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THE INNOVATION ACTIVITY AS A BASIS OF THE SOCIOECONOMIC DEVELOPMENT OF POLAND

1. Introduction

On 1 May 2004, as a result of many years' preparations, Poland became a member of the family of 25 countries of the United Europe. The Accession Act means that Poland's space and Poland's economy became opened on the European scale, including the global one. The open economy and space must become innovation space and economy, otherwise they will forfeit their independence within the competitive and dynamic surrounding, and will be dependent on others on many planes such as: economic, political, cultural and scientific.

On the threshold of the new Millennium, it is the abilities of states and nations to create, popularize and make use of achievements of science and knowledge that have become the basic source of their development and rise in affluence. A condition and – at same time – manifestation of acquisition of the capabilities is a high level of innovation activity undertaken in various domains of the economic and social life.

The level of innovation of the Polish economy is generally estimated to be low. So is the level of innovation of the Polish industry, especially vital in making processes of development and modernization of the whole economy more dynamic. The present paper aims at verifying such evaluations and essays to explain causes of this state of things, as well as to point to desired directions that induce innovation processes in Poland. It also makes use of ample literature of the subject and results of own research and publications of the Central Statistical Office.

2. The notion and scope of innovation

The complex an dynamic character of innovation processes makes it impossible to implicitly interpret and define the term "innovations". In the most general way, innovations means a process of progressive creative changes in various domains of man's activity. Innovations can thus occur in different spheres of activity and their main feature is the element of novelty. It is in the above-mentioned sense that S. Kuznets understands innovations when writing that "Innovation can be defined as applications of a new method to reach a practical end. All these three features are significant. There should be a new method. We should obtain some positive effect. There should appear an application, which means that it differs from an idea, theory or a project" [1972].

Others define innovations in a broader manner, as any thought, behavior or a thing that is qualitatively different from the existing ones to date [Barnett, 1953]. It follows from this definition that only changes of general nature, which occur for the first time on a world's (global) scale, are regarded as innovations.

A similar standpoint is presented by other authors who deal with the problem of innovation, such as: J. Schumpeter, P.F. Druckner, E. Mansfield, R.F. Solow [Marciniak, 2000]. Also M. Kalecki considered new solutions (inventions) applied for the first time ever on a global scale to be innovations [1980]. Other Polish authors like B. Ileczko [1979], B. Fiedor [1979] or W. Janasz [2000] advocate the same understanding of the term.

Accepting the following four basic subsystems of the global system: man, society, nature, technology, B. Ileczko [1979] differentiated 4 groups of innovations:

1) anthropocentric innovations relating to desired physiological changes, functional and neuropsychic features of man, lines of man's conduct, lifestyle, and the like;

2) social innovations, connected with interpersonal relations, changes in economic systems, socioeconomic policy, organization of social life, etc.;

3) biotic innovations related to changes in nature, pro-ecological activities, perfecting breeds of animals and plants, etc.;

4) technological innovations connected with changes in technology, transport, chemical substances, constructions, etc.

Nonetheless, there are definitions that formulate the notion of innovation differently, extending it over everything that is perceived as new, yet not necessarily on the global, world's, scale, but for everybody who applies given innovations, independent of the objective novelty of the given idea or thing [Rogers, 1962, 13]. Such an approach is accepted, among others, in the currently applied methodology of statistical research into technological innovations,

included in the so-called "Oslo manual" that was a result of the cooperation between OECD, Eurostat and the Nordic Fund of Industrial Development. According to the "Oslo methodology", which is applied in preparation of materials by the Central Statistical Office in Poland, technological innovation is recognized only when a new or enhanced product (process) is novel on the world's scale, or on the scale of the given country or market in which the company is active, despite the fact that it has already been implemented or known in other companies, branches or countries [*Działalność innowacyjna przedsiębiorstw...*, 2006].

The term "innovation" can be used with the following two meanings:

a) as an object (substantial meaning), with reference to new social processes, economic systems, natural processes, new products and services, etc.;

b) as an activity (functional meaning) understood as a process that includes creating, designing, realization, adaptations and usage (application) of the new product, methods of manufacture, elements of socioeconomic system, etc.

The innovation that is used with the above-mentioned meanings is a process of carrying out innovation changes independent of the branch and the area, or the stage of innovation activity in which it occurs.

In the Polish scientific research, in elaborations and statistical publications, and also – consequently – in the popular consciousness, the term "innovation" is associated with production processes, and particularly with changes in production technology and undertaking manufacture of new products [Szabłowski, 2000, 133]. It is rare to associate them with changes in other domains of social, ecological, organizational or administrative activities. This could be explained with the fact that changes in technology and manufacture techniques influence people and environment in a much more direct and significant manner – people who live in the environment can perceive the transformations a lot more intensely than innovation processes in other kinds of activity.

Accordingly, the present paper will primarily deal with technology-related innovations limited to those realized in the Polish industry, as well as with their economic effects.

3. Models of innovations

In the past, innovations made for a peculiar "side effect" of the production process. They appeared in the form of improvements and changes introduced in the wake of direct observations of the work of production installations and applied methods of manufacture.

In the time after the war, for over three successive decades (until the 1980s) there had dominated the concept of a linear model of innovations. The model assumed the existence of one-direction chain of relations and their effects con-

necting science and research, technology and production in the form of a series of events whose realization is presented in the following scheme:

fundamental sciences → applied sciences → developmental works → new technologies and techniques → production

Such a model (of innovation "pushed forward by science") was regarded as basic, especially in the case of technical innovations, and was referred to as the basis of supply-related concept of innovation sources.

At the end of the 20th century, under the influence of the great progress in science and knowledge, in the place of the linear model some new models were proposed (works by J. Ziman, S.J. Kline, N. Rosenberg, P.F. Drucker, D.N. Frey), among which was the most popular interactive model which formed the basis of the demand-related concepts of sources of innovation. The above-mentioned model attributes a special role to interactions and feedbacks occurring between science, research and knowledge, and technology and individual stages of innovation process, as presented below in the scheme of "tied chain" of innovation (Fig.1).

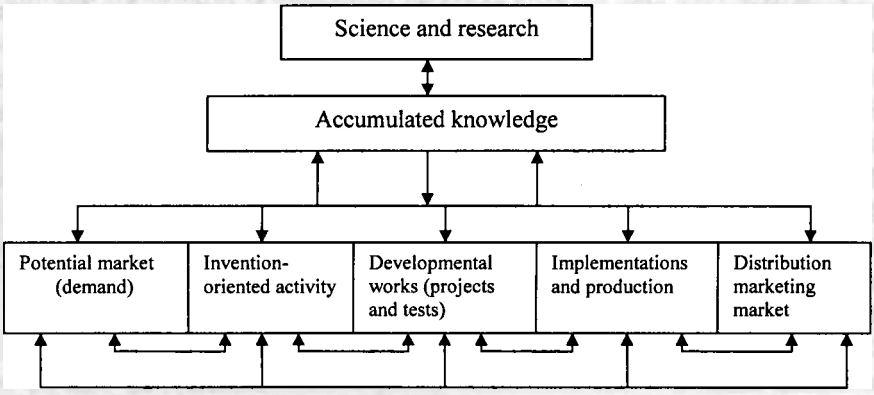

Fig. 1. The model of "tied chain" of innovation

Source: elaborated on the basis of S.J. Kline, N. Rosenberg, "An overview of innovation", in: *The Positive Sum Strategy*. Washington: National Academy Press. 1986, p. 290

The interactive model of Kline and Rosenberg points to 5 paths (phases) of innovation, underlining that they are all equally significant.

The innovation process, by the rule, begins with establishing the potential demand market – without demand innovation has no chance to occur. The next element of "innovation chain" is inventions that appear under the influence of market demand, and which are inspired by knowledge (accumulated and created in the course of scientific research). At the successive stage (developmental works) there appear prototypes of new products, technologies

or constructions, and necessary tests (checks) are carried out to qualify the prototype to be implemented and manufactured. The final stage, at the same time one that opens the next cycle of "innovation chain", is sales and marketing research related to the former.

The practice of implementation of technical innovations points to the fact that neither of the presented models finds a universal application, and that, in principle, confronting the demand-related and the supply-based models of innovation sources is of no use any longer. It is either the first or the latter that can be useful to a greater or lesser extent, depending on the domain and phase of the innovation process, in which they are being applied.

4. Sources of innovation

The condition to maintain the sufficient level and dynamics of innovation is obtaining access to various sources (factors) of innovation.

Although scientific research has proved that about 70% of innovations have their demand-related sources (are induced as an effect of demand for them, mainly on the part of companies) and only 30% stem from supply-related sources (as a result of the offer proposed by the sectors of science, research and inventions), there is no doubt that without the latter the former would not be possible. Therefore, both the supply- and demand-related sources of innovations must be regarded as vital and indispensable, the most significant among them being:

1) scientific-research works;
2) resources and streams of knowledge;
3) the structure of economy and industry;
4) investments;
5) cooperation with centers abroad.

Science and research. The term "science" has a number of meanings: it means multiplication of knowledge of reality that surrounds us, activities of teaching and learning, and in the functional sense – all research-oriented actions, which aim at development of science in the cognitive sense. Science is still a continuously developing system of knowledge fixed in respective notions, laws, hypotheses, empirical facts, theories and ideas. It reflects objective features and regularities of natural, economic and social reality [Janasz, 2000, 260–261]. Science is, thus, a creation of research activity within the framework of which the following are distinguished according to its practical usability: basic research, applied research and developmental-implementation works.

Basic research – aims at making scientific discovery and broadening the knowledge connected with a given problem; as a result there is a deepened knowledge of reality and laws occurring in it.

Applied research – consists in making use of resources of knowledge and results of basic research in order to facilitate realization of determined practical tasks through indicating how (in what way) to solve the problem.

Developmental works – are designed to connect results of research works with technical knowledge necessary to produce a new product, introduce new technology or system of organization; these are construction or design-technological works which comprise making a prototype or test series of a new (modernized) product.

Implementation works – consist in executing adaptation activities (of technical, organizational, investment character) indispensable to start production of a new product, application of a new technology or new organization.

Inasmuch contemporary practice points to the fact that in processes of technological innovations it is mainly propositions and ideas created in industrial laboratories that are being applied, still the long-term innovation intensity, indeed, depends on progress in science, including basic research. Solving complicated technical, economic, ecological, social and other type problems is not possible without a share of science at the moment. In consequence, science ought to offer potential responding to developmental needs of economy, technology and other domains that are necessary to create innovations, as well as their adaptation (absorption).

Resources and stream of knowledge – contemporary world is entering a new stage of development of market economy, which differs from the previous ones. Its essence is a change in the system of production factors. The position of the basic manufacture factor has been taken over by human knowledge causing a relative decrease in the role of traditional factors: labor and capital. Knowledge resources are created by knowledge acquired and accumulated in previous periods that preceded the innovation activity. The stream of knowledge is formed by current knowledge whose source are scientific and research works.

Knowledge has always been in demand, yet it has never before occupied such a place in processes of management as it does today, the consequence of which is, among others, a change in the character of expenditure on knowledge (formerly – consumption expenses, at present – investment outlays), as well as the nature of market competition [Sadowski, 2005, 402]. The skill of organized accumulation, creating and using knowledge, both for the needs of current production and further creation of new knowledge and its fast transfer onto innovation processes has become the main subject of the competition between companies. The growing significance of knowledge, which is becoming the most important factor in development and progress, has found its expression in distinguishing new, the so-called "knowledge-consuming" sectors of economy and in foundation of new kinds of industrial manufacture (automatics, nuclear engineering, biotechnology, informatics, microelectronics, material engineering and others).

The structure of economy and industry. Economic structures and their transformations can, in a significant way, influence the intensity of innovation processes, since different branches of economy are characterized by a varied level of demand for innovations. High demand and relatively big range of innovation occur in industry, transport, telecommunications, financial brokerage, healthcare, whereas a relatively low level is typical of agriculture, construction industry, trading, communal management, public administration, education.

As regards industry, its modern branches and groups, especially such as: manufacture of cars, office machinery and computers, audio and TV equipment and devices, medical instruments, precision and optical instruments, electrical machinery and installations, chemical articles, including pharmaceutical ones, are distinguished by a high level of innovation. Research into structural transformations of the national economy and restructuring of industry [Mikołajewicz 2004b; Mikołajewicz 2003], which have been going on in Poland since 1990, point to changes that are unfavorable from the point of view innovation processes. Of the above-mentioned pro-innovating sectors of the national economy it is only in telecommunications and financial brokerage that significant investments and developmental processes did occur. Changes in the objective structure of industry indicate a drop in the share of modern branches of electro-machine and chemical industry at the simultaneous considerable increase in the traditional highly outlay-consuming and low-innovating branches such as: fuel and electric power industries, mineral, timber-processing and paper manufacture.

In order to stimulate innovation processes it is indispensable to carry out real restructuring of the Polish industry, which would aim at making it more modern and instill a significant improvement in its effectiveness of management.

Investments. Innovatory processes require making constant changes in material technological means that follow mainly as a result of undertaken investments. The latter are then an indispensable carrier of innovations, and the expansion of investments favors innovation dynamism. Such dependences, on the other hand, demand satisfying additional conditions, which is necessary if investment expenditure should yield desired results. The conditions include the following:

a) pro-innovation structure of investments directed to modern highly-innovative domains of economy and industry;

b) securing possibilities of financing innovation investments; a generally low level of productivity of companies results in lacking in own financial means and enforces making efforts to obtain external means, acquiring of which ought to be executed effectively, possibly in a short period of time and at lowest costs;

c) availability of investment means that are possible to use at the moment of innovation readiness.

Cooperation with foreign centers. Effectiveness of scientific-research and innovation activity requires maximum drawing from the heritage of world's science and technological experience. The development of all the civilizations to date has been based on this principle, including the industrial civilization in particular. International transmission of technological innovations is becoming a necessity in the conditions of deepening specialization in the field of scientific-technical research.

Among the main sources of the scientific-technical thought and its materialization in the form of innovation activity, one can differentiate the following: import of modern machinery, installations, equipment, technologies, licenses, *know-how*, exchange of scientific-technical documentation, provision of technical services, international cooperation, creation of joint companies, exchange and education of the personnel.

Thus, in many areas of the scientific-research and innovation activity, drawing from foreign achievements conditions progress and effectiveness, which should not mean resigning from own creativity or limiting it at all. Here, recurring discussions should be mentioned in which import of scientific-research achievements, new technologies and the like are set against development based on own research (compare the opinions on this topic by the President of the National Bank of Poland, Prof. Leszek Balcerowicz, the President of the Polish Academy of Sciences, Prof. A.B. Łagocki and the Minister of the Committee of Scientific Research, Prof. M. Kleiberg, published in the columns of the weekly *Wprost* Nos. 49/2004 and 1/2005). Such a juxtaposition seems unjustified and can lead to nowhere. Own accomplishments can develop on the basis of making use of what has already been achieved by others. This has been proved by experience of many countries and nations. Still, if Poland does not want to remain on the position of a mere supplier of resources and workforce for countries of information civilization, it must itself get engaged in creating the resource of the highest importance today, that is science and knowledge.

5. Effects of the innovation activity in the Polish industry

The so-called production renewal coefficient is regarded as the basic measure of innovation activity effects. In compliance with "Oslo methodology" the coefficient expresses the share of production sold values with reference to products that are manufactured as a result of technical innovation, that is ones that are technically new or substantially improved, at least from the viewpoint of the company that is implementing them, introduced in the market within the last three years, in the aggregate value of production sold of products in a given year.

The production renewal coefficient constructed in this way has been applied in Poland since 1996. In previous years a national formula was applied, which

defined this coefficient as the share of production sold of new or modernized products, introduced in the market in a given year, in the value of production sold of all products in a given year. Values of the coefficient calculated with the use of each of the methods differ considerably: the coefficient calculated with the use of "Oslo method" is each time about 2.5 times higher than that calculated by means of the home method. The data included in Table 1 offer the best illustration of the differences. They inform about the level of production renewal according to both methods in the first period of introduction of the new "Oslo methodology" in Poland.

Table 1. Total comparative renewal coefficients of industrial production according to the home and "Oslo" methods in the years 1996–1998

Research method	1996	1997	1998
Home method (sales of new products in a given year)	8.4	7.9	8.2
"Oslo method" (sales of new products in recent three years)	18.7	20.1	20.0

Source: *Rocznik statystyczny przemysłu* [*Statistical Yearbook for Industry*]. Warszawa: GUS, 1999, p. 256

As a result of the applied procedure of the new method of calculations, the "achieved" level of production renewal in Poland is close to that in certain countries of the EU-15, which, in 1996, in companies belonging to the branch of "industrial manufacture", amounted to the following [*Działalność innowacyjna przedsiębiorstw...*, 2004, 114]:

- European Union (E–15) – 33% [1]
- Germany – 45%
- Ireland – 32%
- Sweden – 31%
- Spain – 27%
- Finland – 25%
- G. Britain – 23%
- Portugal (1997) – 14%
- Poland – 19.7%.[2]

The information about the level of industrial production renewal on the whole and in selected branches of industry within the sector of "industrial manufacture" in the years 1998–2004 is contained in Table 2. The slow but

[1] The indexes for the EU and the EU countries concern all companies (including non–innovating ones) with the personnel of 20 and more employees.

[2] Concerns innovating companies in which the number of the employed exceeds 50 persons and more.

continuous rise in the share of new and modernized products in the value of the production sold, which occurred in the second half of the 1990s, slowed down rapidly in 2000. The production renewal coefficient in the whole industry dropped by almost 5 percentage points in comparison with the previous year; in the sector of "industrial manufacture" – by 6.2 percentage points, respectively.

An even lower drop (by 9 percentage points) occurred in the private sector of industry. As a result, the year 2000 turned out the only one (out of seven years covered by the research) in which the level of production renewal in the public sector was higher (17%) than in the private one (16.1%). In the previous period, especially after 2000, the public sector displayed considerably lower coefficients of production renewal at the simultaneous constant decreasing trend (down to 6.4% in 2004).

As far as the section "industrial manufacture" is concerned, the production renewal coefficient rose during that time to almost 24% and has stayed on a similar level to that at the end of the 1990s. In individual branches of manufacture industry the level of renewal differs greatly. A considerably lower than the average one in section "E" is the share of new and modernized goods in the following industries: food, light, wood-processing, paper, mineral materials, steelwork, that is in sectors of industry regarded as traditional, "non-modern", or even declining. On the other hand, a considerably higher level of production renewal, and this in the whole of the examined period, turns out to be that in the sectors of industry which are considered modern and prospective, including mainly the following branches of electro-machine industry:

- production of machines and installation,
- production of office machines and computers,
- production of machines and electrical devices,
- production of radio, TV and telecommunications equipment and devices,
- production of medical, precision, optical instruments, clocks and watches,
- production of cars and vehicles, trailers, semi-trailers and transportation equipment.

Conclusions from an analysis of Table 2 confirm the vital role of transformations of the objective structure of industry for the general increase in the innovativeness level in Poland.

The scope and effects of innovation processes, to a considerable extent, are conditioned by results of research-developmental works in the form of inventions coming from companies' own research potential, units of R&D sector and exchange with foreign countries.

An invention is a new solution of technical character (that is not part of the technology output to date), which is suitable for application. An invention is regarded as suitable for industrial usage if, on its basis, it is possible to obtain a product or to run a manufacture process in the understanding of technology

Table 2. Production renewal coefficients concerning industrial manufactured goods in Poland in the years 1998–2004

Ordering no.	Specification	1998	1999	2000	2001	2002	2003	2004
		Goods whose manufacture was begun in the years:						
		1996–1998	1997–1999	1998–2000	1999–2001	2000–2002	2001–2003	2002–2004
		in % of sold production of goods						
1.	Total	20.0	21.3	16.4	18.0	16.7	20.7	20.9
2.	Including the public sector	14.6	17.0	17.0	9.5	7.7	6.2	6.4
3.	Private sector	24.3	25.1	16.1	21.0	19.2	25.0	24.5
4.	Including industrial manufacture	22.4	24.7	18.5	20.8	19.1	23.8	23.8
4.1	– manufacture of food products and beverages	11.6	12.5	9.6	10.3	7.3	13.4	12.5
4.2	– manufacture of clothing and fur products	2.6	6.6	2.4	3.8	5.3	8.2	4.8
4.3	– manufacture of wood and wooden products	25.2	23.5	14.0	7.3	9.7	7.3	9.2
4.4	– manufacture of fiber mass and paper	7.3	26.4	7.6	2.1	4.0	10.1	14.5
4.5	– manufacture of coke and products of oil refining	32.9	37.7	36.0	48.4	52.0	20.8	14.3
4.6	– manufacture of chemical products	19.8	21.9	17.7	16.8	13.3	15.0	20.9
4.7	– manufacture of goods of non-metallic materials	9.2	11.0	12.6	14.1	14.2	19.0	17.5
4.8	– manufacture of metals	5.3	8.4	6.7	6.2	6.2	8.8	11.7
4.9	– manufacture of machines and equipment	40.5	63.5	29.5	29.0	32.1	30.2	27.6
4.10	– manufacture of office equipment and computers	88.3	96.3	48.3	13.9	6.6	59.4	49.9
4.11	– manufacture of machines and electrical equipment	22.1	38.7	24.3	28.1	21.8	33.1	31.5
4.12	– manufacture of radio-TV and telecommunications equipment	16.2	37.3	10.9	30.6	42.0	61.3	39.9
4.13	– manufacture of medical and optical precision instruments	24.0	71.6	75.0	21.3	47.4	52.6	35.9
4.14	– manufacture of vehicles	79.2	50.1	34.9	39.1	43.8	59.1	69.5
4.15	– manufacture of other transport equipment	44.7	58.6	37.0	36.8	18.9	64.2	36.3
4.16	– manufacture of furniture and other production sections	15.3	17.8	10.6	23.6	14.1	27.7	21.6

Source: *Działalność innowacyjna przedsiębiorstw przemysłowych w latach 1998–2000* [*Innovation Activity of Industrial Enterprises in the Years 1998–2000*]. Warszawa: GUS. p. 112; *Działalność innowacyjna przedsiębiorstw przemysłowych w latach 2002–2004*. Warszawa: GUS, 2006. p. 95

in any industrial activity. An invention is subject to legal protection in the form of a patent that acknowledges the right of property to the inventor and granting the latter the monopoly on exploitation of it during a determined period of time (15–20 years).

A license means obtaining authority to make use of foreign scientific-technological solutions and manufacture experience which are legally protected (fully or partially). Active licenses are those issued on the basis of a valid license agreement. During the whole period of the transformation, the pro-inventive activity has displayed a downward trend.

Table 3. The invention- and license-oriented activity in the years 1990–2004

Specification	1990	1995	2000	2001	2002	2003	2004
1. **Domestic inventions**							
1.1. submitted	4105	2595	2404	2202	2313	2268	2381
1.2. patents granted	3242	1619	939	851	834	613	778
2. **Foreign inventions**							
2.1. submitted in Poland	1316	2874	4894	4344	4295	3941	5359
2.2. patents granted	405	989	1524	1171	1437	1103	1016
3. **Polish inventions**							
3.1. Submitted abroad	154	903	6327	6969	9039	*	*
3.2. Patents granted	149	65	123	116	142	*	*
4. **Realizations of licenses**							
4.1. Active foreign licenses	*	118[a]	238	261	284	328	337
4.2. Polish licenses sold abroad	*	6[a]	7	10	16	7	9

[a] refers to 1996

Source: *Rocznik Statystyczny Przemysłu* [*The Statistical Yearbook for Industry*]. Warszawa: GUS, 2003, pp. 371 and 375; *Rocznik Statystyczny Przemysłu*. Warszawa: GUS, 2005, pp. 451 and 455

Especially dramatic regress in the area of invention-related activity occurred in the years 1990–1995. Fortunately, from the year 2000 the number of home inventions and patents granted has been fairly stable, still on a very low level. The number of patents granted in the years 2000–2004 was four times lower in comparison with that in the year 1990. There followed a deep fall in the scope of inventions-related effectiveness. In the 1990s, over three fourths of the inventions submitted for approval were granted the rights of patent, whereas since 2000 – merely one third. The drop in the number of domestic inventions was complemented by those submitted in Poland but coming from abroad. Out of the relatively great number of submitted inventions, 20–30% were granted patent rights. As a result, the total number of patent rights granted in Poland

to home and foreign inventions was on a steady decline and looked as follows in selected years:

in 1990 – 3,242 + 405 = 3,647 patents
in 1995 – 1,619 + 989 = 2,608 patents
in 2000 – 939 + 1,524 = 2,463 patents
in 2002 – 834 + 1,437 = 2,271 patents
in 2004 – 778 + 1,016 = 1,794 patents

At the same time, from the year 2000, there has been a rapid growth in the number of inventions prepared in Poland and submitted for patenting abroad. Still, in the view of the general number of inventions submitted there the percentage of patent rights granted to them is desperately low, below 2%.

The basic cause of the poor effects in the field of invention-making is a lack of interest in this activity on the part of industrial companies. Among a total of 28,614 "innovating" enterprises that were examined by the Central Statistical Office only 600 of them, that is merely 2.1%, submitted at least one invention for patenting within the period of 3 years (2002–2004) [*Działalność innowacyjna przedsiębiorstw...*, 2006, 26, 98].

Also, the turnout of licenses with countries abroad is unfavorable and far from being balanced. Altogether, in the years 2000–2004, there were 1,448 licenses purchased abroad. At the same time, only 49 (!) Polish licenses were sold abroad. Unfortunately, the proportions have not been better since then; what is more, it appears that the situation is deteriorating further in this respect (see Table 3).

The negative effects of the lack of progress in the area of invention-related activity and more broadly – innovation activity – find their deplorable reflection in analyses of the Polish industry production sold according to the level of technology. Qualifying production sold turned out by manufacture industry in compliance with criteria established by the OECD has been carried out in Poland since 1995. Table 4 presents some of the findings.

Table 4. Structure of production sold in the section "industrial manufacture" [a] according to the level of technology

Specification	1995	1998	2000	2001	2002	2003	2004
High technology products	3.3	3.9	5.6	4.3	4.8	4.5	4.5
Medium-high technology products	24.4	25.2	34.0	22.6	21.4	23.6	25.6
Medium-low technology products	13.8	14.5	21.3	15.8	17.3	17.7	31.3
Low technology products	58.5	56.3	39.1	57.3	56.5	54.2	38.6

[a] in subjects employing more than 49 workforce

Source: *Rocznik Statystyczny Przemysłu [The Statistical Yearbook for Industry]*. Warszawa: GUS, 2002, p.369; *Rocznik Statystyczny Przemysłu*. Warszawa: GUS, 2004, p. 393; *Rocznik Statystyczny Przemysłu*. Warszawa: GUS, 2005, p. 456

During the whole period under analysis (with the exception of 2000 and 2004) the products which were qualified into the group of "low technology" made for over 50% of the total value of manufacturing industry production sold in Poland. In total, the ones belonging to the groups "low and medium-low technology" constituted almost three fourths of the production sold. The share of products of "high technology" remained within the range 3–5% (merely), which did not change in any substantial way within the examined decade. It should be underlined, at the same time, that the group of "high and medium-high technology" included solely products of electro-machine and chemical industry (excluding rubber and plastics). These modern branches of industry, which are characterized by a high share of added value and high cost-effectiveness, belong to the most dynamically developing in almost all of the European countries, excluding Poland. Research into structural transformations of the Polish industry points to the fact that in the period of transformation, there follows a drop in the share of the electro-machine industry in the total value of production sold of the Polish industry, a considerable fall in their industrial investment outlays, as well as an absolute decrease in turnouts of the majority of the most important products that are recorded by the Central Statistical Office [Mikołajewicz 2004a]. Similar processes, though of less acute character, occurred in the chemical industry, too. Thus, this direction of structural transformations to date should be regarded as one of the main causes of the lack of sufficient development of scientific-research and innovation activities in the Polish industry.

6. Obstacles and barriers limiting the innovation activity

The reasons why the innovation activity is so limited can be of varied nature, can stem from various sources, and differ in their force of influence. In the second edition of "Oslo manual" there are differentiated 18 factors hampering innovation activity, while in the international questionnaire UE/OECD applied at stage II of CIS (Community Innovation Survey) research into innovation there are differentiated 9 obstacles to innovation activity, which are included in three groups as follows: economic, internal and others [*Działalność innowacyjna przedsiębiorstw...*, 2006, 95].

Studies carried out by the Central Statistical Office for the years 2002–2004, which covered 28,614 industrial enterprises in Poland, point to the economic factors as the most inhibiting ones to the innovation activity, with a lack of financial means (both own and external), as well as too high innovation costs in the lead (Table 5).

A considerable part of enterprises consider also uncertain demand or a lack of demand for innovative products to be "serious" obstacles in innovation activity. On the other hand, in the opinions of the enterprises, a lack of qualified

Table 5. Influence of factors hampering innovation activity in the years 2002–2004 to a "high" degree, in the opinions of the examined industrial enterprises (in%)

Type of factor	Total number of enterprises	Enterprises in the sections		
		mining	manufacturing industry	generating and supplying electric energy, gas, water
	in % of the total number of enterprises			
1. Economic factors				
1.1. lack of financial means in companies or groups of companies	36.4	28.1	36.6	27.5
1.2. lack of financial means from external sources	28.5	22.7	28.7	22.7
1.3. too high costs of innovation	34.5	30.5	34.6	26.5
2. Factors tied to knowledge				
2.1. lack of qualified personnel	8.1	5.5	8.3	1.1
2.2. lack of information on technology	5.5	4.7	5.5	2.3
2.3. lack of information on markets	5.5	4.7	5.6	2.0
2.4. difficulty finding partners to collaborate in the area of innovation	12.3	7.0	12.5	4.6
3. Market-related factors				
3.1. market controlled by dominating companies	18.3	12.5	18.6	4.3
3.2. uncertain demand for innovative products	20.3	17.2	20.6	6.4
4. Other factors				
4.1. lack of need for innovation activity due to implementation of innovations in previous years	6.3	7.0	6.3	4.1
4.2. lack of demand for innovations	8.8	10.9	8.9	4.1

Source: *Działalność innowacyjna przedsiębiorstw przemysłowych w latach 2002–2004* [*Innovation Activity of Industrial Enterprises in the Years 2002–2004*]. Warszawa: GUS, Warszawa 2006, p. 90

personnel or lack of information on innovation technologies is only a minor obstacle here.

On the basis of observations of the Polish economy and research conducted in industrial enterprises by the Central Statistical Office, the following can be regarded as the main causes of the low innovation activity at the moment:

1) lack of sufficient engagement on the part of enterprises in running the innovation activity,

2) lack of sufficient incentive and aid on the part of the state to undertake innovation activities by enterprises,

3) general lack of financial means for R&D and innovation activity,

4) insufficient cooperation between enterprises and institutions of the R&D sphere.

Involvement of enterprises. The basic measure of enterprises being involved in the innovation activity is their share in the general set of the so-called "innovating enterprises", that is ones that, in the period of recent three years, implemented at least one new or modernized product or technological process in the production cycle.

In the period of 10 years under examination by the Central Statistical Office, the share of innovating enterprises in the total number of the analyzed industrial enterprises was changing to a significant degree and developed in different directions, the most substantial share falling on the years 1994–1996 (37.6%). In the successive research period it dropped to a level of 16.9%. It was the time of "cooling down" the Polish economy and a decrease in the economic activity, which was reflected in the fall in the increase rate of the GDP and a dramatic decrease in the dynamics of investment outlays, including outlays on research and implementation of innovations. It was not until 2003 that there followed a new economic boom, including investment activity and also innovation activity (Table 6).

Particularly deep regress in the share of innovating enterprises (from30.3% to 15.7%) followed in the private ownership sector and in the section of "indus-

Table 6. Share of innovating enterprises in the total number of examined industrial companies according to sectors of ownership and sections in the period 1994–2004[a]

Specification	in the period 1994–1996	in the period 1998–2000	in the period 2002–20004
Total % of innovating enterprises	37.6	16.9	25.9
Including: public sector	52.0	35.3	50.8[b]
private sector	30.3	15.7	24.9[b]
Sectiqns: mining and excavating	29.5	29.1	30.5
industrial manufacturing	38.6	16.7	25.6
supply of electric energy, gas and water	28.0	24.6	42.1

[a] The years 1994–1996 included, in the sections "Mining" and "Industrial manufacturing", units, where the number of the employed exceeded 50 persons, and in the section "Supply of electric energy, gas and water" – 20 persons. In the other years – all the enterprises employing over 9 persons.

[b] Concerns only the section "Industrial manufacturing"

Source: *Działalność innowacyjna przedsiębiorstw przemysłowych w latach 1998–2000* [*Innovation Activity of Industrial Enterprises in the Years 1998–2000*], Warszawa: GUS, 2002; *Działalność innowacyjna przedsiębiorstw przemysłowych w latach 2002–2004*, Warszawa: GUS, 2006

trial manufacturing" (from 38.6% to 16.7%). In the successive research period (the years 2002–2004) there occurred a rise in the share of innovating enterprises; still, it did not lead to achieving the level of the years 1994–1996.

Despite a seemingly high level of innovativeness of the Polish industry, which expresses itself in the index of 26% of innovating enterprises in the total number of the examined companies in the years 2002–2004, it must be acknowledged that this level is low since it is formed by innovations deriving from a period spanning as many as three years and consisting in implementation of only one product or process during that time. Moreover, it covered exclusively technical changes about the product or technology, without paying attention to economic, social, ecological, or other effects resulting from the changes. The conclusion is that the criteria which qualify changes in technology and techniques of manufacturing as innovations, accepted by the Central Statistical Office on the basis of "Oslo methodology", seems to be fairly soft and easy to satisfy by suggesting that the innovation standard of the Polish industry is high, whereas – in fact – it is quite low indeed.

The opinion of the low level of innovativeness of the Polish industry is confirmed by comparing corresponding data from different EU countries (Table 7).

Table 7. Share of innovating enterprises in industry in selected countries of the European Union

Country	Examined period	Innovating enterprises share index %
European Union E-15	1994–1996	51.0
Denmark	1994–1996	71.0
Finland	1994–1996	36.0
France	1994–1996	43.0
Spain	1994–1996	29.0
Ireland	1994–1996	73.0
German	1994–1996	69.0
Norway	1995–1997	48.0
POLAND	1994–1996	37.6
	1998–2000	16.9
	2002–2004	25.9
Portugal	1995–1997	26.0
Slovakia	1997–1999	16.9

Source: *Działalność innowacyjna przedsiębiorstw przemysłowych w latach 1998–2000* [*Innovation Activity of Industrial Enterprises in the Years 1998–2000*]. Warszawa: GUS, 2002, pp. 31, 42 and 49

Again, the so-called innovation intensity index recommended for application in "Oslo methodology" can testify to the low level of enterprises' involvement in innovation activity. It expresses the relation of outlays on innovation activity with reference to the value of the production sold or (which is rare) to one employed person. The level of the index in the period of last five years is presented in Table 8.

Table 8. Intensity of innovations in the Polish industry

Specification	Outlays on innovations (PLN) per PLN 100 of sales value in the years		
	2000	2002	2004
Industry total	3.10	3.43	2.77
including sections:			
– mining	1.54	1.23	1.32
– industrial manufacturing.	3.39	3.89	2.98
– supply of electric energy, gas, water	2.06	2.03	2.07
Ownership sectors:			
– public sector	2.91	2.13	1.54
– private sector	3.21	3.97	3.14

Source: *Rocznik Statystyczny Przemysłu* [*The Statistical Yearbook for Industry*], Warszawa: GUS, 2005, pp. 110 and 443

Per PLN 100.00 obtained from sales, Polish enterprises allotted merely about PLN 3.00 to innovation activity. These values fluctuated from PLN 3.10 in the year 2000, through PLN 3.43 in 2002, into the fall of PLN 2.77 in the year 2004.

Similar conclusions as regards the low level of involvement on the part of enterprises in innovation activity can be drawn upon an analysis of the structure of costs of industrial companies activity. In this structure, the share of the expenditure on innovations remained on a low level of about 2.5% in the whole period of 2000–2004. Regarding all the expenses borne on innovation activity, about 80–83% were those on investment-related targets connected with realization of intended innovations.

Engagement of the state for the development of research-developmental and innovation activity in Poland has been weak, being the lowest in Europe. Outlays on R&D made merely 0.64% of the GDP in 2000, and in 2004 dropped to the level of 0.56%, amounting to a total of PLN 5,155 million [*Rocznik Statystyczny RP*, 2005, 420 and 443]. The outlays on this sphere in the industry amounted to PLN 995 million in 2004, PLN 146 million of which, that is about 14.7% being financial means from the state budget. This means a fall of over 50% in comparison with

the year 2000 [*Rocznik Statystyczny Przemysłu*, 2005, 437]. The outlays on the innovation activity in the industry were being raised in the years 2000–2004 at the rate of 5% per year and amounted to PLN 15,628 million in 2004, of which about PLN 167 million were means from the state budget [*Działalność innowacyjna przedsiębiorstw...*, 2006, 64]. Altogether, the outlays on the research-developmental and innovation activities in industry, which were covered by the state budget, amounted to about PLN 313 million in 2004, which made for 0.16% of the expenses of the state budget and about 0.03% of the GDP.

The above-quoted data testify to the fact that direct financial engagement of the state in supporting the research-developmental and innovatory activity in the Polish industry has been minimal so far. Neither does the Polish state make use of other possibilities of stimulating R&D and innovatory activity in the economy and industry through:

– legislative activity that creates favorable conditions for development of science, research and implementations on many planes (*e.g.* legal, economic, financial or organizational);

– supporting structural transformations in the economy and industry, which would promote development of highly innovative sectors;

– application of instruments of financial policy (credits, taxes and others) that would support possibilities of realization of research results and innovations;

– direct responsibility for the scope, quality and structure of educating on all levels in a variety of forms, by satisfying the basic condition of forming an information society and economy based on knowledge, science and permanent innovation activity.

The activities on the part of the state proposed above contradict the regulative role of the market mechanism. Contemporary market economy is founded on a development connecting features of free market, indispensable for releasing people's initiatives and business activity, with reasonable steering that is necessary to delineate a desired direction for a long-distance development. This means strengthening the role of a democratic state in creating the economic policy and attaining a synergic effect of cooperation between the market and the state.

7. Recapitulation and conclusions

1. The results of the research presented here confirm the opinion of the low level of innovation activity in the Polish industry. This conclusion rests, among others, on the following:

– low share of innovating enterprises in the total group of industrial companies, particularly in the private sector (24.9%) and in the group of small companies – employing 10–49 workers (17.7%);

- low share of outlays on innovation activities in enterprises, making for merely about 2.5% of the total income costs obtained from the whole of the enterprises' activity and a low growth rate of these outlays (on the average 4% annually in the years 2000–2004);
- low and declining share, in the structure of outlays on innovation activity, of means appropriated for own R&D activity of the enterprises (a drop from 12.8% in 2000 to 7.5% in 2004), as well as for purchase of ready technology;
- low and decreasing level of innovation intensity coefficient in the Polish industry (a drop from 3.10% to 2.77% in the years 2000–2004), particularly, in the section "mining and excavating" and in the public enterprises ownership sector (a drop from 2.91% to 1.54%);
- weak engagement of the state in financing innovation activity of industrial enterprises (1.1% of all the outlays on innovations), especially in the private enterprises sector;
- poor results of innovation activity of enterprises to date, an expression of which is the production renewal coefficient that is low and has been constantly decreasing for many years now; serious regress in the innovation activity and deficit in the exchange of licenses with abroad;
- lack of progress in production quality measured with the level of technology of manufactured products.

2. A change in the existing situation requires an intensive and coherent engagement for the sake of development of scientific-research and innovation-oriented activity on the part of basic subjects of the innovation-related policy in Poland, that is the state and enterprises.

3. The state functioning within the system of market economy and free competition should create a climate and conditions which promote scientific, R&D and innovation activity through the following:

- pro-innovation legislative activity;
- supporting structural transformations which promote development of modern domains of economy and industry, and which are highly science-dependent and susceptible to innovative processes;
- activating and applying financial instruments in the form of credit preferences, tax allowances, subsidies, budgetary grants, and the like, which support research-developmental and innovation activity;
- greater, direct engagement in the development of science and research by maintaining, organizing and financing R&D sector (centers of the Polish Academy of Sciences, higher school system, research-developmental units), which conditions development of innovation activity;
- facilitating international cooperation in the area of exchange of scientific-research achievements, licenses, scientific-technical documenta-

tions, import of modern technologies, educating personnel and other actions of this type that make it possible to use the world's scientific output and technical experience;
- directing more extensive and effective organizational-legal and financial aid to the sector of small and medium-sized enterprises with the aim to expand their possibilities of absorption of applying achievements of science, research and innovations.

4. Enterprises, independent of the form of ownership in which they function, should generally acknowledge that knowledge, science and research implemented in the economic practice in the form of more and more intensive innovation activity are becoming their basic source of progress, effectiveness and competitiveness. In consequence, the enterprises ought to:
- increase their interest in the sphere of R&D and innovation activity, among others by appropriating much larger means to this purpose in the expenses structure of their activity;
- to a broader extent make use of their own and external (domestic and foreign) sources of financing the R&D and innovation activities, raising the disposability of means that are possible to use at the moment of innovative readiness;
- appropriate larger means, in the structure of outlays designed for innovations, purchase of (ready) technologies and financing their own R&D activity;
- considerably raise the share of new and modernized goods and processes in the general value of production sold, in this way improving the production quality and its technical level;
- develop invention-oriented activity by increasing the number and quality of submitted inventions, registered designs, industrial designs, trade marks, patents and certificates of protection;
- develop cooperation and create networks of connections between different subjects which participate in realization of innovative projects, including – in particular- those between enterprises and units dealing in the R&D sphere;
- extend the scope and forms o cooperation with foreign enterprises by exchanging technical documentation, patents and personnel, providing technical services, cooperation in production, establishment of joint companies.

In the light of the above-presented considerations it can be concluded that there exist in Poland premises for indispensable imparting dynamism to development processes based on knowledge, science and research, implemented, among others, in the form of innovation undertakings. They require, however, determined and coherent activity of the state and enterprises, as well as other subjects, institutions and citizens so that the industry and the

whole economy of Poland would be capable of meeting the new challenges of the 21st century.

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