8. Innovation Networking in a Transition Economy: Experiences from Slovenia

Knut Koschatzky, Ulrike Bross

8.1 Problems of System Transformation and of the Development of Innovation Networks in Slovenia

At the beginning of the 1990s, due to the abolition of the socialist economic structure, the Central and Eastern European Countries (CEECs) were suddenly forced to thoroughly transform their political and economic order. This drastic situation is unique in history. With the transformation process, high expectations arose regarding policy, economy, and science. Due to the dissolution of the Yugoslavian Federation, Slovenian firms had to find new markets, and Slovenian research institutes had to alter their research priorities and intensify their contacts with industry (Walter/Bross 1997). Already in former Yugoslavia, Slovenia was the most industrialised region, which achieved 29% of the total of Yugoslavian exports with only 8% of the total population in 1990 (European Commission 1993: 5). Even after its independence in 1991,1 the small country has remained primarily export-oriented with approximately 20% of higher-priced technology products (pharmaceutical products, goods from the electronic and electrical engineering industry), approximately 50% mid-tech and about 20% low-tech products. Due to the process of economic adaptation, a drop in production was noted in all branches. Economic collapse especially threatened traditional industrial sectors such as steel and heavy machine construction, the automobile industry, and the textile and furniture sector. Although the transition of the industrial sector is not yet complete, the number of business enterprises has obviously grown during the past years, especially in the areas of small enterprises and the service sector.

1 On 15 January, 1992, the Republic of Slovenia was recognised as an independent state by the EU, and has been associated with the EU since 10 June 1996. In Slovenia, approximately 2 million inhabitants live on a surface of 20,256 km² (for a map of Slovenia cf. Figure 8-1). In 1996, the Gross Domestic Product (GDP) per capita reached 9,279 USD (EBRD 1997), the annual GDP growth rates were 3.1% in 1996 and 3.8% in 1998 (estimated); in 1997, the unemployment rate was 14.4% (IMAD 1998; Raiser/Sanfey 1998). The largest towns are Ljubljana (276,000 inhabitants) and Maribor (108,000 inhabitants).
Proportionally to its small size, Slovenia's research potential is impressive: the number of students trained at the universities of Ljubljana and Maribor is 38,000; in addition, besides the Academy of Science and Arts, there are approximately 50 independent research institutes including the two most important ones, the Jozef Stefan Institute and the National Chemistry Institute. Already during the Yugoslav period, Slovenia's scientific exchange with international partners was important. During the past years, several new exchange with international partners was important. During the past years, several new institutions in the innovation infrastructure have been created. These are, for example, the Technology and Development Fund of the Slovenian Republic which, among other objectives, finances young technology firms and founders; several Technology and Business Incubator Centres were established at Ljubljana, Maribor, and Koper. However, at least until the mid-1990s, the readiness for co-operation both in the research sector and between science and industry remained insufficient in spite of the innovation policy led by the Ministry of Economy and Technology, which was oriented towards co-operation promotion; consequently, the potential of the Slovenian research and innovation sectors could not be utilised (Stanovnik 1998).

Figure 8-1: General map of the Republic of Slovenia

Due to these comparatively favourable framework conditions, Slovenia's technology and innovation policy is considered as exemplary in comparison with that of other Central and Eastern European Countries (e.g. Croatia, Slovakia, Hungary); consequently, it is seen as an example of an innovation system showing a definite approach of re-evaluating and re-structuring innovation activities and innovation-related network relationships, an approach resulting from the transition process which has taken place on a political, economic, and social level (Walter/Bross
1997). However, it must be clarified whether the pre-conditions for the development of innovation-oriented network relationships are present in transition countries, or if their socialist inheritance hinders their coming into existence.

A linear innovation model according to the soviet-leninist science push also predominated in the Slovenian part of Yugoslavia during the socialist period. Interactive learning processes and the feedback of users’ requirements were either underdeveloped or non-existent. This was also shown by the high degree of fragmentation which existed between the individual innovation institutions (Dyker/Perrin 1997; Meske 1998). These structural characteristics are linked to behaviours and routines which might have outlasted system transformation both in companies and in research institutes, and which now possibly hinder the co-operative organisation of innovation processes. The question is whether or not pre-conditions do exist for the development of innovation-oriented co-operation relationships in transition countries, or if the socialist history hinders their coming into existence.

Consequently, this contribution is based on the following assumptions:

• Due to a high degree of vertical integration, both innovation networks and the acquisition of complementary knowledge were less relevant during the socialist period than today.

• If external contacts existed, these were mostly related to production and sales (vertical relationships), with a strongly specialised knowledge exchange (fragmentation of innovation actors).

• For enterprises and research institutes it was almost or completely impossible to develop the ability to enter a horizontal knowledge exchange and realise appropriate learning processes. Horizontal co-operative relationships only had a complementary character in the socialist system, with the acquisition of material resources as their main role.

• Traditional structures and routines, e.g. those implemented in former public organisations and practised by executives without any (free market) experience abroad have survived the system transition.

• Most Slovenian research institutions are still strongly basic research oriented and are therefore not very well qualified to act as co-operation partners for innovation support and market oriented knowledge exchange with an industrial sector producing on an average technological level.

Based on these presumptions, Slovenia serves as a case study for an analysis of the entrepreneurial pre-conditions for innovation activities and innovation co-operation in a transition economy; moreover, the character and intensity of network relationships between firms and research institutes will be shown. This objective is not only of scientific interest but is also relevant for innovation policy. The promotional measures granted up to the present by the Directorates-General "Enterprise" (Di-
rectorate Innovation) and "Regional Policy" of the European Commission in view of the development and implementation of regional innovation strategies in European countries (cf. Landabaso/Youds 1999) will also be offered in a similar form to the accession countries of the European Union. As these measures are based on the concept of regional innovation systems and, consequently, on a close networking and co-operation system between regional actors (Braczyk et al. 1998; Cooke/Morgan 1998), this analysis of existing co-operation patterns between research institutions and companies can significantly contribute to the questions whether regional innovation systems do exist in transition economies and whether such measures should be applied in these countries. Therefore, the following research questions should be answered:

(1) What is the significance of innovation-relevant co-operation relationships in Slovenia? With which partners do firms and research institutes co-operate, how frequently, and has the significance of external co-operation changed over time?

(2) What kinds of firms are mainly integrated into networks? Is there a difference between vertical and horizontal innovation networks?

(3) What kinds of co-operation relationships are predominant, and what is their spatial reach?

(4) Which research institutes co-operate with companies, and in what way? What is their spatial co-operation pattern?

(5) Which conclusions can be drawn for the existence and for the effects of innovation networks in Slovenia?

8.2 Basic Data

The data used in this analysis comes from a postal innovation survey carried out by the Fraunhofer Institute for Systems and Innovation Research (ISI), Karlsruhe, in co-operation with the Institute for Economic Research (IER), Ljubljana, among industrial companies, service companies, and research institutions, between October 1997 and March 1998. In order to validate the postal survey, 27 additional interviews took place with industrial and service companies, research and transfer institutions, and Slovenian experts. The following analysis is based on the industry and the research institutions’ sample.

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2 This survey was part of the European Regional Innovation Survey (ERIS) carried out in 11 European regions by the Department of Economic Geography from Hanover University, the Chair of Economic Policy from the Technical University Bergakademie Freiberg, the Department of Economic and Social Geography of the University of Cologne, and the Fraunhofer Institute for Systems and Innovation Research, Karlsruhe, financially supported by the German Research Council (cf. Fritsch et al. 1998: 249; Sternberg 2000: 396-402).
Tables 8-1 and 8-2 show a comparison between the branch and size structure of both the total population and the sample of the industrial survey. The total population was identified from data received from the Slovenian Office for Statistics (SURS) about companies with 10 and more employees from the NACE categories 15-37. A total of 1,336 questionnaires were distributed, 416 of these could be used for the empirical analysis, corresponding to a response rate of 31.1%.

Table 8-1: Composition of the industrial survey according to branches

<table>
<thead>
<tr>
<th>NACE</th>
<th>Branch</th>
<th>Total population</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Firms</td>
<td>Percent</td>
<td>Number of Firms</td>
</tr>
<tr>
<td>15, 16</td>
<td>Food, Beverages, Tobacco</td>
<td>118</td>
<td>8.8</td>
</tr>
<tr>
<td>17-19</td>
<td>Textiles, Clothing</td>
<td>160</td>
<td>12.0</td>
</tr>
<tr>
<td>23-26</td>
<td>Chemical products, Plastics</td>
<td>194</td>
<td>14.5</td>
</tr>
<tr>
<td>27, 28</td>
<td>Metal processing</td>
<td>200</td>
<td>15.0</td>
</tr>
<tr>
<td>29, 34</td>
<td>Mechanical engineering,</td>
<td>203</td>
<td>15.2</td>
</tr>
<tr>
<td>35, 37</td>
<td>Vehicles</td>
<td>203</td>
<td>15.2</td>
</tr>
<tr>
<td>30-33</td>
<td>Electrical and optical eqpm.</td>
<td>168</td>
<td>12.6</td>
</tr>
<tr>
<td>Total</td>
<td>1,336</td>
<td>100.0</td>
<td>416</td>
</tr>
</tbody>
</table>

Source: ERIS Slovenia

Regarding the structure of branches and size of the companies, only slight, statistically insignificant differences were found between the total population and the sample; consequently, the sample may be considered to be a relatively representative image of the Slovenian companies which constitute the total population of the Slovenian manufacturing industry. The most important branch from a numerical point of view is the wood, paper and printing industry with a share of 19% of the companies, followed by the metal processing industry with 18.5%. Also in terms of employment figures, these two branches are the most important Slovenian industry sectors, of which metal processing clearly precedes the wood, paper and printing sector with a share of 23.1%. The following positions are held by the electrical and optical equipment industry (15.4% of the companies resp. a share of 15.8% of all industrial employees), the mechanical engineering and vehicles industry (15.1% resp. 13.6%), and the chemical and plastics industry (13% resp. 12.2%). Consequently, Slovenia’s industrial structure is dominated by two branches which are characterised by a relatively underdeveloped level of research and development activities in international comparison (Koschatzky/Traxel 1997: 27; Muller/Traxel 1997: 9). In Slovenia, this applies particularly to the wood, paper and printing industry, which spends 2% of its turnover on average on R&D (median 1%) (Bross

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Survey units were enterprises, i.e. local production units including or in close proximity to administrative and auxiliary departments. For reasons of style, the terms "company", "enterprise", and "plant" are used as synonyms in this paper.
et al. 1999: 24). The industrial average in Slovenia is 3.8 % (median 2 %). In contrast to this, companies from the metal processing industry spend 5.2 % of their turnover on average on R&D; consequently, this branch holds the second position regarding R&D intensity, following the electrical and optical equipment industry with 6.5 %.

Table 8-2: Composition of the industrial survey according to size classes

<table>
<thead>
<tr>
<th>Size classes (Employment)</th>
<th>Total population</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Firms</td>
<td>Percent</td>
</tr>
<tr>
<td>1-19 Employees</td>
<td>319</td>
<td>23.9</td>
</tr>
<tr>
<td>20 – 49 Employees</td>
<td>326</td>
<td>24.4</td>
</tr>
<tr>
<td>50 – 99 Employees</td>
<td>225</td>
<td>16.8</td>
</tr>
<tr>
<td>100 – 199 Employees</td>
<td>220</td>
<td>16.5</td>
</tr>
<tr>
<td>200 – 499 Employees</td>
<td>169</td>
<td>12.6</td>
</tr>
<tr>
<td>500 – 999 Employees</td>
<td>49</td>
<td>3.7</td>
</tr>
<tr>
<td>&gt; 1000 Employees</td>
<td>27</td>
<td>2.0</td>
</tr>
<tr>
<td>no information</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Total</td>
<td>1,336</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: ERIS Slovenia

Regarding the size structure, the emphasis is on companies with up to 200 employees; 77.7 % of the companies of the sample firms fall within this area. On average, an industrial company in Slovenia has 235 employees (median 87). This level is clearly surpassed by the metal industry (average 293; median 46, however) but not reached by the wood, paper and printing industry (with an average of 202 employees at a median of 93). Large-scale enterprises with more than 500 employees hold a share of 9.1 %. Large-scale companies are found especially in the metal processing industry and in machine and automobile construction. In total, middle-class industrial structures are predominant in Slovenia, whereas the share of large-scale companies with more than 500 employees is obviously higher than, for example, in Saxony,4 where the ERIS data shows only 2 % (Fritsch et al. 1996: 5).5

The research data record comprises 60 institutions (response rate 47.6 %); compared with the total population, the university institutes are slightly underrepresented, public research institutes and transfer offices are slightly over-represented. 50 % of the sample account for the latter, whereas private research institutes are

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4 In the following, the German Federal State of Saxony, one of the ERIS regions, will serve as a comparative example regarding certain aspects of cooperation, due to the fact that Saxony also experienced a new orientation of innovation networks after the political change.

5 For further structural characteristics of the industrial sample, please refer to Bross et al. (1999).
represented with a share of 28.3% and university institutes with a share of 21.7% (cf. Table 8-3).

### Table 8-3: Composition of the sample according to types of research institutes

<table>
<thead>
<tr>
<th>Type of research institute</th>
<th>Population</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percent</td>
</tr>
<tr>
<td>University institutes</td>
<td>38</td>
<td>30.2</td>
</tr>
<tr>
<td>Public research institutes and transfer offices</td>
<td>53</td>
<td>42.1</td>
</tr>
<tr>
<td>Other research institutes</td>
<td>35</td>
<td>27.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>126</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Source: ERIS Slovenia

No special emphasis can be found when examining the size structure of the institutes. Institutes with up to 10 researchers account for 30.5%, institutes with more than 51 scientists account for 27.1% (11-20: 22%, 21-50: 20.3%). Natural science and medicine are predominant research areas, where 37.9% of all institutes focus on research and development activities, followed by economics and social science (22.4%). While natural sciences are considered a typical research focus for Central and Eastern European Countries, in the areas of economics and social science the gap is currently being closed.

### 8.3 Co-Operation Patterns of Slovenian Companies

Innovation relevant co-operation is a very important information and knowledge resource for Slovenian companies. Of the 416 firms included in the industrial survey, 385 confirmed that their co-operation with at least one partner surpassed normal business relationships in the case of innovation relevant activities. This is a remarkably high number when considering that 318 companies (76.4% of the sample) accomplished product or process innovation between 1994 and 1996. It can therefore be concluded that not all of the cited co-operative relationships are innovation-bound contacts, but that "normal" business relationships were also mentioned especially concerning co-operation with service companies.

Therefore, business-related service companies represent the most important co-operation partner; their role was emphasised by 80% of the interviewed companies. Contacts with customers (72%) and suppliers (56%) reflect the importance of networks within the vertical value added chain. Co-operations which are characterised

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6 We thank Daniela Rink for her assistance in analysing the research data.
by a high degree of freedom in partner search, are distinctly less significant for informa-
tion and knowledge exchange: 37% of the companies co-operate with re-
search institutes, 27% with other companies. As shown by these shares, there is
hardly any difference between the co-operation behaviour of Slovenian companies
and the co-operation patterns identified in other regions by the ERIS survey. In the
case of Saxony, for example, co-operation partners are called on in a comparable
sequence and with similar frequency (Fritsch et al. 1996: 21). Consequently, it is
clear that vertical network relationships play a predominant role, but Slovenia does
not represent an exception on this point.

The great significance of vertical co-operation is also shown by the changes which
have taken place in external collaboration since 1991. 64% of the companies have
increased their contacts with customers and 58% of them have increased their
number of suppliers, whereas only 6% and 5% resp. of the firms have reduced
their co-operation relationships. This increase shows the changes which have taken
place in industrial co-operation since the decline of the socialist economic system.
Contacts with business-related service companies have also been intensified, how-
ever less strongly, since only 38% of the interviewed firms indicated such an in-
crease in co-operation. An interesting fact is that former relationships with uni-
versities and industrial research institutions have been broken off since 1991. Whereas
11% of the companies entered new co-operation relationships, 14% of them gave
up their contacts. Changes in the originally linear innovation model according to the
soviet-leninist science push could have caused the decrease in co-operative behav-
ior. Industrial research requirements were apparently not always satisfied by the
formerly mandatory co-operation relationships, so that discontent has led to a
breaking off of former contacts. In addition, the economic transition process also
brought with it significant reductions in the companies' R&D budgets, so that re-
search institutes were called upon less often.

As has been shown by a variety of empirical studies, small enterprises are at a dis-
advantage in comparison with large-scale companies regarding the access to exter-
nal knowledge (Koschatzky/Zenker 1999a). They have less personnel and financial
resources to organise networks and to maintain effective network management. If
they carry out R&D, then their innovation activity often focuses on the develop-
ment of new technology solutions without being able to introduce them onto the market; 
where such complex innovation activities are necessary and where work has to be
shared with other partners, such innovation activities are mostly carried out by
larger companies working in close co-operation with external partners (Frisch 1993:
285). Due to familiarity with their spatial environment, as well as a supposed lesser
risk regarding the control of regional network partners, the networks built up by
smaller companies are oriented towards their closer spatial environment. Moreover,
small and medium-sized companies without own R&D capacities have limited
knowledge potential at their disposal, which, however, could ensure access to re-
search networks (Rosenberg 1990: 170; Hicks 1995). For these reasons such companies only practice co-operation in a limited way.

This fundamental pattern of industrial co-operation behaviour is confirmed in the case of Slovenia (cf. Figure 8-2). The share of small companies with up to 100 employees maintaining external innovation co-operation, is far below that of companies with more than 100 employees. This is true for all three of the groups of cooperation partners; with a strikingly clear increase in research co-operation for companies with more than 100 employees. Moreover, an effect of size is seen regarding the frequency of co-operation in view of their export orientation, i.e. their presence on international markets. Contacts with customers, suppliers and research partners increase on average up to an export share of 75%; and beyond this, most of them remain on the same level. The necessity for external co-operation in view of the development and adaptation of internationally competitive products is shown by the increasing shares, especially for those companies which depend on international demand.

**Figure 8-2:** Co-operation with different partners according to employment size-classes and export shares

![Co-operation with different partners according to employment size-classes and export shares](image)

Source: ERIS Slovenia

Although statistically insignificant, a difference in co-operation behaviour is also found between the branches of the manufacturing industry. In Table 8-4, those companies which carried out innovation projects between 1994 and 1996 are distinguished from the total. It can also be seen in the case of Slovenia that innovating
companies show more tendency for co-operation than all companies on average. Whereas, in comparison with the average co-operation frequency, fewer companies of the food processing industry have an information and knowledge exchange with their customers (probably due to the high number of final consumers), contacts with suppliers and information exchange with research institutions play an above-average role in this sector. The most intense co-operation with all three of the groups of partners is found in the chemical and plastics industry and the electrical and optical equipment industry. Both branches also excel with the highest intensity of scientific contacts. In the light of the generally decreasing number of co-operation activities with research institutions, this could point to a demand-oriented research offer for these companies, as well as to a high absorptive capacity due to the high technological standard in these sectors.

Table 8-4: Co-operation partners according to branches

<table>
<thead>
<tr>
<th>Co-operation partners branches</th>
<th>Customers</th>
<th>Suppliers</th>
<th>Research institutes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>all firms</td>
<td>innov. firms</td>
<td>all firms</td>
</tr>
<tr>
<td>Food, Beverages, Tobacco</td>
<td>57.6</td>
<td>66.7</td>
<td>63.4</td>
</tr>
<tr>
<td>Textiles, Clothing</td>
<td>71.7</td>
<td>91.2</td>
<td>56.5</td>
</tr>
<tr>
<td>Wood, Paper, Printing</td>
<td>63.3</td>
<td>80.4</td>
<td>49.4</td>
</tr>
<tr>
<td>Chemical products, Plastics</td>
<td>75.9</td>
<td>88.1</td>
<td>61.1</td>
</tr>
<tr>
<td>Metal processing</td>
<td>76.6</td>
<td>92.7</td>
<td>49.4</td>
</tr>
<tr>
<td>Mechanical eng., Vehicles</td>
<td>74.6</td>
<td>87.5</td>
<td>55.6</td>
</tr>
<tr>
<td>Total</td>
<td>71.9</td>
<td>85.5</td>
<td>55.8</td>
</tr>
</tbody>
</table>

Source: ERIS Slovenia

The increasing tendency towards co-operation on the side of companies in accordance with the increase of R&D or innovation intensity, is also shown by the following two input indicators. The number of employees holding a university degree (or a comparable qualification) is an indicator for both the knowledge intensity and the absorptive capacity of companies. R&D intensity, which is measured by the turnover percentage spent on R&D, reflects a company's R&D commitment in monetary terms. Often R&D intensity is also used to classify companies in Low-Tech (up to 3.5 % R&D intensity), Medium-Tech (3.5-8.5 %), and High-Tech companies (more than 8.5 %) (Gehrke/Grupp 1994: 40). Both with the rising share of highly qualified employees and the increasing R&D intensity, the share of companies with co-operative relationships is increasing, whereby there is an obvious link between the frequency of research contacts and an increased number of qualified employees (cf. Figure 8-3).
Innovative co-operation with external partners according to input factors

Source: ERIS Slovenia

In contrast to the characteristics used for the differentiation of industrial co-operation intensity so far, transition-specific aspects are shown by the types of ownership of the companies, as well as by their date of privatisation. The most intensive network connections with partners (in particular with customers) are maintained by Slovenian public enterprises, which is certainly also due to the size of these companies. Only gradual differences exist between the remaining types of ownership (social ownership, foreign ownership, private companies with Slovene owners) especially regarding co-operation activities with research institutions, which, for their part, have co-operation with a few foreign companies and private Slovenian companies. Consequently, the type of ownership does not significantly influence the choice of partners for innovation networking. The most important co-operation shares are shown by companies which were privatised by 1992, whereas a lower degree of co-operation intensity is shown by firms which have only recently been privatised, or which have not yet been privatised. This pattern is due to several reasons. In this way, competitive companies with intense external co-operation relationships, were the first to be privatised. Moreover, in comparison with companies which were only recently privatised, they have had more time to establish new contacts and gather experience with innovation networks.
8.4 Types of Co-Operation

Different functions can be fulfilled by innovation networks. They enable access to information, for which informal contact is usually sufficient. The more the relationships are directed towards joint R&D projects or the market introduction of new products, the more they have to be formal (and reliable). R&D-oriented networks especially allow for learning processes, since not only information but also knowledge and competence are exchanged.

The general exchange of information, the generation of new ideas, and the development of concepts are the characteristics of relationships mostly organised on an informal level, whereas the development of prototypes, pilot applications, and market introduction represent formal co-operation relationships. Informal contacts between all partners are predominant in Slovenian networks, and here it is also obvious that co-operation relationships in Slovenian industry exist mainly with customers and service companies. Regarding customers, increasingly formalised co-operation relationships have, for the present, led to a drop in the number of intense or very intense co-operation partnerships although, finally, the ranking of market introduction reached a level of importance as high as for general information exchange. This reflects the sales-oriented contacts with this industrial group, in which innovations are realised in close co-operation and with respect of the market. Suppliers’ networks are primarily oriented towards general information exchange and the generation of new ideas. Compared with customer relationships, co-operation relationships aimed at market introduction play a distinctly minor role. Service companies play a predominant role as information partners, whereas the remaining aspects of innovation are obviously less important. Not only do research institutions have a minor position as co-operation partners; they are also only considered to be supportive in the early phases of the innovation process. They are only called on in a limited way for the joint development of prototypes, for pilot applications or even for market introduction. This low level of utilisation might point to an insufficient qualification of the institutes regarding innovation support close to the market. However, an analysis of the research co-operation from the point of view of the institutes should be consulted before drawing more serious conclusions (cf. section 8.6).

The type of co-operation relationships shows that formal aspects of co-operation only play a significant role in vertical networks with customers (market introduction). Otherwise, informal contacts are predominant. Also on this point, Slovenian industrial companies only differ slightly from those of other regions. In Saxony, for example, a similar structure of co-operation types is found (Fritsch et al. 1996: 24-25). The comparison of further regions will show whether this is a universally valid character of networks, or whether transition has led to cautious behaviour with external partners.
8.5 Spatial Reach of Co-Operation Relationships

Sufficient access to information and knowledge is only assured if companies maintain complementary networks, i.e. if they can access both regional and interregional networks (Camagni 1994). Of the three co-operation partners customers, suppliers, and research institutions, Figure 8-4 shows the shares of companies which maintain contacts with their respective partners from Slovenia and the neighbouring countries (Hungary, Austria, Italy, Croatia), as well as from other foreign countries. A similar spatial structure of both the co-operation relationships with customers and those with suppliers is found. Approximately 38% of the companies co-operate with customers and suppliers from Slovenia, 29% with the corresponding partners from the neighbouring countries, and 33% with companies from other foreign countries. The spatial openness of vertical networks is due to the limited market potential available in a country of the size of Slovenia, which necessitates co-operation with foreign partners. Even if the neighbouring countries were considered with the region of Slovenia for reasons of comparability, the remaining share of foreign contacts is distinctly higher than that of Saxonian companies with only approximately 7% of their co-operating customers and suppliers being foreign (Fritsch et al. 1996: 27). In the same way, in Baden, another ERIS region, co-operation partners which are located abroad only play a comparably minor role, whereas Alsatian companies, with an average share of 25% of foreign customers and suppliers, are oriented towards long-distance contacts in about the same way as Slovenian firms (Koschatzky 1998: 284).

Figure 8-4: Spatial reach of co-operation relationships of Slovenian companies

Source: ERIS Slovenia
A completely different pattern is seen in the area of research co-operation: here, national institutions predominate with a share of almost 80%. Only 10% of the companies co-operate with institutes from neighbouring countries and the remaining foreign countries. As has already been shown, it is true that networks with research institutions rank distinctly lower than vertical relationships; however, if appropriate contacts are established, then they are built with national institutions. Consequently, an insufficient Slovenian research offer cannot be the only reason for the low level of co-operation intensity; in this case, companies would take more advantage of foreign institutes. On the one hand, this co-operative behaviour could be due to routine (former negative experience is projected onto the present); on the other hand, it might be due to companies’ lack of capacity and competence to establish contacts with research institutions. Companies which do co-operate with research institutes seem to use them as a bridgehead which guarantees access to internationally available information and knowledge. Such behaviour is also found in other regions of the ERIS database (e.g. Saxony, Baden), and does not represent a Slovenian particularity.

Where a relationship is built up between different industrial characteristics and the spatial reach of innovation networks, the following is found:

- There are no explicit differences between branches; these are only significant regarding the relationships with customers and suppliers from the remaining foreign countries, including EU countries. In this way, electrical and optical equipment producing companies especially co-operate with customers and suppliers from the remaining foreign countries, whereas supplier networks of the mechanical engineering and vehicles industry are restricted to Slovenia and its neighbouring countries. Companies from the chemical and plastics industry co-operate closely with national customers, whereas, due to the comparably high Slovenian wage level, the textile and clothing industry concentrates on suppliers of intermediate products from neighbouring and other countries.

- Related to the size of companies (employment figures), an increase in international co-operation relationships (with neighbouring and other countries) is found parallel to an increase in size. This shows that the capacity to organise networks and to establish contacts with international partners grows with an increase in company size. Whereas the share of companies co-operating with customers located in Slovenia slightly decreases with an increase in company size, no such effect of size is found in the suppliers’ networks. From this angle, no change of the spatial co-operation pattern is found in horizontal networks due to altered company sizes; the reason for this is the great significance Slovenian research institutions have as network partners.

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7 Here, company size is not only seen as a quantitative variable, but as an indicator of various structural features which characterise companies of different sizes. One of these features is their absorptive capacity, which is increased due to manifold resources with growing firm size (Koschatzky/Zenker 1999a).
Regarding R&D intensity of the companies, a minimal difference is found as in the spatial reach of vertical and horizontal innovation networks of the different sectors. No relationship is found between increased R&D intensity and a widened spatial reach of networks. However, companies from the R&D intensity class reaching from 3.5% - 8.5% co-operate more frequently with customers from other countries than with their respective national partners. Otherwise, cooperation partners from Slovenia hold the first place, followed by companies and research institutions from neighbouring and other foreign countries.

A differentiation according to the companies’ type of ownership only reveals significant differences for few of the three groups of spatial reach. Nevertheless, a predominant tendency shows that both foreign companies and state-owned Slovenian companies maintain an above-average frequency of international contacts with customers, suppliers and research institutions, whereas private Slovenian companies are more intensely integrated into their closer spatial environment. An even more intense regional orientation regarding innovation networks is shown by socially owned companies, the prevailing business type until independence. Their customer and research contacts especially are oriented towards Slovenia, whereas relations with suppliers correspond more or less to the average pattern of all other companies. This co-operation behaviour points to more openness in the use of internationally available knowledge on the side of foreign companies and Slovenian public firms, whereas private firms and the still socially owned companies prefer spatial closeness for their information and knowledge exchange. This is also due to size effects showing that increased performance and absorptive capacities of larger companies (e.g. state-owned companies) lead to a wider spatial reach of innovation-relevant co-operation relationships.

8.6 Innovation Co-Operation with Companies from the Point of View of Research Institutions

When considering all Slovenian research and transfer institutions, companies from the production and service sector represent the most important co-operation partners. 82.5% of the sample institutions co-operate with firms, 80.7% co-operate with other research institutions. The successive positions are held by public administration (59.6%), trade associations (49.1%), transfer institutions (43.9%), research institutions which participate in common research programmes promoted by the EC (42.1%), as well as banks and financial institutes (15.8%). Besides contacts with other research institutions, this distribution shows a strong orientation towards the business sector by the Slovenian research institutes, which was not revealed as such by the industrial survey. This could be due to the fact that the survey showed

8 Privatisation of these companies has not yet been concluded.
the co-operation behaviour of companies from the manufacturing industry, whereas
the comments of the research institutes referred to production and service compa­
nies. Furthermore, the government (public administration) still plays an important
role regarding both the country’s scientific exchange and the financing of universi­
ties and public research institutions.

On the whole, co-operation with companies has improved since independence in
1991: this was confirmed by 36.2 % of all research institutions. For more than half
of them, co-operation has remained the same, and only 12.1 % consider it as worse
than before. Also from the point of view of the other co-operation partners, an im­
provement in co-operation relationships predominates in contrast to a deterioration.
In this way, research institutes consider the development of their external contacts
as clearly more positive than industrial companies do.

Distinguishing between university institutes, public R&D institutions or transfer
agencies and other, mainly private research institutes, differences become obvious
concerning the intensity of co-operation shared with companies and other research
institutions (cf. Table 8-5). Although these are not statistically significant due to the
small number of cases, they point to the fact that university institutes co-operate less
intensely with companies than the other two groups of research institutions. This is
partly due to the predominance of the educational role played by universities in the
socialist system, so that research capacities had to be improved following the coun­
try’s independence. The closest co-operation exists between Slovenian university
institutes and the public administration (66.7 % indicated intense or very intense co­
operation), which reveals that university research activities are still closely related
to the public sector. In contrast to this, other, mainly private institutes are clearly
more oriented towards industry. They co-operate principally with enterprises, while
only 23.5 % co-operate intensely with the public administration. However, this
closeness is relativised by the fact that only a few of these institutes maintain in­
tense contact with trade associations and financial institutions. The data does not
indicate whether reservedness regarding co-operation predominates on the side of
the trade associations and banks, or on the side of the institutes. As far as the mixed
group of public R&D and transfer institutes is concerned, they also show an above­
average orientation towards both companies and other research institutions; there­
fore, they are more intensely embedded in innovation networks with these partners
than the other organisations.
Table 8-5: Intensity of research institutes’ co-operation with firms and other partners (shares in %)

<table>
<thead>
<tr>
<th>Type of institute</th>
<th>Co-operation with...</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Firms</td>
<td>Institutes</td>
<td>Public Administration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>low</td>
<td>intensive</td>
<td>low</td>
<td>intensive</td>
</tr>
<tr>
<td>University institute</td>
<td>58.3</td>
<td>41.7</td>
<td>50.0</td>
<td>50.0</td>
</tr>
<tr>
<td>(n=12)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public research institute/transfer office</td>
<td>36.7</td>
<td>63.3</td>
<td>40.0</td>
<td>60.0</td>
</tr>
<tr>
<td>(n=30)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>other research institute</td>
<td>41.2</td>
<td>58.8</td>
<td>70.6</td>
<td>29.4</td>
</tr>
<tr>
<td>(n=17)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: ERIS Slovenia

Regarding research institutions, the tendency towards co-operation has also increased parallel to growth, which is comparable with industry. This is true both for co-operation relationships with industry and with other research institutions. Concerning co-operation relationships with industry, this size effect is statistically significant (5 % level). Regarding research co-operation, it is less pronounced due to the fact that small institutes frequently co-operate with other institutes. Referring to the institutes’ disciplines, mechanical engineering has the largest share of co-operation with industry; all of the institutions of this discipline co-operate with industry. With a co-operation share of 81.8 %, the second place is held by the natural sciences and medicine. Economics and the social sciences, as well as electrical engineering, do not reach the Slovenian average for institutes co-operating with industry of 70.7 %.

As shown in Figure 8-5, research institutions assess co-operation with industry in a slightly different way from companies. The most important element of co-operation is the development of prototypes, during which 38 of the 53 institutions (71.7 %) worked intensely to very intensely with companies from the industry and service sector. This is reflected by the production-oriented competence on the side of the institutes, attained during the socialist period; many of the institutes had even created their own small production units in order to earn money. Other important aspects of co-operation are conceptional work and the generation of new ideas. In comparison with these, general information exchange, pilot applications, or co-operation in view of market introduction play a slightly less important role. Consequently, as seen from the perspective of all industrial co-operation partners of research institutions, formal relationships hold a high position. Due to the fact that formal relationships often grow through informal contacts and the mutual trust
gained therein (Beise/Stahl 1999: 410), research institutions have been able to de­
velop such connections based on trust with their partners from industry to a higher
degree than companies did up to then. This is also shown by "market introduction"
as an objective of co-operation, which was only relevant for few industrial compa­
nies. In contrast to this, no less than 37.7 % of the institutes indicated intense or
very intense co-operation aimed at market introduction. Especially for this kind of
co-operation, the transfer of implicit or at least sensitive knowledge must be pre­
sumed. Together with the high share of national scientific co-operation, seen from
an industrial perspective, this result is at least a weak prove for the significance of
spatial proximity for the exchange of implicit and trust-based knowledge.

**Figure 8-5:** Kinds of co-operative relationships of research institutes
with firms
(absolute number of institutes)

![Diagram of co-operative relationships](image)

Source: ERIS Slovenia

A slightly different picture is found when looking at the three sub-groups of insti­
tutes. It is shown that, with the exception of the co-operation target "market intro­
duction", other R&D institutions have less intense co-operation with companies
than the remaining institutes (cf. Figure 8-6). Surprisingly, this aspect of innovation
seems to be one of the strong points of university institutes; in fact, the share of
university institutes which have market-close co-operation with companies aimed at
innovation is higher than the share found for all other institutions and for all other
regions. Due to the limited number of Slovenian cases, this result should not be
over-estimated; however, it points to the fact that some university institutes have

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9 In Saxony, for example, the 22 % share of private research institutions which co-operate with
companies in order to realise ideas which have already been developed, is higher than the 17 %
percentage shown by universities (Fritsch et al. 1997: 23).
market related qualifications in spite of their generally limited number of industrial contacts. In contrast to this, the involvement of public R&D institutions in market introduction is only 29.6%; they are more specialised in basic research and, consequently, offer only limited support for this kind of co-operative relationship.

Figure 8-6: Kind of co-operative relationships with firms according to type of institute
(share of institutes in %)

![Diagram showing co-operative relationships]

Source: ERIS Slovenia

One of the roles of research institutions is to serve as a bridgehead for small and medium-sized companies, the co-operative behaviour of which is mostly limited to their regional environment (Feldman 1994; Koschatzky/Zenker 1999a), by providing internationally available information and scientific know-how; in order to accomplish this function, they must have access to international knowledge networks. This points to the spatial reach of co-operation with research institutions in one respect, and with firms in another. Figure 8-7 shows the numbers of research institutions intensely co-operating with other institutions from Slovenia, from the neighbouring countries Italy, Croatia, Hungary and Austria, as well as from other European and non-European countries. It is shown that especially the other, non-governmental R&D institutions of the sample are not able to fulfil a science-oriented bridgehead function. Their scientific co-operation is almost exclusively oriented towards Slovenia. Noteworthy international links are non-existent. University and public R&D institutions are subject to different conditions.10 About 40 %

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10 Due to their status, the so-called "national institutes" benefit from higher basic funding and have good chances of being granted state assistance for projects. In Central and Eastern European
of them are integrated into European and world-wide knowledge networks; public institutes are slightly more oriented towards Slovenian regions than university institutes are. Consequently, these two groups should be able to make international knowledge accessible to companies. On the one hand, university institutions have the potential for this kind of positive network effects; on the other hand, due to the fact that they co-operate less with firms than the other two groups (cf. Table 8-5), this potential is not yet sufficiently known to and made use of by companies.

Figure 8-7: Spatial pattern of research co-operation according to type of institute
(share of co-operating institutes in %)

![Figure 8-7: Spatial pattern of research co-operation according to type of institute](image)

Source: ERIS Slovenia

Regarding co-operation with companies, both university and public research institutes focus on Slovenian co-operation partners (cf. Figure 8-8). This share is approximately 55% for the university institutes and more than 70% for public organisations. This confirms the results of the industrial survey for both of the groups, according to which industrial relationships are organised over shorter spatial distances. Consequently, not only public institutes but also university institutes fulfil the function of a national bridgehead by providing Slovenian companies with their own knowledge and with knowledge acquired on an international level. On the other hand, it is also possible to conclude that Slovenian university institutes and public research institutes do not represent interesting co-operation partners for many foreign companies, since their services are only called upon in a limited way. Pri-
Private institutes show different co-operation behaviour; their innovation co-operation with industrial partners has a distinctly more international character. Due to the fact that they are less integrated in scientific networks, companies are their most important co-operation partners and their most important sources of knowledge. Innovation-relevant knowledge, which qualifies them as interesting co-operation partners, can be accumulated not only through scientific networking but also through learning processes which are induced by industrial co-operation.

**Figure 8-8:** Spatial pattern of firm co-operation according to type of institute
(share of co-operating institutes in %)

![Spatial pattern of firm co-operation according to type of institute](image)

Source: ERIS Slovenia

### 8.7 Summary and Conclusions for Innovation Policy

To the research questions formulated in chapter 8.1, the following answers result from the empirical analysis:

1. Slovenian companies show the same level of external co-operation relationships as companies from Central European regions. This represents a predominance of vertical co-operation relationships with customers and subcontractors as was found in the compared regions. Vertical networks have gained importance since the system change, in comparison to a distinctly smaller gain in the importance of horizontal networks with service companies and research institutions. Co-operation with research institutions represents a special case; apparently, during the socialist period, these could not prove to
be reliable partners, meeting all industrial requirements; consequently, after 1991, relationships with them were broken off by many companies.

(2) Slovenian firms show a tendency to increased co-operation activity parallel with company size, with a distinct increase in scientific co-operation for companies with more than 100 employees. Size effects also exist regarding the export share, the share of qualified employees, and the R&D intensity. Here, with the primary significance of vertical co-operation (customers, suppliers) and the secondary significance of horizontal co-operation (research institutions) remains unchanged. Higher shares of co-operation relationships (especially with customers) are shown by companies which were privatised a longer time ago, as well as by state-owned companies. Whether former sales relationships were maintained in the first case was not answered by the data. It is presumed that the companies which were privatised at an earlier time distinguish themselves by better performance and more intense network relationships, whereas external relationships first have to be established or stabilised by companies which have only recently been privatised.

(3) Slovenian companies primarily use innovation networks for information exchange organised on an informal level. No note-worthy learning processes can be expected from the realisation of R&D or innovation projects in close co-operation. Only in vertical networks companies accept formalised co-operation with customers aimed at market introduction. Due to the size of Slovenia, companies depend on foreign co-operation partners. More than 60% of the firms indicated co-operation with customers and suppliers from the neighbouring countries and the remaining foreign countries. The existence of relationships with Hungarian and Croatian companies dating from the socialist area is presumed at least as far as contacts with the neighbouring countries are concerned. Despite this, the high share of co-operation partners from the remaining foreign countries points to a strong orientation of Slovenian industry towards foreign countries, which is explained by the necessity of a presence on international markets, and which also has a long tradition. Whereas, regarding the spatial reach of innovation networks, only slight differences exist between branches or even companies with different R&D intensity,11 the share of network relationships with foreign partners shows a clear increase due to growing company size. This is not a Slovenian particularity; rather, it shows that it is easier for large-scale companies than for small firms to establish and maintain international networks. At least partially, the size effect also plays a role regarding the companies’ type of ownership. Larger public firms and foreign companies are more oriented towards long-distance network relationships than private Slovenian companies. These, however, distin-

11 At least in the case of Slovenia, this allows for the conclusion that no causal relation exists between the increase in R&D intensity and the international character of innovation co-operation.
guish themselves from the companies which have not yet been privatised and which are even more bound to Slovenia for innovation relevant information.

(4) Company-related co-operation relationships are especially maintained by public and private R&D institutions. University institutes show intense co-operation with public administration and are represented in scientific networks in the same way as public R&D institutions. However, private R&D institutes only have minimal co-operation with other research institutes. Although university institutes co-operate less with companies than other institutions, the main emphasis of this co-operation is the support of market introduction. Consequently, knowledge potential, although present at university institutes, is apparently not sufficiently emphasised in contacts with companies. In total, the share of formal contacts with companies is distinctly higher than that of company-close innovation networks with research institutions; this can be seen as an indication of actually existing knowledge exchange, and evaluated as realised learning processes between science and economy. The close contact between Slovenian research institutions and companies is also shown by the spatial reach of innovation networks. While universities and public institutes in particular maintain co-operation relationships in their regional environments, they are also integrated into international scientific networks. Consequently, they have the potential to make international scientific know-how available and utilisable for industry. Private research institutions face a different situation. Although working mainly with Slovenian institutes, their frequency of co-operation with foreign companies is distinctly higher. Their relationships seem to focus on practical aspects of the innovation process, for which industrial experience is more important than scientific knowledge.

In order to carry out innovations, companies rely both on the presence of internal innovation capacity and on co-operation with external partners. In Slovenia, this is particularly true for vertical relationships with customers as well as, though to a lesser degree, with suppliers. As the most important vehicles for co-operation, Slovenian companies indicated access to resources, the minimisation of uncertainties, and the entrance to new fields of technology. The empirical analysis revealed that the chances of common interactive learning processes and of implicit knowledge transfer are not fully utilised, despite a relatively high share of co-operating companies at first glance. Co-operation takes place firstly on the level of information exchange and less so on the level of joint research and development.

Compared with vertical co-operation, Slovenian industry and research show a lack of co-operation, which is a typical pattern for all Central and Eastern European transition countries. Co-operation with foreign research institutes, in particular, is almost non-existent. However, integration into global research networks and international industrial networks is indispensable for gaining new knowledge. In this area, at least a partial docking function is assumed by Slovenian research institutes.
Innovation networks seem to be an appropriate model for the support of the restructuring process of regions and industries, based on existing technology competence and potential. For the initiation of concrete networks, an important role is played not only by private and public participants but above all by regional actors. However, the experience gained with the establishment and expansion of regional innovation networks in a fully developed free market economy cannot simply be applied to a post-socialist transition economy. Instead, experience must be adapted to the structure of the innovation process pursued in the transition country. In this way, innovation can be based on the application of scientific findings in industry or on a new combination of technological know-how.

Different political conclusions come out of the preceding analysis. Regarding the Slovenian example, it must be queried for which industries a "technology transfer" from the scientific sector seems important, or, which industries need support in particular through industrial co-operation. Both the technology paradigm as a general basis on which industry is based, and the absorptive capacity of firms are important criteria for the introduction of political measures. However, changing innovation networks in developed free market economies also point to the fact that continuing competitiveness is not guaranteed. On the contrary, also for transition countries which are able to master a "catching up process" in comparison with developed free market economies, it is true that new technology must continuously be further developed and spread, if they do not want to fall back in the international innovation competition. Essential pre-conditions therefore are the openness of innovation networks and the adaptation of national and regional strategies of innovation policy. Neither developed free market economies nor former transition countries are spared this continuous process of adaptation; however, in contrast to the former socialist system, the newly developing economic systems should enable this adaptation process more easily.

8.8 References


