Obstacles in Developing University, Government and Industry Links: **The Case of Slovenia**

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A Discrepancy between Government Goals and Practice

While there are many problems regarding science in the transitional period in Slovenia, this article concentrates on only one, but the most crucial: the social barriers preventing stronger links between the research produced at academic institutions and the development of industry. The causes for these barriers are numerous. As in (all) other post-communist countries, academic science in Slovenia is in too large an extent on its own, without a suitable involvement with the industrial sector. It is not possible, in a single article, to analyse comprehensively all the issues regarding the complex forms of cooperation between academic science and industry, but let us list, at the very beginning, some of the most evident, which should be subject for further discussion: insufficient research efforts in industry, uncertainties about the quality of the knowledge transfer system, researchers' lack of industrial experience and immobility of academic researchers.

The social situation is never completely homogeneous. Therefore, any discussion of problems regarding the transfer of academic scientific knowledge to industry should take into account the whole socio-political and historical context. The transition of the R&D system in Slovenia suffers from similar structural problems as R&D systems in most other East and Central European countries. Notwithstanding, there exist also important differences. Slovenia is considered to be one of the most socio-economically developed Eastern and Central European countries in transition. It has always been the most developed and industrialised part of former Yugoslavia, with the highest standard of living, an intensive manufacturing sector and very strong foreign trade. GNP per capita is now about $10 000. Assessments by external observers are that Slovenia has executed a successful transition to democratic political rule in the

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ten years since achieving her independence (see Bukowski, 1999). The country, however, has not found an optimal solution regarding the processes of functional differentiation and integration of different social subsystems.

In this article, I present the main social barriers occurring in the transfer of academic knowledge from university to industry in Slovenia. It is very important for Slovenia, in the emerging processes of globalisation, to break through these barriers. Globalisation of economies and research systems and the intensification of international industrial competition demand from this small country the development of a smart strategy to effectively organise the weak national innovation system. Here, the experiences of small countries in the European Union could be used. Unfortunately it seems that these experiences are mainly ignored, or are at least not accounted for in the R&D policy discussions.

A major problem of R&D in Slovenia today is the lack of funding. However, an even greater (long-term) problem is how to make R&D more "efficient" and "accountable". In the last few years, there has been a constant decline in the funding of R&D. There is a significant disproportion between government declarations and the actual realisation of R&D policy. According to official governmental documents, the main focus of R&D policy should be on the following: maintaining the internationally competitive quality of R&D, increasing the engagement of R&D institutions in the technology upgrading of the Slovenian economy, promoting the dissemination and transfer of knowledge and enhancing R&D capacities (in a qualitative and quantitative sense) by linking academic research activities with the needs of business sector. In order to implement these orientations and targets, various operative measures have been prepared. For example, in the so-called "Slovenian National Research Programme" prepared by government and adopted by Slovene Parliament in 1994, it was foreseen that 30% of state funds for R&D should be invested into basic R&D projects. The support of basic R&D projects should include subsidies for pre-competitive research, for salaries of researchers employed in R&D departments of the business sector, and for technological parks and information centres. In practice there was no advancement in the planned technological upgrading of industry. In the period from 1994 to 1998, technological support schemes were diminishing from year to year. According to the latest analysis, only 2,7% of industrial investment in R&D belongs to the so-called state funds (Kos, 1998:34). In 1994 it amounted to 15,1% of the total governmental budget for R&D, but fell to 7,2% in 1998. In the same period the state budget for R&D in % of GNP had fallen as well, from 0,74% to 0,69%, although according to the "National Research Programme", the state budget should have had a real growth of 10% per year during the same period.

One of the reasons why the state financial resources were not directed more towards the experimental phases of R&D projects can be found in the existing evaluation system of R&D. In addition, the Ministry of Science and Technology has declared the necessity to support research development in industry with public money, while the evaluation system in the selection of the R&D project proposals has contained mainly

scientific criteria (the science citation index and the number of publications in journals with impact factors). The criteria relevant to the technological development of industry were rather neglected, especially in technical and natural sciences. An additional selective criterion was the requirement that only Ph.D.s could file a project proposal. In the past, projects for applied research could be entered also by M.A. scholars and in some cases, engineers without academic titles.

The state support for the experimental phases of R&D projects for industry is much more important in small post-communist countries than in the West-European developed market economies. The Slovenian industry is not strong enough to invest substantial funds in science, although the general official statistical figures on the business sector expenditure for R&D in 1998 (latest available statistical data) seem surprisingly high. For example, in 1998 the total R&D expenditure in percentage of GDP amounted to 1,4 in Slovenia, 53% of the sum belonging to the business sector, the rest to the public sector (Research & Development Statistics, 1999). Slovenian experts on industrial R&D express doubt regarding the official statistical data (see Stanovnik, 1995; Trstenjak, 1999). Their opinion is that business enterprises declare expenditures that by Frascati's definition are not R&D. For that reason, figures obtained for business sector expenditures on R&D appear unexpectedly high when compared to the rather modest general picture of the current investment capacity of the Slovenian industry.[1]

The transfer of scientific knowledge from academic institutions to industry is critical as well. In the following I will try to identify key factors, which I believe hinder new forms of cooperation between the academic scientific sphere and the industrial sector. The factors hindering the transfer of knowledge in Slovenia, however, are functionally overlapping. As a result, none of the factors followed up in the discussion can be considered as exclusive.

Slowly Modernising Industrial Sector

The industry in Slovenia is still not oriented enough towards development, modernisation and innovation. Many critics say that industry is changing into a disorganised, crumbling, uneconomic supply structure typical of dependent economies without their own developmental capacities (see Kos, 1998; Stanovnik *et al.*, 1998). Even if we do not agree entirely with the radical forms of critique, the lack of development and innovative orientation of industry is the Achilles heel of the Slovenian economic structure. The new types of industrial managers who rely on the new role of R&D are still rare. The results of empirical studies performed in different periods of the 1990s show that the application of R&D results in industry were not perceived by most leaders of Slovenian firms to be the core problem (Pompe, 1998; Mali, 1998a). One of the arguments often heard on why industrial managers did not centre more attention on innovation and application of knowledge at academic research institutions, was their preoccupation with the problems of privatisation. This argument was acceptable to some degree in the first half of the 1990s when the private economic

sector was still in its infancy, but not at the present time, when the privatisation process is at the end. Industrial managers could not turn from tasks concerning effective management, innovation and development problems of the enterprises. It seems that in the end of the 1990s the situation has not improved much. The private initiatives based on innovation, knowledge and new forms of management, are not yet fully developed. Additionally, the complicated formal base of the privatisation process has, in a number of companies, postponed the necessary economic and technological restructuring of industry.

There is also a lack of organised R&D efforts in industry. On the one hand, only 20% of the big companies (1000 and more employees) in Slovenia dispose of in-house R&D facilities. On the other hand, the activities of small and medium-sized enterprises (SMEs) have little to do with high technology and innovative activity. The big companies, which have succeeded to maintain their own R&D units during the transitional period, have been able to keep some form of contacts with research groups from the academic sphere. For example, according to Kos' analyses, firms with more than 1000 employees plan twice as much cooperation with government institutes and universities than enterprises with less than 50 employees (Kos, 1998: 39). They are mostly large and successful companies with organised development orientation, especially in the areas of pharmacy, electronic components and technologies and polymer materials production, which comprise 88,5% of all expenditure for R&D in Slovenian.

Concerning data on the concentration of R&D potential in small industrial areas, it is questionable whether such a small economy as Slovenia can afford research in all fields. Although attention should be given to the development of a wide spectrum of basic scientific disciplines at both Slovenian universities, it should be stressed that the allocation of resources in strategic research areas to meet the demands of the most developed industrial fields in Slovenia is equally important. A sound scientific base of university research is of outstanding importance for the education of high-skilled professionals. In this sense it is positive that university research in Slovenia is open to relatively many fields of knowledge. But it cannot be considered as an argument against the establishment of a priority system in science. In the context of the data on the concentration of R&D potential in individual industrial branches and the general crisis in public financing of R&D, it is unrealistic to demand that all fields of basic and even applied sciences deserve the same social attention. Priority setting is a typical feature for the R&D policy of smaller EU countries and the Slovenian R&D policy should make it as its primary goal as well.

The reasons for the concentration of R&D potential within a few areas of industry are various. One is the collapse of integrated development and technology groups within the remaining big corporations. Many big firms like Iskra, TAM, Metalna and Slovenijales have over the last few years, lost a substantial part of their R&D potential. Industrial branches that have witnessed major losses in R&D potential include transport equipment manufacturing, electrical equipment manufacturing, metal products manufacturing, furniture and other wood prod-

uct manufacturing. Except for two very large in-house R&D units in the pharmaceutical firms Krka and Lek, the average number of people involved in in-house RTD is 15. The continuation of such negative trends could even erode some of Slovenia's advantages over other transitional countries because Slovenia, as the part of the former Yugoslavia, did not strictly follow the former Soviet pattern in the organisation of R&D. In Eastern Europe, where the Soviet model was prevalent, scientists were mainly concentrated in institutions outside industry and university. There was no in-house research and development potential in the industry itself. The industry operated under central planning, so that firms were only executive agents of the plan, with no development strategy of their own (see Maynetz *et al.*, 1998; Kuklinski, 1996). Also, the model of separating education from research, which had been equally present in some East-European countries, was never introduced on a full scale in Slovenia. The university system has remained throughout an important centre of research.

For Slovenia, a small economy with limited resources and insufficient domestic industrial competition, it would be necessary to create new innovative links between academic science and SMEs. The transitional economies in general still lack the symbiotic linkages between big and small companies which are an important element in the networking pattern in some of the West European countries. SMEs are a dynamic element in transitional economies, and there is some correlation between the intensity of SMEs activity and the rate of labour productivity growth in such economies. But these firms seldom have big R&D departments or dispose with the capital to start up new activities. The expectation that such firms should link with academic research is, for that reason, much higher. A high degree of cooperation with the research sphere is expected on significant issues, especially in the creation of new products.

Although SMEs are an important field of economic activity in Slovenia (they have increased to more than 80% of all firms), their major deficiency is a lack of development orientation. They are usually small family companies. Their typical characteristic is that they express an unwillingness to employ professional (non-family) managers. (Slovenia also suffers from a lack of qualified managers.) One of the reasons for this type of behaviour of SMEs is a lack of trust between individuals outside the family which remains a destructive legacy during the transitional period. The Polish sociologist Piotr Sztompka has aptly written, that

> the most fundamental and lasting cultural code organising thought and action in the conditions of real-socialism was the opposition of two spheres of life: private and public." (Sztompka, 1999:153).

According to Sztompka the process of post-communist transition cannot be successful without the three basic components of social and moral cohesion: social trust, loyalty and solidarity. Trust, i.e. the expectancy that others will treat us in a dignified way. Loyalty, i.e. the obligation to refrain from breaching the trust that others have bestowed upon us and to meet obligations one has taken on oneself. Solidarity, i.e. caring for other people's interests and readiness to take action on behalf of other people even if

this is in conflict with our own interests. It seems that all three components of social and moral cohesion are still lacking in Slovenia.

Even where more innovative and technologically advanced small firms have been able to develop in Slovenia, there is a lack of networking with the academic scientific institutions. Here, the linear innovation model is still alive, although this concept is out-dated. In this old method of implementing innovative projects, activities are performed consecutively: research is followed by development, tooling-up and the production itself. Therefore, market performance and outcome can be very unpredictable. The linear innovation model was popular in the West during the 1970s and in the 1980s, but it has been replaced by new, co-evolutionary models of the innovation process (see Leydesdorff, 1994; Lemola, 1995). One of them, the chain-linked innovation model, seems to be especially useful in changing the old static view about the innovation processes. According to Kline and Rosenberg (1986), the chain-linked model consists of a series of components that are linked differently. Within such a complex structure numerous main lines of the innovation process appear. For example, the first, central line runs within the framework of the following steps: invention, construction, development, production and marketing. The second path appears as a series of feedback links from the market to the other stages of the central path, wherein the main feedback connects the market to a block called the potential market, which is located before the invention. The third line links science, divided into research and knowledge, to all steps of the central line. Science does not appear only in the initial phase (invention) but alongside the development process. Kline and Rosenberg emphasise that experts primarily try to find a solution to their problems on the basis of the existing knowledge. Only if they fail to provide an answer on this basis, they initiate research for the creation of new knowledge, which is the fourth path of the model. The fifth line is the feedback from innovation to science, perhaps, in the form of new or improved analytical instruments. Although in this model great emphasis is given to the market as a factor of stimulating innovation processes (the main path begins and ends with the market), an equally important role has been attributed to basic science. To conclude, basic research is not being dealt with as a source of inventive ideas but as a strategy for solving problems and which can used at any needed moment when introducing innovative products.

The industrial firms in Slovenia today are still unable, or are not motivated, to articulate their strategic development demands. They express an even smaller desire to work with researchers at academic research institutions in solving urgent development and innovation problems; in spite of the fact that a survey of the development plans of industrial enterprises has shown that only 25% of them estimate that they are capable of development on their own (see Stanovnik *et al.*, 1998). Generally, the technological level of manufacturing and service industries – especially in SMEs – lag substantially behind the European market economies. Comparing these economies, the degree of technological development in Slovenian products is very low (the average score 5 out of 15). Slovenian manufacturing enterprises are mostly classified as medium or low

technology branches. (Bucar and Stanovnik, 1999)

The attitude, that basic university research is a form of social consumption, is not unusual. Industrial firms, instead of investing in risky domestic knowledge, still prefer to buy foreign knowledge (licences and know-how), which is at the moment, perhaps much cheaper. Slovenian industry should have access to global scientific and technological resources, information, know-how. The transition to intangible production factors demands new skills and know-how new to Slovenian enterprises and a substantial part of this know-how should be obtained only from abroad.[2]

However, even if Slovenian industry were totally dependent on foreign technology, the importance of a domestic scientific base cannot be ignored. The role of highly qualified researchers, even in cases when they are situated mostly at academic institutions, is important not only as a source of new knowledge (for firms), but also as advisors on how to utilise imported technological knowledge, how to adapt it to local needs and how to pass the knowledge onto the others. In the process of technological learning and upgrading of innovation capabilities, it is recommended, primarily for all transitional economies, to combine the domestic R&D resources and different channels of technology transfer from abroad.

Social Barriers in Cooperation between Academic Science and Industry

If cooperation between academic research and industry exists at all, it is based mostly on short-range contacts remaining from the past. Various surveys performed during the 1990s have shown that most Slovenian companies use academic scientific institutions to obtain single consultations, as opposed to long-range forms of formal and informal co-operation (Phare Report, 1995; Mali, 1998a). What Slovenia lacks is established links between public R&D and industrial requirements, which might be created in the so-called intermediary sphere. Complaints from the industrial sector, that academic research is characterised by *l'art pour l'art* research, are often justified. Academic researchers are not aware of industrial problems or cannot solve them. One of the reasons is that the direct influence of industry and other potential users of research results in society remained small during the 1990s. There was a lasting predominance of scientists' autonomy, which was financed by government, in selecting research priorities. The investigation of academic research group activities in Slovenia in the middle of the 1990s showed that in 80% of all cases, the research project content had been proposed by the heads of research groups themselves, and only in 20% of all cases was this done by potential users of the results (Mali and Sorcan, 1995).

The reason for the separation between the producers and the users of scientific knowledge can again be located in the past. During the communist regime, the dominant activity of the central state-party blocked the links between social subsystems. The Communist Party's political domination left little room for the self-dynamics and self-organisation of various parts of society. There was no place for the autonomy of social subsystems. In contrast to the pro-

claimed communist ideology of the integration of education, science and production, the reality was separation. Since academic researchers often entered into contracts with industry merely to demonstrate that the socialist intelligentsia was acting to support the working class, research projects tended to be formal in nature (Etzkowitz, 1996; Balazs, 1997). As a logical consequence, the scientific and technological systems tended to isolate actors on both international and domestic economic levels.

It seems that in addition to Slovenia, post-communist Eastern and Central European countries in general still encounter a deficiency in informal and unstructured scientific networking that would override the bureaucratic environment which is not conducive to the development of ideas and innovation (Mali, 1998: 350). Certainly, academic research in the most developed countries in the West also sometimes comes up against organisational problems. However, the advantage in the West, in contrast to post-communist Eastern and Central Europe, is that it has a strong and long tradition of what David A. Dyker has called "civil scientific society" (1995: 184). In this environment, informal networking is, in practice, often powerful enough to achieve new breakthroughs. The study by Faulkner *et al.* has revealed that in UK, for example, the role of information interactions in transferring knowledge from university to industry far outweighs the contributions from formal links (see Faulkner *et al.*, 1995). If university departments do not develop formal networks with industry, it does not follow that individuals within those departments are prevented from building their own networks.

Although social trust is an ambivalent and multi-layered concept depending on many factors (Sztompka, 1999:14), it is of special importance for the establishment of a new "social contract" between academic science and industry in transitional countries. A well-functioning partnership and informal networks between all the above-mentioned social actors are in, and of themselves, a form of social and cultural capital (Fountain, 1998:107). As we have already mentioned above, social trust, which could be seen as the central resource determining the dynamic social potential in transitional societies, is still not present in Slovenian society. Without the formation of trust, the complete consolidation of the innovation system, which is especially important for Slovenian's efforts to catch up with the European Union, will not be possible.

Transfer of Academic Knowledge and New Scientific Agencies

The main social actors in Slovenia with significant political power (government, parliament, political parties) are not aware of the challenges appearing with the changing forms of scientific knowledge production. For example, politicians are still looking at the R&D in terms of sectors that should be socially isolated and not connected with other parts of society in terms of knowledge production,. For politicians, science is more an idle bottleneck in the social system than a strategic factor for economic recovery and growth of society. This thesis could be proven in various ways. For example, there is no rule in Slovenia that prime ministers should attend sessions of the National Science and Technology Coun-

cil. The experiences from several countries in the European Union are just the opposite. There is a lack of coordination among ministries concerning R&D strategies. One could tolerate such a lack of coordination if Slovenia was a large country, but given its small size coordination is an important factor.

Not only in post-communist countries in transition, but in all Europe, the increasing social complexity demands a shift in science policy towards organisational and institutional reforms. Notwithstanding, the most radical systemic changes are still necessary in the group of former communist countries. In Slovenia the most precarious issue is how to arrive at a more efficient R&D system based on stronger cooperation between academic science and industry. The government administration continues to make statements of how its primary task is to revitalise the R&D potential of industry. However, the key institutional changes, which could – if I use the categories of Mode 2 (Gibbons *et al.*, 1994) – lead to heterogeneity and organisational diversity, have not been executed in practice.

In the middle of the 1990, foreign experts who reviewed the institutional organisation of R&D in Slovenia warned about the low levels of interconnections between the academic scientific community and the external social environment (Phare Report, 1995; Walter, 1997). They suggested a reorganisation of the existing academic sciences under the umbrella of the Slovenian Ministry of Science and Technology into new independent national research agencies. This reorganisation should be accompanied by transferring a part of the scientific management from the state to these agencies. The emergence of new scientific agencies could be treated as the first and the most important step to the establishment of contemporary intermediary scientific structures. The intermediary bodies in parliamentary democracy have a relative autonomy from the state, which is especially important in the negotiation processes between the interests of different parts of society (Braun, 1997; Maynetz *et al.*, 1998). Arie Rip and Barend J. R. van der Meulen, who have analysed the science policy in seven scientifically developed countries, have ascertained that "the new agencies allow new interdependencies to be created, and the role of the state (with its specific steering models) to become less dominant" (Rip and Meulen, 1996:349).

Looking at the actual situation in Slovenia, it seems that the political establishment still does not understand the new role of scientific (research) councils and agencies in a parliamentary democracy. The new law on the organisation and financing of R&D in Slovenia, which should introduce a more European dimension into the processes of social regulation of science, has not yet been passed by parliament and put into force. The reason is a clash of opinion between different social actors, the issue being whether the proposed definition of agency's responsibilities meets the required institutional changes of public funds of R&D. The Slovene R&D policy has become highly politicised. Processes of state regulation of R&D demand continuity and strategic orientation, but have been disturbed by frequent changes of ministers of science during the last few years. In a very short time (less than 10 years) there has been a change of four ministers, each of them

from a different political party. Each of them endeavoured, with a narrow team, to change the strategic policy orientation of the preceding ministry chair. Scientists are not satisfied with the functioning of the existing expert bodies. Daily politics has too great an influence on these bodies.

For Slovenia it is important that the bodies of the new agencies should represent different parts of society. It is clear that the election of the majority of agency council members from the scientific community, and not from other parts of society, would lead to an unacceptable isolation of science. Indeed, in many western countries in recent years, major changes have occurred in the organisational structure of national research agencies. In almost all of them, new trends are characterised by the division of classical research agencies into disciplinary agencies and mission-oriented sectoral agencies. In addition both agencies are more entrepreneurial, stressing the role of strategic research, and targeting research towards priority areas (Skoie, 1996: 75). The main outcome of this change has been a reduction in the freedom previously afforded to agencies, in terms of spending, as a result of budget specifications, instructions and expectations incorporated into budgets and other policy documents.

We can only hope that the government R&D policy in Slovenia will shift as soon as possible to new research agencies. The new phase in cooperation between academic science, industry and government will not commence before the establishment of new scientific agencies, which will take over some of the state's management in the science field. It is very important that in these new agencies the voice of the business sector will be heard as well. Until now the representatives of the business world and industry in Slovenia, have not had a lot of opportunities to participate in the defining of research programmes and projects performed at academic institutions. Their role in the selection of criteria and in the appraisal of programme and project proposals has been negligible as well. Moreover, in the existing circumstances, where science and technology policy has been too concentrated in the narrow frames of one ministry, the economic sector in general has not had sufficient overview of the relevant research programmes and projects at research institutes and universities. A prompt establishment of new scientific agencies, as well as a more active role of other, already existing intermediate bodies (chambers of commerce, regional entrepreneurs' associations), is necessary to improve the situation concerning the cooperation between academic institutions and industry.

The lag in institutional reforms could be assessed as a political mistake, because during the 1990s, contrary to other post-communist countries in transition, Slovenia has seen no erosion of the public confidence in science. Public opinion surveys in the 1990s have shown that people are mostly against the reduction of financial support for science even at times of socio-economic crisis. According to longitudinal large-scale surveys, conducted between 1990-1998, 66,1% of respondents was against the reduction of financial support for science (Tos *et al.*, 1999). At the same time, these surveys have shown that, in the eyes of the "average" Slovenians, the professional

group of scientists has always appeared among the three most prestigious occupations, usually after the professional group of medical doctors. Although we must be cautious about the quantitative data of these types of surveys (Wynne, 1995: 367), we can conclude that scientists in Slovenia during the 1990s enjoyed high social standing.

This positive attitude towards science and researchers in society could be a source of cultural capital for the future. For that reason, there is a need in Slovenia to shift the discourse of R&D science policy away from the authority of credentialed scientists, who advocate only their privileged "insider" status, and from politicians and governmental decision-makers, who lack professionalism and competence in leading public policy.

Lack of Entrepreneurial Orientation of Academic Research

In regard to the relative size of research stock in Slovenian higher education institutions, the University of Ljubljana and the University of Maribor are the major sources of scientific knowledge that could be commercialised and concomitantly, contribute to socio-economic growth. The University of Ljubljana was established in 1919 and at present it comprises 23 faculties, academies and colleges. The beginnings of the University of Maribor go back to 1959 and today it comprises eight faculties and two colleges. There were, in 1998, about 7000 researchers in Slovenia, the majority of them (43%) located at the above universities. (Research & Development Statistics, 1999) The majority of employees holding doctorates are in higher education as well. The share of employees holding doctorates is highest among employees of the University of Ljubljana (48%), followed by the University of Maribor (38%) and national research institutes with an average of 37%. The share of PhDs in other institutes is 18% and only 1,2% among researchers in commercial companies.

For the development of the two universities as modern research institutions it is important to introduce the diversification of functions of academic staff into their management. Experts agree that diversification is a welcome trend in higher education in modern societies, which should be supported (Farnham *et al.*, 1999: 25). The division between research and teaching is not acceptable for larger countries with numerous universities, let alone for a small country with only two universities. It is necessary to mention that Slovenia, concerning institutional proliferation of the university system, is very undeveloped. Even when compared it with other European countries with a similar or somewhat higher level of population. For example, today there are 20 universities in Finland, mostly multifaculty universities and those specialised in technical and commercial sciences. In addition Finland is one of the characteristic EU-countries, where during the 1990s, the aims of technology policy have deeply penetrated university policy (see Häyrinen-Alestalo, 1999). Today Finland appears to be one of the leading countries in specific fields of high technology.

The concept of the commercialisation (capitalisation) of academic knowledge at the universities in Slovenia still lacks social legitimation. Attempts to evaluate academic life as an economic commodity with market value, rather than as an

intellectual pursuit for its own sake, are challenging the concept of the university as a highly hierarchical organised institution. In that sense, it is important how university systems are managed and governed. University governance is concerned with the accountability of institutions, their strategic direction and policy formulation. In expert literature, various models of university management have been proposed. In terms of Clark's typology of forms of university management (Clark, 1983), it seems that Slovenian universities are closer to the bureaucratic (not entrepreneurial) model of academic (university) life.

The idea of the university as a place of learning and, at best, as an institution of basic science is still prevalent among academic staff. As long as this idea holds among the university and faculty management, no urgent need for a more efficient transfer of academic knowledge to industry seems probable. Lately, there has developed a disparity between the increasing trend in the number of student enrolments and the decrease trend in the financial resources available for research work of academic staff.[3]

The quantitative expansion in the number of students has not been accompanied by a parallel increase of teaching staff. As a consequence, there is an increasing teaching load on academic staff (Mali, 1998b). In 1998 an anonymous opinion poll was carried out among a representative group of all teaching staff at the University of Ljubljana (Kump *et al.*, 1998). University teachers were asked about their opinions on different issues regarding their working conditions, satisfaction with their salaries and future professional plans. From our point of view, the most interesting result was that less than half of the academic staff at the University of Ljubljana (49,4 have expressed the wish to focus more on research work in their future academic career. The results of the survey demonstrate that external institutional pressure (the increased teaching, the lack of money for research activities, etc.) divert academic staff from actual research work, although it is expected that the academic personnel at faculties should feel responsible for further development of science and concomitantly generate more of their income from non-governmental (and non-teaching) financial sources. The increasing financial constraints and the teaching overloading could lead, in the near future, to unacceptable trends: a change in both universities towards teaching only (and not into research) institutions.

The first signs of the appearance of spin-off companies and technological centres are present in Slovenia. For example, after providing the legal framework, two technological parks were established in 1994. The main objective of the parks, the first in Ljubljana and the second in Marlboro, was to create a favourable infrastructure for SMEs to commercialise innovations from the research sphere, market services and products of new technologies and stimulate the mobility of researchers to entrepreneurship. Within the technological park in Ljubljana there currently operate 32 small companies, with about 300 employees (Lesjak, 2000). These small companies are included in the following high technology programmes: industrial automation, information technology, biotechnology, optoelectronics, new materials and environmental tech-

nologies. The companies in the technological parks cooperate mainly with individual research groups from the University of Ljubljana, primarily with the Faculty of Engineering, the Faculty of Chemistry and the Faculty of Mathematics and Physical Science. At present, the Steir Technology Park, which is located in Maribor, a traditional industrial city in the northeast of Slovenia, is even more renowned, although only about 20 small companies operate under his umbrella (Knez, 2000). At present it has succeeded in establishing not only strong connections with the University of Ljubljana, but even with the technological parks and technological centres in Graz, an industrially developed university city in Austria, situated only about 50 km from Maribor.

Spin-off companies from universities are the most visible form of knowledge transfer from the academic sphere to industry. The role played by high technology start-up firms in Slovenia is very important as they exert pressure on the established industrial structure in accelerating innovations. Although the enthusiasm for academic spin-off companies of the 1980s has in the 1990s been replaced by "a more reserved attitude" (Stankiewicz, 1994:100), it is understandable that the formation of numerous institutional mechanisms for the application of academic knowledge in Slovenia is in the same way, as the already mentioned establishment of new scientific agencies, highly recommended by foreign experts (Phare Report, 1995; Walter, 1997). Spin-off companies from universities stir up entrepreneurship among academics. Additionally, university and faculty management need more expertise in what we call industry liaison activities. These activities must pay more attention to the problem of maintaining and licensing the intellectual property that is the product of university research.

For the transfer of knowledge from university to industry, the movement of young research staff from universities to industrial corporations is very important. Not only because there is a lack of highly educated and trained staff within industry, but also because the most effective vehicle for knowledge transfer between university and industry is the transfer of highly educated personnel. The social distribution of scientific knowledge is, above all, performed by people and their ways of interacting in socially organised form. Emphasis is on the tacit components of knowledge.

Slovenian society reveals a low intra-sectoral mobility of highly qualified experts. This has had a positive effect on the nation, as it has reduced the importance of "brain-drain". In the last few years among all the researchers with a doctor's degree in Slovenia only 0,2% of them have annually emigrated, mostly young doctors of science from the fields of medicine, chemistry and biology. (Bevc, 1997) On the other hand, the absence of better-educated people in Slovenian companies is critical. The average number of years of education of employees in Slovenian industry is very low, only 9,7 years. Beside a low rate of investment in R&D in proportion to the revenue, this is a serious obstacle for economic prosperity of Slovenian industry.

To improve the intra-sectoral mobility of highly qualified experts, we should also consider modifying the so-called "Young Scientist Programme". The ob-

jective of this postgraduate doctor's programme, which is wholly funded by the government, is not only to revitalise the ageing research academic groups, but also to support non-research organisations. Although young doctors are expected to bridge the gap between university and industry, this type of postgraduate education has been too closely linked with the basic research support facilities. The data that most young doctors, after completing their studies, stay within higher educational institutions confirms this conclusion. Of the number, who have already completed their postgraduate studies and obtained a doctoral degree (in the last ten years about 2000), only 26% have continued their professional career in industry (Bertoncelj, 1998).

Bureaucratic Organisation of University System

The recent emergence of private higher education institutions, especially in Central and Eastern Europe have, until now, excluded Slovenia. The private higher education institutions often prove to be more dynamic and flexible in cooperation with industry. The public financing of the university cannot remain uninterrupted despite economic difficulties in the process of transition. Attention should also be paid to the possibility of introducing other forms of financing higher education. According to the statement expressed at the World Conference on Higher Education "universities that lack entrepreneurial impulse are not destined to flourish" (Unesco, 1998: 4). However, it must be said that it is almost impossible to find in practice the optimal structure for the improvement of links between university and industry. Therefore, the modification of the existing system should not rely exclusively on copying those national systems, which are regarded as being more efficient. For example, the Massachusetts Institute of Technology (MIT) often provides a model for other higher education institutions seeking to commercialise their activities. Notwithstanding, it would be difficult to imagine that this model can simply be copied in Slovenia. Even some universities in Western Europe, which adopted the organisational structure found at MIT, did not see it as a blueprint for their establishment. There are major differences in attitudes regarding the capitalisation of academic knowledge not only among the highly-industrialised and post-communist countries, but also between the USA and most of the West European countries. (See for details Geenhuizen and Nijkamp, 1996)

Given the size and bureaucratic organisation of both universities in Slovenia (The University of Ljubljana with more than 45 000 students can be ranked among the biggest universities even in world context), conflicts between various interest groups are not unusual. Some conflicts appear between faculties, others appear more within faculties. Whatever forms of conflict emerge, managing and resolving them take enormous amounts of energy and concomitantly hinders the realisation of new ideas regarding the transfer of academic knowledge into practice. For example, there exist tensions between senior members of faculties and junior members of academic staffs. The new Act on Higher Education, which was adopted in 1995, has given too much power to the

senates of faculties and old professor's establishments. They have real power in their hands and can hamper good ideas for reorienting research at the universities. In that sense the situation is similar to other post-communist countries. In this context there emerges a challenge of how to create a framework for more collaborative work between academic research and industry that is based on the formation of new young research groups with cross-disciplinary interests, skills and contacts (see Syzmonsky and Guzik, 1997; Schimak, 1995). Unfortunately, university research in Slovenia is, even after the legislative reform, seriously fragmented with disciplines and branches strongly separated from each other.

The problem of pulling together deeply divided parts of the university has recently become acute. As we know from various expert studies, the new concept of the university and cooperation between university and industry is also connected with the new understanding of the transdisciplinary structure of science (e.g. Gibbons at al., 1994; Sigurdson, 1996). The principle characteristics of the new mode of knowledge production are not only the context of application, organisational heterogeneity, social accountability, new forms of quality control, but also trans- and interdisciplinarity. Work in transdisciplinary groups requires a flexible system of financing of R&D in Slovenia, whereas during the 1990s, public financing of R&D was based on the grant system. Under the pressure of lobby groups from big state research institutes, it has been replaced during the last year by the long-range programme for financing of R&D. Although the grant system often prevented the setting of long-term policy by not giving an assurance of funding over several years, it strongly fostered competition among research groups. The researchers had to work in a less secure environment. For that reason they found themselves under pressure to be more flexible in work practices: they had to adopt new management techniques and skills (proposal writing, networking and fund raising for projects, managing PhD students and researchers, project management, particularly relating to industrial and international partners etc.). We can only hope that the new system of public financing of R&D will not become a life insurance for researchers. Namely, lack of scientific competition and evaluation drops the quality of scientific work and decreases the readiness of researchers to withdraw from the "ivory tower" of science.

Even if a good institutional frame in the university system in Slovenia would develop for the transfer of academic knowledge to industry, a number of other external conditions for its success should be fulfilled. Every process of transformation is multidimensional and its final shape depends on the interaction between the institutional levels on the one hand and the mental-cultural level on the other.

In that sense the capitalisation of academic knowledge, as condition sine qua non for the transfer of knowledge from university to industry cannot just be institutionalised. It has to become a value of academic community. It should give rise to entrepreneurial behaviour of the university staff, without any fear of universities becoming a bad imitation of industrial corporations. On the other hand, industrial sectors should consider

academic norms. To state further academic and industrial sectors should consider "the mixing of norms and values in different segments of society" (Gibbons *et al.*, 1994: 37), without forgetting the differences between universities and business firms.

Conclusions

In this paper I have identified major obstacles, which stand in the way of greater, and much needed university and industry cooperation in Slovenia. Bridging the gap between these systems is not only a matter of formal institutional conditions. A new legislation is only the first step in changing unfavourable conditions. However, it does not mean that the definition of the national R&D policy priorities, based on the consensual agreement of all the key social actors, are not of primary importance. The strategic goals of national R&D policy determine not only the ways of solving issues, but also the speed with which they are solved. Slovenia appears today before a crucial challenge in its short history of national sovereignty. It is a time of eligibility to the EU. The Slovenian public supports the political endeavours at home directed toward attaining an early membership to the group of developed European countries and the Brussels administration has expressed that Slovenia is one of the first candidates to become a full member of the EU. According to the most optimistic scenario we should become part of the EU in less than five years. In the period of preaccession Slovenia will particularly need to increase its awareness on the importance of the technological and societal development of the scientific system. The technological gap between Slovenia and the European developed market economies is too wide. Yet general assessments by the EU on Slovenia are based on the assumption that no major difficulties are to be expected in this area in the process of Slovenia's inclusion into the EU. However, questions on how to make academic science economically and technologically more effective are in no way less serious. As I have pointed out there are many obstacles, which still hinder the efficient transfer of academic knowledge from university to industry, such as the lack of development orientation of industry, too extensive professional incompetence of governmental administration and strong academic conservatism of university personnel. All the above obstacles are functionally overlapping, but not insurmountable.

Notes

1 Since 1994, the regular national statistical R&D surveys in Slovenia have been based on the international methodology of the well-known OECD Frascati manual. The national statistical office has published these surveys regularly.

2 The small size of the Slovenian market, the unclear government attitude towards foreign investment and the delays in the privatisation process have not attracted much foreign investment as a means of financial support in the transformation process. In some cases that is not good even for domestic R&D potential, in spite of the fact that multinationals are often looking for cheap labour rather than research innovations developed in local research centres.

3 The number of student enrolments at both Slovenian universities grew from 33 565 in the academic year 1991/92 to 60 086 in academic year 1998/99. The statistical figures show a particularly rapid rate of growth for social sciences.

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