THE ROLE OF INTERMEDIARY SCIENTIFIC ORGANIZATIONS IN SYNERGISTIC COMBINATION OF THE NEW ARISING TECHNOLOGIES

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Dr. Franc Mali
University of Ljubljana
Faculty of Social Sciences
Kardeljeva pl. 5
1000 Ljubljana
Slovenia
e-mail: franc.mali@fdv.uni-lj.si

Summary

In the contribution, there is given critical insight in the characteristics and social functions of intermediary organizations in science. In the first part of contribution, the focus is on the clarification of the concept of intermediary organization. In the practice, it does not exist unified model of intermediary scientific organizations. These structures vary according to the principles of mobilizing all stakeholders involved in the whole innovation network and the main strategic goals performed by this type of network. In the second part of the paper, an overview of the role of intermediary organizations in Slovenia is given. In Slovenia, in the last few years a lot of new intermediary organizations have been established which connect actors from academic

research sector and business-enterprise sector. To overview the main characteristics in the functioning of the intermediary organizations in Slovenia interviews with 30 heads and directors of centres of excellence, technological platforms, technological clusters, technological parks and innovation incubators have been made. The results of this empirical survey pointed out a lot of deficiencies in functioning of scientific intermediary organizations in Slovenia.

Introduction

In the paper, there will be presented at first a more general social and historical context of recent processes of commercialization of academic research results. During the whole history of modern science, the processes of commercialization and commodification of academic research results have been connected with the much more general and complex topic of relation between science and technology. But, in both cases the structural problems have been in many ways similar. After that, in the second part there will be presented the key changes arising from the increased processes of commercialisation of academic research results in the recent times. One of these changes regards to the new social role of intermediary scientific organizations. In my presentation, the term "intermediary organization" will regard to various institutional forms in which the commercialization of academic research results is more efficiently realised. Without any intention to follow the manifold theoretical discussions about the role of intermediary organizations in modern societies, I'd like already now to put the thesis that it is possible to find by many of sociological theories the good theoretical

framework for the analysis of recent arising scientific intermediary structures. Let me mention only the concept of social interpenetration introduced by Talcott Parsons (1967) and later extensively elaborated by Niklas Luhmann (1990). The concept of interpenetration were used by both social system theorists to describe the situation when two or more social sub-systems overlap in some manner (share certain elements or have closely coupled elements) without loosing their autonomy and identity. In the last part of the paper, an overview of the role of intermediary organizations in Slovenia will be given. In Slovenia, in the last few years a lot of new intermediary organizations have been established which connect actors from academic research sector and business-enterprise sector. These intermediary organizations in Slovenia are: technological centres, technological parks, technological clusters, centres of competence, university innovation incubators. The legal status and the size among these intermediary organizations vary strongly. Notwithstanding, they should have in common the prevalent orientation: to increase the links between the academic research sector and business-enterprise sector. The interviews among the 30 heads of various intermediary organizations in Slovenia have been made. The interviews have been performed in the last quarter of year 2007. The results of this empirical survey pointed out a lot of deficiencies in functioning of intermediary organizations in Slovenia. In the contribution, a short snapshot of deficiencies will also be given. In Slovenia, a very small number of empirical sociological studies have been conducted to evaluate the role of various intermediary structures which are important for commercialisation of academic research knowledge. The interpretations of these crucial problems are still mainly in the hands of officers from government basing their views more on norms than on empirical facts. For

that reason the performed empirical research of how intermediary organizations really function can give more objective picture.

The links between science and technology as historical condition to come to modern science intermediary structures

As it was already said, the discussion about the scientific intermediary structures are connected with the more general and complex topic of relation between science and technology. There exist different theoretical and practical views on the interlinks between science and technology. We could say that predecessor of modern discussion on this issue was already middle-age philosopher Francis Bacon. He outlined in his visionary New Atlantis the kind of modern science which put itself in the role of technological power.

Today, the historians and sociologists of science mostly agree that first industrial revolution did not embody the technical appliance of science. Namely if we look back in the history, it is hard to say that science in the time of first industrial revolution have offered very much to technology. The theoretical knowledge was too rudimentary to find the way to technological problems. For example, Watt's improved steam engine broke all the rules of contemporary physics. According to Terence Kealey *"…the industrial revolution did not represent the application of science to technology, it represented the development of pre-existing technology by hands-on technologies'* (Kealy 1996, 72). Or it is said by other author, German sociologist Matthias Wingens: „*Die Anfangsphase der industriellen Revolution eine Dominanz technischer Erfahrungswissens gegenueber*

wissenschaftlichen Erkenntnissen festgestellt hat, waehrend die heutigen ‚Schluesseltechnologien' vollig wissenschaftsabhaengig sind" (Wingens 1998, 166).

The productive links of science and technology did not arise before the end of 19th century. After that period both systems began to strongly interact each other. The recent times are characterized by bloom of "techno-sciences" if we use the term invented by Bruno Latour, the French sociologists of science (Latour 1987). Taking in regard the increased processes of interlinks between science and technology in 20th century, there is some surprise that many social science theorists insisted until recent times very strongly on old-fashioned interpretation of science as phenomenon which is totally independent from technology. Already before Second World War, under the influence of controversial discussions about the autonomy and (social) relevance of science, Michael Polany proclaimed the strict autonomistic idea about *"the republic of science"* (Polany 1962, 56). According to this view science is committed exclusively to own professional values and codes. Science was glorified as strongly autonomous and self-referential social subsystem. It is interesting that Polany's ideas and even his terminology is still frequently used in recent theoretical discussions (see for example: Fuller 2000, 11).

Immediately after Second World War, the interlinks between scientific and technical subsystems have been mostly ignored. How to explain the prevalence of very strict interpretation of science as entirely autonomous system which doesn't have nothing together with technology? There are

many reasons contributing to the views separating science from technology. Here, let us number two of them:

1. The opinion that the domains of science and technology are separated by their social organization and reward structure was all the time very strong. There was presented belief that scientists and technologists are "committed" to different norms and rules of the professional "game". The big theoretical support to these points of view contributed the concepts of (professional) ethos of science developed by Robert Merton. Robert Merton has elaborated the basic ethical canons of science which are followed by researchers in the frame of scientific community: universalism, communitarianism, disinterestedness, organized skepticism (Merton 1973, 270). Indeed, the big merit of Merton is that he elaborated very articulated arguments against different forms of (political, ideological, etc.) suppressions of scientific autonomy and research freedom. His arguments contributed a lot to the understanding of the internal reward mechanisms in academic scientific community as well. According to him the main motivation of scientists is to come to professional reputation and scientific awards. Publications and citations are one of the key signals that the scientists have established a reputation within the academic community. Or as it was said by Robert Merton: *"The public nature of scientific knowledge encourages its use by others, and in so doing, increases the reputation of the researcher"* (Merton 1973, 272). Actually, as it is pointed out in Merton's works, the motivation of scientists in academic scientific community is not only individual research curiosity, but recognition by professional peers as well.

2. The practical reasons encouraging the strict autonomistic position of science regard to the whole "philosophy" staying behind the governmental science and technology policy in West after Second World War (Of course, discussing about autonomy and heteronomy of science at that time, the situation in East European communist countries was not comparable with situation in West.) There was accepted the rationale according to which exist relatively clear distinction between basic and applied research. The former should be the domain of the academic institutions and the latter the domain of business-enterprise sector. The main argument of state was that it would be a mistake to look at practical orientation of academic science as a guide to where state fund for R&D should be allocated. Vannevar Bush was the key proponent of this type of R&D policy. The title of his report advocating this program of unrestricted public support of science caught best the spirit of that time: science as endless frontier (see for example: Zachary 1997).

There was coming in the last two and half decades to the basic shift in view of key policy actors on the (social) role of academic science. First of all, this sphere is no more supported by governments of various states only for that reason, because it produces basic scientific discoveries. Even from university system who has main mission to teach it is required not only to play an active role in basic science, but also in applied science and innovation activities. Today, all around the world, the universities are especially under pressure to improve their performance in the area of

intellectual property management and exploitation their basic research results.

To be clear, the role of academic science as an actor in solution of practical problems cannot be limited only to the recent times. Already in the past time there existed different mechanisms to link academic science with business-enterprise sector (see for example: Etzkowitz 2002). Let us number some of these forms of cooperation between academic science and industry:

1. the employment of fresh graduates from university in different sectors of industry; graduates regularly carry knowledge from universities to industry and other sectors;
2. traditional academic forms of communications (publications, conferences etc.) permit industry to monitor and exploit new knowledge public available at academic institutions;
3. it is also true that university staff appeared relatively early in consulting function which directly contribute to the transfer of knowledge;
4. there were established a lot of other forms of collaboration between academic sphere and industry, either on a bi-lateral basis or on a consortium basis.

It seems that modern universities serve a growing variety of functions from the most basic research to the most applicative oriented research projects. The diversification of functions is a key characteristic for the modern universities. The recent trends in academic research sphere point out that old-fashioned interpretations of academic science as strict autonomous model do not fit

any more to the reality. They maybe fit to the situation fifty years ago. However, the increased expectations of modern societies that the academic researchers will take over the responsibility to create commercial valuable knowledge and contribute to the solving of practical problems in industry are today much more better explained in theoretical thinking which does not strongly isolate science in its own codes and rules.

The role of intermediary structures in the recent processes of commercialization of academic research

The researchers coming from the academic scientific institutions have moved in the last two and half decades away from free enquiry to solve more practical problems. Even at the universities as the basic academic institutions research work becomes less curiosity-driven and more problem-oriented. One of the major changes that is now taking place is the extent to which the state, nearly everywhere, is seeking to direct the university system and exploit its usefulness for socio-economic ends. In the time of last two and half decades there was coming to the new forms of commercialization ob academic research knowledge. Let us shortly explain some of these changes:

1. The business enterprises are beginning to handle the knowledge from academic institutions as the key source to come to the industrial innovations. Or as it is said by Johannes Glaeser: " *Grundlagenforschung soll heute verkaufbares Wissen produzieren"* (Glaeser 2003, 57). Why for the business-enterprises sector the academic institutions are becoming the key source of the industrial innovations? Certainly, it is one of the important factors the

prevalence of small and medium enterprises in economic sector and the increased specialization of scientific knowledge. Both factors push business enterprises to increase their reliance on combination of in-house and contract R&D.

2. There was coming to the unrestricted extension of intellectual property rights (IPR) to the all spheres of academic science. Why did come to the unrestricted extension of IPR to the area of academic science? Why the extension of IPR reached the stage when some analysts began to write that *"...whereas formerly IPR tended to be seen as an aspect of the management of universities' research agreements with firms, the current view is that the central task of technology transfer agents is to assess and protect IPR and make it available to industry"* (Geuna & Nesta 2006, 791). Certainly, it is one of the important factors the support of governments to academic institutions (especially to universities) to be able to put into force the property rights for their research results. Namely, governments offered numerous legal instruments for universities and public scientific institutes to use IPR. New legislative came into force at first in U.S. (the Bayh-Dole Act) (see for example: Etzkowitz 2002; Vest 2005). In the last few years, also in many European countries there is a big focus on the mechanisms of transfer over which IPR can be established (see for example: Geuna & Nesta 2006). In the last few years, in many European countries, most national legislative changed regard to employment laws so that university professors are no longer exempted from legislation that gives employers the IPR generated by employees. It is also true that in many countries still exist dual system

regarding the allocation of intellectual property rights: title is granted to the professor (inventor) at universities. Institution retains title at non-university public research organisation. According to OECD survey, this is the case in Norway, Finland, Germany (OECD 2003). Notwithstanding, although some world first-class universities do succeed in attracting substantial additional financial incomes from IPR, there would be wrong to exaggerate with the expected benefits. According to OECD survey, the vast majority of US universities, including Standford and MIT, earn less than 10% of their research expenditure from IP commercialization (OECD 2003, 71). All analysis point out that universities succeeded in attracting substantial additional incomes from IPR in narrow circle of scientific fields. There exists the dominance by bio-sciences and nano-sciences. For example, in U.S. in terms of revenues (income from licences), about half of total royalties were related to life sciences, including biotechnology. Or it is said by Jeannette Colyvas: *" The department dealing with life sciences has generated the most revenues from commercialization. Moreover, extensive interviews and careful readings of the archives made abundantly clear that faculty in this department played a large role in shaping university practices, both as exemplars of success as well as advocates for change"* (Colyvas 2007, 475). In this regard there is no big difference between U.S. and Europe. Notwithstanding, the academic institutions in U.S. are much more active than their European counterparts in enforcing and exploiting IPRs on the basic research. Academic scientists in United States have the much longer history of working with industry. They began to combine research and teaching with regional economic

development. Already in the beginning of 20th century, Vannevar Bush and his colleagues at MIT originated a model for science-based regional economic development (see for example: Zachary 1999). They linked a venture capital instrument to academic research groups. The venture capital firm provided a systematic method for organizing high-tech firms based upon academic research. The practice of firm formation from academic research assisted by venture capital became known in U.S. already before the Second World War. In Europe, the development of university through modern history has been determined through social position of Humboldt's concept of university (Mali 2006). After Second World War, the reduction of public support of academic science (universities) was coming earlier in U.S. than in Europe. In U.S., policy actors follow more bottom-up approach: government does not dictate all forms of mechanisms of partnership. In contrast to the European universities, American universities are highly decentralized and intensively competitive. In the most EU countries, there are much more presented expectations that governments will take over the initiatives and create mechanisms that facilitate commercialization (see for example: Goldfarb & Henrekson 2003). It is partially connected with the historical position of academic staff in Europe.

3. There was coming the formation of various intermediary structures. Which kinds of institutions can also be called intermediaries? In general, an intermediate organization is an organization that functions in the midst of the users and producers of knowledge. The concept of

intermediary is defined as a framework in which the roles of different actors is studied. The intermediaries represent usually a complex network of many kinds of actors, for example scientists from academic scientific institutions, industrials from, financiers from governmental or other institutions etc. The main purpose of these networks is to bring together different actors and resources to raise the value of the network. The relations in these networks cross many traditional borders of hierarchy. The mission of a national intermediate organization is to ensure the success of the nation as a whole. The mission of a regional intermediary is to support the success factors of the region, and the mission of a local intermediary is to serve local firms in their business. The macro, meso and micro level have a different effect on the functioning of various intermediary structures. According to Smedlund (2006), intermediaries can be found between the public and the private sector. These intermediaries have a significant effect on the performance of business-enterprise sector. Defining clear roles for intermediaries is not simple. According to narrow definition, the purpose of an intermediary is primarily knowledge transfer from the creators of knowledge to the users of knowledge. This is the definition that is usually used when the transfer of knowledge from universities to local small and medium enterprises is studied. However, the effect of an intermediary to the surrounding environment (regional, national, etc.) is broader than just transfer of scientific knowledge from academic research sector to business-enterprise sector. Last but not least, as it is said by Dietmar Braun, *"…intermediaere Systeme sind institutionalisierte Formen, die es ermoeglichen sollen, die Wissenschaftler flexibel in ekonomische*

und staatliche Steuerungszusammenhaenge einzubinden. Sie sollen erlauben, ad hoc neue Informationen aus der Wissenschaft abzurufen oder Akzeptanz fuer politische und ekonomische Steuerungsziele zu generieren.“ (Braun 1997,81).

The commercialization of academic research and intermediary organizations in Slovenia

As it has been already said, the intermediary organizations in science are important because they represent one of the new institutional forms in which the commercialization of academic science is more efficiently realised. In Slovenia, there exist at the moment various intermediary organizations in science which have been formed in the last few years to link academic research sector with business-enterprise sector.

Let us shortly present the landscape of intermediary organizations in Slovenia.

1. Centres of excellence have been formed in Slovenia in year 2004 as an institutional response to EU-wide endeavours to establish stronger connections between scientific and business-enterprise sector. Their creation was initiated by the government. We could say that the creation of centres of excellence is a typical case how top-down policy approach is used. For centres of excellence is characteristic that they receive a big financial support from European Structural Fund. At the moment, there exist 10 centres of excellence: for biotechnology with pharmacy, for nanotechnology,

for environmental technologies (it is dealing with activities to put in effect sustainable methods of water protection and purification), for advanced metallic materials, electronics of next generation, for supercritical fluids, for ICT, etc.

2. National technological platforms have been also created as a respond to EU Commission initiative. The EU Commission in 2004 started to actively encourage the development of the European Technology Platforms. Technological platforms should appear as infrastructural and personnel support of families of technological options. These initiatives should unite as many as possible European stakeholders in a certain technological field. In 2005, Slovenian Ministry of Higher Education, Science and Technology published a first call for proposals for the formation of national technological platforms. Here, we could again say that the creation of national technological platforms is a case of top-down policy approach. There exist in Slovenia at the moment 24 national technological platforms: full cell technology platform, textile technology platform, manufacture construction technology platform, photovoltaics technology platform, forest based products technology platform, clean waters technology platform, etc.

3.Technological clusters are the predecessors of technological platforms. The main purpose of their creation was to increase the comparative advantages of domestic technologies in the global environment. Technological clusters should encourage the formation of technological centers, incubators and other types of innovation networks. The first technological clusters in Slovenia have been created already in 2001. They mostly link academic research community and small and medium enterprises

across regional innovation networks. Today it is difficult to determine the precise number of technological clusters in Slovenia because some of them are no more active or they are in the phase of transformation to technological platforms.

4. Technological parks in Slovenia are those intermediary organizations which provide the organization and infrastructure for the development of technology based entrepreneurship. It motivates, verifies and assists in the realization of entrepreneurial initiatives through a concentration of expert and organization skills, infrastructure, etc. On this way they offer to innovative small and medium enterprises a high growth potential. Their mission is to ensure a top-quality business support environment for the transfer of research findings and innovative commercial ideas to successful and internationally competitive technological entrepreneurship. There exist at the moment 4 technological parks in Slovenia: Technological park Ljubljana, Technological park Maribor, Technological park Celje, Technological park Koper.

5. Innovation incubators at universities in Slovenia try to follow the recent trends in the world to accelerate entrepreneurship among academic staff and students. The innovative ideas that spring up on universities should be put into effect in the reality. They should give complete support to newly developed enterprises helping them to overcome all difficulties at the beginning of innovation processes. There exist at the moment innovation incubators at three Slovenian universities: at University of Ljubljana, at University of Koper and at University of Maribor.

To overview the main characteristics in the functioning of the intermediary organizations in Slovenia we have made interviews with 30 heads and directors of centres of excellence, technological platforms, technological clusters, technological parks and innovation incubators. The interviews have been conducted in October and November 2007. The responses to our inquiry were very positive.[1] All respondents agreed to give us interviews. Thus our data sample makes possible some interesting conclusions. The used methodological approach in this type of empirical investigation could be included in the interpretative tradition of social science. We used the qualitative content analysis of the information obtained from the interviews. In some of our conclusions some additional data were also used. Namely, to understand the answers of heads and directors, it was necessary to look also at the background and to shed light on the broader social context concerning the processes of commercialization of academic research results in Slovenia.

Interviews among heads and directors focused on the very broad area of issues. Here, let us present the part of the opinions regarding more specific issue of commercialization of academic science and support of state for intermediary organizations.

1. The respondents in our empirical research assessed that working on applicative research projects is quite similar to work on basic research projects financed by public research agencies in Slovenia. Because the important aim of intermediary structures should be to put research

[1] The interviews have been made together with Blanka Jelinkar, young research assisstant at The Faculty of Social Sciences (University of Ljubljana).

results to use in practical applications, the big attention in mixed groups of experts (they are coming from academic research sphere and industry) is given to the flexible form of transfer of knowledge. They are endeavouring to effectively reconcile the demands of both sectors: research and entrepreneurial. This fact is especially important because most of heads working in centres of excellence or university incubators are distinguished university professors, actively involved in research work and with international references. They are either leaders of research groups, laboratories or even departments of academic or research institution.

2. It is very well known that diversification of organisational structures of both sectors (research and business) is one of the most important elements of successful collaboration. However, the results of our interviews show that intermediary organizations have positively influenced links between academic researchers and engineers from industrial development laboratories. Both groups can share sophisticated research equipment and other infrastructure. Namely, public research laboratories in Slovenia have still insufficient and out-of-dated research infrastructure. For example, the heads from centres of excellence interviewed admitted that one of the main reasons for forming this kind of institutions was to gain funds for new, sophisticated and usually very expensive equipment. From new equipment benefit both: university researchers and practitioners from business sector. That brings important advantage of this type of collaboration: creating of the new interdisciplinary knowledge.

3. The heads of intermediary organizations interviewed have agreed that their position acquires the knowledge of research management, better skills in regard IPR etc. Notwithstanding, on the ground of additional answers of respondents, it would be difficult to say that they strongly support the new models regulating IPR. For example, in the framework of our interviews there were not given precise answers on how relations among partners are regulated concerning the right to revenues arising from emerging patents and other licensed knowledge. It was impossible to obtain any (reliable) information about the forms of undisclosed technologies produced by researchers involved in the partnership. Currently the intellectual property matters and rights to revenues arising from patents and other licensed knowledge are left to university regulations. According to them researcher-inventor has a right to one third of patent/license income, the other two thirds goes to university and laboratory or department. However, in our empirical investigation it was very difficult to obtain straight answers regarding regulations of IPR among partners involved in innovation networks.

4. We asked heads and directors of intermediary organizations to assess, if cooperation with industrial partners does mean for researchers to loose the academic culture and ethos. Based on their experiences, most of them are convinced, that collaboration with industry does not lead to the direct conflicts of interest. However, there is always a danger of neglecting basic research in order to fulfil contractual obligations to industrial partners. One of the interviewees coming from innovation incubator from university emphasised disadvantages of a R&D policy environment, stimulating in the last only work on

applicative projects. He expressed the threat that new R&D policy environment could destimulate younger researchers for basic research. By respondents, there was exposed additional deficiency destimulating researchers for creative (basic) research work: the irrational and in many circumstances unnecessary administrative work, proceeded from strict governmental legislative provisions. Among interviewees, there was expressed a great need for simplification of control procedures.

5. Finally, the serious issue, mentioned by many respondents, is a very complex administrative procedure regulating the governmental support to intermediary organizations. Let us take again the example of centers of excellence. Centers of excellence receive the financial support only after the final approval of the mid-term reports. They are especially during the initial year were often returned for additional clarification or missing data due to poor instructions from different supervisory governmental bodies. It is a serious and continuous problem. One needs to take into consideration the fact that there are few intermediary organizations of the large enough size and financial resources to be able to cope with complex bureaucracy.

Conclusion

Idea of setting up a various forms of intermediary organizations to support the commercialization of academic research in Slovenia is in

principle not a bad one, but this type of policy actions would need to be based on clear analyses of the existing capacities of business-enterprise sector to absorb to available innovations. The innovation infrastructure has not existed in the vacuum: it has received financial support off and on from the government and functioned in relation to that: in some areas more successfully than in others and at times better than at the other times. The "survival" of existing intermediary organizations depend primarily on their integration in the business-enterprise sector. The results of our empirical survey performed in the last quarter of 2007 pointed out a lot of deficiencies in functioning of intermediary organizations in Slovenia as well. There is need to introduce the new policy instruments to improve the efficiency of intermediary organizations in Slovenia.

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