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EUROPEAN TECHNOLOGY TRANSFER IN ACCESSION COUNTRIES – CASE STUDY FROM WEST POLAND

BERENIKA M. MARCINIEC (IRC Project Manager)
JACEK GULINSKI (Deputy Director of Poznan Science & Technology Park)

POZNAN SCIENCE & TECHNOLOGY PARK OF ADAM MICKIEWICZ UNIVERSITY FOUNDATION
Rubiez 46, 61-612 Poznan
Poland
Tel.: +48-61 827 9746 • Fax: +48-61 827 9741
E-mail: bm@ppnt.poznan.pl
Internet: http://www.ppnt.poznan.pl

ABSTRACT

The effective transfer of innovations and technologies poses a strategic challenge for the economies of Central and Eastern Europe. The ongoing economic and scientific integration, coupled with the necessity for accelerated growth of small and medium-sized companies on the continent, makes it necessary to engage in international scientific cooperation as well as innovation and technology transfer across borders. The mission of Polish organizations that offer the technology transfer services in these countries is to strengthen the competitiveness of local enterprises through international technology transfer and to be a force driving an active technology and innovation policy in support of the regional growth of industry.

INTRODUCTION

"Eagles should be able to hatch even from cuckoo's eggs"
Stanislaw Jerzy Lec

The development of modern nations and knowledge-based economies hinges on the variety of innovative technological designs available worldwide. To the eyes of a lay person, this development is visible in a new type of telephone available at a store, a smaller and more efficient vacuum cleaner or a more streamlined model of motor car. When buying such products or replacing old ones with new ones, average consumers may frequently, without realizing it, witness the development of a new technology or a new design concept. While to the latter such items are sources of joy and promises of a better future, the happiness that they bring to their designers or developing scientists is immeasurably greater.

Innovation, or technological change (progress), is a fundamental requirement that a corporation must fulfill in order to survive on the market and be successful. The rate and extent of the changes in this environment prove that if a corporation fails to adapt, it will perish. The practical means of corporate adaptation and survival is innovation, which some businesses may implement more effectively than others. While survival is obviously neither compulsory nor officially required, it may interest a corporate market player that out of the 500 top corporations listed by the *Fortune* magazine in 1975, more than a third had disappeared from the market by 1985. A smaller business finds it much more difficult to change. In short, innovation is a necessity.

The evolution of a corporation's manufacturing processes need not amount to giant leaps or consist in revolutionary new concepts. Usually it occurs stepwise, as a succession of small and cumulating improvements. Thus, e.g., although the invention of the electric light bulb was a scientific breakthrough, it was only a series of minor improvements in its design and manufacturing processes that brought its prices down by more than 80% between the years 1880 and 1896. To quote an example from a more recent period, the rapid expansion and spectacular achievements of the Japanese automotive industry resulted mainly from a forty years' program of ongoing systematic improvement of the designs of the products and of processes.

Even if, as we have stated, civilizational quantum leaps are not an absolute prerequisite, technological requirements which entail the implementation of innovation and the modernization of manufacturing processes, are highly desirable. Still, not all corporations are aware of such requirements. Those that are and that may be called "pro-innovative," frequently value very highly scientists' new ideas and state-of-the-art manufacturing concepts. This is because such corporations realize that without ample scientific and research-and-development facilities all innovation would lose its *raison d'être*.

Innovation is what transports us from prehistory to a modern knowledge-based economy. When innovation is practically implemented, the advantages are even greater. The transfer of technology from science to the practical realm is the process determining the rate of the civilizational progress of modern economies. In fact, "technology transfer is the process by which technology, knowledge, and/or information developed in one organization, in one area, or for one purpose is applied and utilized in another organization, in another area, or for another purpose".

CONTENT

The scientific and technological potential of Europe and Poland

In the modern environment of advanced technology, research is clearly the keystone to economic development. Accordingly, the rate of this development is determined by the policies

setting up the patterns of the progress of science and manufacturing technology. Scientists and engineers are turning into full-fledged capitalists as science and technology are evolving into increasingly vital components of the manufacturing processes, rivaling the labor force and the capital in their significance.

The innovativeness of science stimulates the economic development and, conversely, an innovative economy stimulates scientific progress. Convincing evidence that science and economy evolve in highly interdependent manners in the well-developed nations, is provided by various aspects of the relations between the two. In practice, however, the rapid expansion of Poland's economy during the last decade and the fact that the rate of the growth of the nation's Gross National Product (GNP) is among the highest ones worldwide, while making it aspire to attain the level of social-and-economic development represented by the member states of the European Union, unfortunately are not paralleled by an adequate increase of the funds assigned to scientific activity.

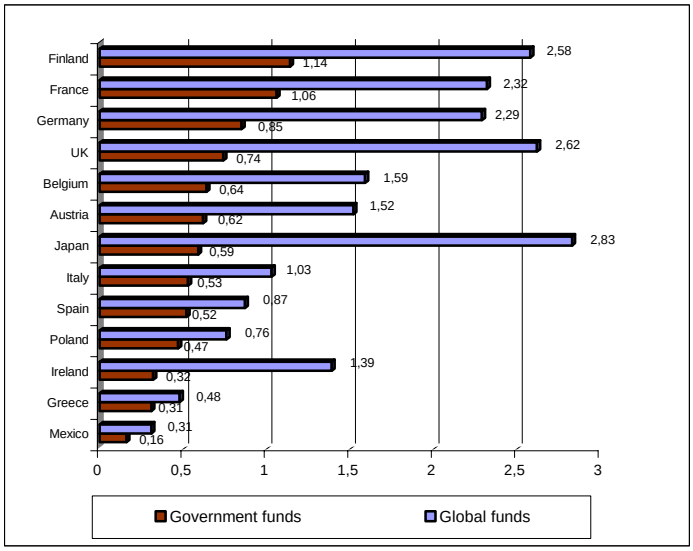
The index of the ratio of the Global Expenditure on Research and Development (GERD) to the Gross National Product (GNP) amounted in Poland to 1.52 in 1980, 0.96 in 1990 and as little as 0.70 in 1993. It is now slowly improving, having gone up to 0.76 in 1996 and 0.73 in 1998. The value of this index remains in Poland, a nation of a GNP of $7,463, similar to those of nations of higher GNPs, including Hungary ($9,830), Portugal ($14,582) or Spain ($15,985). At the same time, the most disturbing aspect of the funding of R&D activity in Poland is the low involvement of the industry.

When discussing the financing of scientific activity, it is relevant to distinguish between the funds assigned by a nation's government and by other sources. The total amount of the funds assigned in a nation to R&D work must subsequently be broken down into the sources of financing. Fig. 1 below lists the funds assigned to this purpose in selected nations worldwide, specifying government financing as a separate component.

By specifying the share of government funds in the Global Expenditure on Research and Development, the percentage financed by non-governmental sources may be easily calculated, as a transparent measure of the innovativeness of the nation's economy. The amounts of the funds assigned by the governments of the discussed nations are fairly similar. Obviously, one must not validly compare the value for Mexico with that for Finland, but these differences are not as striking as those between the amounts of the Global Expenditure on R&D. Under this respect, such nations as Greece, Mexico, Poland, Spain or Italy, where most financing of R&D work derives from governmental sources, are in a highly disadvantageous position in comparison with, e.g., Japan, where the amount of the governmental funding of scientific activity is roughly the same as in the former nations, but the Global Expenditure is several times higher.

In comparison with the averagely developed member states of the EU, not only is the financing of R&D work in Poland by public sources conspicuously low (the assigned amount was reduced from 1% of the GNP in 1989 to 0.42% in 2000), but the non-governmental sources (corporations) remain alarmingly inactive in this matter (their estimated contribution amounting to 0.2–0.3% of the GNP), which in fact is typical of a developing nation.

Figure 1
Governmental funds and global funds on R&D (as % of GDP in 1997)



Source: *Stan nauki w Polsce*, (1999), red. Wanke-Jakubowska, M., Wanke-Jerie, M., Komitet Badań Naukowych, Warszawa, Poland

The Global Expenditure on R&D in the years 1994–1998 may be broken down into the funds allotted by the government (as much as 59.1%), companies and corporations (26.9%), research units of the Polish Academy of Science (*Polska Akademia Nauk*, PAN) and other R&D units (10.5%), foreign organizations and institutions (1.5%) and other sources (app. 2%). In most OECD member states during the same period, the average share of the government funds in the Global Expenditure on R&D was app. 30% (18.7% in Japan, 20.3% in Korea and 22.6% in Ireland).

The general opinion is that the existing economic tools of the state's pro-innovative policy do not provide sufficient incentives for a desirable behavior of the parties effecting the transfer of technology from science to the practical realm. The mere publication of the results of essential research is still valued higher than their practical implementation. Polish science has been traditionally ranking fairly high in the worldwide statistics (where it took 21st place in 1998), but its innovativeness, measured by the number of patent applications and of patents issued, has been extremely low: in 1997, the total number of patent applications per 100,000 citizens was 9, while in the Czech Republic it amounted to 16, in Germany, to 331, and in Sweden, to 994.

Scientific – technological policy in Poland

There are several factories concerning ideas of a scientific – technological policy in Poland and other central and East Europe:

- A relic of the centralized system of socialist economy is its organization of science based on a inefficient linear model of innovation. Basic, applied research, applied developmental works and industrial production were performed in institutionalized isolation apart from one another.
- A fundamental characteristic of the R&D sector (another relic of centralized management) is its control by designed state departments to the exclusion of various industrially-based research centers.
- The fundamental flaw in R&D financing, as compared to moderately developed countries of European Union, is not only the low level of global financing from public sources but the exceedingly low extra-budgetary financing.

- The low overall competitiveness of the industry, particularly the low level of modern technology in the total production, as well as a lack of a formulated industrial policy in the course of the last decade.
- The lack of the system for connecting and coordinating science with economic activity

In view of insufficient instruments to encourage firms to financially support R&D we should extend those presently existing and find new forms of pro-innovative policy in Poland particularly through:

- Creation and promotion of a broad range of mainly private innovative centres, venture capital corporations, research and technology parks etc., as well as other institutions dealing with marketing and R&D promotion.
- Offering tax exemptions and concessions for R&D expenditures. Tax incentives could be an especially efficient way to encourage domestic and particularly, foreign based Hi-Tech firms investing in Poland and opening R&D facilities and plants here.
- Stimulating the development of non-profit research institutions by granting them tax-exempt status.
- Establishment or extension of special strategic programs stimulating, e.g. the application and implementation of Polish technology in industry and the promotion of transfer technology purchases to new technologies, introduction on foreign markets etc.
- Provision of special funding for extension of strategic R&D programs directed at given sectors (e.g. mining, constructions or the pharmaceutical industry) through invoice write-offs and targeted funds.
- A multi-faceted promotion of competitiveness (e.g. joint research-development programs) between universities, institutes of the Polish Academy of Sciences, on the one hand, and broadly understood industrial science (research and development works) on he other.

It is also significant to formulate a strategic industrial policy, based on innovation and appropriate regional strategies as well as scientific-technological potential particularly where there is a possibility for educating a given region according to these criteria. Scientific policy should be connected with innovative policies in employment, industry and even foreign trade. A state innovative strategic policy thus understood is also based on the creation of new scientific and technological knowledge, together with its dissemination and practical application.

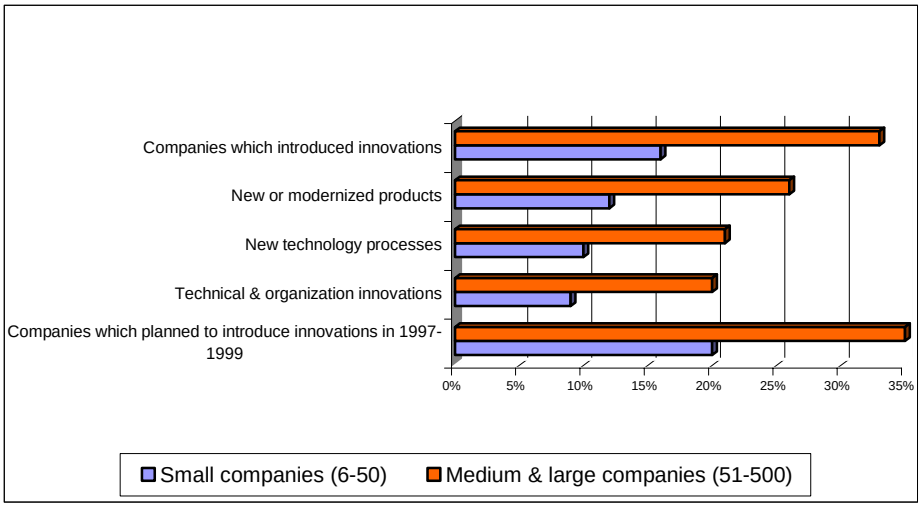
The innovativeness of enterprises in Europe and Poland

The accumulation of wealth by enterprises and the generation of new jobs largely depend on the rate of the corporations' development, which consists in its modernization and the implementation of advanced concepts in its manufacturing processes. This is because by applying new solutions in terms of science and technology as well as the capital and management, an enterprise improves the efficiency of its operation and become a more competitive market player. Most small and medium-sized enterprises (SMEs) are still not very likely to undertake cooperation with a view to developing innovative products.

The Scandinavian nations traditionally turn out to be in the vanguard of innovation. Denmark boasts the highest European percentage of companies involved in innovative cooperation (almost 40%), while the same figure for Sweden is nearly 30%. Ireland (23%) and Finland (close to 20%), which are also Northern countries, rank next. Technological cooperation between enterprises is the least innovative in South European countries, and particularly so in Portugal, Spain and Italy (each scoring app. 4%). The figure for Belgium (8% of corporations involved in innovative activity) is also surprisingly low. The European Union's average value is 12%.

In Poland, almost 38% of the studied sample of enterprises had already implemented innovative solutions in their operations in the years 1994–1998, and another 40% intended to do so (Fig. 2).

Figure 2
Innovation companies in Poland (1994 – 1998)



Source: *Stan nauki i techniki w Polsce*, (1999), red. Wanke-Jakubowska, M., Wanke-Jerie, M., Komitet Badań Naukowych, Warszawa, Poland

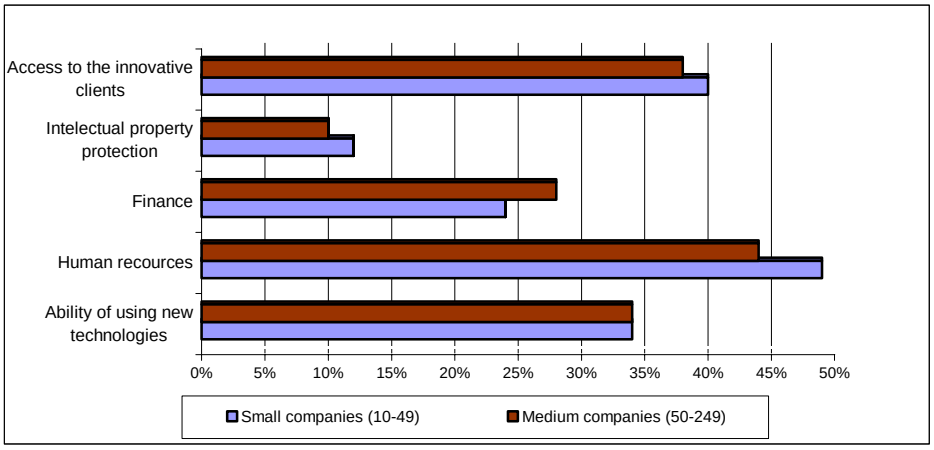
Out of small companies (with an employment of up to 50 persons), only one sixth declared having implemented innovations, and one fifth, intending to do so. In the category of medium-sized and large enterprises (with an employment of 51–500 persons), the result is much better, with every third subject proving to be innovative. This figure becomes somehow less optimistic if we remember that very small businesses, employing up to ten persons, account for more than 90% of the total number of Polish enterprises, and small ones (with an employment of 10–50 persons), for 6.5%.

Although no joint statistics covering both the member states of the European Union and the pre-accession nations, are available, it is evident that the innovation activity of Polish enterprises remains insufficient, even if it has noticeably improved during the last few years. Innovation is often difficult to implement because of technical or administrative problems. While the modernization of the Polish industry, and particularly of the heavy industry, the adaptation of manufacturing processes and legal regulations to the standards of the European Union, and the attaining of the level of development in various areas of activity which is represented by the member states of the EU will continue to be top priorities of the Polish economy for a long time, the resulting difficulties are by no means all the barriers that our enterprises must overcome when implementing innovation.

The barriers to innovation facing European and Polish enterprises

Certain barriers may altogether prevent the implementation of innovation. Studies have shown that such crucial factors include the ability to use new technologies and the unavailability of innovative clients. Fig. 3 below presents statistics on the most significant barriers to innovation.

Figure 3
Two most important causes of stopping the innovation development in an enterprise



Source: *Enterprises in Europe – does size matter?,*(2002), Statistics in Focus, European Communities

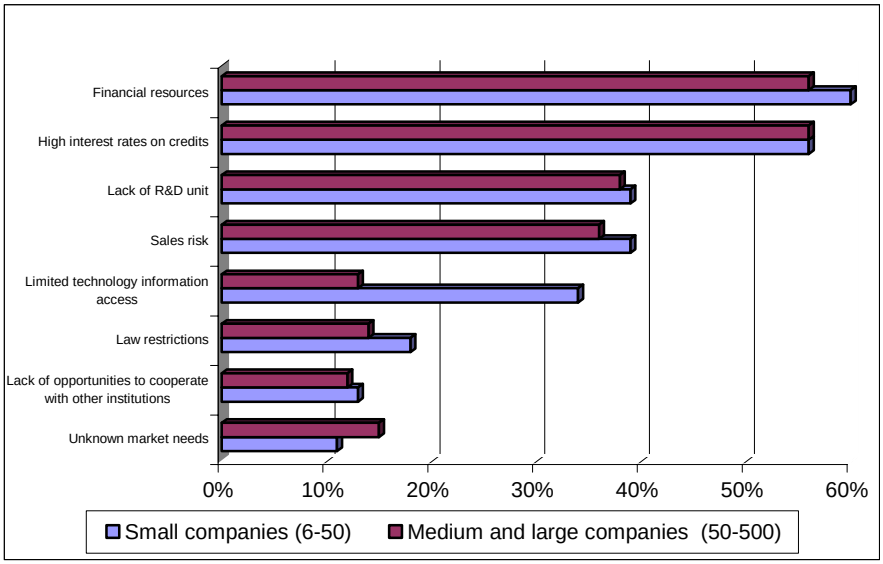
Asked about the factors that impede the development of innovation in their enterprises, European businesspeople most frequently identify human resources (44% of small and as much as 49% of medium-sized enterprises). This is evidence of a lack of skilled staff capable of a competent management of modern technology in an enterprise. It is quite a surprising conclusion, since both the demand for and the supply of highly qualified professionals is great and steadily increases. Another commonly mentioned barrier to the development of innovation is the unavailability of innovative clients. This is also fairly unexpected, in view of the ongoing expansion of communication and information technology and of the high level of information awareness in contemporary societies.

Another factor identified as a barrier to the development of innovation in enterprises is their ability to use state-of-the-art technologies. Apparently, this refers to technical or technological skills, or the physical adaptation of enterprises and any possible other similar factors. The least significant barrier to the development of innovation are the various issues of the protection of intellectual property. Neither do companies consider their financial resources a troubling issue in the matters of innovative activity.

The above statistics on the barriers to innovation refer to the enterprises in the member states of the European Union. While Polish industrial enterprises are also concerned over the difficulties of the implementation of innovation, they mention them in a somehow different order of importance. Polls have established that a number of such impeding factors exist (Fig. 4):

- economic barriers: defined as inadequate funds and excessive interest rates on the available credits and loans;
- market barriers: defined as inadequate knowledge of the demand on the market, and consequently, uncertainty concerning the future demand for a new product;
- research barriers: concerning deficient scientific and R&D activity due to inadequate R&D facilities, insufficient awareness of the new technology among business enterprises, and inadequate cooperation with institutions in such matters;
- legislative barriers: resulting from the provisions of legislative regulations and standards, whose practical application does not stimulate pro-innovative behavior and activity.

Figure 4
The most significant barriers to the implementation of innovation, as identified by Polish corporations



Source: Gulinski, J., Meissner, J., (2000), *Innowacyjnosc i konkurencyjnosc w Wielkopolsce. Diagnoza i program na przyszlosc*, Wydawnictwo Pozanskie, Poznan

As we can see, the hierarchy of the importance of the barriers to the implementation of innovation is somehow different in the case of Polish enterprises. While respondents from the European Union identified human resources and the unavailability of innovative clients as the principal obstacles, in Poland the most worrying issues are insufficient financial resources and excessively high interest rates on the available credits and loans. Less significant factors include inadequate research-and-development facilities and the risk related to the marketing of innovative products, the latter conceivably due to imperfect familiarity with the market situation and insufficient availability of information.

All of the above data and discussions demonstrate that small and medium-sized enterprises in the European Union are trying to be innovative and competitive, and are usually willing to implement new concepts. Polish companies are additionally handicapped by the lack of funds for the purchase of modern production facilities or the upgrading of the existing ones. The fact that both EU and Polish enterprises find it difficult to implement new concepts proves that both groups of companies are to a large degree unprepared for modernization or inadequately managed.

Practical view of European technology transfer

The Innovation Relay Centres Network are set up as independent business and technology consulting organizations. Most of the centres consist of a consortium moderator and various partner units, thus ensuring transparency in organizational structure and easy accessibility through the European network system. Each centre has been selected in an open competition, as the best one in its region. The units range from small independent companies, to departments of local government agencies. This structure ensures that each centre understands and responds to the particular set of economic and industrial conditions prevalent in a region that it serves. The goal of the IRC network is to promote innovation, to encourage the exchange of research results between organizations across Europe, and to provide advice, consulting and training support which meets the specific needs of each company and its local industrial situation. The IRC network is a service for companies, especially for Small and Medium-Sized Enterprises (SMEs), however universities and research institutes may also benefit from its services for transferring their results to industry.

The first priority is to help companies identify technology transfer needs and promote new technological development in the various regions through internal/inward technology transfer. In addition, local industry is assisted in the identification of suitable technologies eligible for transfer to other regions or industries, thus building the basis for outward technology transfer. To do this, the IRCs encourage the circulation of European research results in every local industrial community involved and offer training and consulting services at the request of local companies.

The current IRCs in Central Europe were selected through the European Commission Open Call for Proposals issued in 1999. In order to qualify as an IRC, each organisation or consortium had to meet specific criteria, such as for example: to have an experienced staff with intimate knowledge of the regional industrial needs, with backgrounds in research, business and/or industry, and to have solid technological expertise. All new IRCs were awarded a two-year contract (July 1, 2000 – June 1. 2002), which was extended until March 2004. Then will be announced next Call for Proposals for the further period of IRC Network activity.

The ten IRCs in Central and Eastern Europe are operating under a set of very specific economical and political conditions. Some of those conditions may become determining characteristics as far as the development of new technologies and innovations is concerned. This holds true also for the situation of IRCs in Poland, where one of the positive characteristics is an advanced scientific development and a relatively high level of outlays for innovations. It is also worth emphasizing that SMEs in these countries produce more than 50% of the GDP. On the negative side is a lack of pro-innovation awareness among SMEs, which results in a low level of innovations in industry. That means that the implementation of scientific research results into the economy is also limited. Additionally, there are few strong R&D units and technology transfer institutions in these countries, and the implementation of the science and technology park model is very slow. But the most important obstacle on the way to permanent and effective innovation development in these countries is a very low level of outlays for R&D in their national budgets. That, in short, is the situation that the new IRCs in Eastern Europe have to contend with. In Poland there are three locations of the Innovation Relay Centres Network (IRC East Poland, IRC South Poland and IRC West Poland). Each of these centres consists of one consortium moderator and 1 or 2 partners.

The mission of Polish IRCs is to strengthen the competitiveness of Polish enterprises through international technology transfer and to be a force driving an active technology and innovation policy in support of the regional growth of industry. Their most important goal is to foster awareness of the innovative process and international technological co-operation. The goal is realised through helping local companies in identifying their technological needs and offering them assistance in implementing new technologies in the innovation process.

There appear of course some problems which are the main barriers in our day-to-day activity. There are, for example, gaining new innovative clients and financial problems which are a real tendon of Achilles of majority of Polish enterprises. It catches a possibility for them of financing and implementing new technologies. From the other side the banks don't finance any innovation initiatives as well. The other still existing problem, which touches mainly very small enterprises, is the language barrier and always existing risk of client's resignation during a very far-gone negotiations.

However, besides the hard work, all the efforts and inconveniences, we can find some advantages for our clients, which may make this work more successful. First of all, all the standard services provided by IRC West Poland are free of charge. The centre provides as well assistance in international TT negotiations, technology audits, searching for technology partner and financial sources. Moreover it gives an opportunity to access the R&D projects results in all over Europe and the information about new research projects financed by the European Union.

Poznań Science & Technology Park is the only partner of the consortium moderator - Wrocław Centre of Technology Transfer (TT); the two form one of three new IRCs in Poland – the IRC West Poland. The main activities of the IRC West Poland include consultation and assistance in TT negotiation agreements, technological audits, promotion of technology offers abroad, and TT partner matching. Moreover, the IRC West Poland provides information about technology transfer potential (technology profiles catalogue, informational web-site), and organises specialised events, such as Technology Transfer Days, trade missions, technological fairs, brokerage events, etc.

The best "success story" made by IRC West Poland

These events have proven to be very effective tools in promoting contacts between companies. For proving this there is one "success story", which was realised by IRC West Poland (WCTT) and which is worth to present. A Polish SME came up with a new production method for use in the manufacture of polymer/glass fibre pipes used in sewage systems. They approached the West Poland IRC and, with the help of IRC MEDIA - Sicilia e Calabria in Italy, they found the ideal partner to help the company capitalize on this innovative technology. Continuing IRC support has enabled the two SMEs to take the new technique to the brink of full commercialization.

An SME based in Wroclaw, had the idea of using microwaves as an energy source in this manufacturing process, and had taken the concept some way towards commercialization. Then they realized they needed a partner to see the technology through to the market place, and they came to us for help in finding one. The first step was to carry out a full technology audit. When we were satisfied with their technical credentials, we issued a technology offer on the IRC BBS network. It worked. IRC MEDIA - Sicilia e Calabria came back to us with details of an Italian SME that wanted to replace existing infra-red drying systems, as these generate high-temperature hot spots that can damage the work piece. Microwave curing seemed to offer an answer.

Things moved fast. The request for exchange of addresses and technical information was made by the Italian IRC, IRC West Poland passed through this contact to their client, and the first exchange of technical data - including drawings - took place in June 2001. Then, after three months of correspondence, the first decision about laboratory tests was made and samples of polymers were sent by the Italian SME, VED Spa. After two months of testing in Polish laboratories, it was clear from the samples sent from Italy that positive results could be obtained. The next logical move was for VED technicians to visit Poland and agree on the format of more extensive testing. The test results were positive and the IRC West Poland arranged a further technical meeting. The aim was to enable the two companies to sign a preliminary agreement on more assessment, including industrial-scale trials. In the meantime, the Italian IRC had checked the Polish technology to ensure that its client could implement the techniques. The visit was agreed by both companies, coordinated by the IRCs, and took place in April 2002. The two IRCs were at the disposal of both clients throughout the whole three-day visit, and during the subsequent negotiation phase, which involved several further meetings. Technical experts of both IRCs were on hand to support their clients through these negotiations.

The talks were a success. An agreement was signed by the companies, under which there would be a thorough analysis of the current glass fibre pipe production process, introduction of the new technology, and agreed and verified exclusivity for the Polish company to carry out other industrial installations. Six months after the first agreement was signed, both companies came to the conclusion that, while the technology heralded a way forward, it was not yet totally sound. The question of the effects of high levels of microwaves on machine operatives' health was one area of concern. They have since embarked on the development of a combinative preheating and microwave process that will allay these fears, and a further agreement to share the rights to this new process is close. The technology should soon be implemented in production.

CONCLUSION

Central and Eastern Europe countries are operating under a set of very specific economical and political conditions. Some of those conditions may become determining characteristics as far as the development of new technologies and innovations is concerned. The most important goal of technology transfer services provided in Poland is to foster awareness of the innovative process and the international technological cooperation. The experience coming from the European project – Innovation Relay Centres Network undergoing in Poznan Science and Technology Park has been allowed us to find the ways to facilitate the current situation and enhance involvement of Polish SMEs and R&D sector into the European technology transfer system.

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