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R&D Cooperation between Universities and Enterprises

by
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Preface

From the second half of the 20th century, organised cooperation between universities and enterprises became an essential factor in R&D. Globalisation helped open a new chapter of R&D with the organisational fragmentation of R&D as an important feature: Multinational companies began to relocate part of this activity in other well developed and less developed countries. In addition, governments are increasingly willing not only to support but also to participate in R&D cooperations (known as the "triple helix model") (*Malecki,* 1980; *Etzkowitz–Leydersdorff,* 1997). As a consequence, an open system of international innovation has evolved.

For Hungary as one of the post-transition economies it is vitally important to find ways to participate in the worldwide innovation process. The new situation allows universities and enterprises in the less developed countries, too, to be actors in this process. Earlier research and dedicated literature deal mainly with the relationship between foreign large companies, multinationals and local universities in the field of R&D. However, this is only one element of R&D cooperation. To create a stable and concrete mutual interest between universities and the economy has become a general goal. There are numerous obstacles – legal, financial, economic, etc. – which hinder the formation of a university–enterprise relationship (*Dőry,* 2005; *Csonka,* 2007).

Research work dealing with R&D analyses mainly the types of partnership, characteristics of the partners, the content and results of a cooperation (*Inzelt*, 2004, 2010; *Varga,* 2004; *Varga–Parag,* 2009; *Horváth,* 2010; *Erdős–Varga,* 2010). The scope of our empirical study is particular in that it explores the long-term effect of those important R&D cooperation that had already ended. The purpose of the study was to examine whether the working connections developed among the partners survived the end of large projects, continued later and could be utilised for new purposes. For the network capital thus created carries a large value, particularly if the local possibilities are limited (for example, if only one local university and a few companies can be found in one region). If this research can demonstrate the positive influence of large projects initiated and funded by state agencies, it would help to justify and encourage governmental support in R&D.

The study consists of two main parts:

In the introduction (first part) we deal

- with the history of cooperation between the universities and companies, the different types of their relationship, the cases of developed and less developed countries
- the special situation in Hungary after the change of the political system

– the characteristics of the partners involved (foreign and domestic enterprises and the local universities).

The second part describes the empirical study:

– preliminaries,
– the purpose and scope of the study,
– the details and results of our research,
– the potential practical use of the results.

The research group consists of Tibor Dőry (SZE Győr), Csaba Deák and Anett Kiss (ME, Miskolc), Balázs Lengyel (SZTE, Szeged) and is headed by Györgyi Barta (CRS, Budapest). Our investigation included the universities of Szeged (SZTE), Győr (SZE) and Miskolc (ME) and their enterprise-partners. The interviews were conducted in 2009.

1 Part I: Introduction

1.1 General background: the past and types of cooperation between universities and companies

The history of cooperation between universities and the economy is not long, and the open system of innovation is also a rather recent development. In this system the roles of enterprises and universities have radically changed (*Dévai* et al. 2004).

In the beginning, large industrial companies had their own in-house research departments and occasionally bought the results of research from outside sources. (*Lawton Smith,* 2006).

Beginning in the second half of the 20th century, universities have increasingly become producers and sellers of research results. Globalisation opened a new chapter in R&D. Multinational companies; whose leading role in innovation is still essential, have always regarded R&D of strategic importance and formerly kept it close to their headquarters. Later this strategic activity became fragmented, and a part of research and most of the development activity was shifted to branch plants of a company located in developed and less developed countries. In addition, large companies began to organise their R&D as activities separate from routine production.

In our modern and more democratic times, universities lost their former role of offering education only for the elites of societies; the gates of the universities were opened for the masses. At the same time, governments were less and less able to finance higher education. Universities had and have to find new funding

for developing their activities, and for becoming or remaining competitive. This is the main reason for any fundamental reform in higher education. The two major missions of universities – i.e. being the sources of knowledge and providing education on the highest level – are complemented with a new function: The university is becoming one of the most important actors of the knowledge economy. Universities are participating in the economy; they are aiming at selling their R&D results and services to enterprises (*Acs–Audretsch–Feldman*, 1991; *Geuna,* 1999).

Cooperation between universities and enterprises can be divided in four main groups according to their characteristics (*Inzelt,* 2004):

- between individuals (experts' papers, conferences, scientific meetings, purchase of licenses, etc.)
- between individuals and institutions (university lectures, common publications, organisation of master and PhD courses, common intellectual property of the results of research activity, patents, licences)
- between institutions (utilising enterprise/university infrastructure, laboratories, investment of enterprises in universities to assist in R&D, planned and permanent purchase of university patents by enterprises, research contracts between universities and companies, cooperation in common research projects)
- organisational changes (spin-off companies, mobility of individuals).

1.2 University–enterprise relationship in Hungary

1.2.1 In the socialist era

The socialist system was characterised by a lack of innovativeness, and the necessity of technical renewal was amiss among the basic „codes" of the system (innovation, the so-called „creative destruction" is a key element of capitalism as emphasised by Schumpeter). From time to time innovation was introduced into the socialist system under external pressure such as requirements for exports, limits to imports, and as a permanent effort to catch up with the leading capitalist economies.

The characteristics of R&D in the socialist system can be understood only in that context. The socialist states spent relatively significant money on R&D (in general more than 1% of the national income). However, they were not really interested in the outcome of such activities. The results produced by R&D departments of the large factories, or by independent research institutes were not or hardly ever utilised in the economy as even the goods produced by obsolete

technology found ready buyers in those countries which were suffering under the permanent shortage of goods and services. The introduction of innovations into production processes was seen as causing unnecessary problems.

Independent research institutes (universities, too) were poorly financed by the state, but they did not need to find further resources for survival as their existence was never questioned. At the same time the permanent need for economic growth required the use of all available resources: For example, R&D departments at the universities carried out contract work for enterprises (generating welcome and important extra income for universities).

1.2.2 After the change of the political system

During the privatisation phase, socialist companies disintegrated along with their R&D departments, and largely disappeared. (There were a few exceptions: GE regarded the R&D activity of the large light bulb company, Tungsram, as particularly valuable, and continued to fund it after privatisation. The R&D activities in the pharmaceutical companies also survived more or less intact.)

After the 1990s, the research institutes belonging to the Hungarian Academy of Sciences continued to exist, but the number of researchers was halved, and they are continually fighting for their survival. There has been some increase in human and financial resources at the universities. Teachers are obliged to participate in research and to engage in postgraduate and postdoctoral work, but this cannot be regarded as a successful endeavour, partly because of inadequate funding, partly because of teachers' overload due to the priorities set by mass education.

University-enterprise cooperation is always driven by the demand for innovation from the enterprise side. As a consequence, one needs to examine the attitude of the different new groups of enterprises towards innovation, and whether they require new R&D results, particularly from universities or research institutes. Recent experience has shown that all cooperation involving industrial production requires long-term commitment, because such relationships need to be based on trust. This goes for university-enterprise relationships as well.

1.3 The new potential enterprise-partners of universities in R&D

Twenty years after the change of the political system, Hungary is still struggling with the problems of a dual economy. The economic differences between the economies driven by foreign-owned companies, on the one hand, and by the domestic companies, on the other, are so huge that even the relationships between them are very limited, and not really expanding.

Innovation[1] plays a key role in catching up, i.e. in decreasing the dual character of the economy. This is the reason why a willingness and ability of companies to innovate is crucial.

In this chapter, enterprises are analysed according to their innovativeness. The underlying question is whether the dual structure of the economy can be explained, at least in part, by the differing capability of enterprises for renewal. It is obvious that only innovative enterprises are potential partners of universities in the R&D field.

According to the survey of the Hungarian Statistical Office[2], the differences of companies regarding innovative capacity can be determined by three main criteria:

- size of company,
- sector of the company,
- ownership (foreign or domestic).

1.3.1 Innovative companies – according to size

The survey shows that nearly 60% of the large companies, one third of the medium-size companies, and only 16% of the small companies could be called innovative in 2008 (*Figure 1*).

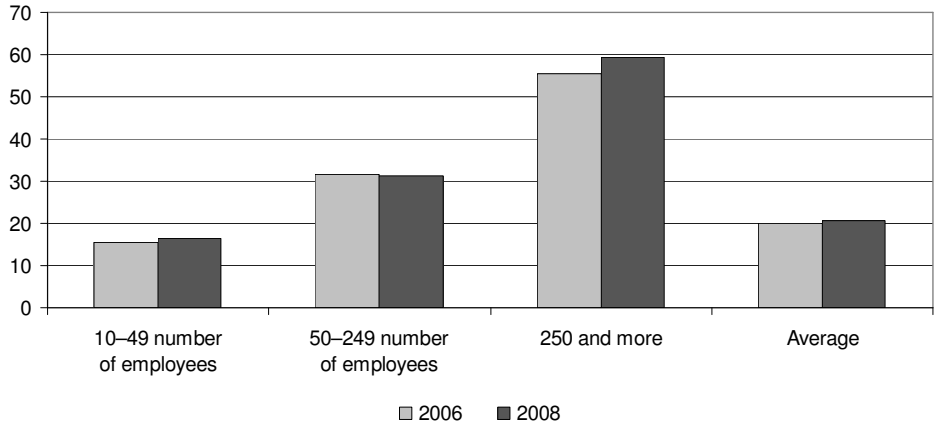
Moreover, between 2006 and 2008, the proportions changed in favour of the large companies, while the innovativeness of medium-size companies stagnated or decreased (in line with enduring disadvantageous features of the Hungarian economy). Within the group of foreign companies, the number of large companies is more strongly represented than within that of the domestic companies. (According to a study the average size of a foreign company [number of employees per company] is almost four times as large as that of the average Hungarian company – *Barta,* 2010.)

[1] In the Oslo Manual (3rd edition) published by the OECD in 2005 (p. 46), the definition of innovation is as follows: An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations.

[2] Beginning in 2005, the Hungarian Statistical Office has conducted statistical surveys about the innovativeness of companies. 5000 companies returned the questionnaires in 2009 (our data show the situations as of 2008).

Figure 1

Proportion of innovative enterprises according to size, %



Sources: KSH Statisztikai tükör, 2010. 80.

1.3.2 Innovative companies according to sector and ownership

Only those sectors were selected whose index of innovativeness exceeds the average of manufacturing at least twofold. Each sector is characterised by a high degree of foreign ownership. It can be seen that the contribution to the production value of manufacturing is decisive in two sectors: electronics and vehicles (altogether 40%) (*Table 1*).

Table 1

Proportion of innovative enterprises in manufacturing, 2008, %

Innovative sectors	Proportion of innovative enterprises	Proportion in production value of manufacturing	Proportion of foreign property (1998)
Tobacco industry	50.0	–	93.3
Coke production, oil industry	60.0	6.5	
Chemicals	45.2	4.4	54.8
Pharmaceutical industry	70.0	3.5	
Computers, electronics	42.0	20.9	74.3
Vehicles	40.8	18.8	72.0
Manufacturing	21.6	100.0	56.8

Sources: KSH Statisztikai tükör, 2010. 80.

1.3.3 Private-sector R&D

R&D is the most important field in any enterprise-university cooperation. Thus potential partners of universities are to be found among those companies with the highest R&D expenditure (in terms of money, labour and infrastructure). A number of results and facts mentioned in this chapter were published in a remarkable article by *Inzelt* (2010).

In general, R&D expenditure of multinational companies is highest in six sectors (information technology, car industry, pharmaceutical industry, biotechnology, electronics, aircraft and space industry). From the aspect of FDI in Hungary, four of them can be identified: pharmaceutical industry, information technology, car industry and electronics which account for 75% of the R&D expenditure of all foreign companies, with the car industry and pharmaceuticals in the lead (*Table 2*).

Table 2

R&D expenditure of enterprises by sectors in Hungarian manufacturing, 2007, %

Sectors	Foreign companies	Domestic companies	Total
Pharmaceutical industry	23.9	17.1	22.3
Information technology	0.5	8.4	2.3
Car industry	48.3	0.9	37.2
Electronics	2.9	4.8	3.4
4 sectors together	75.6	31.2	65.2
Others	24.4	68.8	34.8
Total	100.0	100.0	100.0

Sources: Inzelt, 2010. p. 440.

The R&D expenditure of the Hungarian-owned companies in these four sectors hardly reaches one third of all expenditure, and only the pharmaceutical industry's is significant. However, Hungarian-owned information technology and electronics companies show at least higher R&D expenditure than their foreign-owned counterparts.

In Hungary, 67% of all private-sector R&D expenditure is paid by foreign companies, out of which the car industry accounts for 32%, and the pharmaceutical industry, for 16%. The most important Hungarian-owned pharmaceutical's R&D expenditure is only 6% of the total.

Part of the R&D activities of companies is outsourced. It is important to note the role of contract work, as R&D cooperation between universities and enter-

prises takes place mainly in specialised research firms. According to Inzelt's survey, 37% of private-sector R&D is carried out by such research firms in the form of contract work, and in the four sectors grouped together contract work accounts for more than 50%. In the wholly foreign-owned car industry, more than 80% of R&D is outsourced contract work. Hungarian-owned companies (mainly in the pharmaceutical industry and in information technology) outsource their research much less frequently.

It is not exactly know how much of this contract work outsourced by companies is offered to universities, but it is certain that in funding university R&D activities the proportion made up by contract work is considerably higher than the EU average. The fact that foreign companies cover two-thirds of the expenditure of private-sector R&D allows the conclusion that FDI plays a highly significant role in research and development activities of universities, particularly in research dealing with automotive and pharmaceutical issues (*Barta* et al. 2007).

1.4 Slow change in universities – towards potential R&D partnerships

Leaving aside the general transformation of high-level education and the reforms in university education, we will focus on the universities as potential partners of enterprises in the R&D field. The starting-point is the fact that, in their efforts to innovate, it is the enterprises which are the main initiators of any cooperation. In the previous chapter we showed that a key role in this cooperation is played by the large companies, particularly the foreign multinationals, especially those in the car and the pharmaceutical industries.

The Hungarian universities went through an important transformational phase in the two decades after the change of the political system, but these changes were not as radical as those in the economy. The majority of universities remained in state hands (a few private, mainly smaller universities were founded), and the number of academic entities hardly changed. An attempt at consolidation of the university system („integration") was not very successful (after this process, about 75 institutions remained of the original 100). The teaching staff is largely the same, and the funding of infrastructure and operating costs remained parsimonious. At the same time, mainly as an effect of EU-accession, mass education became central, and the number of students quadrupled. Yet the number of teaching staff hardly increased, and faculty members are totally exhausted by their teaching burden. As a consequence, they have no time for research work, publications or even furthering their careers.

The question is how the universities can accept the challenge, i. e. answer the expectations of enterprises looking for partners in R&D. That the universities have no choice but to meet industrial requirements seems beyond dispute, partly

because they need this important source of income, partly because this is the only possibility to catch up with technological development. In addition, such cooperation is mandated by governmental educational and research policy. However, in order to be partners in R&D cooperation with enterprises, Hungarian universities will face keen competition from foreign companies and research groups already settled in Hungary.

Over the last twenty years, a positive shift has been observed regarding both the increasing attention paid to those requirements by local universities, and a growing willingness of universities to enter into cooperation with enterprises.

1.4.1 Which university partners are of interest to enterprises?

Formerly, multinational companies would locate R&D activities in another country in order to assist in the introduction of their products on the local markets, or to support production in branch plants. Foreign companies would carry out development work (but not research) in the host countries, whereas research activities were strictly kept near headquarters.

Globalisation causes multinational companies to locate increasingly large parts of R&D activities in developed and developing host countries. The main reason is that those companies need quickly increasing numbers of highly educated, talented experts. A factor not to be neglected is the lower costs of local experts (mainly young beginners). Multinational companies employ local researchers to participate in both basic and applied research, but essentially they seek innovation, and are ready to purchase innovative results from local R&D institutions. However, joint research with local R&D firms is rarely initiated by multinational companies.

On the other hand, some of the larger foreign enterprises contribute considerable funds to the special education of their potential employees. They need new young graduates whose knowledge and skills meet their requirements. That is why multinationals are willing to contribute to the running costs of universities, create and finance new departments, install laboratories, assist in the scientific activity of the teaching staff, and even participate actively in education (for example, Audi at Széchenyi University in Győr, or Bosch at Miskolc University). This approach enables foreign enterprises to accept (and improve on) the knowledge available at the university of a less developed host country instead of expecting it to instantly provide new, up-to-date knowledge all by itself in certain fields (such as engineering).

1.4.2 What have universities to offer?

In a backward host environment, the sheer existence of local universities is of large value. Backwardness means first of all a poor economic milieu, a region where there are only a few enterprises ready to cooperate, where the labour market is not able to provide enough qualified personnel, and where there is a shortage of modern business services. The role of universities in such backward regions – as owners and transmitters of knowledge, and as cooperative partners in the knowledge economy – is of great importance, even if, from an international point of view, those universities are not competitive.

The enterprise-university relationship in Western countries is positively influenced by the high quality of research activity at the universities and the advanced technological level of production in the enterprises. In the Western countries, the universities develop innovative solutions; their research work is, generally speaking, on a higher technological level than that of the enterprises. As a consequence, it is the universities which initiate and dominate the R&D relationship between university and enterprise. In Hungary (and in other less developed countries, particularly in post-communist countries), FDI-driven companies represent a much higher technological level, and the foreign enterprises are able to afford much more capital to create and introduce innovation than the local universities. The foreign enterprises, therefore, dominate R&D, and this fact determines the character of the university-enterprise relationships in turn.

There are several reasons why universities are mired in inertia when it comes to establishing R&D relationships with enterprises:

- Their intellectual property rights are in a state of chaos. Any multinational company is able to purchase practically any Hungarian innovation or new product, a fact that may easily result in the external control of R&D at a university. According to an OECD survey (*Guinet – De Bacher*, 2008), 60% of Hungarian patents are in foreign ownership.
- Universities and enterprises are working in different interest systems (universities are in state hands, basically part of a non-profit system; enterprises are in private ownership, operating in a market system), which may cause difficulties. For example, the management of a university might not accept that only one department, one research group or only a few individuals are supposed to be financed by an enterprise, because as a matter of principle, the management wants to distribute any special income within the whole university. Yet this principle does not stimulate competition and causes tension. At the same time, it is difficult to control or hinder successful experts or talented students from receiving awards from organisations outside the university.

1.4.3 The positive role of the state

The participation of the state has already been mentioned above. It plays the decisive role in forming and financing university-enterprise cooperation (triple helix model). Formerly the Central Technical Development Fund (KMÜFA), later its successor, the National Office of Research and Technology (NKTH) were the main governmental entities to which the support of university-enterprise cooperation was assigned. Major projects were the so-called „cooperative research centres" (KKK), and later „the regional scientific university centres" (RET). These projects will be dealt with in the next chapter in some detail, in order to examine the assertion that „giant" state projects will foster university-enterprise cooperation in the long run.

Lastly, the so-called innovation tax has to be mentioned. It was introduced in Hungary in 2005, and its direct purpose was to enlarge state funding of R&D and, indirectly, to serve university-enterprise connections. Medium-size or large enterprises are freed from paying the innovation tax if they do research „in house", or award R&D contracts to universities or research institutes. One of the effects of this tax was that enterprises decided to increase financing of R&D at the universities (*Dőry*, 2005).

1.5 Summary

It was with some difficulty that a system of university-enterprise cooperation was formed. Regarding the universities, this was mainly the result of some internal and external pressures. These pressures consisted of the need to increase university income, the imperative to participate in high-technology research, and last but not least government stipulations (i.e. state support was contingent on compliance by universities). Large companies, first of all the foreign multinational companies in Hungary, are the main partners of local universities.

Despite the difficulties mentioned, there is some progress in university-enterprise R&D cooperations (*Table 3*).

In parallel with the increase in R&D resources, their structure has changed significantly. The governmental sphere is still the most important supporter, but its relative contribution has decreased drastically. At the same time, revenues from the enterprises grew substantially, one third deriving from domestic companies, the other two thirds, from foreign companies (according to a survey conducted at twelve Hungarian universities between 2000 and 2005; *Inzelt,* 2010).

The simpler types of university-enterprise cooperation have spread throughout Hungary. As in other less developed countries, is takes time to create more sophisticated types of deeper and closer cooperation. The case of the ex-communist,

less developed countries is unique in that their former university-enterprise relationships totally disappeared together with the socialist economy and its enterprises. To harmonise the interest systems of universities and (foreign) enterprises remains a challenge.

Table 3

R&D sources of universities, in %

Sources of funding	1995	2000	2007
Governmental sphere	89.8	85.8	76.8
Enterprises in Hungary	2.1	5.7	13.7
Non-profit	–	1.0	1.8
Foreign (non-enterprise) sources	3.8	5.4	7.7
Others	4.3	–	–
Total	100.0	100.0	100.0

Source: Inzelt, 2010. p. 442.

2 Part II: The durability of R&D relationships between universities and enterprises: an empirical study

2.1 Scope and point of departure

Our study highlights an infrequently considered aspect of R&D cooperation between universities and enterprises; do professional relationships continue, and do professional networks remain active, or are they at least revivable after the conclusion of a larger-scale R&D cooperation programme? The intention of this empirical study was to establish if there are tangible grounds for future state funding of R&D activity.

Before we designed our empirical study, we examined suitable programmes involving universities and enterprises already concluded: KKK and RET programmes fit our criteria sufficiently, being state-funded programmes launched with the main objective of promoting cooperation between universities and enterprises.

The National Office for Research and Technology (NKTH) announced the establishment of so-called Cooperation Research Centres (KKK), two of which were associated with universities in the capital (Inter-university Telecommunication and Informatics Centre, Semmelweis University Cooperation Research Centre), one with the university of Miskolc (Cooperation Research Centre of

Mechatronics and Materials Science), one with the university of Pécs (Cooperation Research Centre of the Southern Dunántúl) and one with the university of Veszprém (Cooperation Research Centre of the Chemical Engineering Institute of Veszprém University). The universities represented the core of these cooperation projects; however, the centres could only be established with the involvement of cooperating enterprises. These KKK centres were assigned the task to include further education, R&D and technology transfer in their strategic objectives.

The government's underlying objective in establishing Regional University Knowledge Centres (RET, 2004) was to facilitate the forming of organisations which would become highly competitive with regard to both research and development and technological innovation so that they may accelerate the development of their region. The National Office for Research and Technology (NKTH) funded six projects in the first year (2004), and a further six projects in each subsequent year within the framework of the RET programme. In contrast to the KKK programme, RET prioritised applied R&D among fundable activities, thus only basic R&D that would also serve applied R&D and experimental development (up to 30% of total R&D funding) could be performed under the programme. It was required that the R&D activity should take place at the host university or in its close vicinity, thus reinforcing the regional dimension of the project and its role in knowledge generation and knowledge dissemination (*Varga,* 2004; *Rechnitzer–Hardi,* 2003).

KKK and RET partnerships mentioned in this study were:

- Cooperation Research Centre of Mechatronics and Materials Science (Miskolc)
- Innovation management Cooperation Research Centre (Miskolc)
- Knowledge-intensive Mechatronic and Logistics Regional Knowledge Centre (Miskolc)
- Vehicle Industry Regional University Knowledge Centre (Győr)
- Life and Materials Science Cooperational Research Centre of Southern Alföld (Szeged)
- Regional University Knowledge Centre of Southern Alföld (Szeged)
- Environmental and Nanotechnological Regional University Knowledge Centre (Szeged)

Of the partnerships mentioned above, three universities were included in our study: the University of Miskolc, Széchenyi University in Győr and the University of Szeged. The cooperation between universities and enterprises was analysed on the basis of one KKK and two RET programmes. The differing profiles of the programmes mandated commensurate compositions of the groups of individuals to be interviewed (*Table 4*).

Table 4

Research areas of respondents within the profiles of RET and KKK programmes, by university

Győr	Miskolc	Szeged
Vehicle industry, electronics, logistics	Mechatronics, material sciences, logistics	Life sciences, neurobiology, nanotechnology

2.1.1 Composition of questionnaires

We had originally planned for a questionnaire-based survey, but because of the low number of respondents, we finally conducted the investigation by means of interviews (using, of course, the same questions as originally intended). We divided the questionnaires into two groups. In the first group, we targeted the institutions taking part in the cooperation and in the second, the individuals involved. The questionnaires directed at the two groups were of slightly different structure.

The questions were divided into 4 groups:

- The first group of questions was directed at institutions and individuals taking part (in order for us to be able to identify the institutions and individuals).
- The second group of questions addressed the history of the cooperation (the reason for participating in the cooperation, earlier partnerships).
- The third group of questions was related to the cooperation programmes themselves, but not so much to the scientific objectives of the respective programme, but rather to the characteristics of the participants.
- And the fourth segment of questions – the most significant for our purposes – was directed at examining the repercussions of the respective cooperation, and in particular, at how earlier experiences were utilised again and whether the established partnerships reappeared in newly established forms of cooperation.

2.1.2 The respondents

79 questionnaires were filled in at 3 universities (31 questionnaires in Győr and Miskolc and only 17 in Szeged). The majority of respondents in Győr is from the corporate sector. This ratio is about 50% in Szeged, while in Miskolc the majority of respondents is from the corporate sector again (*Table 5*).

More than half of the participants of the survey were in a leading position, one-third were lecturers or otherwise employed, and only a little more than 10% described themselves as working in research and development.

Table 5

Sector of present employment by university involved in cooperation, %

What is your present place of employment?	Győr	Miskolc	Szeged
University	26	0	47
Corporate sector	74	93	47
Other	0	7	6

Source: Questionnaire results, 2009.

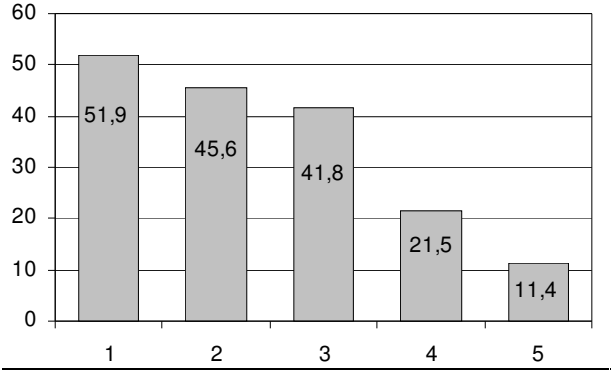
2.2 The History of the Cooperation Programmes

2.2.1 Motivations

In order to understand the participants' *motivational system,* their reasons to participate were identified and categorised according to importance (*Figure 2*).

Figure 2

Reasons for participating in the programme, ranked by importance

Proportion of „plays a significant role" answers	Reasons	Average
	1) Area of interest	2.34
	2) Expansion of professional relationships	2.16
	3) Workplace obligation	1.89
	4) Scientific ambitions	1.28
	5) Expected raise in salary	0.84

Source: Questionnaire results, 2009.

Ranking the importance of reasons to participate showed the most substantial motivating component as a correlation between personal interest and the subject matter. Next was the expansion of professional relationships, and at third place on the list, workplace obligation was mentioned. Interestingly, scientific ambition and financial interest did not score high.

When comparing universities, significant differences were observed. With respect to motivational ranking, the University of Győr shows a dissimilar pattern, as the reason for participating was most often identified as 'workplace obligation'. Participants at the University of Miskolc considered 'professional relationships' to be more important than the average, and the increase in income was also less of a marginal consideration than at the other two institutions. The motivational curve of the University of Szeged was more level. However, it should be emphasized that workplace obligation was the least important argument for participants from this institute.

2.2.2 Involvement in the programmes

Here, the most important information is the *frequency ranking of involvement mode.* 48 percent of respondents received an explicit invitation from the initiators of the programme. This can be considered the most common procedure. With 38%, earlier relationships (with either the university or one of the participating companies) stand at second place among the reasons for involvement. Almost every third respondent also mentioned that their workplace made participation compulsory or a requirement. Every fourth person also responded that they were involved in the programme owing to a personal project. The number of participants involved through tenders is surprisingly low (3 persons).

The typical involvement mode and the form of initiative adopted were very dissimilar at the three universities (*Table 6*). The workplace, acting as an "obligating" or an "insisting" entity was mentioned most frequently in Győr. Only there was tendering applied. The majority of respondents from Szeged indicated they joined because of the invitation. In case of Miskolc University, however, the proportion of answers indicating personal initiative and earlier relationships were exceptionally high.

Table 6

Potential modes of involvement in the programme – positive answers, in %

How did you join the programme?	Győr	Miskolc	Szeged
Initiation of own personal project	9.7	51.6	17.6
Invitation from initiators	35.5	61.3	47.1
Assumed an organising-leading role	6.5	64.5	23.5
Took part in a tender	9.7	0.0	0.0
Workplace obligation, requirement	58.1	22.6	17.6
Had previous contacts with the university or one of the participating companies	25.8	54.8	29.4

Source: Questionnaire results, 2009.

2.2.3 Relationships prior to the programme

Assessing involvement modes, the prior relationship established with the university or participating company appeared to play a major role in involvement. There was a separate question pertaining to the *nature of the relationship* between the person questioned and the individual or the institution participating in the RET or KKK programme *prior to the programme.* 13 possible relationship-types had to be assessed with the indicators weak, moderately strong and strong. This question was intended to measure the extent and complexity of the pre-existing integration of the professionals involved.

Out of 79 respondents, only 12 people (15%) did not have a professional relationship with their potential partners before the start of the programme. Respondents had, on average, three types of prior connections with one of their future partners. The majority of respondents had previous connections to the university or the company through either one (19%) or even four or five (33%) channels.

An analysis of *concrete forms of association prior to the programme* follows (*Table 7*). Relationships that were mentioned by only a few respondents were nevertheless described as stronger associations (joint participation in strategy development, purchasing of research results, joint ownership of intellectual property, business relationships). The only exceptions were earlier R&D projects that were frequent and proved to be resilient forms of association even prior to the commencement of the programmes. Earlier R&D projects were mentioned by 50% of respondents, and this relationship type was assigned the second highest relationship intensity value (2.4). The most frequent prior connection channels

(mentioned in 60% of the cases) were professional meetings, forums and conferences.

Joint publications, lectures, and joint organisation of PhD and Master courses received a surprisingly low value as regards intensity, and these forms of cooperation were only mentioned by a few respondents.

Table 7

Probability analysis of occurrence of relationship-types and average value of relationship intensity

Relationship type	Yes, by number	Yes, in %	Intensity average	Intensity deviation
Ad hoc discussions	48	61	2.0	.824
Regular discussions at professional gatherings and conferences	47	59	2.0	.834
Participation in joint R&D projects	39	49	2.4	.818
Joint publications	24	30	1.5	.721
Occasional university lectures organised by the partner	19	24	1.5	.841
Established other business relationships	14	18	2.1	.829
Held occasional lectures for partner companies	12	15	1.3	.452
Purchasing of research results (patents)	11	14	2.4	.674
Joint ownership of intellectual property	11	14	2.1	.831
Employed regularly by partners as a lecturer, trainer	10	13	1.6	.843
Participated at joint strategy development forums	5	6	2.6	.548
Participated in professional training of partner's employees	5	6	2.0	.707
Joint PhD and Master courses	5	6	1.2	.447

Explanation: The intensity of the relationship may vary between 1 and 3.
Source: Questionnaire results, 2009.

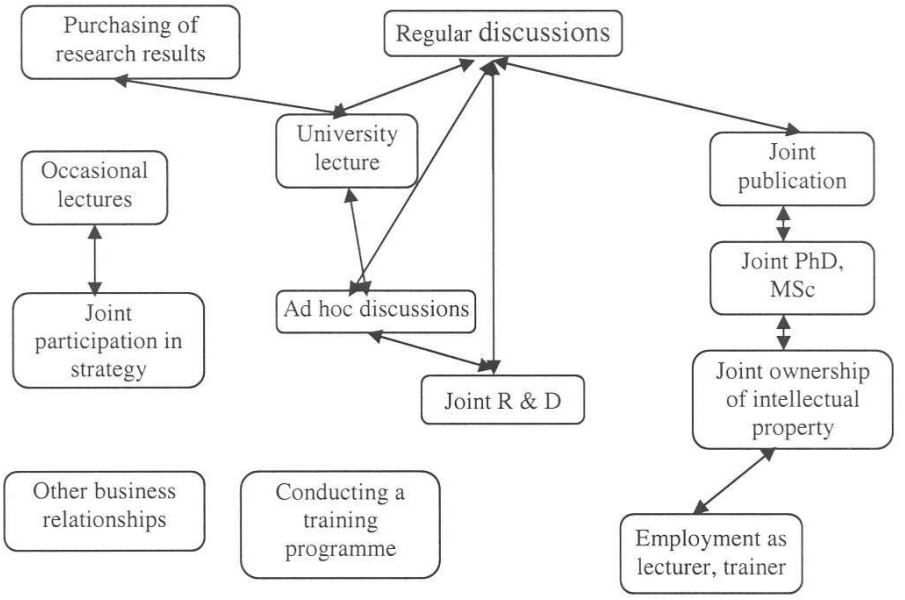
It is obvious that joint projects and the organisation of joint university lectures are frequent and fostered regular and occasional professional gatherings. "Old boys' networks" are also apparent in the system (*Figure 3*). Those who had convened professional gatherings also mentioned joint publications more frequently, and those who mentioned joint publications were involved more frequently in university lecturing programmes.

The results broken down according to the *three universities* disclose *significant deviations.* All respondents with connection to the Szeged University

had prior relationships with the institution or other related companies. In Miskolc, the percentage of those with an earlier association is also very high (97%). Practically all of the respondents who reported having had no connection prior to the RET or KKK programme are from the University of Győr. So it seems that the percentage of new people invited to participate in the programmes was much higher (35%). Integration through relationships prior to the programmes demonstrates deviations of the same nature: 5-6 relationship types were reported from participants in Szeged, 3-4 in Miskolc and only 1-2 in Győr.

Figure 3

Correspondence of pre-programme relationship types
(Correlation of network connections larger than 0.4)



Source: Questionnaire results, 2009.

2.2.4 Prior expectations

Almost all respondents mentioned professional relationships and increase in professional expertise. Similarly, expectations relating to utilisation of professional expertise and practical application of research and development results were mentioned in over 90% of responses. An expected increase in remuneration, achievement of new scientific results and professional career development appear

in the bottom segment of the list, nonetheless showing relatively high percentages (*Table 8*).

Development of social, professional and human capital and the utilisation of research and development results were the expectations most often indicated. Respondents were more reserved when disclosing professional and material advancement that are similarly important from the individual's point of view. There are no significant dissimilarities regarding such personal motivation parameters at the three universities.

Table 8

Ranking of preliminary expectations and the average value of expectation intensity

Type of prior expectation	Yes, %	Expectation intensity
Development of professional relationships	96	2.5
Increase in professional expertise	95	2.5
Utilisation, transfer of professional expertise	91	2.3
Practical application of R&D results	91	2.7
Development of new processes, products	86	2.6
Testing of research and development results	84	2.3
Generating new projects	82	2.1
Professional, scientific career development	67	1.7
Accomplishing scientific objectives (publications)	67	1.9
Salary increase	61	1.8

Source: Questionnaire results, 2009.

2.3 Opinions regarding the RET and KKK programmes

2.3.1 Success of the programmes

According to the personal assessment of the respondents, all of the programmes respondents participated in were successful. 75 out of 79 respondents answered the question, and only one person considered the programme unsuccessful. Respondents were invited to state the reasons behind success in an open question. Some respondents argued that since the programme achieved its set objectives, therefore it could be considered successful. The majority, however, believed that either the reason for success was the *practical application of results* (especially in industry), or the *development and implementation of new research results, tech-*

nology and processes. Professional relationships, the intensity or perhaps efficiency of the *cooperation between the university and the enterprise* were other reasons why participants regarded their programme a success. Success factors mentioned are similar at the three universities.

2.3.2 Organisation of the programmes

There were three questions relating to the respondents' *"work environment"* and *workload* during the programme. The proportion of working hours spent on the programme was one important factor. Another was the size of the workgroup the individual was working in, and finally, the proportion of the partner institutions the individual had direct interactions with. These factors do not represent main focus points of the research, but provide important information regarding the organisational background of the programme operation and implementation.

The RET and KKK programmes were designed for workgroups of less than 10 people. A quarter of the respondents worked in quite small groups of 2–3 people, about a third of them were part of groups of 3–5 or 5–10 professionals. Only a few reported groups of more than 10 people. In general, participants spent 5–20% or their working hours on assignments related to the programme (47%). The other large group of respondents (30%), however, described spending less than 5% of their working time on the programme. The intensity of internal relationships within the cooperation projects was not high. Almost two-thirds of respondents stated that they maintained direct interactions with less than 10% of cooperating partners during the programme.

Fundamental differences in corporate culture and work relationships were revealed at the three universities. In case of *programmes in Győr,* the number of professionals working in workgroups of 5–10 people was higher than average, it was at this site that participants reported high, 20 or even 50% workload, and those who maintained actual work relationships at over 50% of possible cooperating partners were also overrepresented. More intensive work was conducted on a wider base of cooperation with groups larger than the average size. Regarding answers from Miskolc, it can be concluded that the typical group size was 3-5 persons (69%), the majority of participants spent less than 5% of their working hours on projects related to the programme, and this is also where establishment of connections between cooperating partners is most scarce (87% of respondents maintained relationships with less than 10% of partners). A larger proportion of respondents from Szeged reported large workgroups, although their workload was rather moderate (two-thirds reported between 5–20%), and the ratio of partners in the working relationship was between 10–50%. For Győr and Miskolc extreme values were registered for organisational and workload parameters, but with opposite mathematical indicators.

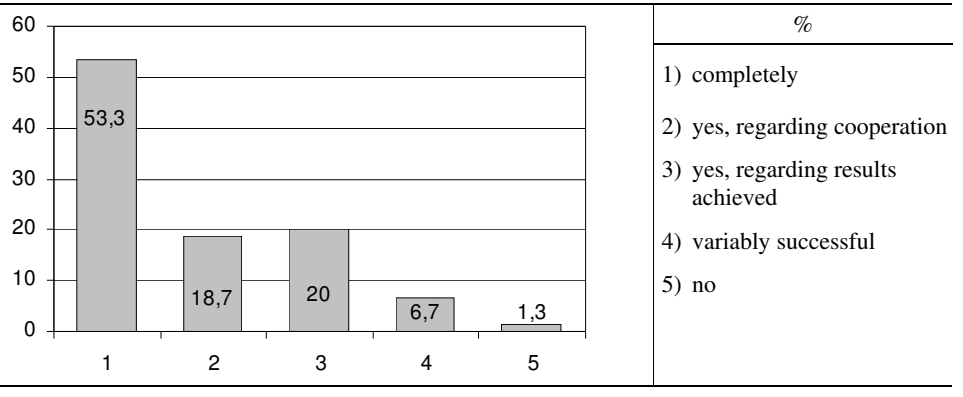
2.3.3 Personal aspects of participation

The evaluation of the RET and KKK programmes becomes more meaningful when personal aspects and benefits of participation are considered. The question pertained to how *satisfied the individual was with his/her own participation* and *role* in the programme (*Figure 4*). Over 50% of respondents were completely satisfied with their role and performance. 19% considered their work successful for the purposes of the cooperation, while 20% assessed it more of a success regarding the results achieved.

Significant differences are observable at the three universities (Table 9). Most of the individuals (72%) in Miskolc considered their participation and performance completely successful. The individuals who were only partly satisfied regarded their activities successful pertaining to its cooperation aspect. The proportion of those completely satisfied was significantly lower among *Szeged respondents* (only 35%), and there are many more respondents who considered their performance only variably successful. In the case of *Győr*, the percentage of those completely satisfied is close to average, while assessment of success based on results achieved was highest. It seems that performance and achieved results were the key considerations for success in Győr, while in Szeged individuals focused on the cooperation itself and its encouragement (where not complete individual success was reported).

Figure 4

Assessment of the success of the programmes regarding personal participation



Source: Questionnaire results, 2009.

Table 9

Assessment of programme success regarding personal participation

Extent of success of personal participation	University		
	Győr	Miskolc	Szeged
Yes, completely	44.8	72.4	35.3
Yes, regarding cooperation	13.8	13.8	35.3
Yes, regarding results achieved	37.9	6.9	11.8
Variably successful	–	6.9	17.6
No	3.4	–	–

Source: Questionnaire results, 2009.

Apart from a general categorisation, we measured in what way *individual success* derived directly from participation was mentioned (*Table 10*). Basically, success as interpreted by individuals can easily be measured based on summarised data. In most cases (65%), starting a new project and participating in it were the main individual success factors. The other factor relates to publication opportunities and was mentioned by every third respondent. Every fourth person reported having gained valuable international contacts. The remaining four success factors were case-specific. Job promotion was not mentioned at all among the responses.

Table 10

What kind of personal success was derived directly from participation in RET and KKK projects?

Direct personal success	Total (Yes, %)	University (Yes, %)		
		Győr	Miskolc	Szeged
Participation in new projects	65	55	71	71
Publication	31	29	17	59
International contacts	22	10	23	41
Patent	8	3	0	29
New position	6	6	3	12
PhD degree	1	0	0	6
Promotion	0	0	0	0

Source: Questionnaire results, 2009.

Individual success factors do not appear in identical combinations and percentages in the university subsamples. In Győr, fewer respondents reported new projects and international relationships, and the number of people mentioning

opportunities of publication was significantly lower in Miskolc and Győr than the respective value in Szeged. Only the Szeged subsample reported patents. It seems to be clear that the Szeged subsample included individuals who also perceived a higher added value regarding the R&D aspect of participating in the programme.

2.4 Relationships following the conclusion of the KKK and RET programmes

The third part of the study, as well as being the actual objective, deals with the ramifications of the programme, the applicability and convertibility of the experience gained, the sustainability of personal and institutional contacts and the success of the cooperation, as well as new opportunities arising from these cooperation projects.

2.4.1 Success and applicability

The success of RET and KKK programmes can be assessed based on the extent the Knowledge acquired can be utilised in subsequent professional assignments, new projects, at some stage in research and development or even production or the rendering of services.

Experience gained and contacts established during the programme were mostly utilised for developing new relationships. Only 25% of respondents replied that they were not able to utilise the experience and information acquired during the course of the programme for this purpose. Approximately 45-50% also utilised their experience at some stage in production, choosing a new research area or responding to a tender. The probability of utilisation in the total sample is lowest in publication and education, but this is not surprising as the majority of respondents have a corporate background.

The two groups of respondents (corporate sector and university) are clearly distinguishable in the area of usability of programme results. Respondents with a corporate background profited from the programmes in two aspects: establishment of relationships and increase in the efficiency and development of production. University respondents' answers differ: Besides establishment of relationships, almost every respondent mentioned further education as well.

Assessing this question for *each university,* two more significant conclusions can be drawn. Respondents from Szeged University reported usability in most areas, followed by Győr and Miskolc respondents. This correlates well with the fact that respondents at the three universities had completely different working environments.

Each opportunity of utilisation had to be rated according to frequency, which may be viewed as a kind of usability index. Experience gained during the programmes can most frequently be utilised in establishing new relationships and in improving production, then in drawing up bids for tenders. Identifying and choosing new research areas stand at third place.

If we evaluate the *success of the cooperation* according to its dimension (organisational, consortial, national or international effect), the low occurrence rate of internationally significant results is an important conclusion (*Table 11*). The other new and important piece of information implies that the majority of respondents was involved in programmes that did not as a result or consequence, place them in the international spectrum or lead to international relationships. Expansion of professional experience, the development of the professional network, new products, and processes would appear with the highest probability as results in the course of cooperation.

Table 11

Evaluation of the results of cooperation according to their significance, %

Aspects	No such results	Significant for my organisation	Significant for a consortium	Significant on a national level	Significant on an international level
Expansion of professional experience	8.9	26.6	20.3	39.2	5.1
Development of professional network	11.4	29.1	17.7	32.9	8.9
New product or process developed	16.5	15.2	20.3	39.2	8.9
Implementation of development as planned	21.5	17.7	17.7	36.7	6.3
Generation of new projects	27.8	20.3	13.9	32.9	5.1
Compliance with contractual obligations	29.1	12.7	22.8	34.2	1.3
Joint publication(s)	43.0	12.7	19.0	19.0	6.3
Expansion of international relationships	53.2	21.5	6.3	15.2	3.8
Reported patent	79.7	3.8	6.3	3.8	6.3

Source: Questionnaire results, 2009.

The responses indicating insufficient results are congruent with the answers given to the question: If the cooperation could be started again, *which aspects should be emphasised more?* The summary table (*Table 12*) contains the results of the answers provided by the first three largest groups among the total sample

and the university subsamples. Besides new product development and the generation of new projects, expanding international relationships were favoured most. The logic behind a shift in emphasis at the universities is not the same. In Győr, respondents would pay more attention to conventional, more frequent aspects, while new opportunities and international cooperation would be of greater emphasis at the other two universities.

Table 12

What aspects should have greater emphasis if the cooperation could be re-started? – Three most frequent answers, %

Aspects	Total sample	Győr	Miskolc	Szeged
Expansion of professional experience		64		
Development of professional network		38		
New product or process developed	47	64		59
Implementation of development as planned				
Generation of new projects	38		45	65
Compliance with contractual obligations				
Joint publication(s)				
Expansion of international relationships	44		61	53
Reported patent			52	

Source: Questionnaire results, 2009.

2.4.2 Characteristics of the relationship-network following the programme

Since the relationships consequent on the programme (i.e. at present) between individuals and organisations were requested to be characterised as well, certain *transformation tendencies* can be anticipated. We would like to demonstrate how the cooperation programmes affected the complexity and strength of these relationships, how well they persevered, how they became more versatile and intense within the university and corporate sector, as well as between sectors.

Regarding the *complexity of the relationship structures,* i.e. considering how many of the 13 possible connection types functioned simultaneously, positive changes occurred as an effect of the programmes (*Table 13*). 48% of respondents in the whole sample reported a wider range of relationships alive than before the programme. There is a significant differentiation among the universities. Respondents from Győr university experienced the highest advancement, 60% maintain more channels of relationships with individuals and institutions than before. In Miskolc, the percentage is close to the sample average, and the smallest

growth in complexity of the relationship structure was experienced in Szeged. This is no surprise as the integration of professionals was already significantly higher prior to the programme.

Table 13

Changes in the relationship structure as a result of the programme, %

Type of sample	Those with more complex relationships
Total sample	48
Győr questionnaires	60
Miskolc questionnaires	47
Szeged questionnaires	35

Source: Questionnaire results, 2009.

The shift is positive in almost all cases regarding the *probability of the occurrence of each type of relationship,* that is to say the number of people associated with other individuals or institutions taking part in the RET or KKK programmes increased in each case. A particularly significant change is observable in four types of relationships: participation in joint R&D projects, joint publications, invitations to lectures, training and tutoring. These relationships are thus productive in character and stimulated by the cooperation (*Table 14*).

The *intensity of the relationships* was to be assessed on a scale of three grades (weak, average, strong). If we compare the intensity of the relationships before and after the programme, again, positive tendencies are observable in certain cases (*Table 15*). The results are more varied: There are several relationship types that weakened after the programme: business relations, purchasing of research results, joint participation at strategy development forums. However, the intensity index associated with the three most frequent relationships did not shift considerably, i.e. the first three relationship-types in the table. If they had existed before, joint publications, organisation of lectures and joint PhD and Master courses increased. *On the whole, strengthening is not unequivocally characteristic of relationship intensity,* but joint efforts did enliven cooperation in certain areas.

When examining the intensity and the occurrence probability of the relationships by each *university,* totally dissimilar *relationship-structure profiles* become apparent at the three institutions. In Győr, only a few respondents maintain relationships considered strong at present (e.g. joint PhD and Master courses, joint intellectual property), most of the relations were evaluated as average (joint R&D project, joint publication, regular discussions).

Table 14

Changes in the occurrence of relationship types as a result of the programme, %

Types of relationships	Before (Yes)	After (Yes)
Ad hoc discussions	61	76
Regular discussions at professional gatherings, conferences	59	63
Joint participation in R&D projects	49	58
Joint publication	30	47
Held occasional university lectures organised by the partner	24	21
Established a different kind of business relationship	18	24
Held occasional lectures for the partner companies	15	11
Purchasing of research results (patents)	14	17
Joint intellectual property	14	19
Was employed regularly by the partners as a trainer, lecturer	13	22
Participated jointly at strategy development forums	6	13
Participated in training of the partner's employees	6	18
Joint PhD and Master courses	6	10

Source: Questionnaire results, 2009.

Table 15

Change in intensity of relationships as a result of the programme

Type of relationship	Intensity before	Intensity after
Ad hoc discussions	2.0	2.1
Regular discussions at professional gatherings, conferences	2.0	2.0
Joint participation in R&D projects	2.4	2.4
Joint publication	1.5	1.8
Held occasional university lectures organised by the partner	1.5	1.9
Established a different kind of business relationship	2.1	1.7
Held occasional lectures for the partner companies	1.3	1.4
Purchasing of research results (patents)	2.4	1.7
Joint intellectual property	2.1	1.9
Was employed regularly by the partners as a trainer, lecturer	1.6	1.7
Participated jointly at strategy development forums	2.6	1.8
Participated in training of the partner's employees	2.0	1.7
Joint PhD and Master courses	1.2	1.7

Explanation: The intensity of the relationship varies between 1 and 3 (weak, average, strong).
Source: Questionnaire results, 2009.

The relationship-structure profile of professionals at the Miskolc University demonstrates a very different pattern. The relationships reported to be most intensive were also the most frequent: joint R&D, university lecturing, ad hoc and regular professional discussions. This correlation is valid for Szeged as well. However, besides projects and discussions, other relationship types were also allocated a higher priority (joint intellectual property, joint publications). Basically, the results indicate that the programmes did not generate identical effects regarding the development of relationships as a result of the RET and KKK programmes and the range of the professionals involved.

One question was: What are the *key factors regarding the sustainability of personal and institutional relationships and the implementation of durable, long-term cooperation projects?* To this, the respondents' opinions were fairly uniform (*Table 16*). Two out of four answers were allocated priority (either 'critical' or 'important'). The most important factor in sustaining cooperation has to do with the regular exchange of professional experience (reciprocity), and the initiation of joint development work, although the significance factor varied slightly. Fewer respondents considered the time necessary for establishing and maintaining relationships and providing and utilising adequate financial motivation decisive, although these were also significant factors.

Respondents emphasised that regularity and reciprocity are the main pillars of long-term, sustained operation of such cooperation programmes.

Table 16

Key factors regarding the sustainability of relationships and the implementation of long-term cooperation according to significance, %

Conditions	Critical	Important
Regular exchange of professional experience	44	32
Initiation of joint development	42	34
More time for establishment and maintaining relationships	29	28
Adequate financial motivation	19	30

Source: Questionnaire results, 2009.

2.5 Characteristics of relationships in the case of foreign-owned corporate players

Three-quarters of the 79 respondents were employed in the corporate sector. Based on the ownership structure of the company concerned, this subsample of 60 individuals can be divided into two groups. 16 people (27%) worked at foreign-

owned companies and 43 (73%) at those with Hungarian ownership. Based on this information, we can *compare relationship-structure characteristics of individuals connected to the two different company types* before, during and after the RET and KKK programmes. Owing to the small sample, this can only be regarded as an experiment, a "hunt" for potentially significant correlations, but no universal, reliable conclusions valid for the whole population of almost 300 persons can be drawn from such a small subsample. The assessment is also complicated by the high "project-heterogeneity" of the database, that is to say we are looking at representatives of research teams of diverse sizes and operational modes, established for very different purposes. In addition, the relationships with the three universities show great differences.

2.5.1 Earlier relationships

The fact that an individual participant is a manager or an employee in a foreign-owned company did not significantly influence the incidence of relationships before the RET or KKK programmes on either an individual or an organisational level. The probability of earlier relationships with later partners is of a similar percentage (87%). In fact, regarding the question of how *complex their relationship-structure was before the programmes*, their data is even more significant. In this sample of 16 individuals, every second person had already had a relationship with an earlier university or corporate partner through at least 5 relationship channels. Managers and employees at companies of Hungarian ownership demonstrate quite the opposite: The largest proportion (44%) revealed prior integration through one channel at most. Representatives of foreign-owned companies showed a higher probability of previous relationships in most relationship types (*Figure 5*).

The deviation between the two groups is outstandingly high regarding three relationship types: purchasing of research results, joint intellectual property, occasional organisation of lectures and training courses. Individuals working at foreign-owned companies reported all three relationships occurring with significantly higher probability. There were certain relationship types that only occurred at one of the groups.

The *evaluation of the intensity of preceding relationships* shows a similar picture. Respondents who were involved in the programme while working at a foreign-owned company evaluated their preceding relationships to be stronger (*Table 17*).

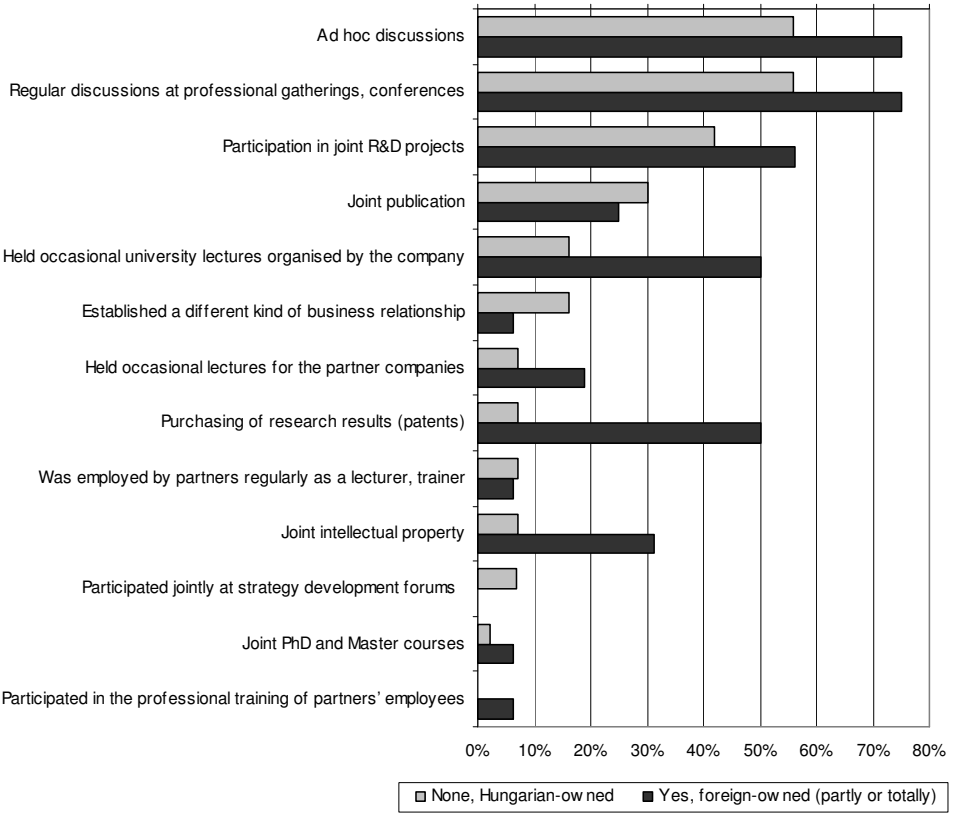
In this sample, positive deviation is significant in average intensity values regarding previous relationship channels established through purchasing of research results, discussions and joint intellectual property.

From the cumulative assessment, it has become apparent that one of the most important motivation factors regarding involvement in the programme was the expansion of one's professional network. It appears to have been very strong with 75% of individuals with a foreign-owned company background, while only 56% from Hungarian-owned companies expressed similar views.

All things considered, managers and employees of foreign-owned companies are no more isolated regarding preceding relationships than their colleagues working at Hungarian companies. Moreover, previous relationships were more complex, and it seems, once such a relationship was established, it represents a higher value in this group and thus is considered stronger regarding intensity.

Figure 5

Probability of previous occurrence of each relationship type in the two groups



Source: Questionnaire results, 2009.

Table 17

Intensity evaluation of preceding relationships in the two respondent groups

Relationship types	Ownership structure – Is there foreign ownership in the company?	
	No	Yes
Participation in joint R&D projects	2.44	2.89
Purchasing of research results (patents)	1.67	2.63
Ad hoc discussions	1.88	2.58
Regular discussions at professional gatherings, conferences	1.79	2.25
Joint intellectual property	1.33	2.20
Held occasional university lectures organised by the company	1.29	2.00
Held occasional lectures for partner companies	1.33	–
Joint publication	1.38	1.75
Established a different kind of business relationship	2.00	–
Participated jointly at strategy development forums	2.67	–

Source: Questionnaire results, 2009.

2.5.2 Evaluation of relationships established during the programme

Two questions have been examined regarding the direction and characteristics of cooperation during the programme. (1) What role did the development of professional relationships (see above) play in assessing the expectations relating to the programme? (2) What percentage of the partner institutions did the given individual have genuine work relationships with throughout the project period?

The two groups of professionals evaluated the programmes differently when it comes to *meeting previous expectations regarding the expansion of professional relationships.* In this aspect, programmes were judged less favourably by respondents of Hungarian-owned companies. (Only 40% reported the cooperation met their expectations, whereas 87% of managers and employees of foreign-owned companies were satisfied. Needs and expectations of 14 out of the total sample of 16 individuals were basically satisfied by the programme.

Although the difference is not significant from a statistical point of view, the two respondent groups are characterised by differing relationship network activities throughout the project. The question was, to what extent a respondent had work relationships with the respective partner institution throughout the project period. The cumulative assessment showed that 70% of the professionals taking part in the project had work relationships with merely 10% of all possible partner

institutions. In case of managers and employees from Hungarian companies, the percentage was lower: 64% had such a limited-range network, while 88% of professionals employed at foreign-owned companies had work relationships with a particularly small number of partners out of the total possible number of institutions. The difference is 24%.

All things considered, respondents from foreign-owned companies reported that on the one hand, the programme met their expectations more regarding the development of their professional network, and, on the other hand, most of them maintained actual work relationships with only a handful of partners throughout the duration of the project.

2.5.3 Characteristics of relationships after the programme

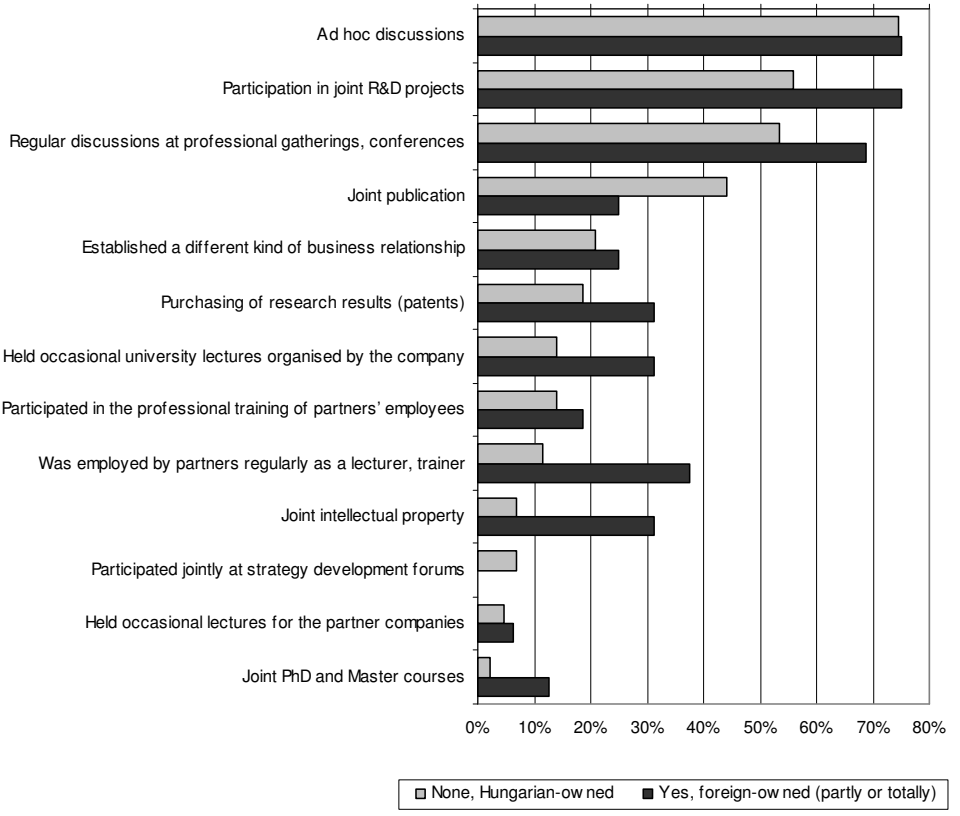
The ranking of direction and channels of cooperation after the programme does not differ considerably in the two groups (*Figure 6*). However, regarding almost every relationship type maintained at present, the ratio of positive answers is higher in case of employees working at foreign-owned companies. The complexity of the relationship structures, however, did not change as an effect of the programme. The percentage of those who perceived the relationships to have become less complex is similar in the two groups (22%), about one-third believe the complexity of the earlier and the present relationship structure was the same, 43–44% however, considered the projects to have intensified the earlier relationship structures between the institutions.

When evaluating the success of the cooperation projects, two questions were asked that are also significant from a professional network aspect. In what range and to what extent did the project complement the expansion of the professional network and the strengthening of international relations? For both questions, the number of managers and employees of foreign-owned companies who evaluated the projects to be of national or even international significance was much higher than in the total sample. If the project could be started again, only 25% of both groups would put greater emphasis on the expansion of the professional network. However, the development of international relationships would be focused on more by employees working at foreign-owned companies. 10 out of 16 people (62.5%) would regard this issue as important in the case of a new project, while in case of employees from Hungarian-owned companies, this proportion was only 13 (30%) out of 43 persons.

For all three periods, the deviation between the answers of the two groups is clearly observable. The most obvious divergence does not relate to occurrence ratios or complexity indicators, but in the way respondents of the two company types handle, interpret and evaluate the significance, value, intensity and future importance of national and international relations, networks and cooperations.

Figure 6

Probability of the occurrence of each relationship type after the programme (at present) among the two groups



Source: Questionnaire results, 2009.

3 Summary

From the end of the 20th century onwards, organised cooperation between universities and corporations became a significant factor in R&D. A new situation has arisen for both companies and universities. In this age of mass education, universities have to unearth their own new financing resources in order to develop their scope of activity and strengthen their competitiveness. This has led to the two main missions of universities – namely, to be resources of knowledge and providers of higher education – being augmented with a new function: to become

important players of the knowledge economy. They are participating in the economy, it has become an objective for them to market and sell their R&D results, cooperate with companies and to offer them their innovations as a service.

The corporate environment has also changed. Globalisation helped open a new chapter of R&D as organisational fragmentation became manifest in this sector as well. Multinational companies, the first and foremost beneficiaries of R&D, began to relocate part of this activity in other well developed and in developing countries. Additionally, governments, as new role-players of R&D cooperation, not only support, but are also willing to participate in, R&D cooperation projects. These processes offer explanations as to how an open system for international innovation is evolving. It is essential for Hungary to be capable of taking part in the international processes of innovation.

Our study is founded on the assertion that professional networks established in the course of R&D are of great value, especially if local opportunities are limited. Our empirical study investigates the *aftermath* of significant, already concluded R&D projects. Our objective was to assess whether the relationships established between the partners during the programmes survived the conclusion of these projects, and whether these relationships were utilised again later when organising new projects.

The study consists of two parts: The first part introduces an overview of the general experience regarding cooperation in R&D projects undertaken by universities and enterprises, while in the second part, we present the results of our empirical study.

3.1. Part 1

3.1.1 The new role of universities in R&D

The question is, how our universities can meet the expectations of enterprises looking for R&D partners. In an underdeveloped receiving environment, universities are overvalued, as knowledge-creating, knowledge-disseminating and cooperating partners in a knowledge economy, although in reality, a university may not be competitive enough internationally.

In Hungary, a particular situation can be observed: Foreign companies often employ significantly higher technologies than are available for university research and they possess incomparable resources for creating and implementing innovations. As a consequence, enterprises dominate the relationship established between them and a university. Universities still have laborious ways regarding the development of relationships (intellectual property is obscure, universities operate out of different interests and with a different cost allocation system com-

pared with corporate entities). The position of universities and companies is disparate, and this situation could make it vulnerable to external interference.

3.1.2 Innovative companies in Hungary

For universities, innovative companies represent a group with a potential to become partners in R&D. Based on innovativity ratio, company size and the proportion of total production, the electronics and the road vehicle manufacturing industries are obvious choices. Foreign capital is significant in both sectors. Regarding R&D expenditures, multinational companies in six sectors (information technology, vehicle industry, pharmaceutical industry, biotechnology, electronics industry, aviation and space research industry) are of highest importance. In Hungarian FDI, four of these industries have emerged and attained significance: the pharmaceutical industry, information technology, the vehicle industry and the electronics industry. 75% of R&D of foreign-owned companies is concentrated in these four sectors, with the vehicle and pharmaceutical industry playing the most significant roles. In Hungarian-owned companies, R&D expenditure pertaining to these four sectors amounts to merely a third of all business-related R&D, and only the pharmaceutical industry is conspicuous. Some enterprises outsource their R&D to other companies. Outsourced R&D is of special interest as this is where university-enterprise cooperation is concentrated, primarily in research related to the vehicle and pharmaceutical industries.

3.1.3 University-enterprise cooperation

The relationship between enterprises and universities is always inspired by an enterprise's need for innovation – under normal circumstances. Thus the following issues need to be assessed: How do various groups of newly established enterprises in Hungary relate to innovation, do they need R&D results, and do they expect these results to be provided by universities? Experience shows that relationships form with difficulty in our country, and they are entered into by universities more or less under coercion. The motivation rests in the need for revenue, an expected income from companies, the access to high technology and, last but not least, the compliance with state requirements, as state funding is often conditional on R&D cooperation with industrial enterprises. For various reasons, it is mostly large companies, and again, mostly multinationals that will partner with universities.

Despite all difficulties, university-enterprise cooperation has found its place in Hungary as well. R&D resources have increased considerably, and their structure

has undergone a significant change: Although the public sector is still the major financial resource, its proportion has markedly decreased, while R&D revenues from the private sector have increased significantly. Research indicates the distribution is as follows: one third of the funds are derived from domestic sources and two thirds from abroad.

3.2 Part II

In order to demonstrate whether professional relationships are maintained after the conclusion of a significant R&D cooperation programme, state-funded KKK and RET programmes concluded in the first decade after the year 2000 were perfect examples. Their main objective was to foster cooperation between universities and enterprises. Three universities were involved in the study: Miskolc University, Széchenyi University in Győr and Szeged University.

Originally, only a questionnaire survey was planned, but because of the low number of respondents, field research was conducted through interviews. The questionnaire was sectioned into four parts: questions pertaining to the participating institutions and individuals, questions about events preceding the cooperation, the cooperation programme itself, and events subsequent to the cooperation programme. This final group of questions were most significant to us, as we were aiming to ascertain how earlier relationships were utilised, and whether the relationships already established were turned to again for subsequent cooperation programmes.

In total, 79 questionnaires were filled in at 3 universities.

Our empirical study supports three important conclusions:

- State-funded, large-volume programmes contributed to the formation of permanent networks linking university and enterprise professionals.
- Characteristic local dissimilarities between the nature, the scope and the durability of cooperation between the universities and enterprises in the three cities were observed.
- A significant difference was revealed regarding the willingness to participate and to cooperate between foreign-owned and Hungarian-owned companies.

Long-term sustainability of relationship networks

The answers received showed that relationship networks already existed before the commencement of the extensive programmes in several areas, but even more significantly, in the field of R&D. Participants joined these programmes enthusiastically and with great expectations. Predominantly, they were interested in strengthening their relationship “capital”, and in utilising the results in production

and scientific research. Financial considerations were not a significant motivation. Most of the participants considered the cooperation successful, meeting their expectations. *Following the conclusion of the programme, the relationship capital grew, the relationship networks expanded.* Certain relationship-types intensified: joint participation, joint publications, organisation of joint educational events, whereas business relations weakened, fewer research results were purchased and the role of joint strategic forums decreased. In other words, it was more the universities which gained, while corporate participation – regarding content – narrowed. It was the unanimous opinion of respondents that the most important benefit of participation in these extensive programmes lies in the continuation of relationships on a personal and institutional level and in intensifying long-term cooperation.

Differences between regional organisations

The attitudes towards cooperation differ because the universities of Miskolc and Szeged had close and multifaceted earlier relationships with the enterprises taking part in the cooperation, while these relationships were rather feeble at the Széchenyi University in Győr. *The circumstances in Győr were different from those at the other two institutions from the very beginning, the reason for which is to be found precisely in the history of the cooperation programmes.*

The forms of participation in the programme also differed between the universities: In Győr, more people took part in the cooperation and were working in larger groups, individual workload relating to the programme was higher, and their involvement was associated more with preparing bids in response to tenders than at the other two institutions. In Miskolc, respondents formed smaller workgroups and spent a smaller proportion of their working hours with assignments relating to the programme, while Szeged participants worked with a smaller workload but larger groups. Participants in Győr were the most satisfied with the programme once concluded, respondents in Miskolc and Szeged only partly so (mainly because of the limitations of the cooperation).

The programmes were assessed as useful primarily at Szeged University (with special regard to establishment of relationships, positive effects on production and the experience gained in compiling tender material, less so regarding access to new research results), Miskolc and Szeged would emphasise the international character of the cooperation more, should the opportunity for cooperation arise again. The programmes expanded and strengthened the relationship network of Győr University most significantly (the explanation for this is the smaller number and weaker nature of earlier relationships before the programmes), and of Szeged, least significantly. However, joint intellectual property and joint publications were reported as being of exceptional importance in Szeged.

International relations

It was generally characteristic of the universities that cooperation with foreign enterprises was rare and sporadic. In contrast, foreign companies which took part in the programmes had already maintained strong Hungarian relationships on several levels. However, this being the first opportunity for Hungarian enterprises to become involved in the programmes, their cooperation with the universities was rather one-dimensional. The shift towards a business-like cooperation (purchasing of research results, joint ownership of intellectual property) was significantly more frequent in the case of cooperation with foreign companies than in internally-focused Hungarian university-enterprise cooperation. *Cooperation with foreign enterprises did not intensify during the programmes* (compared to the situation prior to the programmes). Universities invited foreign companies mainly in order to strengthen professional networks, this having been already a part of the university's long-term strategy. The main motivating factor on the corporate side was to establish deeper and more stable relationships, which, however, motivated Hungarian companies less. It is therefore understandable, that foreign-owned companies were more satisfied by the expansion of professional relationships than Hungarian-owned companies. Furthermore, the Hungarian relationship network of foreign enterprises was and still is more limited than that of Hungarian companies. Regarding the assessment of the success of the programmes, it was foreign companies rather than Hungarian participants, who considered the programmes internationally significant.

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