



**PhD Degree of  
Sociology**

## **Summary of Thesis**

**László Csonka**

**The role of R&D and innovation networks in enhancing the scientific and technological capabilities of Hungarian enterprises**

**Knowledge networks in the Hungarian automotive industry**

**Supervisor:**

**Dr. Annamária Inzelt**  
University Private Lecturer

Budapest, 2009

**Institute of Sociology and Social Policy**

**SUMMARY OF THESIS**

**László Csonka**

**The role of R&D and innovation networks in enhancing the scientific and technological capabilities of Hungarian enterprises**

**Knowledge networks in the Hungarian automotive industry**

**Supervisor:**

**Dr. Annamária Inzelt**  
University Private Lecturer

## Contents

<b>CONTENTS .....</b>	<b>3</b>
<b>I. TOPIC AND AIMS OF THE RESEARCH.....</b>	<b>4</b>
I. 1. HYPOTHESES .....	6
<b>II. THEORETICAL BACKGROUND AND RESEARCH METHODOLOGY.....</b>	<b>9</b>
<b>III. MAIN OBSERVATIONS AND RESULTS OF THE THESIS .....</b>	<b>11</b>
<b>IV. LIST OF MAIN REFERENCES .....</b>	<b>16</b>
IV. 1. PUBLICATIONS OF THE AUTHOR IN THE TOPIC OF HIS THESIS .....	22

## **I. Topic and aims of the research**

During the last three decades the number of research and development and innovation (RDI) collaborations has grown rapidly. (Hagedoorn [2002]) They spread not only in the most developed countries but also on a global scene. This is the result of a number of changes in the economy after the 2<sup>nd</sup> World War (OECD [1996]), which enabled and reinforced the growth of the importance of R&D, innovation and knowledge in economic growth. The growing complexity of products and processes, the multidisciplinary nature of present scientific and technological advances forces companies to develop new capabilities to meet these new challenges and valorises the external sources of knowledge.

In Hungary the RDI networking has some special relevance and characteristics in addition to this phenomenon's general features. As in many other transition and developing countries the role of foreign direct investments (FDI) is relatively important. In Hungary the 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 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.

The general impression before I started my research was rather negative about the state of Hungarian R&D networking. I have been participating in an EU 5<sup>th</sup> RTD Framework Programme supported project of IKU<sup>1</sup> which strengthened the view that opposite to some developed countries where this process is flourishing the Hungarian situation is yet worse. Later, during the elaboration of the thesis I took part in another IKU project<sup>2</sup> on the collaboration of business and academia and this provided further evidences that the collaboration between the different elements of the innovation system is still underdeveloped. This apparent contrast between the international and Hungarian experiences drove me to do this research.

---

<sup>1</sup> MESIAS: The Relationships between Technological Strategies of MNCs and National Systems of Innovation. Consequences for National and European S&T Policies. HPV1-CT-1999-00003

<sup>2</sup> VERINEKT: Competitive integration into the European Research Area. Enhancing the collaboration between business enterprises and public financed research organisations. NKFP-5/123/2004

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 most important factors in favour and against RDI networking. It is also important to broaden our knowledge about the opportunities of the transition economies to join existing networks and about the type of networks they are involved. The research investigates the development of RDI networks relying on the results documented and models developed in the national and international literature. It refers to them to see if the Hungarian experiences are following those trends or show any kind of variance. 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.

*The main aim of the research is to reveal 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. Another important aim of the empirical research is to provide evidence on the research hypotheses. 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 rolling back 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).

## I. 1. Hypotheses

The previous section summarized that the research is dealing with question like: a) How and how much could the Hungarian enterprises benefit from RDI networking? b) How open these networks towards foreign and new entrants? or c) What are the main characteristics of Hungarian RDI networking? Based on the international and national literature it is possible to draft a number of hypotheses about the networks and about their structure and impact.

The various efforts to categorize networks have taken into account a number of different features of the relationships between the partners but it is very rare that they consider the content of those relationships. However the information on the number (form, length etc.) of contacts is of limited value without information on what type of work they represent. A single but complex, substantial project may have more significant impact on the long run than many short-term, trivial assignments. Thus,

*Hypothesis 1: In the research of RDI networks the number and extent of relations are widely used indicators but the content of the relationships determine their significance.*

In the Hungarian economy FDI plays an important role therefore she could be an interesting field to investigate the role of foreign owners in enhancing networking. Looking at their importance in R&D and export one may expect that they are an important player in driving networking too. Therefore,

*Hypothesis 2: In the creation of RDI networks foreign-owned companies may play a leading role.*

The proper functioning of the innovation systems requires the cooperation of its different elements. If they are capable to create a favourable environment it may attract other – foreign – players to join. In such an environment long lasting relationships can evolve and with time they will improve their quality too. The creation of RDI relations may be built upon previous experiences in other fields therefore the openness and ‘general’ networking activity of the partners may have significant influence on the development of RDI networks. Therefore in areas where the networking is a widely accepted business

practice (in field of manufacturing, finance, HR etc.) the RDI networks are more common, too. Hence,

*Hypothesis 3: RDI networking is more developed in areas and industries where networking in other business functions more frequent.*

In assessing the role of RDI networks for the Hungarian enterprises it is essential to know how the Hungarian enterprises could participate in the process of knowledge generation, acquirement and distribution. It is largely depending on the absorptive capability of the enterprises. Supposedly, those enterprises that spend less on RDI activities will have weaker absorptive capabilities. This, in turn will make it more difficult for these entities to utilize the possible benefits of RDI networking and therefore they will consider this type of engagement of lesser value in the market competition. On the other side the RDI intensive enterprises will raise their activities in such networks. Thus,

*Hypothesis 4: The more RDI capabilities an enterprise possess the more active role it can play in the RDI network(s).*

As the RDI essentially influences competitiveness and growth opportunities the involvement of an external partner into these activities is a risky matter of trust. The partners will share knowledge that otherwise could not be obtained and they have to know each other very well to be able to collaborate successfully. Where the trust lacks, there the partners will start building walls and bails and will start to limit the extent of collaboration. Hence,

*Hypothesis 5: The RDI networking requires a higher level of confidence among the partners than in other territories and the level of trust will affect the enterprises' actual position in the network.*

Enterprises will choose partners for long-term collaboration because this enables to gain experiences and trust with them. It is true in general and in RDI networks that negative experiences will deter enterprises to maintain collaboration but positive experiences will help to grow commitment towards the partners. Furthermore, enterprises will try to transfer and utilize their positive experiences in other fields or in other collaborations. This reduces uncertainty and improves effectiveness. Therefore,

*Hypothesis 6: The development of RDI networks is influenced by a number of cumulative processes (e.g. learning) that will affect the number of collaborations of the partners and their positions in those relationships.*

The different composition and attributes of the networks have various impact on their aims, functioning and impact on members and environment. They might improve knowledge transfer, long-term strategic research or contribute to actual problem-solving efforts. Competitors might collaborate or buyer-suppliers as well as the business entities with academia. During the investigation of the various characteristics of the RDI networks the real subject and content of the collaboration is rarely discussed. However the significance of a single multi-partner multi-year complex strategic research project is not the same as many simple and only a few months long assignments where the enterprise have to create only limited value added. Hence,

*Hypothesis 7: The impact of RDI networks on the capabilities of their members is depending on the content of the achieved projects.*

Having in mind these hypotheses the research will review the relevant theories and empirical evidences and analyse the situation of RDI networks in Hungary and their impact for the local economy. To do this it will elaborate two case studies in the automotive industry.



## II. Theoretical background and research methodology

The network phenomenon is investigated by the representatives of many different disciplines (from mathematics through physics to sociology). (See e.g. Barabasi [2002].) The more specific field of RDI networks represents a socio-economic phenomenon that is in the intersection of many theoretical approaches of economics and sociology. This research draws on both strands of theories, more specifically on evolutionary and network theories and on social network theory.

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.*

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 the same industry. The results obtained by the structured interviews are complemented by the visualization techniques of social network analysis. For the investigation the field of automotive industry (car parts suppliers) was chosen because of two reasons: a) it is a significant industry in the Hungarian economy and b) this industry is characterised by intense networking at least in the assembling and a broad range of suppliers have been established in Hungary.

A more detailed overview of background theories, research methodology and the empirical results of the two case studies can be read in PhD conference papers:

[http://prime\\_mexico2008.xoc.uam.mx/papers/Laszlo\\_Csonka\\_The\\_role\\_of\\_R\\_D.pdf](http://prime_mexico2008.xoc.uam.mx/papers/Laszlo_Csonka_The_role_of_R_D.pdf)

and a previous version with another case:

<http://www.mbs.ac.uk/research/engineeringpolicy/researchprojects/prime/phd-conference.aspx>

(Session 4, Paper of Laszlo Csonka).

### III. Main observations and results of the thesis

The global RDI networking can be observed in Hungary too but it has some distinct characteristics from that of the developed countries. This is to a large part due to the overall low level of RDI expenditures and to the different positions of enterprises. The empirical research investigated two Hungarian RDI networks that – although their fundamental motivations and aims are very similar – show some interesting differences in their structure and functioning. Both networks aim to enhance the RDI activity of their members and to build and utilize a unique knowledge base in their specific fields of expertise.

An important observation about the development of these *partnerships* is that only *in a small number of the cases they are based on long-term strategic planning and in most cases they are established on an ad hoc basis*. Furthermore, the positive experiences cannot be transformed into routines because they could hardly be transferred into other fields or other networks. *Despite these shortcomings the networks are a unique source of new knowledge, processes and they raise the prestige of the partners' RDI capabilities*. The networks also support learning processes in the field of RDI and RDI collaborations, which makes easier for the partners to meet the new technological challenges and build productive networks of the future.

The investigated cases belong to the group of RDI networks, which are made up of the representatives of different sectors, realize a wide range of activities in two-way relationships. They serve the interest of not a single central actor but all – or at least most – of the partners by incorporating them into the research program. Therefore their activity is flexible and can be adjusted to the changing environment. The results have underlined the relevance of the evolutionary approach because these structures serve to break with the present equilibrium and they keep changing (developing) through time. The networks bring together the members of a whole innovation 'chain' of an industry to share and lessen the risk of innovation (from idea generation to market introduction).

If we would like to position these cases among those to be found in the international literature we could say that they align with those studies that investigated the relationship between network structure and firm performance. (e.g. Gulati et al. [2000]) The interdisciplinary approach to network investigation contributed to the complex analysis of

the network characteristics and to the refinement of different categorizations in the international literature.

The establishment of the two investigated network happened afterwards than those appeared in the international case studies therefore *they are in an earlier part of their development and life cycle* than their international counterparts. Thus they have a somewhat different function for and impact on their members. In their present situation *they contribute more to the development of relationships, trust and to learning than to the development of world leading innovations*. The Hungarian networks, as well as their members, have to reach a level of maturity to be able to significantly enhance RDI expenditures and results.

*The interviews strengthened the view about the openness of the innovation model within the automotive industry* where external collaborators play an important role. This is an international trend that after the ‘relocation’ of production capacities now more and more RDI activities are entrusted to suppliers, while the brand owners concentrate on design and marketing. In our cases *only a few of the network members are capable to took over such RDI responsibilities but there is a growing number of enterprises who are capable of working with them*. But there are a much larger number of enterprises (lower-tier suppliers) that are outside this sphere and still concentrate on their production capabilities and low value added activities.

Among the aims of the empirical research was to collect information for the verifying of the initial hypotheses, to contribute to the analysis of a certain type of RDI networks. The two cases provided positive evidences on *Hypotheses 1*, that *in the analysis of the network significance and impact the number of relationships alone is not a sufficient indicator*. It can be taken as a fact that the central partners in the network are more active and have more partners than those in the periphery but the content and significance of the relationships are very uneven. A single but multi-year and multi-partner strategic development project will have more significant impact on the partners than many simple and low value added assignments or ‘lease-works’. But studies with economics background rarely take into account this aspect of the relationships. A common experience of the networks is that complex, high rewarding projects are based on strong ties. Weak ties are an important addition from this point of view: they are less useful in significant projects but important in utilizing or spread the results.

Considering *Hypothesis 2*, the research find that in Hungary and in the field of RDI activities the *FDI plays an important role and they have a dual role*. On the one hand they introduce competitive new business practices that otherwise would not diffuse here. Their RDI intensity is notably higher than that of the domestic owned enterprises. On the other hand they represent more sophisticated requirements than the domestic market and search for new knowledge that urges companies to raise the level of their own activities, get information on the latest technological developments and trends thus enhance competitiveness. Through the collaboration with foreign owned companies they are in a position to get experiences form the first hand and to translate them into their own organisation.

The expectation that the *general level of networking may influence the networking intensity in RDI* (Hypothesis 3) has also been supported by the cases. This is partly the result of the openness of the automotive industry because in many cases the production collaboration is a preliminary step towards common RDI project. But some other factors play their role too. It can be seen that in certain (geographical) areas – e.g. around higher education institutes – there is a concentration of network members which offers the opportunity of strong and multi-faceted interactions. Business meetings, conferences provide opportunities for frequent appointments and thus real collaborations rather than contacting attempts between unfamiliar partners.

Considering *Hypothesis 4*, the research supported the view that *central members of the network have more significant and intensive RDI activities than the enterprises on the periphery*. This enables them to become active members and utilize the results of the collaboration. They are not only performing and receiving payments for their work but they are able to form the way the network develops. The situation when firms not only adapting but understanding and shaping the new knowledge and technology is referred to in the literature as ‘assimilation’ (e.g. Bell and Pavitt [1997]).

The cases provided clear indication that *RDI collaboration requires strong trust among the partners, which is usually originate from previous common work* (usually in different, less ‘sensitive’ areas, like production). (Of course the two case studies are not sufficient to measure the level of trust, this should be done in the framework of further socio-psychological studies.) *The trust is strongest among the central members of the network and also supplied by strong inter-personal linkages*. The trust towards the peripheral members is less intense but the network contribute to its strengthening. If firms

have achieved a certain level of trust and proved their reliability, they have overcome one of the most important barriers in front of RDI collaborations.

All interviews provided some kind of evidence that *there are important cumulative processes behind RDI networking*. (Hypothesis 6.) In positive case this strengthens the commitment of partners. They can learn a lot about ‘know what’ and ‘know why’ as well as about ‘know how’ and ‘know who’. In the Hungarian case this latter two types of knowledge just as important (if not more important) than the first two types. In addition these networks provide access to tacit knowledge that could not be achieved otherwise. The stable relationships create network (social) capital for the members and thus competitive advantages over those outside of the network. However there were no strong signs that the enterprises could use this capital or their other experiences in establishing further networks or relationships. This is the problem of the general RDI environment because there are only a few actors who could join such activities.

Considering the last *Hypothesis 7* about the relationship of network impact and complex, intensive collaborations we found positive evidences. *The few significant strategic projects provided the most benefits* for the enterprises beyond the mere price of their work. In addition it turned out that many assignments towards peripheral partners referred to work that is only relevant for the client but not for the assignee. The only positive situation for these assignees arise when they get a work that pushes their limit and they have to invest in new hardware or software or have to learn new processes. At present there are rather few such examples are provided by the networks.



Altogether the observations based on the two 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 scene*. 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.

The direct impact of the networks (e.g. number of innovations, number of collaborations, growth of RDI expenditures) does not seem to be outstanding in

international comparison but for their members they are still useful to pull them out from the bulk of lower-tier suppliers and thus their role in the Hungarian economy is inevitable. Indirectly *they contribute to the development and establishment of new and relevant capabilities that could lay the foundation of more intensive and more substantial RDI activities in the future.* It became clear with the interviews that network development is a timely process where Hungarian enterprises start with some handicap because of being a latecomer and being less developed. All members of the innovation system have to acquire new capabilities and new practices that were missing previously from the system (at least in the proper form). *Openness, trust and sufficient human resources will pave the way towards networking and a good functioning RDI system.*

This research raised some basic questions about the Hungarian RDI networking activities and it can further developed in a number of ways. The analysis could be repeated on a broader base, which could be either the region(s) or the whole industry. Both cases would provide valuable information for policymakers. If we broaden the investigation and involve more subjects one can further refine the research methodology and utilize more robust statistical tools and models for underpinning research conclusions. A useful way to continue the investigation of this field would be to compare different types of networks, the different impact they may have on the enterprises and on their behaviour and to control for the role of government support in RDI activities. The broadening of the investigated time period would provide more insights about the dynamics of network formation and development.

#### IV. List of main references

- Archibugi, D., B-A. Lundvall [2001, eds.]; *The Globalizing Learning Economy. Major Socio-economic Trends and European Innovation Policy*, Oxford University Press, Oxford,
- Ancori, B., A. Bureth, P. Cohendet [2000]; The Economics of Knowledge: The Debate about Codification and Tacit Knowledge, *Industrial and Corporate Change*, vol. 9, nr. 2, pp. 255-287.
- Barabási L. [2002]; *Behálózva. A hálózatok új tudománya*, Magyar Könyvklub, Budapest.
- Batagelj, V., A. Mrvar: *Pajek – Program for Large Network Analysis*. <http://vlado.fmf.uni-lj.si/pub/networks/pajek/>
- Bell M., K. Pavitt [1997]; Technological Accumulation and Industrial Growth, in Archibugi, D. és J., Michie (eds.) *Technology, Globalisation and Economic Performance*, Cambridge University Press, Cambridge, pp. 83–137.
- Bourdieu, P. [1980]; *The logic of practice*, Stanford University Press, Stanford,
- Burt, R. [2005]; *Brokerage and Closure – An introduction to social capital*, Oxford University Press, Oxford.
- Burt, R. [1992]; *Structural Holes – The social Structure of Competition*, Harvard University Press, Cambridge.
- Callon, M. [1998]; An essay on framing and overflowing: economic externalities revisited by sociology. In: Callon, M. (ed.), *The Laws of the Market*. Macmillan, London, pp. 244–269.
- Carlsson, B., R. Stankiewicz [1995]; On the nature, function and composition of technological systems. In: Carlsson B. (szerk.), *Technological Systems and Economic Performance*, Kluwer Academic Publishers, Dordrecht.
- Chesbrough, H. [2003]; *Open Innovation*, Harvard Business School Press, Boston.
- Cohen, W. M., D. A. Levinthal [1990]; Absorptive Capacity: A New Perspective on Learning and Innovation, *Administrative Science Quarterly*, Vol. 35, Nr. 1, pp. 128-152.
- Coleman, J. [1988]; Social Capital in the Creation of Human Capital, in *American Journal of Sociology*, Vol. 94, pp. 95-120.
- Cooke, P. [2001]; Regional Innovation Systems, Clusters and the Knowledge Economy, *Industrial and Corporate Change*, Vol. 10, Nr. 4, pp. 945-974.



- Cowan, R. [2004]; *Network models of innovation and knowledge diffusion*, MERIT – Infonomics Research Memorandum Series, Maastricht.
- Csizmadia Z. [2004]; *Az innováció hálózati alapú megközelítése*, MTA RKK NYUTI, [www.socialnetwork.hu](http://www.socialnetwork.hu)
- Czakó, Á., Sík E. [1995]; A hálózati tőke szerepe Magyarországon a rendszerváltás előtt és után, in *2000*, Vol. 7, pp. 3-12.
- Dodgson, M., D. Gann, A. Salter [2005]; *Think, Play, Do: Innovation, Technology and Organization*, Oxford University Press, New York.
- Dosi, G., R. Nelson [2000]; An Introduction to Evolutionary Theories in Economics in G. Dosi (ed.) *Innovation, Organisation and Economic Dynamics*, Edward Elgar Publishing Ltd, Cheltenham, pp. 327-346.
- Dosi, G. [1988]; Sources, Procedures, and Microeconomic Effects of Innovation, *Journal of Economic Literature*, Vol. 26, Nr. 3, pp. 1120-1171.
- Dyker, D., A. Nagy, P. Stanovnik, J. Turk, H. Usenik, P. Vince [2003]; 'East'-'West' networks and their alignment: industrial networks in Hungary and Slovenia in *Technovation*, Vol. 23, pp. 603-616.
- Edquist, Ch. [1997, eds.]; *Systems of Innovation: technologies, institutions and organizations*, Pinter, London.
- Fagerberg, J., D. C. Mowery, R. Nelson [2005, eds.]; *The Oxford Handbook of Innovation*, Oxford University Press, Oxford.
- Farkas, J. [2002]; Az innovációpolitika társadalmi meghatározottsága, *Szociológiai Szemle*, 2002/2, pp. 77-98.
- Fisher, M. M. [2002]; The new economy and networking in Jones, D.C., Steil, B., Litan, R.E., Freeman, R.B. és Brynjolfsson, E. (szerk.): *Handbook of Economics in the Information Age*. Academic Press
- Freeman, C., L. Soete [1997]; *The economics of industrial innovation*, 3<sup>rd</sup> Edition, Pinter Publishers, London.
- Freeman, C. [1991]; Networks of innovators: a synthesis of research issues, in *Research Policy*, Vol. 20, pp. 499–514.
- Fukuyama, F. [1995]; *Trust: The Social Virtues and the Creation of Prosperity*, Hamis Hamilton, London.
- Gilsing, V. [2005]; *The Dynamics of Innovation and Inter-firm Networks. Exploration, Exploitation and Co-Evolution*, Edward Elgar Publishing, Cheltenham.

- Granovetter, M. [1991]; A gyenge kötések ereje – A hálózatelmélet felülvizsgálata, in Tardos, R., Angelusz, R. (szerk.), *Társadalmak rejtett hálózata*, MKI, Budapest, pp. 371-400.
- Granovetter, M. [1973]; The Strength of weak ties, in *The American Journal of Sociology*, Vol. 78, No. 6 (May, 1973), pp. 1360-1380
- Granstrand, O., L. Hakanson, S. Sjolander [1993]; Internationalization of R&D – a survey of some recent research, in *Research Policy*, Vol. 22, Nr. 5-6, pp. 413-430.
- Gyukits, Gy., Szántó Z. [1998]; Privatizáció és társadalmi tőke. Gazdasági folyamatok beágyazottsága egy kórházi osztály privatizációs kísérletének példáján, *Szociológiai Szemle* 1998/3, pp. 83-98.
- Gulati, R., N. Nohria, A. Zaheer [2000]; Strategic Networks, in *Strategic Management Journal*, vol. 21, pp. 203-215.
- Hagedoorn, J. [2002]; Inter-firm R&D partnerships: an overview of major trends and patterns since 1960, in *Research Policy*, Vol. 31, pp. 477-492.
- Hagedoorn, J., D. Cloudt, H. v. Kranenburg [2005]; *The Strength of R&D Network Ties in High-tech Industries – A Multi-dimensional Analysis of the Effects of Tie Strength on Technological Performance*, [www.sussex.ac.uk/spru/documents/hagedoorn.doc](http://www.sussex.ac.uk/spru/documents/hagedoorn.doc)
- Inzelt, A. [2008]; „Strengthen and Upgrade Regional Capabilities (Regional University Knowledge Centre Program in Hungary)” in *Romanian Journal of Economics*, vol. 26, 2008 June, pp. 133-154.
- Inzelt, A. [2007]; *Technológiai haladás és társadalmi fejlődés*, MTA Doktori Értekezés, Budapest.
- Inzelt, A. [2004]; The evolution of university-industry-government relationships during transition in *Research Policy*, Vol. 33, pp. 975-995.
- Inzelt, A. [2003]; Foreign involvement in acquiring and producing new knowledge: the case of Hungary in J. Molero, J. Cantwell (eds.) *Multinational Enterprises, Innovative Strategies and Systems of Innovation*, Edward Elgar Publishing, Cheltenham, pp. 234-267.
- Inzelt, A. [1998, szerk.]; *Bevezetés az innovációmenedzsmentbe*, Műszaki Könyvkiadó, Budapest.
- Kim, L., R. R. Nelson [2000, eds.]; *Technology, Learning and Innovation – Experiences of newly industrializing economics*, Cambridge University Press, New York.
- Kis, J. [2005]; *Az innováció és a technológiai fejlődés elmélete az evolucionista közgazdaságban*. BCE Műhelytanulmányok, Világgazdaságtan Intézet, 59. sz.

- Kline, S. J. and N. Rosenberg [1986]; An overview of innovation in R. Landau, R. Rosenberg (eds.) *The Positive Sum Strategy*, National Academy Press, Washington.
- Kocsis É., Szabó K. [1999]; *Tanuló vállalatok – sikeres üzleti hálózatok* OMFB, Budapest.
- Kreis-Hoyer, P., J. Grünberg [2002]; Inter-Organizational Knowledge Networks: A Theoretical Foundation in *IMC Working Papers*, no. 3, European Business School, Oestrich-Winkel.
- KSH [2008a]; *Kutatás és Fejlesztés 2007*, KSH, Budapest.
- KSH [2006]; *Innováció 2004*, KSH, Budapest
- Kuczi, T., Cs. Makó [1996]; Toward industrial districts? Small firm networking in Hungary, in Grabher,G., Stark,D. (eds.) *Legacies, Linkages, Localities: Restructuring networks in post-socialist economies* Oxford University Press, Oxford
- Lemmens, Ch. [2004]; *Innovation in technology alliance networks*, Edward Elgar Publishing, Cheltenham.
- Letenyei L. [2002]; Helyhez kötött kapcsolatok. Egy társadalmi kapcsolathálókön alapuló magyarázat a földrajzi munkamegosztás kialakulására, *Közgazdasági Szemle*, XLIX. évf., pp. 875-888.
- Letenyei L. [2000]; Regionális társadalmi hálózatok. A kapcsolatháló elemzés alkalmazásának lehetőségei a regionális fejlesztésben, *Falu, Város, Régió*, 2000/6, pp. 20-25.
- Lundvall, B-A. [2006]; *Nation states, social capital and economic development – a system's approach to knowledge creation and learning*. Development Research Series, Research Center on Development and International Relations (DIR), Working Paper No. 135, Aalborg.
- Lundvall, B-A. [1996]; *The Social Dimension of the Learning Economy*, DRUID Working Paper, No 1, University, Department of Business Studies, Aalborg
- Lundvall, B-A. [1992, eds.]; *National Systems of Innovation – Towards a theory of innovation and interactive learning*, Pinter Publishers, London, UK
- Lundvall, B-A., B. Johnson, [1994]; The learning economy, in *Journal of Industry Studies*, Vol. 1, No. 2, pp. 23-42.
- Malerba, F., L. Orsenigo [1997]; Technological regimes and sectoral patterns of innovative activities, *Industrial and Corporate Change*, Vol. 6, pp. 83–117.
- Milgram, S. [1967]; The Small-world Problem. *Psychology Today*. Vol. 1, pp. 60-67.

- Mizruchi, M. S., J. Galaskiewicz [1994]; Networks of Interorganizational Relations. In Wassermann, S., J. Galaskiewicz (eds.) *Advances in Social Network Analysis*, Sage Publications.
- Nahapiet, J. and S. Ghoshal [1998]; Social Capital, Intellectual Capital, and the Organizational Advantage, in *Academy of Management Review*, Vol. 23, No. 2, pp. 242-266.
- Narula, R., J. Hagedoorn [1999]; Innovating through alliances: moving toward international partnerships and contractual agreements in *Technovation*, Vol. 19, pp. 283-294.
- Nelson, R. [1993, eds.]; *National Innovation Systems*, Oxford University Press, New York
- Nelson, R., S. Winter [1982]; *An Evolutionary Theory of Economic Change*, Harvard University Press, Cambridge
- OECD [2008]; *OECD Reviews of Innovation Policy – Hungary*, OECD, Paris.
- OECD [2001]; *Innovative Networks – Co-operation in National Innovation Systems*, OECD, Paris.
- OECD [1996]; *The Knowledge Based Economy*, OECD, Paris.
- Orbán A., Szántó Z. [2005]; Társadalmi tőke *Erdélyi Társadalom* 2005/2. pp. 55-70.
- Polányi, M. [1967]; *The Tacit Dimension*, Routledge & Kegan Paul Ltd, London.
- Putnam, R. D. [1993]; The Prosperous Community: Social Capital and Public Life, in *American Prospect*, Vol. 13, pp. 35-42.
- Putnam, R. D. [2000]; *Bowling alone – The collapse and revival of American community*, Touchstone, New York.
- Pyka, A. [2002]; Innovation Networks in Economics: From the Incentive-based to the Knowledge-based Approaches, *European Journal of Innovation Management*, Vol. 5, Issue 3, pp. 152-163.
- Richter, F. J. [2000]; *Strategic Networks – The art of Japanese Interfirm Cooperation*, International Business Press, New York.
- Rogers, E. [1995]; *Diffusion of Innovations*, Fourth Edition, Free Press, New York.
- Rothwell, R. [1994]; "Towards the fifth-generation innovation process", in *International Marketing Review*, Vol. 11, pp.7 - 31.
- Sako, M. [1998]; Does trust improve business performance? in C. Lane, R. Buchman (eds.) *Trust within and between organizations. Conceptual issues and empirical applications*, Oxford University Press, New York.

- Sako, M. [1992]; *Prices, quality and trust – Inter-firm relations in Britain and Japan*, Cambridge University Press, Cambridge.
- Sass, M. [2003]; Versenyképesség és a közvetlen külföldi működőtőke-befektetésekkel kapcsolatos gazdaságpolitikák, *PM Kutatási Füzetek*, 3. szám, 2003 szeptember, [www.pm.gov.hu/Dokumentumok/Seo/fuzetek.htm](http://www.pm.gov.hu/Dokumentumok/Seo/fuzetek.htm)
- Scott, J. [2000]; *Social Network Analysis: a Handbook*, (2<sup>nd</sup> edition) Sage Publications, London
- Scott, W. R. [1987]; The Adolescence of Institutional Theory, in *Administrative Science Quarterly*, Vol. 32, No. 4 (Dec., 1987), pp. 493-511.
- Senker, J., W. Faulkner [1996]; Networks, tacit knowledge and innovation, in: Coombs, R., A. Richards, P. P. Saviotti, V. Walsh (szerk.) *Technological Collaboration – The Dynamics of Cooperation in Industrial Innovation*, Edward Elgar Publishing, Cheltenham, pp. 76-97.
- Szalavetz, A. [2003] Hálózati szerveződés az „új gazdaságban” – a világgazdaság centrumán belül és azon kívül, Információs társadalom, *Információs társadalom*, vol. 3, nr. 1, pp. 96-110.
- Szanyi, M. [2001]; Stratégiai szövetségek és tartós vertikális kapcsolatok a magyar gazdaságban. *Vezetéstudomány*, vol. 32, nr. 1, pp. 31-37.
- Szántó, Z., Tóth I. Gy. [1993]; Társadalmi hálózatok elemzése, *Társadalom és Gazdaság*, 1993/1, pp. 33-55.
- Tamás P. [1995, ed.]; *Innovációs folyamatok a magyar gazdaságban*, OMFB, Budapest.
- Tardos, R. [1995]; Kapcsolathálózati megközelítés: új paradigma? *Szociológiai Szemle* 1995/4, pp. 73-81.
- Thompson, G. F., [2003]; *Between Hierarchies and Markets. The Logic and Limits of Network Forms of Organisation*, Oxford University Press, New York.
- Tijssen, R. J. W. [1998]; Quantitative assessment of large heterogeneous R&D networks: the case of process engineering in the Netherlands, in *Research Policy*, Vol. 26, pp. 791-809.
- Von Tunzelmann, N. [2004]; Network alignment in the catching-up economies of Europe, in F. McGowan, S. Radosevic, N. Von Tunzelman (szerk.) *The Emerging Industrial Structure of the Wider Europe*, Routledge, London, pp. 23-37.
- Wasserman, S., K. Faust, [1994]; *Social Network Analysis: Methods and Applications*, Cambridge University Press, Cambridge.

#### **IV. 1. Publications of the author in the topic of his thesis**

##### Book chapters, papers:

In English:

Csonka, L. [2009]; The role of R&D networks in strengthening knowledge base and local R&D capabilities: The case of Regional University Knowledge Centre for Vehicle Industry, devoted to *Industry and Innovation*.

Inzelt, A. Csonka, L. [2008]; Strengthening and Upgrading Regional Knowledge Capabilities in Hungary. W. L. Filho, M. Weresa (szerk.) *Fostering Innovation and Knowledge Transfer in European Regions*, Peter Lang, Frankfurt am Main, pp. 109-138.

Csonka, L. [2005]; Review Essay: A unique source of information on collaboration in *Science and Public Policy*, vol. 33, nr. 9, pp. 697-700.

In Hungarian:

Csonka, L. [2009]; Hálózatok az autóiparban: tanulás a kutatás-fejlesztés és innováció érdekében, devoted to *Külgazdaság*.

Csonka, L. [2009]; Azonos forma más tartalommal: autóipari tudásközpontok Magyarországon, devoted to *Európai Tükör*.

Csonka, L. [2007]; „Egyetemek és vállalkozások átalakuló K+F kapcsolatai” in *Külgazdaság*, LI. évf, nr. 3-4, pp. 39-50.

##### Conference presentations:

In English:

Csonka, L. [2008]; „The role of R&D networks in strengthening knowledge base and local R&D capabilities: The case of regional university knowledge centre for vehicle industry”, *PRIME: Europe-Latin America Conference on Science and Innovation Policy*, 24-26 September 2008., Mexico City.

Csonka, L. [2008]; „Building knowledge base through R&D networking: Enterprises in the Regional University Knowledge Centre for Vehicle Industry”, *Globelics Academy* 2-13 June 2008, Tampere.

Csonka, L. [2007]; „Social embeddedness of R&D and innovation networks: the case of AVVC”, Konferenciaelőadás: *4<sup>th</sup> PRIME PhD Conference*, 21-23 June 2007, Budapest.

Csonka, L. [2007]; „The role of R&D networks in upgrading domestic RTDI capabilities”, *2007 PRIME Pisa Annual Meeting PhD Poster Competition*, 3rd Prize, 29 January – 1 February 2007., Pisa.

Csonka, L. [2006]; „The role of networks in upgrading R&D and innovation capabilities in Hungary”, *3<sup>rd</sup> PRIME PhD Conference*, 14-16 June 2006, Kopenhága.

Csonka, L. [2004]; „Hungarian R&D at the light of EU Benchmarking”, *PRIME – STEPS Seminar on S&T and Innovation Indicators*, 10-12 October 2004., Kijev.

#### Studies:

In English:

Gál. Z., Csonka, L. [2006]; “Case Study Regional Report: Dél-Dunántúl (Hungary)” in *RIP-WATCH: Analysis of the Regional Dimension of Investment in Research*, ERAWATCH Network Asbl tanulmány az IPTS, EC részére, <http://cordis.europa.eu/erawatch/index.cfm?fuseaction=intService.home>

In Hungarian:

Csonka, L. [2007]; „Egyetemek és vállalkozások K+F kapcsolata: az Elektronikus Jármű és Járműirányítási Tudásközpont”, Case study for the „*Versenyképes integrálódás az Európai Kutatási Térségbe*” (Competitive integration into the European Research Area) research, NKTH, 5/123/2004, 2004-2007.