9th International Conference on Public Communication of Science and Technology (PCST)
Seoul, South Korea, 17-19 May 2006

INFRASTRUCTURE OF SCIENTIFIC AND TECHNOLOGICAL KNOWLEDGE FLOWS IN SOCIETY: Polish experiences, 1989-2004

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Abstract

In 1990, fundamental politico-economic transformations started in Poland with a primary purpose to introduce the free-market economy into the country. As a legacy after the previous system, there existed – among other things – two separate 'worlds' in the Polish economy: i.e. science and production (in the broad meaning). In the field of science and technology, we inherited: bad communication between science and society, low level of public understanding of science (PUS), weak co-operation between the science sphere and the production sphere, small scale of science commercialisation, practically non-existent infrastructure of scientific and technological knowledge flows in society.

At present, the market reforms are far advanced. So now, the main direction is to build the knowledge-based economy/society. Here, 'knowledge' is obviously understood as a scientific and technological (S&T) one. Achieving this purpose requires a significant intensification of the knowledge flows. There exist two basic sources of this knowledge: (1) a domestic science and technology sector/system, and (2) inflows of S&T knowledge from abroad. Both sources are equally important, however, in my paper I deal mainly with (1).

A broadly developed, well organized and functioning infrastructure of scientific and technological knowledge flows is a basis for the knowledge-based economy or society. However, in the Polish conditions, due to historical occurrences, science-production (S-P) linkages have a crucial role to play in the desired intensification of scientific and technological knowledge flows. Therefore, a special attention must be paid to institutional intermediaries between science and production. I call them 'uttis' (units making up technology transfer infrastructure).

As in other numerous countries, there exist three main types of institutional science-production links: (1) science parks, innovation incubators, technology centres, (2) bridging institutions, and (3) spin-off firms.

A big progress has been achieved in this field during the Polish transformations. Nowadays, we have twelve science parks, three of them in the course of organization; a quite well developed network of bridging institutions, nevertheless, not all of them working properly; and a certain, but not too big, number of spin-offs.

Of course, not only uttis participate in scientific and technological knowledge flows in the Polish society. Also, the other elements of the infrastructure are engaged in such events organized in the country every year as, for example, science festivals, scientific picnics, a national day of science, scientific and technological exhibitions and fairs, etc.

I

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- bad communication between science and society,
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A broadly developed, well organized and functioning infrastructure of scientific and technological knowledge flows (ISTKF) is a basis for the knowledge based economy/society. The infrastructure contains mainly:

- Universities and other higher education institutions (HEIs),
- R&D institutions,
- Science-production intermediaries,
- Mass-media.

Of course, telecommunications and similar networks are necessary, too. They make up a technical infrastructure for the knowledge flows.

The development of the above institutions in Poland - as a country in transition - between 1989 and 2004, is shown in the below table. The Polish R&D sector consists in three sub-sectors: (a) universities and other HEIs, (b) Polish Academy of Sciences' (PAS) research institutes and (c) industrial R&D institutions.

Table. Major elements of infrastructure of scientific and technological knowledge flows in Poland, 1989 and 2004

	1989	2004
Universities and other public HEIs	80	128
Private higher education institutions	Non	over 200
Polish Academy of Sciences' research institutes	81	78
Industrial R&D institutions (public and private)	297	197
Science-production intermediaries	Non	155

Source: GUS (2005) , SOOIPP (2004)

As can be seen, in 1989-2004:

- a number of universities and other higher education institutions increased, mainly because about 30 public HEIs at the bachelor level were established,
- many private HEIs appeared, non-existent in the past,
- a number of PAS's research institutes remained stable,
- a number of industrial R&D institutions decreased because many of small such units merged with each other or just were dissolved, which is a positive phenomenon in the Polish conditions,
- numerous science-production intermediaries were established, practically non-existent before 1990.

Additionally, which is not shown in the table, a sector of mass-media (both traditional and electronic) is now developed very broadly. Also, we have made a big progress in the development of telecommunications and similar networks, especially Internet. For instance, in 2005, about 30% of house-holds and 87% of enterprises had an access to Internet, and there were ca 10 mln internauts, i.e. 25% of the country's population (GUS, 2005).

In result, one can say that infrastructure of scientific and technological knowledge flows in Poland is now quite well developed.

II

In the Polish conditions, due to historical occurrences, science-production (S-P) linkages have a crucial role to play in the desired intensification of scientific and technological knowledge flows. Therefore, a special attention must be paid to institutional intermediaries between science and production. I call them 'uttis' (units making up technology transfer infrastructure). So, uttis are a key component of ISTKF. Their place on the innovation scene is shown in the figure.

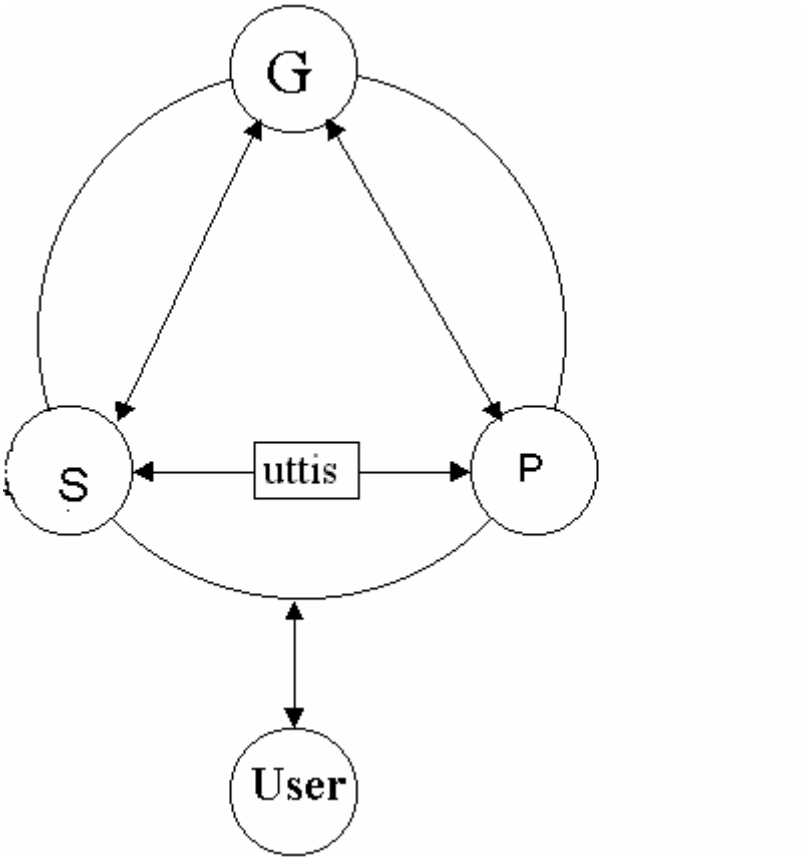
If we treat the innovation scene like a theatre stage, then we will be able to distinguish 'actors' who are in the foreground (science, production and government) and those in the background (uttis). As known, the latter sometimes play a very important role on the stage. Also, here uttis have a significant role to play in the processes of S&T knowledge flows in society[1].

However, the previous political authorities did not 'love' any intermediaries, including science-production go-betweens. Thus, this area of the national economy was underdeveloped and S-P linkages - very poor. In result, flows of S&T knowledge used to be weak in the past.

Institutional science-production links can be divided into three main groups:

(1) science parks, innovation incubators, technology centres,
(2) bridging institutions, and
(3) spin-off firms.

[1] More information on a model of the innovation scene in: Jasinski and Okon-Horodynska (2002). The general inspiration has here been a concept of a Triple Helix (Etzkowitz and Leysedorff, 1995).



Where:
G – government/the state, S – science/the R&D sector, P – production/industry,
uttis – units making up technology transfer infrastructure,
user – usually a consumer.
Figure. A model of the innovation scene as a triangle inscribed into a circle
Source: Jasinski (1999)

At the end of 2004, in Poland there were (Jasinski, 2006):
(1) 91 institutions belonging to the first group, including:
   a) 12 science parks, three of which in the course of organization,
   b) 53 innovation incubators, and
   c) 26 advanced technologies centres,
(2) 64 institutions creating the second group, including:
   a) 29 technology transfer and information centres and
   b) 35 Polish Engineers Association's network of innovation centres,
(3) 600 to 700 spin-offs (an estimate; the precise number is unknown).

Totally 155.

Below, following this classification, several case-studies will be analysed within each of the groups.

III

(1) **Science parks.** A first such institution in Poland was established in 1995. **The Poznan Science and Technology Park** has been formally established as a department of the Adam Mickiewicz University Foundation in Poznan. It is located in the outskirts of the city on a 3.1 ha area which was granted to the Foundation by a local gas-works. After the necessary conversion and maintenance work had been completed, the gas pumping facility was turned into a chemical technology hall. Thus, the post-industrial facilities became the site of the Park's Chemical Synthesis Experimental Station; a section of it was leased to the University's Chemistry Department to house its technological centre. Owing to the renovation, a new unit – New Technologies Incubator – has been established in the premises of the technological hall. The modern facility of

the office building provided space for more Park institutions: the Archaeological Research Centre, the Unimarket Company, and the Innovation Promotion Centre. At present, the Park has 3,000 sq m of high-class office space; 1,700 sq m of warehouse space; a 750 sq m technological hall; a multipurpose hall occupying an area of 680 sq m; some auxiliary buildings; and an old residential facility. The site is the location of the Park's several organisational units, including scientific institutions, and eight tenants, mainly small and medium-sized enterprises with a total staff of 160 people.

(2) As far as **bridging institutions** are concerned, at least five initiatives can be mentioned here.

* In 1996, the Foundation for Polish Science (FNP), a semi-governmental institution, launched an INCOME programme financed by PHARE Sci-Tech. The long-term objective of INCOME was to convince Polish research workers that their achievements can be applied within various branches of the national economy, and to encourage financial institutions to accept the challenge of investing in new high-technology products/processes. Support can be provided for initiatives connected with carrying out advanced technological projects.

Within that programme, some **Technology Transfer Centres** (CTTs) accredited to the Foundation, have been established. The first units approved by the Foundation in 1996 were: CTT affiliated to the Incubator Foundation in Lodz and the Enterprise Development Centre (EDC) at Warsaw University of Technology. (EDC lost the accreditation a year later). In 1997-2000, several new CTTs were established. Their main aim was to seek promising scientific achievements/projects to be assessed, selected by a CTT and then, if approved, implemented using INCOME's financial support. A positive example of such projects, i.e. Biostar Plus, is given below. However, the biggest problem with INCOME has been the lack of sufficient supply of promising market-oriented technological projects. Since financing of INCOME finished in 2000, Technology Transfer Centres must now fully rely on themselves.

* In 1997, a small governmental **Technology Agency (TA)** was established reporting to the Minister of Economy. The main areas of the Agency's activity were:

- support for the implementation of innovations oriented towards manufacturing companies, especially SMEs,
- transfer of technology from R&D institutions to industrial applications, and
- organisation of a competition 'Polish Product of the Future' in two categories: the best product and the best process to be used in practice.

For implementation of innovative projects the Agency used to offer relatively cheap loans, guarantees for bank credits and additional payments for interest and credits. TA, acting as a bridging institution, also maintained databases of:

a) innovation projects ready for implementation,
b) innovation-oriented entrepreneurs, and
c) capital investors interested in investing innovative production.

Huge expectations preceded the establishment of the Technology Agency. The Agency worked for a relatively short period of time: due to the big deficit in the state budget, TA was, unfortunately, liquidated in April 2002. However, while it operated some reservations emerged, which resulted in TA, continually seeking its own place on the innovation scene in Poland. These shortcomings were as follows:

- a very limited Agency budget, which originated almost exclusively from the state budget,
- the small scale of operations, resulting from the above, and
- certain competition from the Foundation for Polish Science.

* In 1998, an **OTI** (**I**nnovation **T**ransfer **C**entre) **consortium** was established as a joint initiative of eleven institutions acting on the scene. As a virtual organisation/network, OTI belongs to a European network named FEMIRC - Fellow Members of Innovation Relay Centres. OTI helps local enterprises to define their needs as well as to identify and establish contacts between partners implementing new technologies. OTI provides access to specialised databases on innovative projects and emerging technologies. It publishes a journal 'Innowacje' (*Innovations*). Some of units belonging to groups (1) and (2) are members of the consortium as well.

* Since 1998/1999, university centres for the transfer of technology have begun to appear. One of them is the **University Technology Transfer Centre** (UOTT) at Warsaw University, which began to operate in 1999. The Centre's specific scope of activities includes, in particular:

1. identification of results of the R&D work within the University which could become the subject of transfer and commercialisation of innovative technologies,
2. implementation of new technologies and patents created in the University,
3. support for academic entrepreneurship offered through the university incubator,
4. courses on commercialisation of R&D results and consultations for scientists and students,
5. support for regional development by strengthening partnerships with SMEs interested in research, training and other forms of co-operation provided by the Centre.

So, the idea of UOTT is similar to the concept of EDC at WUT. The first actions undertaken by UOTT appear very interesting, namely:

- the Centre has prepared Warsaw University's 'technological offer,' which included over 30 innovative projects and laboratory services; some of those achievements were granted the TA's *Polish Product/Process of the Future* award in 2000,
- UOTT has established co-operation with 43 companies within USAID's Fabrykat2000 programme,
- there has been one successful transaction with a Venture Capital Fund to create an Internet firm within the university incubator.

(3) **Spin-off firms.** A first project approved and launched within the INCOME programme has been carried out by **BioStar Plus**, a limited liability company, registered in January 1997 in Zgierz near Lodz. Shareholders in this firm were the Foundation for Polish Science and the Polish Development Bank, each one holding 24% of shares; the remaining 52% were held by the BioStar partnership set up by faculty members of Lodz Technical University. September 1997 saw the launching of production of an agent known as a 'lyophilised backing starter culture' used in making bread, and indispensable for ensuring its high nutrition value.

The story of this case begins in 1991 when Doctor, presently Professor Emeritus Magdalena Wlodarczyk started this research project within her department in Lodz Technical University. The inspiration came from inside: having observed the bread market in Poland, she realised that something had to be done to radically improve the poor quality of Polish bread. A new baking agent was the practical result intended from the very beginning.

The project lasted six years and was financed mainly from funds received directly and indirectly from the State Committee for Scientific Research and partly from the University's own funds. In the final phase of research, Dr Wlodarczyk was assisted by several collaborators from her department. At the beginning of 1997, the unique backing vaccine (four strains in one) was patented.

The Technology Transfer Centre in Lodz, learned of the project and has played a key role in it. The CTT has analysed and evaluated this achievement, and assisted the researchers in preparing a business-plan. Afterwards, an application, recommended by the Centre, was sent to the Foundation for Polish Science which began to arrange funds for implementation. BioStar partnership has brought in the patent as its initial share and so a new firm was established.

Thus, there have been four partners in this successful project:

1. State Committee for Scientific Research contributed the basic funds for research.
2. Lodz Technical University was the location where the research was conducted. Moreover, a group of researchers who established BioStar Plus were affiliated with that university.
3. Technology Transfer Centre in Lodz organised the entire process leading to implementation.
4. Foundation for Polish Science arranged the funds for implementation.

In this case, the first partner represents **government**, the second one – **science**, while the third one is a **bridging institution**. The fourth partner is a kind of semi-governmental agency. Finally, the **spin-off firm** belongs, of course, to **industry**.

Concluding, a big progress has been achieved in this field during the Polish transformations.

IV

Let me now present selected results of my Internet questionnaire research conducted in 2005 (Jasinski, 2006). The questionnaire was sent to **fifteen uttis** being elements of infrastructure of scientific and technological knowledge flows in Poland. All of them answered. Among them there were:

- two science parks,
- seven university technology transfer offices,
- five independent technology transfer or innovation centres,
- one advanced technologies centre.

The surveyed institutions are rather young: seven of them work less then five years; the oldest was established in 1994; the youngest – in 2004. They are rather small: eight of them employs up to 5 employees; six – between 6 and 15, and only one – over 15. In ten institutions, i.e. two thirds, public sources of finance predominate while in the other – private funds.

The main, general conclusions are as follows:

1. As far as the nature of their activities is concerned, most of the institutions deal mainly with research and training/teaching activities, and with actions which are expected to support entrepreneurship among small and medium-sized enterprises (SMEs).

2. The surveyed institutions in principle don't deal with actions for PUS via better communication between science and society.

3. Those units which work within universities may be called 'technology transfer bureaus', however, they don't function like typical liaison offices in highly developed countries (HDCs):

- firstly, in their answers, the respondents practically don't mention a commercialisation as a field of their activities, and
- secondly, non of the respondents mention – among their institution's tasks – issues concerning intellectual property rights (IPRs) protection.

4. The other institutions surveyed don't mention the protection of IPRs among their tasks either. And only few of them operate as professional bridging institutions like typical science-production intermediaries in HDCs.

So, activities of the surveyed uttis on the innovation scene in Poland leave a lot to be desired. They should play a much bigger then now, role in the flows of scientific and technological knowledge between science and industry or society, broadly speaking. Nevertheless, to become a catalyst of the flows, Polish uttis must improve their internal efficiency. They face a big challenge: how to reconcile their social mission (facilitating S&T knowledge flows) with the commercial purpose (gaining incomes).

V

Of course, not only uttis participate in scientific and technological knowledge flows in the Polish society. Also, the other elements of the infrastructure are engaged in such events organized in the country every year as, for example, science festivals, scientific picnics, a national day of science, scientific and technological exhibitions and fairs, etc. (For more information please have a look at: Jasinski, 2004).

Conclusions

1. Many different types of elements of infrastructure of scientific and technological knowledge flows, non-existent in the past, appeared in Poland after 1989.

2. In result, the infrastructure is now quite well developed and diversified.

3. Due to historical occurrences, science-production linkages have a crucial role to play in the desired intensification of the flows.

4. A big progress has been achieved in this field of transformations in Poland.

5.Activities of uttis, being elements of infrastructure of S&T knowledge flows, still leave a lot to be desired. They should concentrate, fist of all, on:

- a commercialisation of results of the R&D work,
- intellectual property rights protection and
- reconciling their social mission with commercial purpose of their activities.

And finally, each of the actors on the innovation scene has an important role to play to facilitate flows of scientific and technological knowledge in society. However, a key role must be played by actors in the background, i.e. uttis (units making up technology transfer infrastructure).

References

- H Etzkowitz and L Leydesdorff L (1995): *The triple helix: University-industry-government relations*, EASST Review, No 1,
- GUS (2005): *Nauka i technika w 2004 roku*, Central Statistical Office, Warsaw,
- A H Jasinski (2004): *S&T policy and science promotion in Poland: Old practices and new challenges,* in A H Jasinski (ed): *Transition economies in the European Research and Innovation Area: New challenges for their science and technology*, The Warsaw University Press, Warsaw,
- A H Jasinski (2006): *Innowacje i transfer techniki w procesie transformacji*, Difin, Warszawa,
- A H Jasinski and E Okon_Horodynska (2002): *Innovation in transition: The case of Poland*, The Warsaw University Press, Warsaw,
- SOOIPP (2004): *Osrodki innowacji i przedsiebiorczosci w Polsce: Raport roczny*, Lodz/Poznan