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S2: Triple Helix Study / University-industry-government linkages

Regional University Knowledge Centres: a comparison between the Hungarian automotive and ICT industries

Abstract

Despite the voluminous literature on the role of RDI networks in economic development there are rather few information about their internal structure and functioning. This information is very relevant to highlight the most important factors in favour or against RDI networking. In places where the general circumstances are not really favouring such knowledge intensive collaborations the governments try to boost the process. The Regional University Knowledge Centres program was an attempt by the Hungarian government to enhance university-industry linkages and collaboration from R&D to innovation. Within the framework of this government programme consortia in different regions and industries received support and formed a more or less sustainable network of actors.

So far the chosen form of government support does not prove to be successful in its every targeted fields but it has very important values to improve the environment for RDI activities. The observations based on the analysed RDI networks show a two-faced scene. They do contribute to raising the level of activities in the core network members but the overall quality of projects among the partners is very uneven and they fail to attract a great number of new entrants into the R&D collaborations. Policymakers should spend more efforts to support fields and activities more suitable for the needs of the industry and thus enhance their commitment towards RDI activities.

Keywords: RDI networks, ICT industry, automotive industry,

1. Introduction

In the past two decades a growing number of evidences (Hagedoorn, 2002, Narula and Hagedoorn, 1999) supported the ever increasing importance and relevance of R&D networks and strategic alliances in economic growth. This process was initiated by economic changes in the second half of the 20th century and later further strengthened by governmental initiatives. The different countries responded to the new challenges in different way and in different time but some common features also emerged.

Despite the efforts in theory and empirical research our knowledge on the (internal) functioning of inter-firm collaborations and networks are rather limited and even so in the case of R&D collaborations between the economy and academia. This study investigates *R&D collaborations among firms and universities (academia) established with government support in Hungary* to identify *major characteristics* of R&D networks. To understand the impact of these networks for the universities and industry – and to see how the programme's initial aims were achieved - it is necessary to investigate what kind of collaborations are developed within these R&D networks and through what kind of mechanisms do they enhance RDI activities and the regional development in broader sense. The research investigates how and how much could the partners *benefit* from the R&D collaborations in different structural positions.

The study is built upon case studies using structured interviews, to get in-depth information. The investigation took place in the information and communication technologies (ICT) and automotive industry analysing the members of two regional university knowledge centres in each industry. (This work was done as part of the PhD research of the author.) In the analysis of information – besides economic theories – *social network analysis* will be used which is suited for the analysis of relational data and for the mapping and analysis of the structure of complete networks.

2. Theoretical background

Since the 1980s more and more economists emphasized the relevance of *interactive, systemic view of innovation* against the traditional linear models. (e.g. Nelson and Winter 1982, Kline and Rosenberg 1986) In their view R&D and innovation – which became the main factor of economic growth and competitiveness – is a continuous, 'evolutionary' process, which builds on the past experiences and thus resulting in path-dependency (or technological trajectory) which enables higher specialization. (Dosi [2000], Dosi és Nelson [2000], Eparvier [2005]) On the one hand R&D and innovation become more complex, knowledge intensive, while on the other hand enterprises – to keep up competitiveness – concentrate on more specific areas, which have the higher profit promises for the firm. Therefore there is a growing territory where inter-firm (or even more inter-sectoral) collaborations, networks gain on importance.

Looking at R&D and innovation activities many economists found that they are best analysed in the framework of national, regional or sectoral innovation systems to explain their impact on and differences in national performance and competitiveness. (Lundvall 1992, Nelson 1993, Edquist 1997) They found that the collaboration between the diverse actors in R&D and innovation – enterprises, research institutes, higher education research centres and other direct or indirect participants, institutions - is key for international competitiveness. This view assumes the recognition that there is a very diverse source of new knowledge in the knowledge production process and enterprises are highly interested to get access to these sources. (It is also found that among the knowledge sources the role of higher education is increasing.)

Another approach to the relationship between the different sectors involved in innovation process is the 'triple helix' model (Etzkowitz and Lleydesdorff, 1997), which emphasises more the evolutionary character of this phenomenon. The "triple helix" is a spiral model of innovation that captures multiple reciprocal relationships at different points in the process of knowledge capitalization. (Etzkowitz, 2002, p. 2.) It emphasizes the importance of university-industry-government collaboration in three dimensions: a) the internal transformation in each of the helices, b) the influence of one helix on another and c) the creation of a new overlay of trilateral networks and organisations from the interaction among the three helices.

There are many types and categories of the collaboration among firms and other actors to be found in the literature and even more in practice. Previously most of these collaborations were based on equity agreement but in the last three decades the number of non-equity agreements is constantly growing and become more popular. (Hagedoorn, 2002) Joint ventures belong to the first category while strategic alliances and networks represent the latter. A possible – and in the literature commonly used - categorization of networks are offered by Fischer (2002, p. 8), differentiating five types of collaborations based on their horizontal or vertical character:

- buyer's network,
- supplier's network,
- production network
- technology network and
- research and development network.

The first three types are vertical, the latter two types are horizontal networks. There could be many other possible categorizations, e.g. based on the types of partners etc.. The cases analysed in this paper are R&D (and innovation) networks in which participants from the industry as well as from the higher education collaborate.

More precisely the subjects of this research are horizontal non-equity agreements among a number of different and independent partners who are sharing (partly) their R&D activities. This characterisation used by Hagedoorn [2002] could be extended with the definition of Kreis-Hoyer and Grünberg [2002] on the role of innovative actors by adding the “goal of achieving a strategic

advantage by production and/or exploitation and/or diffusion of existing or new knowledge." (p.2.) Based on their view a working definition for this research of RDI networks were created by stating that they are *long-lasting horizontal relationships among independent actors from the business and scientific fields with the aim to enhance the position and knowledge base of the partners through common research and development and innovation activities*.

All authors agree with the view that the investigation of networks could not be separated from their socio-economic environment (e.g. Archibugi & Michie, 1997) but so far there are only a few studies to systematically investigate this interaction. In such a work economists might rely on theories and methods from sociology. (This approach is applied by Gilsing, 2005.) Since the now seminal work of Granovetter (1973), who investigated the role of weak and strong ties, and after his works on the social embeddedness of economic actors there is an increasing strand of sociological literature dealing with networks of firms and other actors. A group of scholars emphasize the role and importance of dense networks and strong ties that build up social capital (Coleman, 1988) and trust among partners, while others argue for the importance of structural holes (Burt, 1992) and weak ties enabling the actors to access a wide range of (non-redundant) information. The truth – in practice – is possibly somewhere between the two extremes, that is the actors should maintain a mix of both to manage a successful network. (Hagedoorn et al., 2005.) Social network analysis is one of the increasingly popular fields of sociology that developed own tools for the investigation of complex web of contacts. Its main strength is the investigation of the objectives – individuals, groups, and institutions – in their social context based on relational data. It allows a 'multi-level' (micro and macro) analysis to better map not only the features of certain entities but also the quality, quantity, way and extent of the interactions among those entities. This approach is highly relevant if we accept the interdependence of the actors and their activities in the economic field, the importance of the relational ties in innovative activities (technology transfer, diffusion of innovation etc.) and the need for information about the structural environment of the actors. (Wassermann and Faust, 1994.)

3. Research focus and methodology

In Hungary - as in many other transition and developing countries - the role of foreign direct investments (FDI) is relatively important. Local policymakers regarded FDI and the multinational companies as a useful tool for speeding up the technology catching-up process and for maintaining the RDI capacities. (Inzelt [2000]) As a result foreign-owned enterprises play a relatively significant role in manufacturing, in export and also in the RDI activities. However the embeddedness of these foreign enterprises is always a decisive question. In order to provide benefits for the host countries long-term relationships and embeddedness into the local economy is favourable. RDI networks might be a useful tool to enhance the local embeddedness of foreign-owned companies.

Despite the relative popularity of the topic of R&D networking in the international literature (Fagerberg et al. [2005]) there is only limited knowledge available about the functioning and internal characteristics of RDI networks. (e.g. Lemmens [2004], Gilsing [2005]) The information on the structure and content of these collaborations is very important because they highlight the impact of influential factors in favour and against RDI networking. *The research aims to investigate the (importance and type of) role that RDI networks play in enhancing the position of their members and the general RDI environment.* The study broadens the empirical adaptation of network theories. It is done by revealing *the structure and functioning of a selected type of RDI network in Hungary and the development of the scientific and technological capabilities of the network member enterprises.* There were very few similar attempts in Hungary. As the role of foreign direct investments in RDI in Hungary is relatively significant the analysis will go beyond the characteristics of the partnerships and will investigate the role of foreign ownership in establishing those partnerships. Through the work not only our theoretical knowledge will gain but also it will provide information to a policy that is able to support RDI networking by strengthening the positive processes and diminishing the negative factors.

The network research is a cross-disciplinary area, which is not different in this case. To be able to answer the research questions and to get useful results out from this research it will rely on a number of theories both from economics (evolutionary economics, economics of innovation, network economics) and sociology (e.g. social network theory).

According to the research topic and questions the nature of the work is mainly descriptive, and focuses on the structure, characteristics and impact of the networks. This requires in-depth information therefore the empirical research relies on case studies. This method provides insights into background connections that otherwise (e.g. using statistical analysis) could not be obtained. To be able to get firm results two case studies were done in two industries each. For the investigation the field of automotive (car parts suppliers) and ICT industries was chosen because of two reasons: a) they are significant industries in the Hungarian economy and b) they are supposed to be characterised by intense networking at least at some phase(s) of the industry activities (e.g. assembly in the automotive industry). (See section 4.2. and 4.3. for justification and introduction of the chosen fields (industries) of research.)

4. Regional University Knowledge Centres

4.1. The program

In the past few years the Hungarian Government realised that it should take steps to support the evolution of R&D and innovative capabilities and the creation of new structures (like networks) which support the prosperity of those activities. It was only in 1998 when the first program was

launched to support the creation of Collaborative Research Centres with the clear aim of improving the research collaboration between academia and industry. In 2004 the Government launched a new major programme for the establishment of Regional University Knowledge Centres (officially 'Pázmány Péter' programme). Based on the call's requirements already existing (or at least partly existing) partnerships had some advantages in receiving funding. The main aim of this program is to create regional knowledge centres with the collaboration of university, industry and government partners (universities as main actors) for high-level R&D and innovative activities for the benefit of their regional environment. The regional university knowledge centres (RUKCs) are research consortia bringing together the whole innovation chain by pooling the resources of research organisations, small and large companies of the region in various industries. The program would like to achieve the born of long-lasting structures that will exist also beyond the duration of the governmental support. The first RUKCs were established in 2005 so there are only scarce structured or statistical data available about them. They received funding for four years (in later calls only for three years) so number of these centres are in their final year (in terms of governmental support). The 19 centres were established in various fields of industries – in industries where some national competitive advantages are seen – and 2-2 out of the 19 are heavily involved in the ICT and automotive industry in the Central Hungary region and one automotive centre in the West-Transdanubian region.

The interviews referred not only to the collaborations within the RUKCs but to the external partnerships of the enterprises too. However many of the managers were reluctant to answer the questions regarding their collaborative partners and more so about the content of these collaborations. Nevertheless, the interviews shed light on the real content of their collaborations (or at least their attitude towards collaboration) thus enabling the evaluation of the importance of the linkages.

4.2. The automotive industry

The roots of automotive industry in Hungary dates back to the very beginning of the 19th century. Activities in the industry started then with car (and truck) manufacturing which was shifted towards bus and truck manufacturing during the socialist era only to face severe reforms during the transition. Previous markets collapsed, companies have to adapt themselves to a totally new situation. Multinational companies (Suzuki, Opel, Audi) started operation in the country and they needed many suppliers but there were few to fulfil their requirements. It took some time for the Hungarian entrepreneurial sector to adapt these changes but multination companies were a big boost for this process. Hungarian suppliers focused on activities with minor value added, hardly participated in RDI activities and there were extremely few companies to achieve upper-tier supplier status.

However the last decade brought some changes into this situation, some multinationals broadened their local assembly activity with RDI, some suppliers realised their only chance to stand the global competition – or even to keep their supplier status - is the development of in-house R&D capabilities but the overall picture is still poor. At least more and more company now realise the higher education sector as an important potential partner in RDI activities. The importance of such partnerships could be validated by the fact that within the government's Regional University Knowledge Centre program two such networks were established in major centres of the activity of the automotive industry.
One of the centres were established in Budapest

4.3. The ICT industry

The ICT industry in the Hungarian economy plays an important role and the industry's structure shows duality. A few large, even multinational companies settled down in Hungary and got involved in R&D and innovation activities too. On the other hand there are a large number of small companies established from scratch to operate in small local (or global) niche markets or to utilize internationally competitive human resources. There are a few success stories in the international market (like the software company Graphisoft or the ICT security firm Kürt Ltd. just to name a few) that shows the competitiveness of certain segments of the Hungarian ICT industry.
The contribution of the ICT sector in business value added is around 11% (in 2007) which is the fourth highest value among OECD member states. It is reached after a higher-than-average growth rate during the 1995-2006 period. The important role of foreign-owned companies is one sign of the internationalisation of the industry. In Hungary, the share of such companies from the turnover of IT (hardware) producers (2005) is around 66%, while of IT service providers (2004) it is less than 20%. The first value is among the highest of OECD member states, while the latter is smaller than average. The role of foreign-owned companies in R&D expenditures is even higher. It was 82% (2005), the second highest value after Portugal. However the overall picture in the field of ICT R&D expenditures is not very good. The amount of R&D expenditures lag behind significantly to the Czech Republic, or Greece and Portugal. (OECD, 2008.) In such a two-faceted industry it could be vital to establish collaborations and other flexible but stable structure that can help to catch-up for the whole industry.

4.4. The investigated centres

4.4.1. AVVC network

This automotive network, called Advanced Vehicle and Vehicle Control Knowledge Centre (AVVC), was established in Budapest at the Budapest University of Technology and Economics (BUTE). The knowledge base of the centre is also supported by an academic research group, the

Computer and Automation Research Institute (SZTAKI). Two large automotive companies – subsidiary of Knorr-Bremse Braking Systems Ltd (KBB) and ThyssenKruppPresta Ltd. (TKP) – and local SME (Inventure Ltd) represent the industrial 'needs' in their collaboration and a local ICT consultant SME (Informin.hu) with an international company providing official certifications (TÜV-Nord-KTI) round up the network. The aim of the network is to support RDI activities in the field of vehicle control (electronic) and mechatronics.

In the core of the network we would find the host university and the three automotive company. The managers/researchers of these partners have a long history of collaboration in various bilateral 'combinations' and this close relationships is based on strong personal ties. Many of these 3 company managers graduated from BUTE and still have connection with the institution. Comparing the two largest members of the network KBB has a broader and more open network of RDI relationships because TKP – although the number of partners is similar – collaborates mainly with members o the same vertical chain established by the multinational company itself and have limited contact with the local innovation system. It seems that the two large players are key in enhancing the network and other R&D collaborations but they are created two – only slightly overlapping – sub-networks. The automotive SME is also 'nested' in the core of the network with strong but few relations to the major players KBB and TKP. Although this situation is beneficial for the SME at the moment but on the long run it might constrain it's possibilities in developing their own business. The other specialized partners of the AVVC network, and the collaborative partners of AVVC members are only loosely connected to these players mainly by less complex bilateral agreements. Although these weak ties do convey some information (and positive examples) to less RDI intensive partners and to those who are reluctant to engage in such collaborations their impact on improving the overall situation is rather minimal.

Figure 1 here

During the interviews some of the managers mentioned that in the selection of partners – apart from the most important trust and proven capabilities – the possible indirect connections have a role in the decision. However there was no example of the use of these indirect relationships in the network examining the collaborations. This might be partly related to intellectual property issues, that everybody is keen to avoid leakage of knowledge towards unintended 3rd parties. Furthermore it might take more time to develop a community where such indirect and multi-partner relationships could become a more realistic phenomenon.

The government support of the AVVC network seems to help stabilize an already existing strong and dense collaboration among the RDI active automotive companies. However it seems to be rather week in directly attracting more actors into the scene. Still the improved RDI activity of the network members provided them the opportunity to achieve extra income from the new innovations and their performance draw the attention of many other companies that could be a potential client / partner in RDI activities.

4.4.2. JRET network

The second investigated automotive network is the Regional University Knowledge Centre for Vehicle Industry (JRET) mainly organized around three very active enterprises: Rába Axles Ltd, Borsodi Ltd and Visiocorp Hungary. They are connected by the local university, the 'Széchenyi István' University (SZE) which in turn connected to a few other 'big players' in the local industry, like the local subsidiary of Audi, GM, LuK etc and many other SMEs in the region's industrial parks. The analysis concentrates on the activity of the first three players and on the structure of the network around them.

The three enterprises (Rába, Borsodi and VisioCorp Hun) focus on three different technologies within the JRET: Rába – a large national company - on the construction of complex modules, Borsodi – a local SME - on cutting methodologies and planning/measuring algorithms and Visiocorp Hungary – a multinational subsidiary - on moulding technologies. As a result the enterprises have practically no common R&D work in the network, each of them execute their tasks in collaboration with university researchers. However they formed together the JRET, which added a new dimension to their relationships and to the network structure of the local automotive industry.

The three companies of the network vary not only in their size but in their RDI activities. Rába, the largest of the three, has an R&D department for long and tend to rely its capabilities. They involve external partners only in cases that are outside their core competences and/or in cases when it is more efficient to involve experts than to develop internal capabilities. Borsodi seems to have the most diverse partnership of the three with important linkages to the scientific and business R&D sphere. They follow a very pretentious path which helped them to become from a simple lower-tier supplier an R&D partner of large multinational company and now to develop their business towards the aerospace industry (as parts-supplier). Visiocorp (Hun) embody a unique case: a manufacturing site improve and broaden its activities and after a few R&D collaborations they have created their own in-house R&D department to improve their international competitiveness.

Figure 2 here

Investigating the structure of the relationships of the SZE and the three companies it becomes obvious that the centre of collaborations is the university and some other knowledge institutions. They provide the 'glue' for the network. Furthermore it seems that the three companies built three spheres of further R&D partners and these spheres are hardly overlapping each others. Interestingly the largest Hungarian company has the smallest number of R&D partners and it is the least connected part of the network. Borsodi and Visiocorp (Hun) are in the middle of a more dense network of R&D collaborations and these two companies work together with each other, too. Comparing to the previous automotive network (AVVC) this partnership is less dense, more centralized around the university and the complementary expertise of the companies means they

are connected mainly through weak ties. It seems that these weak ties cannot provide enough cohesion. The use of the R&D relationships are rather incidental in the network and lacks the necessary strategic view to be able to develop into a real useful local system. R&D collaborations are mainly seen as a necessary solution when some problems cannot be solved in house or they need expert opinion but they are not regarded as a tool for opening up new fields and new business opportunities. Therefore the network cannot be as powerful tool as it could be but its impact on the development of the enterprises' capabilities is undisputed.

Interviews strengthened the view that government support played a crucial role in enhancing R&D activities in the region. In this case not only the RDI activities and relationships were stabilized but clearly the level of activities have been raised. The JRET partner companies were able to gear up their R&D efforts but they were also able to involve a couple of other companies into R&D assignments that would not happen without the addition public funds.

4.4.3. IT^2 network

In the case of this network the host university acts as the magnet for partnerships. This is Hungary's largest technical university (the same host organisation as of AVVC network) with very rich and attractive knowledge base in a lot of scientific fields. The university has built up research partnerships with a large share of ICT multinationals and other large companies residing in Hungary and engaged in R&D and innovation. Enterprises find it attractive to collaborate with the university not only because of the knowledge base embedded in its employees but to create early contacts with soon-to-be-graduates and ensure reinforcements.

In the so called *IT^2 network* a big selection of partners collaborate: apart from the host Budapest University of Technology and Economist (BUTE), there are Balabit Ltd, DSS Consulting Ltd, E-Group Services Ltd, ESRI Hungary Ltd, Hewlett-Packard Hungary Ltd, Megatrend Informatics Inc, Nuance-Recognita Inc, Secfone R&D Ltd, and T-Systems Hungary Ltd. Three of the 9 enterprises are subsidiaries of large multinational companies (HP, Nuance-Recognita and T-Systems) and there are two others belonging to international chains ESRI & DSS). Among these partners one can find large, medium and small sized companies. The IT^2 network is active in the core ICT territories and because of the large number of partners there are many smaller projects for software development and a few involving hardware manufacturing.

Figure 3 here

Among the enterprises of the IT^2 network there are rather few direct linkages therefore the university's role in network building is inevitable. It bridges the structural hole among the various fields of IT and its actors. It was a common observation of the interviews that the Hungarian IT enterprises are hardly collaborative and they are unwilling to speak about their partnerships. The enterprises in the network follow a very different approach in RDI collaborations. Large multinationals are open to create durable linkages to the local knowledge base. However the

majority of their local partners are higher education institutions (HEIs) or other public research institutions. The local enterprises tend to rely on their internal capabilities and try to keep their values by secrecy. In the few cases when they need external knowledge they collaborate with a few very reliable partners. These collaborations usually established when some very specific knowledge is needed. Another field for collaboration is in the development process when already existing products (usually software) need to be adjusted to specific needs and circumstances. It is extremely rare that significant R&D and innovation activities are pursued in collaboration.

The network structure shows high centrality: the university and a few big enterprises consists the core. There are a few more enterprises around the core that are more active in RDI and in collaborations than the average 'players'. They are usually connected to only a few further partners and there are no interconnectedness among these partners, no web-like structure in the network. The existing linkages rather weak and they do not involve core competences. The knowledge flow although open to two-way 'traffic' the benefits to be gained are rather limited. One important benefit that firms might achieve is to learn about collaborations, new business practices (e.g. project management).

The role of the government support is not easy to be judged. The IT market is a fast changing territory while governmental programs imply longer projects. However within such complex programs, as the knowledge centres, there are more resilience to realise shorter term projects too. The different ways in which the government supports RDI activities provides good opportunities for enterprises that they are likely to utilize. They make RDI cheaper or speed up the processes. The interviewees mentioned only a very few cases where the project would not be realized without governmental support.

4.4.4. E-Science network

The so called *E-Science network* is a relatively smalr collaboration: the industrial partners of the host Eötvös Loránd University are Delta Electronik Ltd, Econet.hu Informatics Company and MultiRacio Ltd who are loosely collaborating with another RUKC established with ThalesNano Nanotechnology Inc, Diagnosticum Ltd, Bio-Science Ltd and Supertech Ltd. All but the last of them are Hungarian owned enterprises while Supertech Ltd is a Hungarian-German joint venture company. They are all SMEs. This centre acts in the intersection of IT, biotechnology and nanotechnology. Their collaboration is more focused to bioinformatics, cell communication and network informatics.

The aim of the E-Science network is to combine the disciplines that at the moment do research work separately such as biology, physics, mathematics and computer science, and by interconnecting the methods and means of the disciplines mentioned, the Center wishes to create a new cohesion. However this cohesion is not secured by densely connected partners but by strong centrality. This central player is the host university and its technology transfer office (in

utilizing the research results). The present partners were not totally unknown for each other that made it easier to collaborate with them. The previous contacts established a certain level of trust among partners and it is generally true, that linkages are very much depending on certain persons at the enterprises and they are institutionalised only to a very limited extent. Similarly to the previous case the partners in this network are collaborating with only a very small number of partners which is the result on the one hand of their mistrust and on the other hand their limited human resources (in this case the partners are SMEs).

The E-Science network operates in a field, which is very new to everyone; therefore there are a lot of things to learn. This learning takes place not only scientifically but technically (learning about collaborating, learning about new processes etc.) too. The collaboration within the network is more significant for the partner SMEs in terms of competences and workload. Unfortunately this does not reflected in the network structure. The linkages – just as in the previous case – weak and sparse: there are only a few strong ties towards the central university. Interconnectedness occurs only among the central partners external sphere of the network is separated.

Figure 4 here

The government support plays an important role in this case because the subject of the collaboration involves a (scientific) territory without antecedents. In such cases the government's role is crucial because the risk-taking attitude of enterprises and even more of SMEs is very low. Most of the projects within the network could not be realized without such support that provided at least on the short- or medium term calculable financing. The other advantage of government support is that the additional funding makes larger projects available and thus enterprises could keep up with international developments. As a contrast firms are reluctant to rely on such support because of the additional bureaucracy it may imply and only the more flexible more open enterprises will go this way.

5. Conclusions

RDI networks come into practice in more and more fields in Hungary too. Of course this process is hindered by the overall low level of RDI activities and by the low level of business expenditures in R&D. The current networks are an important way of learning for local enterprises but to find the proper form for this process is rather difficult. The Regional University Knowledge Centre program is not the first governmental approach to support RDI collaborations but there are still many weaknesses of the approach. Its predecessor turned out to be a useful tool to exploit the knowledge available at public research organisations (mainly at universities). The present program put more emphasis on the common creation of new knowledge and innovations. However it fails to significantly broaden the number of firms engaged in complex RDI activities and it – so far – fails to achieve significant regional impact.

The second tier of the helices, universities, seems to step on the way towards an entrepreneurial institution. However they seems to be more successful in offering service-type activities and they find more difficulties in the complex, higher value added activities. They still do not really understand the needs of the business actors and the enterprises do not know what to expect from the universities.

Enterprises show a more biased picture. There is a layer of companies that are well aware of the importance of RDI activities. Unfortunately their number is small but they can be found both among foreign-owned and Hungarian companies. So far foreign-owned companies seems to be the most active in such RDI networks but as the example of Inventure, Borsodi or some ICT firms showed even Hungarian companies can be internationally competitive in this field. There is a larger bunch of firms that are trying to strengthen their activities in this field nowadays. For them the RDI networks could be a good example and an anchor where and how to start building up their in-house capabilities. In their case the government support is an important impetus. The majority of the companies at the same time not aware of the importance of this field and not devoting enough efforts for RDI. This can be measured in the (in international comparison) low level of business R&D expenditures in both industries.

In the structure of RDI networks two types could be identified. The AVVC network represent the only example of a real web-style dense collaboration of the core partners. Even in this case the peripheral partners are only weakly connected to the network and their role are only subordinated. The majority of the networks are based on mainly weak ties that provide access to new/complementary fields of knowledge for the central firms but their impact remain rather limited. The interviews revealed that really significant and complex projects require more close and 'intimate' relations from the partners. These networks although involved multiple partners could strengthen only certain bilateral collaborations and realized very few multilateral ones. They also failed to launch a self-reinforcing process in favour of RDI collaborations. There are a number of conditions in the RUKC program that 'prevent' it from achieving full success but the unsteady policy environment adds a further negative effect.

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