&D sector in Poland

The R&D sector in Poland includes branch R&D units (JBRs), the Polish Academy of Science's scientific units, public and non-public higher education institutions that perform R&D activity, development units and other R&D institutions.

Branch R&D units (JBRs) are science-research institutes, central laboratories, and R&D centres. They are mostly state institutions distinguished in a legal, organizational, economic, and financial sense,

and conduct R&D for use in different fields of economic and social life. Their tasks include:

- conducting R&D activities and implementing their results in practice;
- disseminating R&D results;
- undertaking a range of activities with a view to improving methods of conducting R&D;
- conducting supplementary activities, in particular in the fields of training, scientific, technical and economic information, inventiveness, as well as industrial and intellectual property protection;
- conducting analysis and forming opinions related to the state and development of different fields of science and technology, as well as making proposals for using world achievements in science and technology in the national economy.

The term 'development units' refers to economic entities conducting R&D in addition to their basic line of business. They conduct mainly development activities aimed at using already-existing knowledge obtained through basic and applied research, or as a result of a practical experiment, with the intention to create new or improved existing materials, devices, products, processes, systems, or services. Most development units are industrial enterprises that possess their own R&D departments as well as agricultural and veterinary institutions, farm and experimental stations, science-technical centres, and so on.

The term 'other' relates to hospitals conducting R&D in addition to their basic line of activity. These are entities other than medical academy clinics and hospitals, and clinics of the Centre of Post-Diploma Medical Education, which are classified as HEIs, and hospitals holding a status of science-research institutes, classified as R&D units.

Branch research and development units (JBRs) and higher education institutions constitute the main body of the R&D sector in Poland. In 2003, they spent 67.8 per cent of all expenditure on R&D (GUS, 2003: 26).

The enterprise sector is the biggest R&D spender in the country. However, over 50 per cent of expenditure in this sector in 2001 came

from the privatized R&D units, which formed only about a quarter of the sector (*Table 3.8*). The government and higher education sectors were responsible for over 60 per cent of all R&D spending in the country – indicating that state funding of R&D prevails. Private higher education institutions were responsible for less than 2 per cent of total R&D expenditure in the sector.

Table 3.8 Structure of Poland's R&D sector (2001)[10]

Sector	Number of units*	Structure %	R&D spending %	Employment %
Enterprise sector	600	65.22%	38.40%	65.60%
Branch R&D units**	146	24.33%	54.40%	5.10%
Enterprises with R&D departments	453	75.50%	45.60%	94.90%
Government sector	184	20.00%	31.80%	7.96%
PAN science institutions	81	44.02%	39.80%	19.53%
Branch R&D units**	86	46.74%	57.90%	61.28%
Other	17	9.24%	2.30%	19.19%
Higher education sector	121	13.15%	29.70%	26.40%
State HEIs	103	85.12%	98.10%	95.07%
Private HEIs	18	14.88%	1.90%	4.93%
Private non-profit institutions	15	1.63%	0.20%	0.20%
Total	920	100.00%	100.00%	100.00%

Source: Rejn, 2003: 127 and the authors' own calculations based on the source.
* Units surveyed by Polish Central Statistical Office using PNT-01 and PNT-01/s statistical report forms.
** Branch R&D units in the private sector are privatized branch R&D units, which formerly belonged to the government sector. the privatization process of branch R&D units in Poland has not yet been finished.

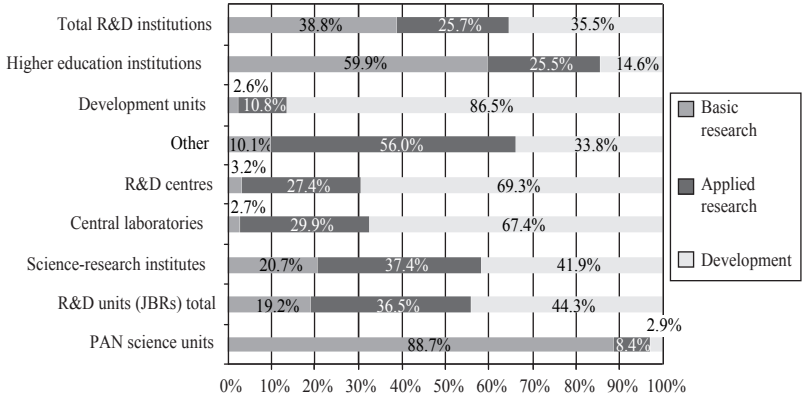
Figure 3.2 presents an overview of the structure of R&D expenditure in the Polish R&D sector. In total, R&D institutions in Poland are mainly involved in basic and applied research (64.5 per cent of all expenditure). This leaves only 35.5 per cent of expenditure for experimental development.

Higher education institutions and the Polish Academy of Sciences units are the most involved in basic research. PAN units spend almost

10. The table contains only data for units surveyed by GUS (each year GUS asks organizations to fill in and send to them statistical forms available for download from the GUS website – in the case of this table, data from forms PNT-01 and PNT-01/s were used. NT in the code of the questionnaire means science and technology, for example the CIS questionnaire in Poland is coded as 'PNT-02'.

90 per cent of their R&D expenditure on basic research and HEIs almost 60 per cent. The 'other' institutions are mainly involved in applied research, as is evident from their R&D expenditure (56 per cent).

Figure 3.2 Structure of R&D expenditure in the Polish R&D sector (2003)



Source: Author's elaboration based on GUS, 2004: 41.

Greater involvement in experimental development is evident on the part of the central laboratories (67.4 per cent), R&D units (69.4 per cent), and above all development units (86.6 per cent). However, their share in the total number of institutions in the Polish R&D sector is too small to influence the overall structure of R&D spending in the country.

National-level R&D expenditure in Poland

National R&D spending in Poland is relatively low and is declining as a percentage of GDP. Although in both nominal and real values a rise in R&D spending was observed in the 1990s, the year 2000 marked the beginning of a period of stagnation.

The most objective measure of R&D spending is its ratio to GDP. A low and decreasing level of this indicator is regarded as the main feature of the Polish innovation system for the period 1994–2003. Although the National Development Plan for the years 2004–2006 postulates achievement of GERD/GDP ratio of 1.5 per cent in 2006, in 2003 this

indicator remained at the level of 0.56 per cent – thus constituting only 30 per cent of the EU average. It is therefore questionable whether Poland will be able to compete on the increasingly technologically advanced European market.

Table 3.9 Basic characteristics of R&D spending in Poland

R&D spending	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	% change 1994–2003
in millions of PLN (current prices)	1,721.0	2,132.8	2,761.4	3,361.0	4,005.1	4,590.5	4,795.9	4,86	4,522.3	4,558.3	165%
in millions of PLN (constant prices)	1,323.5	1,625.2	2,220.2	2,897.2	3,596.6	4,214.1	4,402.6	4,649.1	4,472.6	4,503.6	240%
as % of GDP	0.82	0.69	0.71	0.71	0.68	0.7	0.66	0.64	0.58	0.56	-32%
per inhabitant in PLN (current prices)	44.7	55.3	71.5	87.0	109.4	118.8	124.1	126	120	119	167%
per inhabitant in PLN (constant prices)	29.9	42.1	57.5	75.0	98.2	109.1	113.9	120.6	118.7	117.6	294%

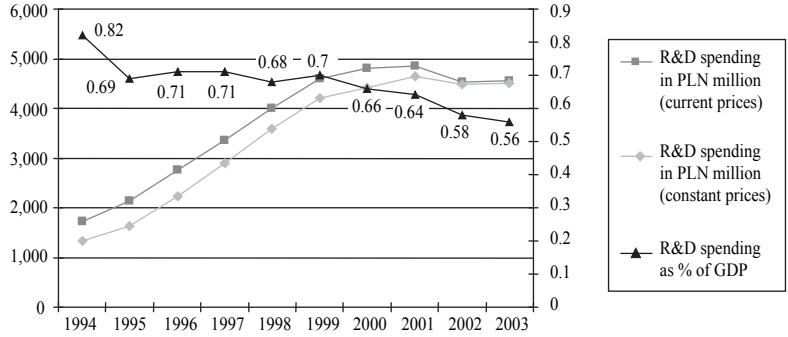
Source: Central Statistical Office (GUS), 2000–2004.

It should also be stressed that there are permanent and significant regional disparities in R&D potential and activities. The ratio between the *voivodships* (provinces) with the highest (Mazowieckie) and the lowest (Swietokrzyskie) indicators amounts to 18/1 in GERD/GDP ratio and 30/1 in GERD per inhabitant. Besides, traditionally more than 60 per cent of spending on GERD is concentrated in three Polish *voivodships* (Mazowieckie, in Warsaw; Malopolskie, in Krakow; and Wielkopolskie, in Poznan), while funding in some other *voivodships* is negligible (Swietokrzyskie, Podlaskie, Opolskie, Lubuskie, Warminsko-Mazurskie, and Zachodniopomorskie). The regional differentiation of R&D financing is attributed to the regional differentiation of the GDP in Poland.

As a member of the EU, Poland has committed itself to accomplishing the principles of the Lisbon Strategy. The most important

of these concerns the structure of R&D financial sources, which is another serious drawback of the Polish innovation system. The trends observed in this respect are just the opposite of what the Lisbon Strategy intends and of what is typical in the most developed economies. For the whole of the last decade, the state budget has been the main funding source for R&D activities in Poland. It accounts for more than 60 per cent of GERD, which is nearly twice the average for the EU countries. Moreover, the share of the state budget has grown, while the enterprise share in R&D financing has decreased.

Figure 3.3 Trends in R&D spending in Poland



Source: Central Statistical Office (GUS), 2000–2004.

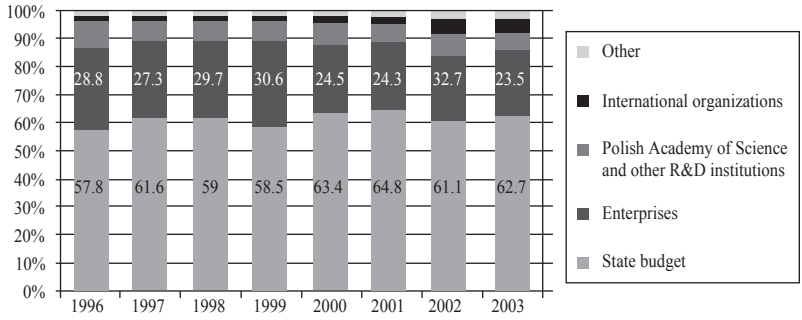
There are several reasons for this situation. On the one hand, enterprises in Poland either do not consider R&D an important factor in their development or do not have enough financial resources to conduct R&D activities. Surveys demonstrate that over 50 per cent of Polish SMEs seek their competitive advantage in lower production costs, with only around 2 per cent aiming to compete on the grounds of innovation and technological advancement. In recent years, however, stable growth of expenditure on innovation in industry has been observed.

Innovation activity in Polish enterprises consists mainly of investment in machinery and equipment, while direct R&D spending accounts only for 11 per cent of all expenditure on innovation.

Several surveys carried out in Poland proved that finding a reliable partner is a serious barrier for enterprises willing to cooperate in the field of R&D. In some cases, the research conducted in Polish scientific institutions does not meet the expectations of the business sector.

Besides these negative tendencies, it is worth noting that although foreign R&D funding is rather low and covers only 4.6 per cent of total R&D spending, it has increased rapidly since the late 1990s.

Figure 3.4 Structure of R&D funding by source (%)



Source: Central Statistical Office (GUS), 2000–2004.

Human resource development and technology diffusion in Poland

State and private higher education institutions are responsible for ensuring human resource development in Poland (*Section 3.3*). HEIs educate future scientists, engineers, technologists, and other specialists in bachelor's or master's degree courses, but also offer a range of lifelong learning possibilities in the form of postgraduate education (post-diploma courses and training).

In addition to HEIs, there are a considerable number of special institutions in Poland that carry out a range of activities in human resource development. Generically known as training and counselling centres, they are identified under different names such as 'centres for entrepreneurship support', 'centres for business support', 'entrepreneurship clubs', and 'consultation' and 'counselling' points.

At the end of 2004, 280 such centres were identified in Poland – twice as many as in 2000. Among the range of services they offer, one can find training and counselling for SMEs (29.6 per cent of working time); help for the unemployed and those seeking employment (23.9 per cent); help for newly founded enterprises (22 per cent); assistance in the creation of new enterprises (9.3 per cent); counselling and training for large enterprises (3.9 per cent); and other services (11.3 per cent) (SOOIPP, 2004: 29–31).

The concept of technology diffusion is relatively new in Poland. The oldest and best-known network of institutions dealing with technology transfer and knowledge diffusion is the National Network of Services for SMEs (KSU). This network was established in 1996 and is coordinated by the Polish Agency for Enterprise Development. The main aim of this network is to provide general support to enterprises' activities. The network already has over 200 accredited institutions, which provide support to SMEs from all of the regions in Poland. These institutions cooperate voluntarily and provide advisory, training, information, and financial services for small and medium-sized enterprises. They are independent and have different organizational forms. Among them, one can find agencies for regional and local development, business support centres, chambers of commerce, branch R&D units, credit guarantee funds, loan funds, and business schools (PARP, 2004: 10).

Poland's 25 Regional Centres of Patent Information (RCPIs) constitute another network that supports technology transfer. The Polish Patent Office disseminates patent information and promotes intellectual property rights in industry through this network. The Centres are located mainly at technical universities (polytechnics) throughout the country as well as in branch R&D units or companies. They offer patent information resources in printed and electronic versions as well as access to databases of the Polish Patent Office, European Patent Office, and others. In addition, there are 29 Technology Transfer Centres in Poland, several of which are located in Polish universities. They are usually created as part of existing institutions like universities and polytechnics, or funded as separate entities by HEIs in cooperation with regional or local authorities and agencies. Their main objective is technology and knowledge transfer from science to the business sector as well as consultancy services, especially for SMEs. They undertake different

initiatives including Innovation Relay Centres and technology parks, or take part in other related activities.

One recent example of the Technology Transfer Centres' activities is the Technology Transfer and SME Innovativeness Support Network (STIM, *Sieć Transferu Technologii i Wspierania Innowacyjności MŚP*) co-financed by the European Regional Development Fund. The project's aim is to build a national network that provides access to information and consultancy services regarding technology transfer.

The IRC network exists in Poland, as in the other EU countries. In April 2004, the structure of Poland's IRCs changed. Currently, four regional consortia host 15 regional institutions. The regional consortia are organized as follows: IRC North-East Poland (covering Lubelskie, Podlaskie, and Warminsko-Mazurskie *voivodships*); IRC Central Poland (covering Lodzkie, Mazowieckie, Pomorskie, and Kujawsko-Pomorskie *voivodships*); IRC South Poland (covering Malopolskie, Podkarpackie, Slaskie, and Swietokrzyskie *voivodships*); and IRC West Poland (covering Dolnoslaskie, Lubuskie, Opolskie, Wielkopolskie, and Zachodniopomorskie *voivodships*). The IRC network aims at promoting innovation and technological exchange between different European organizations.

Another network, which has operated in Poland since 1994, consists of 12 Euro Info Centres. One of the main objectives of these centres is the integration of small and medium-sized enterprises in the Common European Market (CEM). Euro Info Centres undertake a range of activities, such as organizing informational workshops about European programmes open to Polish firms, or about principles and standards in the CEM and individual foreign markets. They are affiliated with different organizations supporting economic development, such as the regional development agencies and chambers of commerce. They are co-financed by the European Commission and affiliated institutions.

Moreover, 50 regional and branch contact points (RCPs and BCPs) of the EU Framework Programme network coordinated by the National Contact Point (NCP) operate in Poland. The role of this network is to encourage Polish scientific teams and individual researchers to participate in the EU Framework Programmes. The Regional and Branch Contact Points are located mainly at universities, in scientific units of

the Polish Academy of Sciences or in branch R&D units. However, they sometimes they work as independent institutions or foundations. The scope of operation of RCPs and BCPs also includes managing part of the EU structural funds related to the R&D sector. Some of the contact points specialize in services for enterprises interested in taking part in European research programmes. The NCP is financed by the Ministry of Scientific Research and Information Technology, as are, partly, the RCP and BCPs.

In 1999, the European Commission announced a call for proposals (Specific International Scientific Cooperation Activities – INCO) for Centres of Excellence from the Candidate Countries. Nine Polish projects were accepted and financed by the Fifth EU Framework Programme. As a result of subsequent calls for proposals for Centres of Excellence, further Centres of Excellence were created: five were established in 1999 (PHARE SCI-TECH II project), 138 Centres of Competence and Excellence were set up in 2001 (NAS-2 project), and five more Centres of Competence and Excellence were founded in 2002 (IST-2002-8.1.6 project).

Centres of Excellence are organizational structures involved in scientific research and the development of world-class technology with measurable scientific effects. Centres of Excellence do not set out to create new research institutions. Rather, they seek to function as a sort of laboratory that cooperates actively with industry and other research users. Centres of Excellence implement projects in fundamental research, as well as search for specific innovative applications. The main objectives of the Centres of Excellence created in Poland are to:

- increase the role of science and research as a factor enhancing the competitiveness of Polish economy and society,
- establish stronger links between research and practices stimulating the development of innovative solutions,
- strengthen cooperation between scientific institutions sharing similar research objectives, and
- improve the national innovation system through creating strong research and implementation structures and promoting outstanding Polish research institutions nationally and internationally (NCP, n.d.).

The most recent initiative in the field of technology transfer in Poland took place in 2002. Poland's National Network of Services lacked efficiency and focus on innovation. In order to meet entrepreneurs' requirements for a transparent and common organizational structure for pro-innovation activities, the National Network of Innovation (*Krajowa Siec Innowacji*/KSI) was created. Individuals affiliated with universities or regional Centres of Technology Transfer developed this initiative. It is worth noting that the KSI structure was based on the model of Innovation Relay Centres. The network's operating model has been established; its first members have been chosen (Gulda, 2005) by a team of experts selected to designate a group of institutions that provide services in the field of innovation within the framework of the broader National Network of Services. The main task of the members of the KSI network is to support the creation of conditions for new technology transfer as well as commercialization and realization of innovative undertakings in SMEs.

3.4 Policies and programmes for the stimulation of academia–industry relations in Poland

History and objectives of academia–industry partnership support programmes

Prior to the 1990s, Poland was characterized by a centralized planning approach to the stimulation of academia–industry partnerships. A great majority of instruments intended to encourage research for industrial implementation therefore took the form of centralized actions and programmes.

Great Research and Development Programmes (GRDP) were the main instruments of science, technology, and production integration in Poland from the beginning of the 1970s until the middle of the 1980s. As the previous system of 'subject' division of funds for science and technology proved to be insufficient, the GRDP shifted the focus to an 'object' approach. Financial resources were granted on demand to project coordinating units for the full range of their activities, from research to building the prototype of a machine or technological process. Financial aid was to be granted to all units participating in research

activities regardless of their organizational status and type of activity (Glikman, 1991: 228–229). In reality, however, the 'subject' approach was not eliminated, since the structure of the funded research coincided with the structure of research units.

In the 1980s, the Polish R&D funding system underwent some changes. In 1984, two central administrative bodies were created: the Committee for Science and Technical Progress and the Science-Technology Progress Council. These bodies were to play the role of coordinators in the field of centrally funded research. The Committee used various methods of encouraging science and technology development in the country, such as initiation of research compliant with the long-term strategy of socio-economic development, coordination of research activities and their financing, and implementation and dissemination of research results. The Central Programmes of Basic Research and Central Programmes of Research and Development included these research initiatives (Jasinski, 1997: 156–157). Government commissions intended to finance activities crucial to economic development, or those related to research activities in view of further scientific development, were other important incentives to scientific and technological progress in Poland (Glikman, 1991: 204–206).

Financial resources for achieving the above initiatives came from the Central Fund for Science and Technology Development. This Fund was divided into two parts: the Central Fund for Research and Development and the Central Fund for Implementation Aid, the smaller of the two. The Central Fund for Research and Development was used to finance large research programmes of varying nature (Glikman, 1991: 204–206). It was created from two sources: payments from Polish enterprises and the central budget. From 1986-1990, enterprises were required to donate a small percentage of their sales earnings to the fund (1 per cent in 1987 to 1.3 per cent in 1990) (Glikman, 1991: 208–210).

The main reason behind creating the above-mentioned incentives was to foster industrial implementation. They were meant to improve the flow of R&D findings to industry (Jasinski, 1997: 157). However, a great majority of funds were granted to R&D units outside enterprises, which meant that the influence of the market mechanism was largely disregarded. In other words, the Polish Government was forcing the technology/supply model of the innovation process, with a major role

being granted to technology suppliers and little influence being attributed to the demand side recognized by the entrepreneurs.

Due to the transition to a market economy, most of Poland's centralized policies concerning regulation of innovation activities had to evolve. Several changes to the formulation of the innovation support framework were introduced at the beginning of the 1990s. A significant share of government initiatives for R&D activities and technical progress, including implementation activities, was discarded and no new incentives were introduced. This resulted in equal access to potential government support for both the public and private sectors. R&D units ceased to act as government units as the prospects of their reorganization and privatization became feasible. The Central Fund for Science and Technology Development was liquidated and enterprises were no longer obligated to make donations to the fund. Since then, financial resources for R&D activities have come from a separate part of the government's central budget (Jasinski, 1997: 159–160). Responsibility for the formulation and coordination of Poland's science and technology policy was assigned to the State Committee for Scientific Research (KBN), created in 1991. Since then, the KBN has granted state financial support to research projects. Priority has been given to projects related to new solutions with potential for implementation. However, the new system has not overcome the problems of the previous one – the 'subject' approach remains predominant and research institutions have submitted most of the projects. The result has been a continuing predominance of basic and applied research financing rather than development activities and implementation.

Because of a lack of effective measures, cooperation between the academic and business environments in Poland is rather scarce. It should be noted that HEIs in Poland today, in particular polytechnics (technical universities), usually create special administrative units responsible for initiating and maintaining contact with the business sector, especially with industry. However, practice shows contact is usually initiated by business rather than by the scientific sector. For the most part, individual entrepreneurs sign cooperation agreements with individual researchers. The administrative units responsible for partnerships with the business sector mentioned above are left out of the process (Olechnicka, 2004). The main reason for this is an overgrown bureaucracy in public HEIs

and the lack of specific legal regulations concerning the commercial use of state-funded research results. This is expected to change following the implementation of the recently published Law on Forms of Support of Innovative Activity.

Although wide debate about the scarcity of academia–industry partnerships in Poland was only initiated recently, it has already given policy-makers an impulse to start designing special programmes that could help to remedy the problem.

Policy-makers acknowledge that some Polish R&D institutions are characterized by a relatively high technological potential and employ excellent specialists in many areas. The main problem is that the new technological solutions developed by R&D institutions rarely find applications in industry. This may be a result of lack of information available to enterprises about activities in the R&D institutions and academia, and hence lack of diffusion of new technologies to the industrial sector. The most important objective of academia–industry partnership support programmes in Poland is therefore to first encourage cooperation between the sectors by eliminating the most obvious obstacles, such as the lack of information-sharing practices.

Programmes to create incentives for joint academia–industry R&D activities

The need to increase joint academia–industry R&D activities was emphasized in a number of policy documents, among which are the *Plan of pro-growth actions from 2003–2004 (entrepreneurship – development – work II)* and *Directions of science, science-technology and innovation state policy through 2020*.

Until very recently, the former State Committee for Scientific Research (now Ministry of Scientific Research and Information Technology) was the only state institution with the financial and organizational power to award funding to different projects submitted by Polish scientists and entrepreneurs.

The state supports scientists and research institutions through the funding of so-called ‘research projects’. Projects are chosen via a competitive process. Each project is reviewed by a group of specialists

in a given area, taking into account potential future implementation of its results (possibly in the business sector). Financial resources are transferred to research institutions (individual scientists use the resources transferred to their home institution) through an agreement. Business sector participation is not necessary to obtain funding, although it is not discouraged. The funded institution or scientists are obliged to submit periodic and final reports to the Ministry, which are then evaluated.

The state supports entrepreneurs through the funding of so-called 'targeted projects'.[11] Projects eligible for funding must support innovation processes in enterprises. As in the case of research projects, targeted projects are chosen for funding through a competitive process and financial resources transferred based on an agreement. State funding can represent up to 70 per cent for SMEs, while other enterprises can obtain up to 50 per cent of the total research costs of a given project. These financial resources can be used to conduct joint research with HEIs or simply to buy their services in a given research area. Research results are to be implemented at the entrepreneur's cost. *Table 3.10* presents the number and value of targeted projects in the years 1994–2001.

Table 3.10 'Targeted' research projects financed by the former State Committee for Scientific Research (KBN) in the years 1994–2001

Targeted research projects financed by the KBN	1994	1995	1996	1997	1998	1999	2000	2001
Number of projects	796	732	772	756	777	834	1,292	1,239
Value of the projects (in mln PLN)	147.3	149.7	191.5	196.9	181.6	203.6	230.8	232.3

Source: Sectoral Operational Programme – Growth of Enterprises Competitiveness, Ministry of Economy and Labour, Warsaw 2004.

Currently, Polish scientists and entrepreneurs have an alternative source of funding for R&D and innovation projects. This is the Sectoral Operational Programme – Growth of Enterprises Competitiveness 2004–2006 (SOP-GCE). Projects submitted within the framework of this programme are partly financed by EU structural funds (mainly the European Regional Development Fund).

11. The original Polish term is *projekty celowe*.

The first priority of the SOP-GCE is 'developing entrepreneurship and increasing innovation by strengthening business support institutions'. Within this first goal, a special measure related to joint academia–industry research activities was designed to strengthen cooperation between the R&D sector and the economy (measure 1.4). The types of projects that can be financed under this measure include:

- R&D projects: industrial and pre-competitive research conducted by enterprises or groups of enterprises and/or in cooperation with science-research institutes (sub-measure 1.4.1);
- investment projects related to the development, modernization, and equipment of specialist laboratories offering specialist services to enterprises (sub-measure 1.4.2);
- investment projects related to the development, modernization and equipment of specialist laboratories in Centres of Advanced Technologies and Centres of Excellence functioning in priority areas for the development of the Polish economy (sub-measure 1.4.3);
- research projects conducted by Centres of Advanced Technologies (sub-measure 1.4.4); and
- research projects in the area of monitoring and forecasting scientific and technological development (sub-measure 1.4.5).

The SOP-GCE operates on a national level. The European Regional Development Fund and Poland's central budget provide the financial backing for this programme and its selected projects.

Programmes to support the development of innovative enterprises

A number of experts have underlined the the Polish business sector's weak financial situation. Improving access to various external sources of enterprise financing has come to the forefront of government actions in recent years.

Currently, the Polish Agency for Enterprise Development (PARP) plays a key role in supporting loans and credit guarantees in the country. The agency makes grants to select non-profit organizations intended to raise the value of the capital funds they manage. It has also set up a network of institutions called regional financing institutions (RFIs).

PARP also took an active part in developing a government loan and credit guarantee system for SMEs in 2002–2004, called Capital for Entrepreneurs (Council of Ministers, 2002*a*). The programme was approved in August 2002; the former Ministry of Economy, Labour and Social Policy approved the specific 'Rules of functioning of loans and credit guarantees' in 2003.

The programme's main objective was to create an integrated and effective system of regional and local financial institutions (providing loans and credit guarantees) that would improve access to external sources of financing for entrepreneurs. A network of credit guarantee institutions was based at the Bank of Domestic Economy and a network of loans at PARP.

If all goes as planned, this programme should create a network of strong regional institutions active in each *voivodship*; as a result, an estimated 100 local institutions will become operational, offering the following financial instruments:

- loans and credit guarantees for entrepreneurs starting up an economic activity, including graduates, and
- loans for SMEs to create more jobs and bring more graduates into the workforce.

Most of the funding for the creation and maintenance of the loans and credit guarantee programme was to become available after Poland joined the EU in 2004. The SOP-GCE includes measures related to financial support to enterprises.

Measure 1.2 of the SOP-GCE is devoted to 'improving accessibility of external financing for enterprises' investments'. Within the framework of this measure, the following actions are planned:

- further capitalization of micro-loan funds (sub-measure 1.2.1),
- further capitalization of credit guarantee funds (sub-measure 1.2.2),
- support for the creation of *seed capital* funds (sub-measure 1.2.3).

As part of SOP-GCE's second priority, 'Direct support for enterprises', two measures are designed to improve Polish enterprises' financial situation as well as their innovative qualities.

Measure 2.2, 'Support for product and technological competitiveness of enterprises', aims at improving enterprise competitiveness by supporting new investments that lead to fundamental changes in products and/or production processes. This measure also promotes Polish enterprises on an international scale.

Measure 2.3, 'Growth of SME competitiveness via investment', aims at increasing Polish SMEs' competitiveness by financing projects to allow enterprises to:

- modernize their facilities;
- undertake mutual investments;
- purchase R&D results and/or industrial property rights;
- implement and commercialize technologies and innovative products;
- implement and use electronic technologies;
- implement and use information technologies in management processes; and
- adjust technologies and products to fit EU requirements, particularly setting standards and enforcing hygiene and safety norms.

The above measures will be financed by a direct grant of up to 50 per cent of the total investment cost depending on the region of the country. Resources designated for support come from the European Regional Development Fund and central budget.

In recent years, the Ministry of Labour and Economics has also been implementing a pilot project called Academic Entrepreneurship Incubators. A number of organizations operating at HEIs, selected through a competitive process, will receive grants to create an incubator. As the grants are small, at around 3,000 euros per organization, other sources of funding must be found, usually in the form of commercial activities plus additional sources of state funding.

Support for creating innovative enterprises can be also understood as helping them to find sources of and acquire innovative technologies. The creation of technology transfer centres in Poland was described in *Section 3.3*. Such centres can be a result of projects submitted to regional authorities and financed within the framework of the Integrated Operational Programme of Regional Development 2004–2006

(IOPRD): 'Regional innovation strategies and transfer of knowledge' (measure 2.6). The projects can be submitted by HEIs and business support organizations, or by consortia of the above.

Programmes to create a climate and structures for innovation

Creating a climate for innovation is understood in Polish policy documents as the promotion of innovation within society and the facilitation of innovation support structures for enterprises.

We can identify two government programmes related to the creation of a climate conducive to innovation activity – these are the above-mentioned IOPRD and SOP-GCE.

Support provided under IOPRD's measure 2.6, 'Regional innovation strategies and transfer of knowledge', is related to creating a climate conducive to innovation, and includes:

- developing and adapting regional innovation strategies (RIS);
- setting up a network for innovation transfer between the R&D sector, enterprises, and other players at the regional and local levels; and
- developing an information and communication system (including data collection and databases);
- collecting and diffusing information on training and education activities in support of transfer of innovations.

IOPRD is coordinated at the regional level, although the Ministry of Economy's Department of Implementation of Regional Development Programmes manages the programme. Funding for the programme comes from the European Regional Development Fund, European Social Fund and Poland's central budget. The Ministry of Economy is in charge of monitoring IOPRD.

The IOPRD measures are of a more general nature than those of the SOP-GCE. The latter's first priority, termed 'Development of entrepreneurship and growth of innovation through strengthening of business environment institutions', aims to achieve the following in order to create a climate for innovation:

- stimulate entrepreneurship and innovative activity by providing access to high-quality business support institution services;
- prepare modern infrastructure for conducting economic activity;
- expand public use of on-line services, in terms of accessibility and range of utilization.

Proposals for the accomplishment of the above objectives are found in measures 1.3 and 1.4 of SOP-GCE's first priority. The main objective of SOP-GCE's second priority (measure 2.1), entitled 'Growth of competitiveness of small and medium-sized enterprises through advisory services', is to facilitate access to specialist advisory services for SMEs.

Also of note are Regional Innovation Strategy projects, implemented in different regions of the country and intended to create a climate conducive to innovation, particularly by reaching a consensus between different regional actors. Three Polish regions took part in the Fifth Framework Programme project on Regional Innovation Strategies in New Acceding Countries and one in the Sixth Framework Programme. Twelve Polish regions took part in a Ministry of Scientific Research and Information Technology project launched in 2002. The results of the projects will be used as a basis for further developing Poland's national innovation strategy.

3.5 Administrative frameworks of policies and programmes for the stimulation of academia–industry relations in Poland

Legal frameworks of the innovation system

The Polish national innovation system functions within the framework of a number of legal texts concerning the higher education, R&D, and business sectors. Regulations also include acts concerning the protection of databases, intellectual and industrial property, and legislation related to public support for enterprises. Polish law is being systematically adjusted to EU legislation.

The Law of 8 October 2004 on Rules of Science Financing (*Journal of Laws*, 2004) defines new legal instruments related to scientific financing and organization. These are:

- the domestic framework programme, which will serve as an instrument for Polish science and science-technology policy and specify scientific research and experimental development priorities;
- scientific consortia – groups of organizational units carrying out joint research or investments;
- scientific networks – groups of scientific units cooperating with the aim of developing their scientific specialities;
- programmes and endeavours aimed to help young scientists, establish information and information technology infrastructure for science, encourage cooperation between science and the economy, foster international science and technology cooperation, reorganize science units, and so on;
- the modification of science units' evaluation procedures;
- development projects for SMEs allowing enterprises to use the results of their R&D;
- targeted projects for entrepreneurs – encompassing applied research, experimental development, industrial R&D investment and implementation work prior to commercialization;
- the decentralization of the applications qualification system.

The activities of branch R&D units, an important part of the Polish R&D sector, are regulated by the Law of 25 July 1985 on Branch Research and Development Units (*Journal of Laws*, 1985). This legislation regulates the creation, liquidation, and transformation of branch R&D units, their organization and their functioning, the object of their activities, as well as their financial management. The law also states how a branch R&D unit can be transformed into a privately owned entity.

The Law of 30 June 2000 on Industrial Property (*Journal of Laws*, 2001) regulates inventions, utility designs, industrial designs, trademarks, geographic signs, and the topography of integrated systems. It sets the terms upon which projects are accepted and rewarded as well as the tasks and organization of the Republic of Poland's Patent Office.

The Law of 11 April 2001 on Patent Representatives was passed in 2001 (*Journal of Laws*, 2001). This legislation enabled the creation of a patent representative profession. The responsibilities of a patent

representative include providing support services on industrial property protection matters to individuals, enterprises, and other organizations.

The Law of 20 March 2002 on Financial Support for Innovation (*Journal of Laws*, 2002) defines the principles and forms of granting financial support to entrepreneurs making new investments or creating new jobs as a result of their investments. Local governments can also apply for financial support related to the creation and modernization of technical infrastructure as long as their plans are directly related to entrepreneurs' investments.

Laws related to intellectual and industrial property rights in Poland are consistent with EU legislation.

Polish policy-makers see the need to stimulate academia–industry partnerships as very important. In order to facilitate the creation of cooperation mechanisms, a new innovation law is being prepared that takes into account the specific characteristics of both the higher education and business sectors in Poland.

The Law of 29 July 2005 on Forms of Innovative Activity Support (*Journal of Laws*, 2005) includes changes to previous laws, including some concerning higher education institutions. It is proposed to add clauses to both the Law on Higher Vocational Education Schools and the Law on Higher Education allowing institutions to cooperate with the economic environment, in particular by delivering the results of their R&D activities to entrepreneurs, with or without payment. In order to make the most of HEIs' intellectual and technological potential, they should be permitted to create academic entrepreneurship incubators and technology transfer centres.

Venture capital in Poland

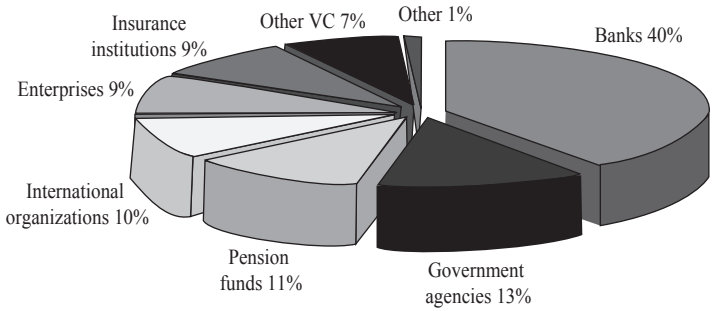
Since 1990, a few dozen financial institutions described as venture capital (VC) organizations operate in Poland. Polish law does not directly regulate VC funds. This means that, in order to conduct this sort of activity, institutions can use a number of different organizational forms allowed by Polish legislation (Garrett-Jones, 2004: 5–12).

At the beginning of 2001, 28 leading closed investment funds with the basic characteristics of VC funds were active in Poland. The

total capital of all VC funds operating in Poland at the beginning of 2001 amounted to over US$2,000 million. This constitutes growth of over 110 per cent since 1997: a result of the emergence of new funds and growth in the capital value of those already existing on the Polish market. The smallest VC funds are those with 100 per cent Polish capital, and the largest those with 100 per cent foreign capital. In 2001, Polish capital constituted only 7 per cent of the whole value of VC funds in the country. However, the share increased systematically during the 1990s (in 1995, it represented only 0.76 per cent) (SOOIPP, 2002: 192–193).

Figure 3.5 presents an overview of sources of capital for VC funds in Poland in 2001.

Figure 3.5 Sources of venture capital in Poland (2001)



Source: SOOIPP, 2002: 193.

The interests of venture capitalists in Poland are mainly in the so-called 'new economy'. Investment possibilities related to the Internet, e-commerce, telecommunications, and information technologies enterprises are the most sought-after.

Many analysts of the Polish VC market indicate that VC in this country is not 'high-risk capital'. Among Polish VC investments, the later stages of enterprise activity predominate. In 2001, most of the VC organizations operating in Poland indicated having made an investment at the second (26 per cent) or later (23 per cent) stage of enterprise

activity. Seed-stage financing was undertaken by only by 7 per cent and start-up financing by 11 per cent of VC institutions (SOOIPP, 2002: 194).

Administrative instruments encouraging applied research with industry

Polish policy-makers recognize the need to encourage joint research initiatives between academia and industry. In *Section 3.4*, existing programmes related to the stimulation of such activities were presented. Aside from those programmes, there are currently no other administrative instruments that particularly encourage applied research in conjunction with industry in Poland.

'Targeted projects' of the former State Committee for Scientific Research and current Ministry of Scientific Research and Information Technology, as well as projects submitted within the framework of the EU structural funds (operational programmes), are intended to change the focus of research organizations from basic to applied research. This could be conducive to cooperation between academia and industry.

The law on support of innovative activity currently being developed by the Department of Innovation in the Ministry of Economy and Labour is intended to encourage joint applied research with industry. The project aims to encourage cooperation between various science and research units (including universities and other HEIs) and industry. This would be achieved by awarding the special status of 'research and development centre' to enterprises that fulfil certain requirements and by allowing HEIs to create technology transfer centres within their structures. It would also regulate sales and the transferral of R&D results.

3.6 Assessment of the effectiveness of academia–industry partnership incentives and support instruments

Evaluation of the effectiveness of national policies, programmes, incentives, and frameworks for the stimulation of academia–industry partnerships

The great majority of policy documents related to academia–industry partnerships were created only recently. It is therefore not yet possible to evaluate their effectiveness in terms of goal achievement and contribution to economic development.

Our analysis indicates that the scarcity of academia–industry partnerships in Poland is owing to a complex set of reasons. It should be considered from three different perspectives: that of the R&D sector, that of the industrial sector, and that of the innovation support structure.

The Polish R&D sector is characterized by low state R&D expenditure and inadequate state funding structures for R&D. The real needs of the economy regarding R&D and related research priorities are not clearly identified, nor is academia sufficiently involved in conducting research that would benefit the economy.

Although Polish R&D institutions are characterized by having relatively high technological potential and employ excellent specialists in many areas, they may not be considered worthy partners by enterprises because of their primary involvement in basic rather than in applied research. Another problem seems to be that new technological solutions developed by R&D institutions rarely find applications in industry because knowledge-sharing practices between the two sectors are non-existent.

Moreover, the higher education sector seems to produce staff who are well-trained but lacking in entrepreneurship skills. In addition, no adequate incentives to start one's own business based on one's technological know-how exist. Thus the scientific staff of R&D institutions have little interest in commercializing R&D results. As a result, the creation of spin-off firms is a very rare phenomenon in Poland.

It is also very characteristic of Poland that in addition to excellent R&D institutions with international renown, there are many 'peripheral' science institutions that focus mainly on training and educational activities, but do not perform any scientific research.

Polish enterprises do not consider R&D an important factor in their development. Surveys demonstrate that over 50 per cent of Polish SMEs seek their competitive advantage in lower production costs; only around 2 per cent aim to compete on the grounds of innovation and technological advancement. It is true that stable growth in industry's innovation expenditure has been observed over recent years, but expenses on fixed capital predominate in the present structure of expenditure among other investment costs.

Enterprises in Poland do not ordinarily have sufficient financial resources to conduct their own in-house R&D activities: the high costs of innovation development and implementation, which exceed the existing financial capacity of most enterprises, are the main obstacle to their innovative activity. The generally low level of R&D expenditure in Polish enterprises shows that they are rather passive in the field of innovative activity and do not generate new technological knowledge for their development.

The low level of domestic R&D financing may lead to a widening of the technological gap between Poland and more developed economies. The existence of the technological gap becomes more evident when we take into account the considerable interest Polish enterprises have in purchasing foreign technologies. Innovation in the Polish economy is becoming increasingly dependent on imported patents, licences, know-how, and technologies. However, inward technology transfer can also be a very important source of technological advancement and in time could help improve the Polish economy.

In addition to the problems related directly to the R&D and enterprise sectors, a network of linkages between the two is also missing. The quality of business support services in Poland leaves much to be desired, and the country's public online information services infrastructure needs further development.

The analysis of the technology transfer structure in Poland has shown its several serious disadvantages (Gulda, 2005). In spite of an apparent multitude of technology transfer support organizations, only a limited number take part in the activities supporting innovation in Poland. Each institution attempts to be involved in several technology transfer structures. This has some positive outcomes, due to the concentration of information and knowledge and their natural flows between networks. But at the same time, such concentration limits the scope of a particular network's influence. In addition, the networking character of the structures is doubtful because of the infrequent use of information technology within networks and little contact with enterprises.

Surveys conducted by PARP and research conducted under the framework of the RIS projects in Poland have proved that Polish technology transfer networks are hardly recognized by the business

sector. Nor is there coordination or spontaneous cooperation between technology transfer networks.

However, some progress in creating measures conducive to academia–industry partnerships and innovation is evident. This may help to turn the situation around. The proposed incentives and structures are based on the experiences of the EU-15 countries and also take into account the special characteristics of the Polish economic system.

Poland has introduced several measures intended to increase R&D financing and reorganize the R&D sector. Until recently, the former State Committee for Scientific Research, now the Ministry of Scientific Research and Information Technology, has been the most important source of state funding of research and development activities in Polish R&D institutions. However, a decade of the Committee's activities has not caused a significant change in the domestic R&D structure – a large share of R&D expenditure continue to go to basic research. Currently, there is a debate about changing the evaluation criteria of projects submitted for funding; institutions with low research potential may not be eligible for state funding in the future. Some of these ideas will be included in the new law on financing scientific activities.

Those drafting the law on financing scientific activities intend to support strong research institutions for the most part. However, there is a need for cooperation between such institutions and weaker ones. This may be the only means for institutions with less research potential to develop. Currently, there are no instruments or incentives related to supporting cooperation between stronger and weaker domestic research centres.

Assuring industry's greater involvement in R&D activities seems to be the best way to increase the value of expenditure on applied research and experimental development. Measures included in the SOP-GEC and IOPRD are designed to do just that. The projects financed by these programmes can be submitted by enterprises and the funding received used to simply buy R&D results, or to conduct joint research with R&D institutions.

A new law supporting innovative activity is in the works. This project includes a proposal to create a Technological Credit Fund using the Domestic Economy Bank's financial resources. Technological

credit would be given for investments related to the development or implementation of new technologies. It would be allocated according to market rules and could be remitted if the enterprise fulfilled certain requirements stated in the law. The project also aims to encourage cooperation between various scientific and research institutions (including universities and other HEIs) and industry. This would be achieved by awarding a special status of 'Research and Development Centre' to enterprises that fulfil certain requirements (a new category of high-tech firms) and by allowing HEIs to create technology transfer centres within their structures, regulating R&D handover and sales. Entrepreneurs often complain about the long bureaucratic procedures involved in technology and knowledge transfer from higher education institutions. The new innovation law will reduce this problem.

The rules of establishing public–private partnerships have not yet been established in the Polish legal system. Cooperation agreements between mostly public R&D institutions and private enterprises are not easy to conclude without regulations. The Ministry of Economy and Labour is drafting a law on public–private partnerships to remedy this.

The lack of linkages between academia and industry sectors and the absence of institutional instruments enforcing their cooperation on innovation are the weakest points of the Polish national innovation system. Moreover, the networking character of the structures is doubtful because of the infrequent use of information technology within networks and little contact with enterprises.

A few measures have been taken in order to improve the situation. The National Network of Innovation (KSI) is a good example. It was created with the aim of consolidating institutions dealing with technology transfer in Poland. This initiative is only in its beginning stages. Researchers and ministerial officers in Poland have high hopes about the future development of this network.

Although the tendency leans towards innovation network consolidation, the remaining initiatives related to the establishment of innovation and technology transfer centres in Poland are dispersed between the SOP-GCE and IOPRD programmes. Nevertheless, experience shows that the same institutions submit most of the projects related to technology transfer. Merging technology transfer initiatives

within one institution could have both positive and negative outcomes. The technology transfer system in any given region or country can only benefit from the involvement of strong and well-known organizations in multiple projects.

Additionally, although attention is increasingly focused on regional development, disparities remain between Polish *voivodships* in relation to R&D financing and the business support infrastructure. The differences between regions are based on their different levels of economic development. Total negligence of peripheral regions will result in their further recession. The policy measures described in this study are not designed to level out those disparities. Policy-makers have been directed by the principle of efficiency rather than equity.

Strengths and weaknesses of organizational modes and management practices

The biggest strength of Polish organizational modes and management practices in academia–industry partnerships is the ability to create various support networks, which have been described in this case study.

PARP is the strong point in the organization of the Polish national innovation system. It consolidates and is responsible for most of the initiatives directed towards SME support in the country, including the creation of Regional Financing Institutions, the National Network of Services, and National Network of Innovation, as well as contact points ('one-stop-shop' information centres for enterprises). It also manages measures related to SME support included in the SOP-GCE programme.

The principal shortcoming of the Polish innovation system is the lack of coordination mechanisms for different initiatives. This also concerns cooperation between the academic and industrial sectors. The substantial disadvantage of this is that existing structures operate separately, without any coordination.

Currently, several operational programmes are being implemented in the country, partly financed by EU structural funds. A number of ministries and government agencies are responsible for their implementation. This means that responsibilities relating to carrying out the current National Development Plan and National Strategy for Regional Development are dispersed between different entities at the

national and regional levels. Moreover, programmes and measures concerning academia–industry partnerships are managed by different organizations. This may have a negative impact on coordination and monitoring of the activities at both the national and regional levels. The dispersion of responsibilities for government programmes also results in inefficient dissemination of information concerning them.

Another drawback of policy management is the inadequate monitoring of policy implementation. Prior to joining the EU, government programmes were hardly ever monitored in Poland. The monitoring process was limited to preparation of ex-post reports. The situation has now changed, mainly due to the requirements of the European Commission regarding policy evaluation.

A majority of Poland's policy documents and programmes were developed with the guidance of the European Commission, taking into account experiences and good practices from other EU countries. This can certainly be considered a positive contribution that greatly improves the effectiveness of these policies and programmes.

It should also be noted that many of the new initiatives related to Polish R&D are a result of debates between the government and the academic sector in response to the requirements of enterprises. There is some willingness on the part of the higher education and R&D sectors to participate in joint initiatives with enterprises. Poland is experiencing the emergence of a milieu that tends towards support for innovation.

The main negative factors affecting innovation in Poland are internal to the Polish economy. They are related to the specific characteristics of the parties concerned – R&D institutions and enterprises. The lack of coordination mechanisms between the various ministries and agencies responsible for programme management, namely the absence of information-sharing practices, is another important obstacle to innovation development. There are also problems with programme implementation, in particular concerning the complicated procedures surrounding project application and reporting. The most important internal factors negatively affecting R&D-related policy implementation in Poland include the country's low R&D potential, high level of bureaucracy, and low involvement in applied research and experimental development.