

**Networking for Innovation:
Pre-Feasibility Study for Transfer of Foreign Technology
To Polish Small and Medium-Sized Enterprises¹**

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1. Introduction

Poland in the first 10 years of post-Communist transition has undoubted economic reform successes to its credit: substantial macroeconomic stabilization, the dynamic growth of the sector of small and medium-sized enterprises (SMEs) both in production and services as well as the privatization of a large portion of the formerly state-owned sector, and the achievement of growth rates among the highest in Europe (both east and west). One of the areas where Poland continues to lag considerably, however, even in comparison with its nearest competitors, Hungary and the Czech Republic, is in the area of technological upgrading and innovation. Much of the post-Communist growth in Poland has been of a relatively crude character, produced by small and medium-sized firms having unsophisticated technological profiles but able to grow through exploitation of market niches for consumer goods and services long neglected by the previous system.

Currently, serious questions are being raised inside and outside of Poland as to the sustainability of this model of extensive, technology-blind growth. Many observers of the Polish business environment have pointed to the links between continued financial weakness of Polish firms (and, in particular, SMEs) and their inability to provide sufficiently advanced products and to respond flexibly to sudden changes in market demand. Two examples are comments made by participants in the Sixth SME Business Forum held in November 1999. According to Prof. Andrzej Herman of the Warsaw School of Economics, in 1999 the financial condition of SMEs deteriorated not only because of the general economic slowdown, but also because the process of their modernization is too slow. Herman added that the most serious threat to the development of Polish small companies comes from themselves rather than from European Union competition, because they are too slow to introduce new cutting-edge technology. However, this is often caused by insufficient financing, said Andrzej Lech, head of the Warsaw Banking Institute, adding that "the introduction of new products for small businesses by banks, is, for the time being, just promises."²

Lack of innovativeness makes many Polish SMEs dependent on outward processing traffic (OPT) arrangements (basically a putting-out form of international trade) with western European (particularly German) final contractors, which are typically associated with small profit margins and negligible possibilities for investment and technological upgrading. Correspondingly, Polish firms tend to be uncompetitive on export markets, particularly in the most profitable upscale final goods niches. This has important negative effects on firm profitability and, at a larger scale, on the balance of payments (particularly disturbing giving the recent alarming growth in the deficit on the country's current account).

The following table illustrates the scale of Poland's problem with research and development investment in comparison with a number of other OECD countries:

¹ The preparation of this paper was made possible by a grant from the German Marshall Fund to CASE – the Center for Social and Economic Analysis.

² *Rzeczpospolita*, 5 November, 1999, page B2.

Table 1
Research and development expenditures (% of GDP)

	1965	1970	1975	1980	1984	1994 or 1995	Central government expenditures
Japan	1.27	1.59	1.73	1.91	2.37	2.69	0.63 (1994)
USA	2.91	2.65	2.27	2.38	2.62	2.45	0.99 (1994)
France	2.03	1.93	1.80	1.84	-	2.38 (1995)	1.05 (1993)
United Kingdom	2.35	2.10	2.02	2.19	-	2.19	0.71 (1994)
Germany (Federal Republic)	1.73	2.18	2.38	2.63	-	2.27 (1995)	0.84 (1995)
Poland	-	-	-	-	-	ca. 0.8 (1995)	0.5

Sources: Michał Pietraszewski, "Innowacyjność gospodarki polskiej: Charakterystyka zjawiska," in T. Markowski, E. Stawasz, R. Zembaczyński (red.), *Instrumenty transferu technologii i pobudzania innowacji: Wybór ekspertów*, Warsaw, 1997, 42-44; Tomasz Parteka, "Japońskie doświadczenia transferu technologii i pobudzania innowacji (lata sześćdziesiąte i osiemdziesiąte)," in T. Markowski et al. (op. cit.), 252.

As the table shows, the largest portion of the distance between Poland and the other OECD countries is not due primarily to the low level of government R&D expenditures but rather to the low level of private R&D spending by industry. Polish industry's spending on R&D amounts to a mere 0.3% of GDP, as opposed to the OECD average of 1.51%.³ This is the case in spite of the existence of 260 state-owned R&D institutes which Polish firms lacking their own R&D facilities could potentially take advantage of. Such institutes should constitute ideal partners for SMEs, which often cannot afford their own laboratories. Nothing could, however, be further from the case in Poland. Cooperation between these institutes and SMEs is practically unheard of; the institutes prefer to concentrate on cooperation with their traditional clients, large industrial producers in the state-owned or formerly state-owned sector, and are, moreover, highly dependent on government grants. Additionally, SMEs themselves usually lack both an awareness of what the institutes could possibly offer them as well as financial resources to pay from R&D services. Possibilities for sectoral SMEs to pool their financial resources in developing cooperation with the institutes remain unexplored, and the institutes generally fail to engage in marketing or promotional activity on any significant scale.

The time has come to begin to identify new tools for enhancing the competitiveness and innovativeness of Polish firms. More specifically, by what means might the mutually beneficial transfer of technology from the West to Poland in a be enabled? This process of transfer is a complex one, demanding the establishment of conditions which are beneficial to both sides: the Polish side is interested in acquiring a new technology, but at a reasonable price and with some assurance that the newly acquired technology will be a source of enhanced competitiveness and profitability; for the western provider, on the other hand, technology is a valuable asset, and profits from various transfer arrangements must be accompanied by some assurance that transfer of intellectual property rights will not harm the provider's position and/or that there will be some longer-term benefits to transfer.

This report is an attempt to provide information on Polish technology transfer needs and to specify possible tools for enabling technology transfer from the most developed countries of the world in mutually beneficial ways. Its underlying assumption is that there is considerable room for such cooperation, but that stimulating it demands a great deal of effort and planning. An additional assumption is that technology transfer should involve existing Polish SMEs and entrepreneurs, rather than bypassing them through greenfield investments which are wholly or majority foreign-owned.

³ See Pietraszewski (op. cit.), 59.

To accomplish this task of specifying possible technology transfer tools, this report analyzes present economic and technological developments and identifies the technology transfer needs of SMEs in three Polish industries: wooden furniture, plastics and synthetics, and medical equipment. These three industries have been selected for a number of reasons, including:

- Poland has a substantial number of firms producing a diverse range of products in each industry;
- firms in each industry are generally in need of pronounced technological upgrading;
- internationally these industries are each characterized by significant recent technological innovation;
- the industries represent diverse patterns of market competition and innovation.

The specification of technology transfer needs and of possible transfer tools is done through a multi-level presentation. It begins with a macro-level overview of economic indicators in the three industries in recent years. Then the three industries are presented in more detail, with each industry presentation composed of three main parts:

- 1) an overview of the results of a benchmarking study of a sample of firms from the industry conducted under the auspices of the Polish Foundation for Promotion and Development of Small and Medium Enterprises;
- 2) a presentation of the primary industrial organizations (including industry associations and R&D institutes) and their views of technology transfer needs;
- 3) an analysis of a firm case-study in light of the first two points.

Finally, on the basis of information provided in the above sections a set of conclusions regarding technology transfer needs and possibilities is presented.

2. Summary of the technology needs of SMEs in three industries in Poland

2.1. Overview of Industry Indicators

In Table 2 we present some figures on firms in three industrial classifications used by the Polish Central Statistical Office. These classifications are broader than the industries analyzed in the rest of the paper; however, we believe that they provide an indication of trends in the three industries which are the subject of our particular attention. As the table indicates, the three target industries differ from each other in a number of fundamental ways. The largest industry in terms of employment (1998) is furniture, followed by rubber and plastic products and then medical and precision instruments. Furniture is also the largest industry by sales, although here its lead over rubber and plastic products is very slight. This employment/sales contrast indicates that productivity is highest in rubber and plastic and lowest in furniture. Over time, there are also a number of interesting differences between the industries. In particular, employment in rubber and plastic has increased consistently year by year since 1995, with about 7,000 new employees added each year. There were enormous employment increases in furniture⁴ in 1995-1997, followed by a slight drop in 1998. Employment changes in medical/precision instruments have been insignificant. Sales have nearly doubled in all three industrial classifications since 1995.

⁴ However, we are unable to say how much of these increases is actually due to growth of the furniture industry, since this statistical category also includes "miscellaneous manufacturing."

Table 2
Various indicators for firms in three industries and manufacturing as a whole, 1995-1998

Indicator	Furniture and miscellaneous manufacturing				Rubber and plastic products				Medical, precision and optical instruments, watches and clocks				Entire manufacturing sector			
	1995	1996	1997	1998	1995	1996	1997	1998	1995	1996	1997	1998	1995	1996	1997	1998
Employment in thousands	185.0	194.3	203.4	200.4	105.5	112.5	119.1	125.5	49.4	49.8	48.5	48.1	3102.5	3158.8	3177.0	3100.3
Production sold (in millions of current zlotys)	7608.6	9364.7	12,573.6	13,745.4	7770.0	9592.4	12,097.2	13,704.7	2197.2	2824.2	3665.7	3917.0	200,348.0	244,192.8	299,825.0	330,457.9
Percentage change in production sold over previous year (in constant 1995 prices)	24.2	14.2	25.4	5.2	17.0	17.2	21.1	17.5	25.7	14.7	19.7	4.0	11.6	9.8	13.4	6.5
Investment spending (in millions of current zlotys)	377.5	423.2	575.4	854.3	542.6	855.0	1171.9	1459.8	90.6	133.2	182.9	197.8	11,732.7	17,214.6	23,083.6	29,054.4
Percentage change in investment spending over previous year (in constant prices)	25.8	-4.7	22.8	37.2	56.6	38.1	22.5	17.0	29.1	26.0	22.7	0.8	16.2	27.5	19.8	17.9
Gross value of fixed assets (in millions of current zlotys)	2795.7	3323.8	3760.7	4409.7	3919.2	5841.4	6865.7	8146.1	1096.8	1523.8	1675.6	1773.5	121,486.5	174,546.8	187,858.3	203,198.8
Percentage of firms in industry introducing innovations in years 1994-1996	37.7				48.0				59.5				38.6			

Source: Central Statistical Office (GUS), *Rocznik statystyczny 1998*, Warsaw, 1999, *Rocznik statystyczny 1999*, Warsaw, 2000.

Moving to data on investment and fixed assets, further significant differences appear (differences which have more evident connotations for issues of technology transfer and innovation). Amongst the three industries, capital intensity is highest in rubber and plastic products and lowest in furniture. Contrary to what one might expect, capital intensity in medical/precision is rather low. Similarly, per capita investment spending over the years 1995-98 has been lowest in medical and precision instruments and highest in rubber and plastic products and wood products, though the dynamics have differed markedly. It is worth noting the dramatic increase in investment spending in furniture in 1998 as well as the constantly decelerating *growth* of investment spending in rubber and plastics, the very industry in which we observe the highest *levels*. The comparatively low capital intensity of production in medical/precision instruments is reinforced by these low rates of investment.

Given these results, the data provided in the final row of the table concerning the percentage of firms introducing innovations by industry are intriguing. Here, medical/precision instruments (59.5%) have a significantly higher proportion of innovating firms than both rubber and plastics (48%) and furniture (37.7%). This result indicates a loose connection at best between innovation and technological sophistication on the one hand and investment in physical capital on the other hand. Clearly, in medical/precision instruments, innovation is driven primarily by other factors (among which one could hypothesize the competitive environment in which firms operate, the human capital of the industry's labor force, and the role of software in innovation). The indication (about which more later) is that firm survival in the medical/precision instruments industry is predicated on the ability to innovate and to continually generate new products, whereas survival and growth in the other two industries (particularly in furniture) are not so strongly tied to innovativeness. These distinctions raise important questions about the type of technology transfer most needed by firms which will be addressed in the conclusions to this report.

2.2. Industry presentations

Having overviewed the broadest industry trends, we move now to a more qualitative evaluation of the three industries of the study. Each industry presentations contains three sections each based on different types of data obtained by the project team.

The first part of each industry presentation is an overview of results emerging from the PHARE-funded EXPROM II project conducted by the Polish Foundation for Promotion and Development of Small and Medium Enterprises (henceforth, the Polish SME Foundation). As part of this project, the SME Foundation has conducted detailed studies of 200 Polish SMEs operating in six industries: wooden furniture, clothing, auto parts, plastics and synthetics, foundries, and medical equipment. The study is an attempt to benchmark a group of Polish SMEs with respect to a group of matched SMEs in the European Union along a wide range of categories relating to export competitiveness and technology, including: sophistication of machinery and fixed assets, research and development, quality control management, supply chain management, marketing and sales strategies, and others. While the results are not easily comparable due to varying methodology in the separate industry studies, the following generalizations emerge from the EXPROM II project:

- Polish SMEs are usually behind in the areas of ISO certification and generally lack formalized quality control procedures.
- With the exception of the auto parts industry, production machinery seems to be generally decrepit.
- Supply management is generally unsophisticated and oftentimes a source of problems in obtaining and completing supply contracts.

- Productivity remains low due to technological and know-how deficiencies, reducing the labor cost-based competitive advantage Polish firms have over their western counterparts.

The second part of each industry presentation presents the results of a set of interviews conducted with industry experts from industry associations and R&D institutes. These are: the Polish Furniture Producers' Business Chamber; the Polish Plastics Producers' Association; the Industrial Chemistry Research Institute; and the Polish Pharmaceuticals and Medical Equipment Industry Chamber "Polfarmed." These sections are provided for two reasons: 1) to present the views of knowledgeable industry actors concerning present developments in their industries; 2) to assess the potential of business and industry associations as intermediaries in the process of technology transfer.

The third part of each industry presentation is a case study of one firm drawn from each of the three industries. These cases are evaluated in light of observations generated in the previous two sections of the industry presentations.

2.2.1. Wooden furniture

A. EXPROM Results. 30 wooden furniture firms participated in the EXPROM sector study. According to EXPROM program administrators, firms from this sector tend to use machines which were purchased second-hand rather than new, although they also mentioned very rare examples of production equipment which had been purchased new (adding that it was predominantly Italian). There have been participating firms that entered into rapid-growth phases and expanded employment dramatically (e.g., to 1000 and more employees). Typically, such firms have satisfied their technological needs to a much greater extent than others. Automation occurs most frequently in the following areas: pattern designing, cutting, drilling and working. The weakest areas for firms in this sector are: supply management, production planning and technology, quality management, and marketing (the strongest are such areas as finance and sales).

B. Associations and Institutes. There is an industry R&D institute (the Wood Technology Institute – *Instytut Technologii Drewna*) and an industry association (the Polish Chamber of Furniture Manufacturers – *Ogólnopolska Izba Gospodarcza Producentów Mebli*). According to the director of the latter, the Polish furniture industry is highly fragmented, composed of approximately 20,000 firms employing five to 50 persons, about 300 firms employing between 50 and 500, and about 100 with employment over 500. He expects consolidation of the industry in Poland, with most small firms exiting or being absorbed. The Chamber's director also estimates that over two thirds (70%) of furniture manufactured in Poland is exported, the vast majority of it to Western Europe, with over half of the value of exports of the sector contributed by exports to Germany. About 60% of the productive capacity of the industry is foreign-owned, again with a preponderance of German participation here. Correspondingly, much of the export occurs through OPT arrangements⁵. The level of technology in the sector was fairly high at the end of the 1980s, according to the Chamber's director. But during the 1990s it became more differentiated, with many small producers using second-hand equipment manufactured in Western Europe (mostly Germany and Italy,

⁵ Other studies of technology transfer processes have reached similar conclusions; see, for example, Julie Pellegrin, *German Production Networks in Central/Eastern Europe, Between Dependency and Globalisation*, WZB, Discussion paper FS I 99 – 3304, 1999, and Slavo Radosevic, *The emerging industrial architecture of the wider Europe: Conceptual and empirical issues for research*, School of Slavonic and East European Studies, University College, London, 2000 (draft of paper prepared within the project 'The emerging industrial architecture of the wider Europe: the co-evolution of political and economic structures', ESRC programme 'One Europe or Several?').

with the Italian market share growing recently). The large market share of German equipment producers is due to a large extent to the large share of Germans in the ownership of Polish firms in the industry. A typical pattern has been for German investors to supply used German machines as part of their capital investment during the initial period of furniture company operation; only after a period of 2-3 years have these German-invested firms begun to introduce new technologies into their production process. Apart from this, far and away the most popular instrument for financing equipment acquisition is leasing. According to the director, all but the smallest producers lease new equipment (the smallest preferring to buy used equipment, as they can seldom afford to do otherwise).

C. Case Studies. (1) *PPH Spar-Meble*, Civil-Law Company. Located in Chojnice, in the Wielkopolska voivodeship. A family company, it was founded in 1991 and employs 60 people. Its main production specialization (90% of production) is in kitchen furniture, including shelves, counters, kitchen tables, bars, and other household equipment. Additional production includes bedrooms, sitting rooms, and book-shelves. The company uses pine and oak in its production process and operates a full production line, beginning with warehousing and wood drying, through production, and ending with sales and design. The domestic market dominates in sales, though in previous years the company had significant sales to customers in Russia and the Ukraine.

Spar-Meble at the time of start-up financed the purchase of a set of Italian machines by taking out a \$50,000 hard currency commercial loan. These machines, while of somewhat lower quality than German machines, were significantly less expensive. Additionally, the Italian machine producers, unlike their German counterparts, have a service center located in Poznan (the capital of the Wielkopolska voivodeship). Company management cites strong emphasis on quality as the reason for having purchased only new, non-Polish machinery. Despite this quality emphasis, however, the company has been unable to introduce quality management systems (e.g. ISO 9000), and attributes this to the high cost of such procedures. The company frequently rotates its equipment, now purchasing German as well as Italian machines, and selling its used machinery to smaller Polish companies. Since the time of its initial machinery purchase, the company has financed almost all of its investment out of its own funds, considering leasing as too costly a financing strategy. At the same time, in purchasing production machinery the company looks for suppliers willing to offer favorable terms of payment through, for example, installment payment programs.

(2) Wood Furniture Plant *Stoltrak*. Located in Myszyniec, 70 km from Olsztyn, in northeastern Poland. This is also a family-owned firm; it was founded in 1990 using property and machinery bought from a liquidated state-owned wood processing company. The company currently employs 30 persons and produces furniture from block pine-based plywood. The firm operates a complete production process and sells its products primarily on the Polish market. Previous attempts to export to Denmark failed due to the financial unreliability of the Danish customer.

In marked contrast to Spar-Meble, Stoltrak produces goods of relatively low quality (particularly in comparison with foreign products), due in large part to its ongoing inability to finance the purchase of expensive up-to-date equipment. At the time of start-up the firm's owners purchased used Polish machines from state-owned enterprises in liquidation. This was followed later by the replacement of this used equipment with new(er) Polish equipment, and subsequently with used Western machinery. Presently the firm's machinery is a mix of used and new Polish equipment and used Western equipment. The firm has attempted to buy used Western machinery when possible, because even in comparison with new Polish machinery it is of the same quality but does not lose its value as quickly. The company acquires Western equipment (a mixture of Italian and German) from trade companies which buy the equipment

internationally or from larger Polish manufacturers upgrading their machine park. Stoltrak has financed all its investments from own funds, due to the high cost of both bank loans and leasing.

2.2.2. Plastics and synthetics

A. EXPROM Results. 43 firms participated in the EXPROM study, with employment ranging from about 20 persons to over 200. Among the goods produced by the firms in this group are: household appliances, construction materials such as piping, cables, packaging (bottles, bags), and other containers. Labor costs per employee are 10 times lower than in the EU, but value added per employee is also 6 times lower, and turnover per employee is 5.2 times lower. R&D employees as a percentage of total employment was 3.7 times lower. Firms in the sector suffer from a competitive disadvantage due to industry associations' relative weakness in gathering market data. In general, the level of marketing and promotion activity among firms in the sector is low compared to their EU counterparts. Program administrators say that the largest firms in the group have generally satisfied their technological needs to the greatest extent and tend to be the most prosperous firms in the group. They added that, as in the case of the wooden furniture industry, most production equipment seems to be second-hand (generally acquired in Germany), but there are a few cases in which new equipment has been purchased (here, too, it seems to be predominantly Italian).

B. Associations and Institutes. There is an industry R&D institute (the Industrial Chemistry Research Institute – *Instytut Chemii Przemysłowej*) and an industry association (the Polish Association of Plastic and Synthetic Goods Producers – *Polskie Stowarzyszenie Przetwórców Tworzyw Sztucznych*). The scale of ICRI activities on behalf of small businesses is very limited, consisting primarily of quality control, standardization, chemical analyses, and hazard and operability studies and analysis on commission; the ICRI also presents products and what it calls “small and medium technologies” at between 15-20 trade shows a year. For the most part, however, the institute, with 300 employees, focuses its technological research and development efforts on large-scale, primarily Polish state-sector clients, oriented to raw materials rather than final products. According to institute experts, this is due largely to the fact that small businesses in the industry show little interest in acquiring new technology, due to their limited ability to finance such purchases either independently or through bank financing

The Plastics Association, which was founded in 1992, has 88 members. While this is only a fraction of the 4500-6000 firms operating at present in the highly fragmented sector (the large majority of the firms employ up to 5 workers), these 88 members represent 30% of national plastics and synthetics production due to the inclusion of several of the dominant raw materials producers in the country. Association experts assert that the technological level of firms varies substantially by type of production. In the packing materials segment (amounting to 40% of the sector's output) a thorough replacement of productive assets has occurred, and product lines have been completely transformed through purchase of machinery and product recipes from Western partners. The sector also purchases some Polish-made packing machines, which are typically of medium quality in comparison with the German and Italian machinery discussed in the previous paragraph, but relatively easily financed through attractive installment arrangements offered by the machine producers. The acquisition of new machinery in this segment has occurred primarily through leasing and installment payment plans, while new product recipes are acquired from the industry R&D institutes. More generally, according to Association experts, the plastics and synthetics sector has, as indicated

in the data from the table discussed earlier, experienced dramatic expansion in the 1990s (fueled primarily by domestic demand, rather than export).

C. Case Study. Bahpol Ltd. Located in Klobuck near Czestochowa, this family firm was founded in 1992 and currently employs 90 workers. Its main product is plastic wrapping materials produced primarily for the domestic market. The company's primary customers include small firms, although it has more recently gained significant clients amongst medium-sized and larger manufacturers of baked goods and noodles. Additionally, the company has also recently moved into the Baltic states with its products, with this trade recently accounting for 10-15% of total production.

The firm consistently invests 75-80% of its profits. At the time of start-up, company management purchased, using own funds, a set of Taiwanese machines for production of plastic foil (extruder, printer, and plastic welder). Such machines employ a more primitive technology than German or Italian machines, but are also much cheaper. The company has now considerably enlarged its production capacities, not only purchasing additional Taiwanese equipment, but also a new German microperforator and several used German and Italian plastic welders. This equipment has been purchased through a combination of outright purchases using own funds and leasing. Management is interested in continuing to upgrade its equipment, and sees particular needs in the area of mono-oriented plastic foil production equipment.

According to Bahpol's managing director, the Italians have shown particular interest and creativity in working with Polish producers. They have accepted longer than usual payment deadlines in cooperation with Poles and have also entered into leasing arrangements involving Polish bank guarantees and Italian leasing firms with which the Italian equipment producers have good working relationships and who are therefore willing to offer competitive interest rates on the leases. More generally, the company managing director is quite knowledgeable about the sector as a result of an additional activity, complementary to manufacturing, in which the company was engaged earlier: acting as a sales and service representative of Taiwanese producers of plastic foil in the period 1993-96, when the firm assisted in the sale of 30 extruders and 50 plastic welders.

2.2.3. Medical equipment

A. EXPROM Results. There are 10 firms participating in EXPROM from this industry. Much of the equipment produced is measuring equipment of various kinds. According to program administrators, firms in this industry import first-rate electronic production equipment; their needs are often in such areas as catheters (e.g., for the heart) and production of plastic parts (e.g., plastic bags for blood). The general pattern in the industry is purchase of components abroad and assembly in Poland. Reflecting data from the table presented earlier, numerically controlled production equipment is not necessary, while software is used in the equipment itself and not in its assembly. Moreover, the software used is of Polish origin, and this is where Polish technological innovation occurs in this sector. Production lines are generally very short, and, generally speaking, the firms in the industry are very small (this is reflected in the table – employment in the industry is significantly smaller than in the other two). The program administrators added that access to knowledge about technology in this industry is greater than in the other two: regular participation in trade fairs keeps managers aware of the most recent innovations in the industry's technology, and they follow such trends more intensively, as a general rule, than managers from the other two industries. Labor costs per employee are 17 times lower and sales profitability 3.5 times higher than in the EU, but value added per employee is also 7.5 times lower, and turnover per employee is 7 times lower. R&D

employees as a percentage of total employment was almost 3 times lower, and the average age of machines was 2.9 times higher.

B. Association. There is an industry association, Polfarmed, grouping both firms in the pharmaceuticals industry and the medical equipment industry. The general activities of Polfarmed are oriented towards domestic firms, and not international companies. Its membership, according to the association's president, includes 50 large firms, and in particular all of the large domestic medical equipment companies, as well as numerous small and medium entities, which together total 160 companies. Polfarmed's primary activities are oriented towards providing its members with information concerning the national and international legal and institutional environment, seminars, conferences, trade fairs, and general market trends. The association's president claims that Polish production is technologically on a par with world standards and notes that the production of the firms is custom-made to the specific demands of individual clients and, correspondingly, that almost all production occurs in short series. Most firms are assemblers of components produced outside of Poland and imported by them to the country. The sector services primarily the domestic market, with only 5% of production going for export.

The health system reform begun in 1999 seems to be creating problems for companies in the sector, which are strongly dependent on the system of public procurements of equipment, which has been thrown into turmoil due to increasing financial pressures placed on public health institutions. At the same time, the Polfarmed president claims, Polish firms face a large number of difficult obstacles to competitiveness which result from an excessively liberal national and international economic environment (e.g., a 0% tariff on the import of medical equipment to Poland). This has negative effects on the viability of domestic production, as the primary competition of national firms is with goods imported by international companies and not produced in-country. There has been very little foreign investment in production capacity in the sector. The Polfarmed president claims that foreign companies frequently sell their products at dumping prices in Poland, and that Polish companies have an extremely difficult time gaining certification of their products in the European Union, despite their high quality, due both to the costs of such certification and to the negative predisposition of officials in Western Europe.

C. Case Study. *Ascor, j.s.c.* This company founded in 1993 by a group of individual small investors as a limited liability company. Initial start-up capital was financed through a high-interest loan provided by the small investors, due to the unwillingness of banks to provide start-up funding. In 1999 the company was transformed into a joint stock company with the arrival of a new minority investor, a domestic distributor of medical equipment. Currently the company has 50 employees. Its main product is infusion pumps, and it operates a full production process beginning with design, extending through production to sales. The company sells its products primarily on the domestic market, and its primary clients are hospitals; most production is purchased by way of public procurement. The company also has a minor level of exports, in particular to India, the Middle East, the Far East, Hungary, Romania, and Russia; due to problems with acquiring the necessary certification, it has been unable to enter the Western European market.

According to its president, the firm's motto is innovativeness, which is a necessity for all companies operating in the sector due to the competitive pressure being brought to bear on them by Western manufacturers. The company designs its own pumps, with the main input into these designs being the development of computer programs for production. Only Polish computer programmers and IT experts are employed in the firm, and this programming know-how is the firm's strongest point. Actual production is assembly-based and practically all

components of the pump are imported, as domestic production is of insufficient quality to guarantee product competitiveness and the company, in contrast to many of the foreign producers with which it competes, is too small to produce its own components. Electrical equipment for production is also imported (from Taiwan). The infusion pump is continually upgraded to maintain its competitiveness and presently the company is producing the 17th version of the pump. When the company began operation in 1993, there was one other Polish infusion pump manufacturer, whose production quality was quite low (though since then it has improved substantially). Ascor struggled for 4-5 years to break through the lack of trust of clients (hospitals) in the quality of Polish production, and today its products are seen as being of equal quality to those produced in the West. The company's president claims that at present, Ascor is the leader in the Polish infusion pump market, having increased sales by 100% from 1993 to 1998. Its activity has led to a dramatic drop in the share of imported pumps in the market, causing, on the one hand, the exit of two international firms (one of which, an American company, attempted a takeover of Ascor) from the Polish market, and, on the other, marked reductions in the price of pumps by the other international firms. Additionally, the company has recently introduced the ISO 9000 quality management system into its operations and plans to acquire the CE certification required by the European Union. The company president has ambitions for this certification to enable Ascor to place 50% of its sales in the European Union in coming years.

Finally, Ascor most recently has also begun to diversify its activities, purchasing a license to technology for the early detection of skin cancer from scientists in Torun, Poland (as part of the agreement, these inventors receive a share of product sales). The company's president expresses the view that there will be high demand for equipment produced on the basis of this technology, both domestically and internationally. Presently, the company is engaged in discussions with a venture capital fund over financing the implementation of this technology.

2.3. Conclusions

Table 3 sums up the preceding material, identifying a set of primary dimensions and characterizing them for each industry. This table illustrates in basic form the primary distinctions amongst the industries. Recent years have seen the industries' development go in different directions. Wood furniture has in the last couple of years leveled out in terms of sales and employment; plastics continues to grow at a dynamic rate; and the previous dynamic growth of sales in medical equipment has been significantly curtailed since 1998. Wood furniture has the largest degree of involvement of both foreign investors and exports, in comparison with the other two industries, which have limited degrees of both. They base sales primarily on the domestic market, with plastics serving primarily private consumers and medical equipment serving primarily public institutions. Investors are primarily domestic in both, with large state-owned and privatized enterprises frequently motivating plastics production, and small entrepreneurs and innovators starting up medical equipment companies.

Technological levels (and origins) are also quite divergent between the industries. Larger, foreign-owned furniture companies generally have reasonably high levels; small domestic firms, on the other hand, are generally underinvested, with low technological capabilities. Plastics companies' technological levels with respect to the specialization of the individual company. Medical equipment companies are primarily assemblers, with the result that their capital equipment is of a sophisticated (e.g. sensitive measuring equipment) but of a small-scale, technically limited nature. More important in medical equipment is the quality of

Table 3. Industry summary

	Wooden Furniture	Plastics and Synthetics	Medical Equipment
<i>Primary Industry Traits</i>	-Recent slowdown -High export levels -High foreign investment levels -Polish raw materials	-Dynamic expansion -Low export levels -Low foreign investment levels -50/50 Polish/foreign raw materials	-Current slowdown (due partly to health system reforms) -Low export levels -Low foreign investment levels -App. 100% subcomponent import levels -High import competition
<i>Technological Level</i>	-Medium -Dependent on strategies of foreign investors -Low in domestic firms	-Highly variant, by market segment low to high -Larger firms more advanced than small	-High (but based in industry know-how, not capital equipment) -Firms primarily assemblers and programmers
<i>Origin of Technology</i>	-German (used and new) -Italian (new, more recently) -Polish, used (small firms) -Polish, but only preliminary wood preparation (5% of market)	-German and Italian (used and new) -Polish (new, e.g. packing machines) -Diverse origins of new product recipes (domestic, European, and U.S.)	-All components imported: EU, US, and Far East -Polish (software development)
<i>Sources of Finance</i>	-Own Funds -In-kind equipment supply by foreign owner -Leasing	-Own Funds -Leasing	-Own Funds
<i>Organizational Dynamics</i>	-High fragmentation of industry -Consolidation/exit expected	-Wide scope of firms, small to large	-Small firms -Consolidation expected

know-how embodied in companies' human resources; these companies are "software" intensive, with important roles being played by IT experts and medical researchers. This contrasts, in turn, with the quality of know-how embodied in the other two industries: furniture companies by and large have know-how imported, with the consequence that domestic design capabilities have contracted; plastics companies have higher levels of know-how than furniture companies, but this finds its outlet primarily in the imitation and adaptation activities necessary to assimilate foreign product recipes into local production and market conditions.

Furniture and plastics firms obtain production technologies primarily from German and Italian machine tool producers, to roughly equivalent degrees. However, while Polish machine production plays a minimal role in the furniture industry, it is more significant in the plastics and synthetics industry. In medical equipment, due to domestic design capacities, Polish engineering plays the most significant role, though within the bounds identified in the previous paragraph. At the same time, all subcomponents of final products of medical equipment firms are imported. The purchase of new equipment is financed primarily from own resources; when outside financing is employed, it usually comes in the form of leasing. The furniture industry, additionally, also obtains new technology via foreign investors, who frequently have supplied companies with used and new Western technologies as part of their initial and subsequent capital investments. In medical equipment, own funds play the primary financing role, though financing appears to be less important than the generation of a viable start-up idea; at the same time, medical companies have extremely limited expansion

capacities, due to the high financial demands of moving beyond assembly-based production in the industry.

One common denominator here is that in all three industries, the industry associations' membership is drawn predominantly from among the largest firms in their respective industries. This means that the associations are unlikely candidates for providers of institutional support for development of SMEs in their respective industries. Polish experience indicates that local governments are often more effective organizers of local institutional support for small businesses.⁶

A further common element in the industry analyses prepared for the EXPROM II program is the observation that in addition to the transfer of specific technologies to Polish firms, the latter would benefit greatly from a transfer of know-how in the areas of quality management and supply management.

Given the above, the final question emerges: What are the consequences of these distinctions for processes of technology transfer to SMEs in these three industries? In the following, we seek to identify technology transfer potentials in each of the industries. While it is impossible to specify precisely the nature of industry technology needs (as these differ from firm to firm), a number of recommendations can be made here, by industry.

Wood Furniture. The competitive position of Polish small businesses in this industry will depend in the medium term on their ability increase value added in production. Results from the EXPROM study suggest that industry SMEs possess a resource of craft-based know-how which could be tapped for this purpose. One possible means of mining this know-how is enhanced interfirm cooperation. We noted the extensive fragmentation of the industry and the endemic lack of cooperation among its firms. But it is clear that these firms face a clear alternative: either they will begin cooperation or many of them will disappear in a process of consolidation, swallowed up by the largest, foreign-owned firms in the industry. What forms of cooperation could help them enhance their competitiveness, simultaneously providing interesting opportunities for foreign partners? It seems that groups of "networks" or "clusters" – planned and negotiated alliances of sets of firms – which could be supported by foreign partners/investors acting as network "organizers" would be ideal for raising the competitiveness of industry SMEs (for example, by employing various methods for sharing various costs – e.g., marketing and promotion, purchasing, but also technologically relevant factors such as design and quality testing). As noted above, industry R&D institutes in Poland generally have failed to reach out to SMEs, and the industry associations' interests appear to lie in the servicing of larger firms rather than SMEs. For these reasons other actors are likely to prove better motivated and able to provide the local knowledge of firms' capabilities necessary to develop such cooperation. Local authorities in areas with concentrations of small businesses in the wood furniture industry might prove to be good candidates for such a role, possibly working together with firms like PPH Spar-Meble, which has gained extensive knowledge of the furniture producers' market through its production machine sales efforts and could act as an advisor to external investors in selecting possible network participants.

Plastics and Synthetics. In contrast to furniture, the possibilities for technology transfer in plastics and synthetics seem more varied and realizable. Foreign investment and export have been more limited in this industry, meaning there is a wider range of possible investment and market opportunities. Moreover, given the greater diversity (in products, technology, size, know-how, etc.) of firms in the industry, the possibility for interfirm cooperation as a basis for technology transfer (with the involvement of foreign firms as either strategic investors or suppliers of technology) in plastics would seem to be greater. First, this diversity means that there is greater likelihood of identifying technological and organizational

⁶ For examples, see the case studies in Grzegorz Gorzelak et al., *Dynamics and Factors of Local Success in Poland*, Warsaw, 1999.

interdependencies which could become the basis of cooperation; production chains, management structures, and financial systems might be more easily integrated without, at the same time, enterprises being threatened with a loss of autonomy, as their production specialization would constitute the basis for their continued productive autonomy. Second, diversity, particularly in terms of size and market power, might make particular Polish firms natural candidates as market organizers through, for example, the creation of diversified holding organizations or strategic alliances carrying on particular strategic activities (finance, marketing, investment) jointly. Here again industry associations, whose attentions are focused primarily on the problems larger enterprises originating in the state sector, seem unlikely candidates to play this central role.

Additionally, it appears that in plastics and synthetics, in contrast to wood furniture, there is greater space to employ both leasing and licensing arrangements in supplying production and product technologies. First, as noted in the case of Bahpol, Italian machinery suppliers have begun to employ more flexible leasing strategies, in partnership with Polish companies, Polish banks, and Italian leasing agencies. This practice could likely be expanded to good effect. Second, licensing of product technologies would seem to be viable in Polish plastics, given the retention of considerable know-how in Polish companies coupled with the continued absence of certain products and materials common in the West. Here, licensing of more advanced technologies, whose implementation would likely resemble more actual innovation than imitation processes, seems to be the next logical step. Moreover, licensing of actual production technologies to Polish plastics machinery producers would seem also a viable business strategy, given the fact that domestic producers have been able to maintain a share of numerous sub-segments of the market. This could also be a stimulus for the broader regeneration of the plastics industry.

Medical Equipment. This highly specialized industry is simultaneously a more and less favorable target than the previous two, more mass production oriented, industries. On the one hand, the level of know-how embodied in firms is higher than in either of the other two industries. This enables technology transfer processes to occur more smoothly and at a higher level of sophistication. On the other hand, firms have very limited actual production capacities – being limited largely to assembly activities – and face increasingly difficult demand constraints, given developments in the health care system. This means that production facilities of more elaborate equipment are difficult to establish in-country and that highly specialized equipment may be also difficult to produce, given the limited adaptations which will be able to be made on imported sub-components. For these reasons, technology transfer is at once more risky but potentially more profitable in the medical equipment industry.

A number of possibilities emerge. The existence of cheap specialist labor in-country might make Poland an excellent base for establishing export-oriented production facilities. Second, of all three industries of the report, medical equipment is the one most clearly suited to the involvement of foreign venture capital finance. It is in this industry where the most original domestic technological ideas and innovations are arising and where the expertise is available to quickly implement ideas. Moreover, firms are small and uncomplicated organizationally, which makes quick (re)organization and growth more feasible. Finally, it should be noted that given the highly proprietary nature of technology transfer and innovation in the industry, as well as small firm size and productive scope, this industry, at least at present, is not likely to be one where interfirm cooperation is a useful vehicle for technology transfer, and that more individual approaches, which are much easier to implement, are therefore much more likely to be promising.

3. Programs supporting technology transfer to Polish SMEs

As mentioned above, the native Polish R&D sector has to date shown little interest in cooperation with Polish SMEs. It is, therefore, likely that in the near to medium term they will find the cultivation of foreign business contacts to be more fruitful in their attempts to increase competitiveness via upgrading their production technology. In the remainder of this paper, we describe briefly a number of programs financed by the Government of Poland, the United States, the European Union and the United Nations which could be utilized in matching foreign partners with Polish SMEs for technology transfer purposes. We also provide some indications of how certain of these programs might be used to pursue opportunities identified in the previous section for the three specific industries discussed there.

Before turning to these programs, we would like to note the “good news” that imports to Poland of high technology are freed from the Value Added Tax in cases where there is no equivalent Polish product. On the other hand, there is also the “bad news” that Polish export promotion is at present insufficiently geared toward the needs of SMEs. Thus, for example, KUKI – the Polish Export Loan Insurance Corporation – insures bank loans for contracts which must be worth at least \$1 million.

The Technology Agency (Agencja Techniki i Technologii), a Polish state agency, holds two yearly competitions for financing technology transfer (including innovation at the design or implementation level, or purchase of machines or licenses) to Polish business. It is important to note that the technology in question can be of Polish or foreign origin. Financial aid includes low-interest loans (up to 1 million PLN for a maximum of 40% of the project cost at 50% of the National Bank of Poland’s Lombard rate), interest subsidies, and guarantees.

The European Commission’s 5th Framework Program (5FP), adopted in December 1998, defines the European Community’s activities in the field of research, technological development, and demonstration (RTD) for the period through 2002. Within 5FP there are three horizontal programs, of which the second is relevant to our concerns. This program is devoted to the “promotion of innovation and encouragement of participation of SMEs.”⁷ There are two sub-programs which are of particular interest for Polish SMEs interested in technology transfer from foreign partners:

- **SME cooperative research (CRAFT) projects.** These enable at least three mutually independent SMEs from at least two member states or one member state and an associated state (such as Poland) to cooperate with an R&D institute in an associated or member state. In these projects, SMEs are the principal contractors, with the R&D institutes acting as subcontractors. Projects may cost from 0.3 to 2 million EURO and last from one to two years. EU co-financing covers up to 50% of the costs. Proposals may be submitted until 17 April, 2002.
- **SME Exploratory Awards.** These awards co-finance up to 75% of total eligible costs for the exploratory phase of a project (lasting up to 12 months), with activities including feasibility studies, market research, and partner search. As in the case of CRAFT projects, SMEs are the principal contractors. The chief

⁷ For the purposes of these programs, SMEs are formally defined as having under 250 employees, under 40 million EURO in annual turnover and a year-end balance of under 27 million EURO. Additionally, not more than 25% of the shares can be held by any entity exceeding the above limits (with the exception of financial institutions such as banks and investment funds).

purpose of such awards is to prepare firms for CRAFT projects. Applications may be submitted until 18 April, 2001.

Other European Union programs of interest are RIS (Regional Innovation Strategies) and RITTS (Regional Innovation and Technology Transfer Strategies), programs which co-finance up to 50% of costs of 350,000-500,000 Euro projects for analyzing regional innovation resources and strategies for their effective organization and cooperation. Such projects do not involve SMEs directly, but rather support public authorities interested in building regional competitiveness. They could, therefore, be used to promote technology transfer to SMEs from a given industry geographical areas in which there is a high concentration of such firms. As we mentioned in our discussion of wood furniture firms, there could be interesting possibilities for organizing clusters of SMEs in this industry around foreign partnerships providing new technology.

Finally, we should mention the Innovation Relay Centre program, designed to create a network of institutions furthering a number of innovation-related goals, including technology transfer. It is not clear how this program will evolve in the future, but those interested in the issue of technology transfer to Polish SMEs should follow its fate closely.

The Global Technology Network (GTN), financed by the U.S. Agency for International Development (USAID), facilitates transfer of U.S. technology and services by matching U.S. firms and businesses from developing and middle-income countries in a number of selected industries, including health technology. U.S. firms pursuing GTN trade leads, as well as developing and middle-income country businesses seeking U.S. partners, can apply to the Office of Business Development for small matching grants for activities such as marketing surveys and travel, limited to 50% of total project cost and not exceeding \$15,000. GTN operates Technology Assistance Centers, which are targeted especially at SMEs. Because one of its foci is in health technology, GTN should be of particular interest for the SMEs in the medical equipment industry.

The United Nations Industrial Development Organization (UNIDO) offers comprehensive services ranging from advice and counsel, to providing engineers for projects, to transferring appropriate technology from one country to another. UNIDO's Investment and Technology Promotion Office (ITPO) in Warsaw offers extensive management training, organizes Investment and Technology Promotion Forums, and matches Polish firms with foreign partners. With respect to the latter service, besides bringing partners together, ITPO aids in, for example, preparation of business plans and search for project financing. UNIDO also disseminates a number of software programs which can be used in investment project analysis.