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Development and Innovation Potential in the Slovene Manufacturing Industry

First analysis of an industrial innovation survey

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1. Aim of the analysis

The prospects of Central and Eastern European Countries to be integrated into the world economy differ considerably depending on their physical and human capital and on their ability to fully transform their industrial sectors. These are the preconditions for innovative industries which will be able to gain and maintain competitiveness also in the long run. The most advanced economies in transition – Hungary, Poland, Estonia, Czech Republic and Slovenia - started in 1998 to negotiate their accession to the European Union which exerts even stronger demand on the completion of reforms and the economic performance in a global economy. As one of these countries, the present survey analyses the development and innovation potential of the Republic of Slovenia.

Slovenia had a specific starting point for transition. After the dissolution of Yugoslavia and the independence of Slovenia in 1991, the economy was transformed from a regional to a national economy including the establishment of a national administration. Slovenia is a relatively small economy with 2 mil inhabitants covering a surface of 20,256 m².

Figure 1: Geographical location of Slovenia

Slovenia was the strongest developed region in former Yugoslavia: While she accounted only for 8 % of Yugoslavia's surface, 29 % of the Federal Republic's exports originated in Slovenia. The collapse of former Yugoslavia led to a drastic decline in trade. Given the small internal market, integration into international trade relations especially with Western Europe is very important. Her favourable geographic situation as a gateway to other Central European and South Eastern European Countries and the traditional openness of the country facilitate such a strategy.

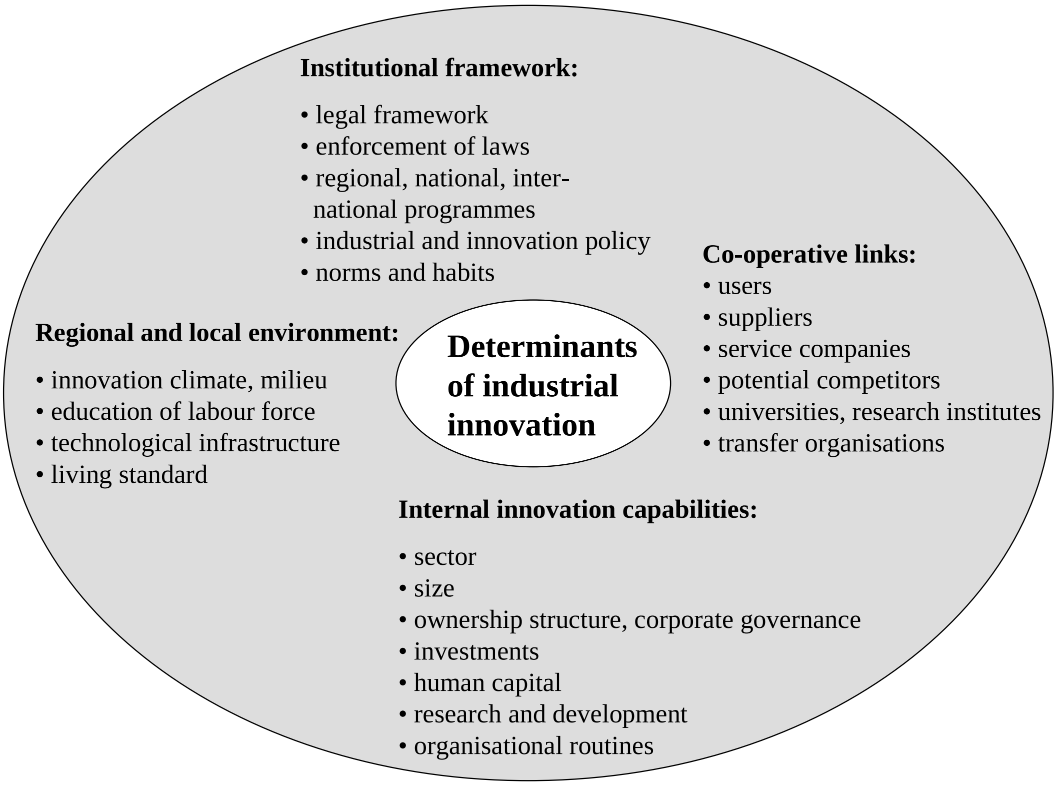
A decade after the start of the reform processes in Central and Eastern European Countries, the analysis of their development and innovation potentials has to adopt a new perspective: On the one side it can be expected that the legacy of the former economic systems still prevails and influences today's innovative performance. On the other side, the outcome of the industrial restructuring programmes and their impact on innovations and firms' competitiveness have to be carefully assessed, even if these effects will be evident fully only in the long run.

Although small in size, Slovenia possesses a noticeable research potential. About 37,000 students are enrolled at the universities of Ljubljana and Maribor. Besides these important institutions, the academy of science and arts and approx. 50 other independent research institutes, among which the Jozef-Stefan-Institute and the National Chemistry Institute are the largest, contribute to research and scientific development in Slovenia (cf. section 5). Nevertheless, interviews in research institutes reveal that this research potential is not yet fully exploited, especially with respect to industrial innovation. Traditional behaviour and an incentive scheme not oriented towards industrial research needs make co-operative ties with industrial clients not very attractive for many of the institutes (Walter/Bross 1997). It is therefore an important objective of this paper to shed some light on the importance of innovation networking between industry and research institutes as well as other economic actors for the innovative activities of manufacturing firms in Slovenia.

The conceptual framework guiding the analysis of the innovation potential of the Slovene industry takes into account four groups of determinants which are the firms' internal innovation capabilities, their regional environment, co-operative linkages with various actors and the institutional framework. Formal and informal institutions as well as the regional environment determine the incentives and rules of the game for economic activities and interaction between firms and their partners.

The institutional framework consists of the legal framework and the enforcement as well as common codes of conduct. The regional environment is characterised not only by the set of innovation supporting organisations but by the pool of labour force, their relevant qualification and by the innovation climate which together are often described as the innovative milieu of a region (Camagni 1991). Due to her small size and regional tradition in former Yugoslavia, Slovenia is treated as one region. A possible later analysis of regional differentiation within Slovenia should take into account the emerging regional structure which is currently revised in the context of EU accession.

Figure 2: Determinants of industrial innovation



Source: Adapted from Muller et al. (1994), Koschatzky/Traxel (1997)

Internal resources and co-operation with other actors represent complementary sources of innovation. The nature of the innovation process and the preconditions differ strongly according to industry sector and company size as pointed out by scholars of economics of technological change and industrial economics (e.g. Pavitt 1984; Acs/Audretsch 1993). Innovations are also expected to depend strongly on transformation-related and organisational characteristics of firms such as corporate governance structures. Investment in research and development (R&D) and human capital are crucial determinants of firms' innovation capabilities. External co-operations and networks are praised as sources for innovation by the theoretical literature (Grabher 1993). Their role in transition economies is underlined by recent evidence from different CEECs (Grabher/Stark 1997; Harter 1997).

Focussing on the firms' internal innovation capabilities and the external co-operative links, it is the aim of the paper to describe the structural composition of Slovenian manufacturing firms with respect to their innovative activities, to analyse their innovative performance using input and output indicators, and to assess their networking intensity with the different actors in the innovation system. Altogether, not only quantitative factors related to innovation will be identified, but also the potential of innovations in industry will be evaluated. This leads to including "soft" or contextual factors as preconditions for realising such potentials. For this reason, an innovation survey has been carried out in Slovenia during October 1997 and early 1998, addressing manufacturing firms, business-related service firms and research institutes.[1] The methodology and the questionnaires of the survey have been applied also to other European regions such as Baden, southeast Lower Saxony and Saxony (Germany), Alsace and Gironde (France), Stockholm (Sweden), Wales (UK), South Holland (Netherlands), Vienna (Austria), and Barcelona (Spain) (see for example Backhaus/Seidel 1997; Fritsch et al. 1996; Koschatzky/Traxel 1997, Muller 1997). Taking into account these previous experiences in other regions and the knowledge of the Slovene situation, the design of the research has been carefully adapted to the transition context by a joint German-Slovene team. This paper concentrates on reporting results derived from the Slovenian manufacturing industry innovation survey. For comparative reasons, some references are made either to the Baden sample or to the results derived for Saxony, a region in transition within the process of German unification.

In advanced market economies, mostly standardised innovation surveys have an established tradition in statistical reporting and contribute to the formulation of international, national or regional policies. During the last years the practice of innovation surveys has been implemented also in CEECs. In addition, market economies have developed a mixture of different policy measures to realise innovation potentials which range from financial incentives to building institutions of the technological infrastructure (Meyer-Krahmer/Kuntze 1992). The development of an innovation policy and the introduction of a coherent promotion framework is still in an early stage in Slovenia and other transition economies. Therefore, the present analysis of industry potentials and needs aims at policy recommendations in order to modify existing instruments and possibly to design new measures.

2. Empirical basis

The Statistical Office of Slovenia (SURS) provided the addresses for all manufacturing companies in the country. The industrial innovation survey includes all manufacturing companies that belong to the NACE classes 15 – 37 and were registered with

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1 This survey is part of a joint research project carried out by Fraunhofer ISI, the Chairs for Economic Geography at the Universities of Hannover and Cologne, and the Chair for Economic Policy at TU Bergakademie Freiberg. The joint research project was kindly supported by a research grant of Deutsche Forschungsgemeinschaft within the programme "Technological Change and Regional Development in Europe".

ten or more employees[2]. The total population of Slovene manufacturing firms included in the survey amounted to 1,336 firms. The postal questionnaires were sent out in October 1997, a reminding action followed one month later. Finally, in January 1998 a focussed reminding action to optimise the size and branch structure of the sample was carried out via fax and telephone. The action was jointly performed by the Fraunhofer Institute for Systems and Innovation Research, Karlsruhe (ISI) and the Institute for Economic Research, Ljubljana (IER) (referred to as ISI-survey in the following). The response rate can be seen from the following table.

Table 1: Response rate

	Type	Number
(1)	Questionnaires posted	1,354
(2)	Invalid addresses	18
(3)	Valid addresses	1,336
(4)	No answer/not usable	920
(5)	Usable questionnaires, Sample	416
(6)	Response rate	31.1 %

In total, 416 companies answered the questionnaires which amounts to a response rate of 31.1 %. Compared to other European regions such as Baden with a response rate of 17.8 % the Slovene figure is a good result. Since the data provided by the statistical office included not only NACE classification but also the number of employees, it was possible to control the composition of the sample for NACE and size distribution.

Table 2: Composition of the sample according to industry

No.	NACE	Type	Total population		Sample	
			Number	Percentage	Number	Percentage
1	15, 16	Food products, beverages and tobacco	118	8.8	33	7.9
2	17 – 19	Textiles, clothing	160	12.0	46	11.1
3	20 – 22, 36	Wood, paper and printing	293	21.9	79	19.0
4	23 – 26	Chemical products and plastics	194	14.5	54	13.0
5	27, 28	Metal processing	200	15.0	77	18.5
6	29, 34, 35, 37	Mechanical engineering, vehicles	203	15.2	63	15.1
7	30 – 33	Electrical and optical equipment	168	12.6	64	15.4
Σ	-	-	1,336	100.0	416	100.0

2 The basis is the central court register which reports changes in numbers of firms or subjects of economic activity monthly to the SURS. In practice, delays could be up to 6 months.

As can be seen from the Tables 2 and 3, the sample is representative according to size and sector when compared to the original population.

Table 3: Composition of the sample according to size classes

		Total population		Sample	
		Number	Percentage	Number	Percentage
1	1-19 employees	319	23.9	79	19.0
2	20 – 49 employees	326	24.4	83	19.9
3	50 – 99 employees	225	16.8	78	18.7
4	100 – 199 employees	220	16.5	83	20.1
5	200 – 499 employees	169	12.6	55	13.2
6	500 – 999 employees	49	3.7	22	5.3
7	1000 and more employees	27	2.0	16	3.8
	no information	1	0.1		
Σ	Total	1336	100.0	416	100.0

Also the regional distribution of firms in the sample represents the structure of the total population fairly well. As can be seen from Table 4, one third of companies (as well in the total population as in the sample) is located in the Ljubljana area; the two urban centres of Ljubljana and Maribor account for 50 % of firms in Slovenia.

Table 4: Composition of the population and the sample according to regional distribution

Code	Region	Total population		Sample	
		Number	Percentage	Number	Percentage
1	Ljubljana	445	33.3	143	34.3
2	Maribor	229	17.1	67	16.1
3	Celje	160	12.0	50	12.0
4	Kranj	147	11.0	46	11.0
5	Nova Gorica	105	7.9	33	8.2
6	Koper	92	6.9	27	6.5
8	Novo Mesto	114	8.5	39	9.4
9	Murska Sobota	44	3.3	11	2.6
Σ	Total	1336	100.0	416	100.0

3. Innovation activities

3.1 Innovations

More than three quarters (76.4 %) of Slovenian manufacturing companies in the sample report innovations in the three-year-period during 1994 to 1996:[3] They introduced product or process innovations into the company or both kind of innovations (Table 5). Product and process innovations were asked for separately. The questionnaire defined product innovations as "*either* significant improvement of an existing product (e.g. in terms of components or performance, quality, product image or design) *or* manufacturing of a product which is new in the firm"; process innovations were defined as "considerably improved or new production processes (organisational change of the production process or change of equipment)".

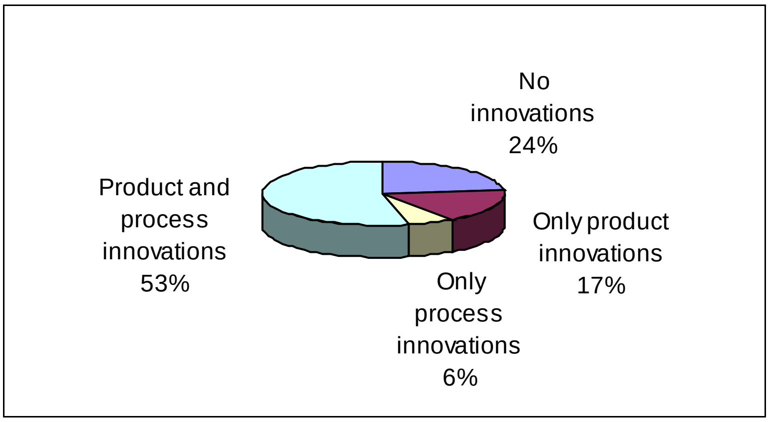
Table 5: Innovative performance

Innovations	Number of firms	Percentage
Product and/or process innovations during 1994 to 1996	318	76.4
No innovations during 1994 – 1996	98	23.6
Total	416	100.0

As could be expected, the majority of companies (53.4 %) carried out both product and process innovations. This reflects the situation, that product innovations often could not be realised without improving firms' outdated technologies. In addition, cost efficiency could not be realised without reducing the high levels of overstaffing prevailing in the former system by introducing new forms of work organisation. From the data, the investment in new technologies or new capital goods cannot be traced. A share of 17 % of firms carried out only product innovations, 6 % only process innovations.

3 According to this definition a firm is classified as being innovative if it realised innovations within a three year period. Compared to other surveys asking for innovations within a shorter range of time this might lead to an overestimation of innovative *activity*, but reflects better the innovative *potential* of the firms under investigation.

Figure 3: Type of innovation



The high percentage of 76.4 % of innovating firms in Slovenia was not expected. For comparison, 70 % of manufacturing companies in Baden and 80 % of those in Saxony which were asked the same questions, reported innovations during the period 1993 until 1995. The recent innovation survey carried out by the Statistical Office of Slovenia employing the methodology of the Community Innovation Survey as developed by the OECD finds a much lower share of innovating firms in manufacturing. Relying on a sample of 880 manufacturing companies, the survey concludes that 31.9 % of firms innovated during the period 1994 – 1996. Possible reasons could be an innovation bias inherent in the chosen methodology or differences in the composition of the sample and underlying definition of innovation.

A higher propensity of innovating firms to return the questionnaires could lead to an innovation bias of the sample which results from a non-obligatory postal survey. The possibility of an innovation bias inherent in the applied methodology has been analysed by Koschatzky and Traxel (1997) for the case of Baden. Comparing the results of different surveys in terms of firm characteristics and indicators of innovative performance for the same region, it cannot be found that the methodology of the ISI-survey would lead to a systematic innovation bias.

The second reason for a deviation in results could be differences in the composition of the sample. However, both surveys cover the same NACE classes of the manufacturing industry (SURS 1998). While the ISI-survey includes firms with 10 and more employees, the SURS-survey considers firms with 20 and more employees. This even leads to a comparable size structure of the two samples. Both samples comprise almost the same share of enterprises with up to 250 employees: 84.6 % in the survey of the statistical office (SURS 1998) and 79.8 % in the ISI-survey (Table 8). Therefore, the composition of the sample does not seem to be a decisive factor in explaining the different share of innovative firms.

While the definition given in the questionnaires of the ISI-survey corresponds to the definition of technological product and process innovations of the Oslo Manual (OECD 1997, 47) which is also followed by the SURS-survey, both surveys employ a slightly different measurement approach. While the ISI-industrial innovation survey asks whether a firm performed product or process innovations as critical characteristic, the survey of the Statistical Office of Slovenia measures specific innovation activities such as R&D activity, purchase of machines and equipment for introducing technologically new and improved products as listed in the Oslo Manual (SURS 1998, 12; see also Stanovnik/Kavas 1998, 6). When considering R&D expenditure, the ISI-survey includes explicitly expenses for construction and design which seem to be a wider definition than used in the SURS-survey. However, the results in the ISI-survey are consistent with each other, as 78.0 % of manufacturing firms report R&D expenditure corresponding to 76.4 % of innovative firms. Therefore, it can be assumed, that the SURS-survey relies more on a quantitative approach than does the ISI-survey which stresses also informal activities relevant for (often incremental) innovation.

A deeper evaluation of the relevance of innovations in the manufacturing industry and their impact will be performed in Chapter 3.4.

A brief examination of the regional specialities of innovative performance does not reveal a pattern of innovation differentials between regions. According to the Chi-square test the hypothesis that regions are homogeneous in their innovative performance cannot be rejected (at a significance level of 0.955).

Table 6: Regional distribution of innovating firms (percentage)

Region	Innovating firms	Non-innovators
Ljubljana	77.1	22.9
Maribor	73.1	26.9
Celje	76.0	24.0
Kranj	76.1	23.9
Nova Gorica	84.4	15.6
Koper	74.1	25.9
Novo Mesto	74.4	25.6
Murska Sobota	81.8	18.2
Total	76.4	23.6

Despite lacking statistical significance it can be noted, that the share of innovating firms is the lowest in the Maribor area, which could be explained by the region being especially hit in the transformation and suffering from economic depression.

3.2 Firm characteristics

3.2.1 Size structure

The analysis of firm characteristics explores sectoral differences, the impact of structural patterns such as size structure and transformation-related characteristics on the innovative performance of the firms in the sample.

The size and age structure across industrial sectors can be seen from Table 7. The average size of Slovene manufacturing firms spans from 202 employees in the wood, paper and printing sector to 293 employees in metal processing. The median shows larger differences in size structure across sectors ranging from 46 employees in metal processing to 127 employees in the textiles and clothing industry. The average sales volume is between 12.0 mil DM in textiles and clothing and 26.0 mil DM in metal processing. On the other hand, the lowest median in sales can also be found in the metal processing industry with 3.0 mil DM followed by the mechanical engineering and vehicles sector with 3.9 mil DM.

Table 7: Size and age structure of firms according to sector

No.	Sector		Employees	Sales (mil DM)	Age
1	Food products, beverages and tobacco	Mean	227	24.0	54
		Median	112	9.9	42
2	Textiles, clothing	Mean	242	12.0	33
		Median	127	5.9	35
3	Wood, paper and printing	Mean	202	16.0	33
		Median	93	6.3	30
4	Chemical products and plastics	Mean	221	25.7	39
		Median	109	10.8	39
5	Metal processing	Mean	293	26.0	32
		Median	46	3.0	19
6	Mechanical engineering, vehicles	Mean	211	24.1	25
		Median	55	3.9	12
7	Electrical and optical equipment	Mean	240	17.1	20
		Median	86	5.7	8
∑	Total	Mean	235	20.7	32
		Median	87	5.8	25

Comparing the size structure of Slovene manufacturing sectors with data from Baden, the German sample reveals much lower average number of employees – 132 compared to 235 in the Slovene sample – and a wider range between sectors (57 and 256 employees) (Koschatzky/Traxel 1997). Also in Saxony the median of employment only reached 35 employees (Fritsch et al. 1996). The dominance of small firms is a characteristic for Germany's new federal states. All large combines were either broken-up into small units or closed during the first years after unification.

When interpreting the sectoral data or comparing it with structural firm characteristics in advanced market economies, the specific situation of a former socialist economy has to be taken into account: On the one side, industry structure was determined to some extent by public planning under the former system. On the other side, the effects of fragmentation of large companies might have affected sectors differently. The production system inherited from former socialist times was characterised by large enterprises especially in the metal working industry and steel production, vehicles, electronics and household appliances sectors. Medium to large enterprises were dominant in the chemical industry. In the special case of Yugoslavia, small workshops were widespread without the existence of dynamic SMEs in manufacturing (Komac 1996). Since the start of the transition, many large companies were split up into smaller units.

Compared to the relatively small differences in size structure across sectors, there is a stronger deviation in firms' age. While the oldest companies (both measured in terms of mean and median) can be found in traditional and long established sectors such as food production with an average age of 54 years and the chemical and plastic producing industry with an average age of 39 years, younger enterprises exist in the electrical and optical equipment sector and in mechanical engineering and vehicle production: The median in these industries is 8 years and 12 years respectively. While there is no statistical significant difference in means for employment and sales across sectors, such difference can be shown even at the 1 % percent level of significance for the age variable.[4]

The next question concerns the difference in structural characteristics between innovating firms and firms which did not innovate between 1994 and 1996. Again, the size and age structure will be examined.

To the lowest size classes of firms with up to 19 employees belong 20 % of the firms without innovations and only 16 % of innovating firms. An even stronger representation of non-innovators can be found in the size class between 20 to 49 employees (34 % compared to 18 %). Only starting in the size class of firms with more than 100 employees, the share of innovators is larger than non-innovators.

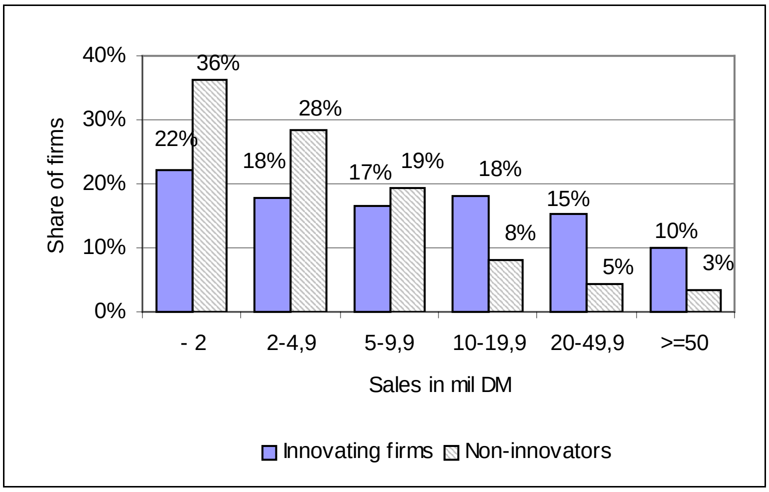
4 This is the result of a one-way ANOVA test. As a precondition, the homogeneity of variances was not rejected by the Levene-test; also the procedure is robust against deviations from the normal distribution.

Table 8: Number of employees (1996) of innovating firms (percentage)

	Innovating firms	Non-innovators	Total
1 – 19 employees	16.1	20.0	17.0
20 – 49 employees	17.7	33.7	21.5
50 – 99 employees	14.5	21.1	16.0
100 – 249 employees	27.7	16.8	25.2
250 – 499 employees	9.0	5.3	8.1
500 and more employees	14.8	3.2	12.1
Total	99.9	100.1	99.9

A similar structure can be found when examining firms' size in terms of sales volume. While 22% of innovators belong to the lowest class with up to 2 mil DM turnover, 36 % of non-innovators are in the group. The share of innovating firms out-weights the non-innovators only from 10 mil DM annual sales on (Figure 4).

Figure 4: Sales distribution of innovating firms and non-innovators



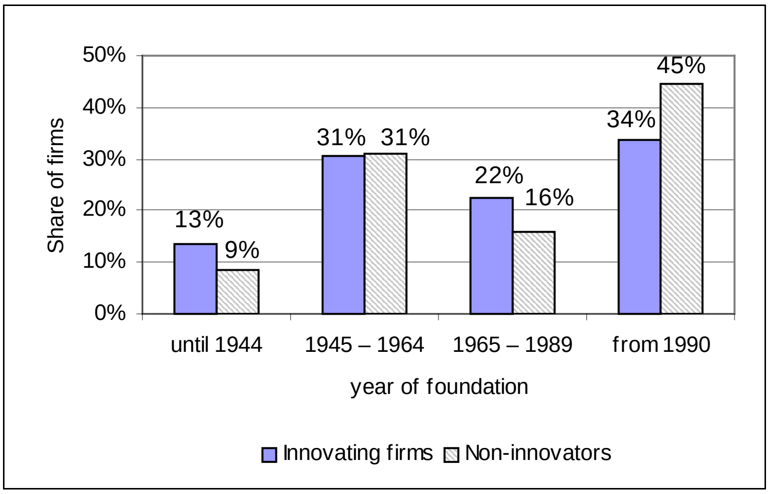
The strong relation between innovations and company size is supported by a wide range of empirical studies. In the ISI-survey, the relation is statistically significant for firms' size measured both in terms of employment and sales on the 1 % level of significance on the basis of a Chi-square test. Large firms tend to be more innovative. While small firms possibly possess more flexibility, they often lack the resources to innovate. Although the Chi-square-test does not show a statistical significant relation between size and R&D expenditure as share of sales[5], it can be argued that a threshold of manpower, investment and R&D activities is necessary to generate innovations.

5 The two-sided χ^2-test between R&D intensity and firm size (i.e. total sales) displays an asymptotic significance of 0.344, with Pearson’s contingency coefficient being 19.389 and 10 DF.

3.2.2 Age structure

The age structure of innovating and non-innovating companies can be seen in Figure 5.

Figure 5: Age distribution of innovating firms and non-innovators



The age distribution of innovating firms and non-innovators is surprising. Among enterprises which were founded after 1991, the share of non-innovating firms (45 %) is much higher than the share of innovating companies (34 %) in the same age group, while in all other groups, the share of innovating firms is higher or equal than non-innovators. On the one hand, the necessity of innovations by older firms that have to adopt new strategies in order to survive becomes clear. On the other hand, young firms founded under the new economic order could be expected to be more dynamic and innovative than older and inflexible companies. This questions the role of newly emerging firms as motor of restructuring and competitiveness of the country.

3.2.3 Ownership structure

At the end of 1997, 67.4 % of the manufacturing companies in the sample have a majority of private Slovene owners. This includes among others firms with known owners and firms of which shares are traded publicly; owners can be insiders such as employees or managers or external owners who are private individuals or companies. Foreign ownership applies to 13.4 % of firms, 15.8 % of firms are socially owned and 3.1 % of firms are state property.

First but not very successful attempts to abolish social ownership were made in former Yugoslavia in the late 1980s, the Marcovic law aiming at a rapid sale of enterprise assets was enacted in 1988 (Stanovnik/Lapornik 1994, 2). After lengthy parliamentary discussion the Slovene Privatisation law passed by the end of 1992. The basic scheme of privatisation combines different methods of privatisation, it foresees a distribution of firms' shares to the Pension Fund, the Reimbursement/Restitution Fund, to special Investment Funds for future free distribution to all Slovene citizens via ownership certificates and to insiders of firms (Stanovnik/Lapornik 1994, 3). This basic scheme could be adapted quite flexible.

Since 1993, 1450 firms were privatised according to the privatisation law. In September 1998, in total 50,656 companies were registered in Slovenia, out of which still 1,725 (3.2 %) were either state or socially owned. According to experts' estimations, state and socially owned companies account for about 20 % of total employment. Domestic capital participated in 92 % of the total number of companies, majority foreign owned companies were 2,069 companies, in 2,178 there was mixed (foreign and domestic) ownership. The relative high share of companies with social ownership in 1997 in the sample can be explained, since socially owned companies were privatised from 1995 up to 1998.

Table 9: Ownership structure of firms (percentage)

Type of owners	Innovating firms	Non-innovators	Total
Private company with Slovene owners	67.1	68.4	67.4
Foreign ownership	14.1	11.2	13.4
Social ownership	15.7	16.3	15.8
State ownership	3.2	4.1	3.1
Total	100.0	100.0	100.0

As can be seen from the Tables 9 and 10, the ownership structure does not have a significant effect on innovative performance. This result was not expected. Partly this could be explained by overlapping size effects, since there is a significant relation between ownership structure and number of employees (the non-parametric correlation analysis leads to Spearman Rho of 0.172 on a significance level of 1 %). However, the unexpected result of insignificance of ownership structure needs further analysis. The most plausible explanation for the Slovene situation is that in spite of privatisation, active owners which exert their ownership rights and supervise management could not develop so far.

Table 10: Impact of transformation-related influences on innovations

Variable		χ^2 Pearson	Degrees of freedom	Asympt. significance
Firm type	Independent firm Headquarters Independent subsidiary Branch	5.145	3	0.161
Ownership	Private owners Foreign owners Social ownership State ownership	0.659	3	0.883
Privatisation	yes no	0.0995	1	0.048
Restructuring	yes no	2.170	1	0.141

Note: The exact (two-sided) Fisher test leads to a significance of 0.159 for restructuring and to 0.56 for privatisation.

Also other transformation-related variables such as privatisation or completed restructuring do not show a significant impact on innovative performance.

3.2.4 Exports

With the collapse of Yugoslavia and the war in other republics, Slovenia did not loose only external markets in the former CMEA countries but also internal markets. This hit the Slovene economy even more severely, since many branches had the production capacity in order to provide the whole Yugoslave market. Already in the former system, Slovenia traded to a high extent – compared not only to other CEECs but also to the other parts of Yugoslavia – with Western countries. However, because of the small size of the internal market, the dissolution of Yugoslavia meant a shock and created the need for rapid reorientation to Western markets. While a part of Slovenian firms had experiences with trade to the West, a large share of companies faced considerable difficulties because they had to introduce new products that would sell on Western markets, to improve their quality and to modernise outdated technology up to the introduction of European standards (especially ISO) in order to meet demands of new clients and users.

Table 11: Development of export share to states of the former Yugoslavia (in percent of production volume)

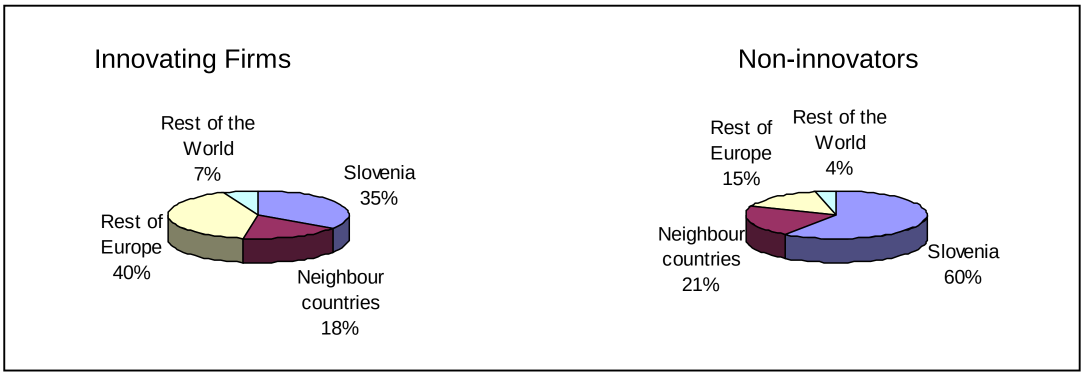
No.	Sector	1992	1995	1995/92
1	Food prod., beverages & tobacco	26.5	13.6	51.3
2	Textiles, clothing	28.3	20.3	71.7
3	Wood, paper and printing	47.8	30.0	62.8
4	Chemical products, plastics	59.1	33.3	56.3
5	Metal processing	17.6	8.5	48.3
6	Mechanical engineering, vehicles	29.0	23.1	79.7
7	Electrical & optical equipment	30.1	19.9	66.1
∑	Total	12.3	6.9	56.1

Source: SURS

As can be seen from Table 11, exports to the other states of the former Yugoslavia has decreased over all industry branches. Only recently, a slight recovery can be seen especially for exports to Croatia (SEM 1/1999).

Against this background, the export structure of the Slovene industry in 1996 shows to what extent firms have succeeded in competing on markets abroad. On average, firms earn 36.9 % of their sales from within Slovenia, 18.4 % of production value are exported to neighbouring countries, i.e. Croatia, Hungary, Austria and Italy. Firms in the sample export on average 38.3 % of their sales to the remaining countries in the European Union and 6.3 % to the rest of the world which includes also the other CEECs except Hungary.

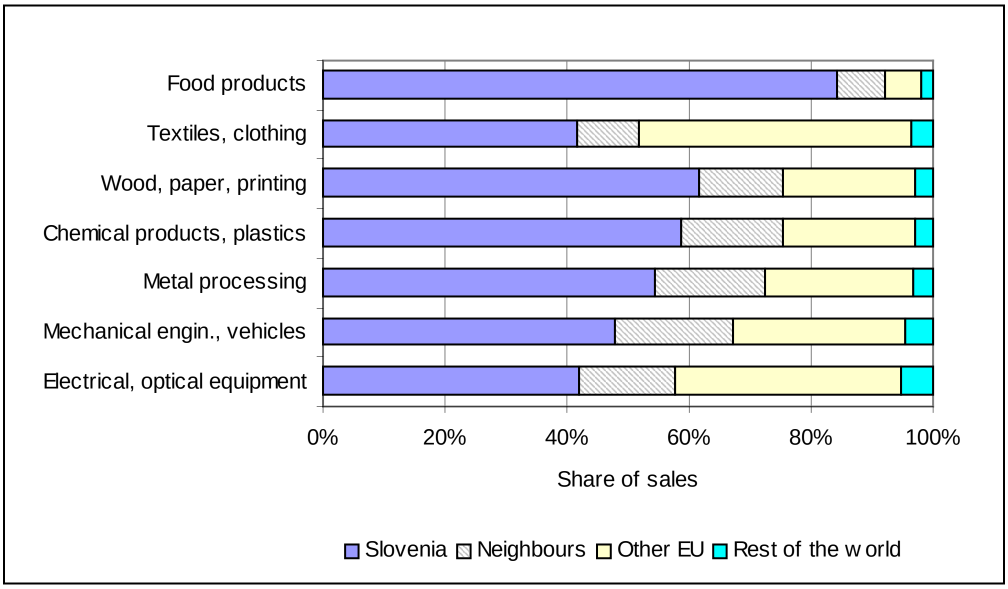
Figure 6: Export share of sales of innovating firms and non-innovators



Firms which do not innovate sell a larger share of their production within Slovenia[6]. One reason could be a lower quality associated with the absence of innovations of products which hinder exports to European markets. Another possible reason might be that those companies are in sectors which per se are less innovative or traditionally oriented towards local markets. However, partial correlation coefficients controlling for sector influences still reveal a statistically significant relation on the 1 % level between innovations and exports. (The significance of the relation between innovations and exports is also confirmed by the non-parametric test using Spearman Rho). As the category neighbour countries includes Croatia, the higher share of non-innovating firms exporting to this region, suggests that they can rely on former trade links without altering their production programme radically. The data does not permit to estimate the share of exports to the successor states of the former Yugoslavia.

While contacts to the other parts in former Yugoslavia still exist, for all countries the establishment of borders and formalities or even the non-functioning of financial transactions has led to a considerable increase of transaction costs hampering trade. Since markets in Croatia are relatively more attractive, the other new republics often lack purchasing power to afford Slovene products. Furthermore, there is a trade embargo against Serbia.

Figure 7: Export share of sales by sector



6 This result is not confined to Slovenia but reflects a general pattern of a stronger orientation towards domestic markets of less or non-innovative firms (Koschatzky/Traxel 1997: 20; Fritsch 1990).

The export performance across sectors shows highest export shares in the electrical and optical equipment industry (average of 60.0 %), textiles and clothing (58.5 %) and in mechanical engineering and vehicles. According to absolute export values in mil DM a slightly different sequence can be observed: mechanical engineering and vehicle production is followed by textiles, electrical and optical equipment and metal processing.

Table 12: Export share of sales by sector 1996

No.	Sector		Export share
1	Food products, beverages and tobacco	Mean Median	15.6 % 1.0 %
2	Textiles, clothing	Mean Median	58.5 % 70.0 %
3	Wood, paper and printing	Mean Median	38.7 % 43.0 %
4	Chemical products and plastics	Mean Median	39.4 % 30.0 %
5	Metal processing	Mean Median	45.1 % 50.0 %
6	Mechanical engineering, vehicles	Mean Median	51.4 % 51.5 %
7	Electrical and optical equipment	Mean Median	60.0 % 68.0 %
∑	Total	Mean Median	45.6 % 47.0 %

The impact of foreign mother firms on export performance which represent non-market relations cannot be singled out clearly. There is only weak statistical evidence of the Chi-square-test on the 10 % level that the ownership structure has an impact on exports. However, since the percentage of firms owned by foreign companies amounts only to 13.4 % of total companies, this is not expected to influence the export performance considerably.

Compared to other Central and Eastern European Countries, Slovene firms face very different preconditions for exports because of high labour costs. While there still exists a wage differential to Western European countries, labour costs have never been a major competitive advantage of Slovenia. An exception could be seen in the textile industry, in which in the sample the average annual labour cost are much under the Slovene average. While labour market regulation foresees a ceiling of wages for highly skilled people, companies have to contribute a payroll tax.

Table 13: Wage level across sectors

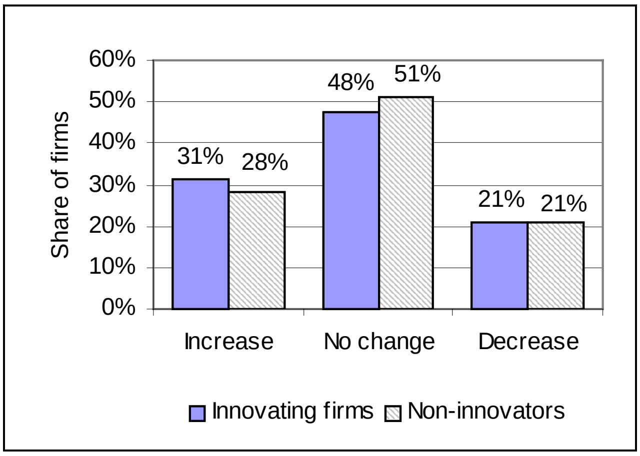
No.	Sector		Sum of labour costs p.a. incl. tax and contributions per employee (thousand DM)
1	Food products, beverages and tobacco	Mean Median	19.4 20.3
2	Textiles, clothing	Mean Median	13.7 13.4
3	Wood, paper and printing	Mean Median	18.5 16.9
4	Chemical products and plastics	Mean Median	19.3 19.6
5	Metal processing	Mean Median	19.7 18.0
6	Mechanical engineering, vehicles	Mean Median	18.0 18.0
7	Electrical and optical equipment	Mean Median	20.8 18.3
∑	Total	Mean Median	18.7 17.7

In general, various non-wage allowances – mostly negotiated through collective bargaining – and high social security charges have a significant impact on gross labour costs: Total labour costs exceed 50 to 60 percent the starting gross wage (OECD 1997, 129).

3.2.5 Employment change

The next question concerns the success of innovations in terms of employment effects. In total, almost one third of the companies in the sample foresee an increase in employment during the next three years from 1997 onwards. Given the reduction of employment until 1996 – 50.9 % of firms in the sample reduced their staff from 1994 to 1996 with an average reduction of 28 employees – this can be interpreted as an optimistic sign. Among the firms in the sample, especially heavy industry such as the metal processing sector and the mechanical engineering and vehicles production were heavily affected by the decline in employment.

Figure 8: Expected employment change



Surprisingly, there is neither a clear impact of innovative performance on expected employment changes in companies (see Figure 8) nor on the employment change between 1994 and 1996. The Chi-square test also does not show any significant relation.[7]

There are many possible reasons for this. On the one side, process innovations could lead at the same time to rationalisation with the reduction of employment in the firm, but also to strengthening the competitive position of the company and thus to safeguarding of the remaining employment. Therefore, an increase in employment is not the only indicator of measuring relative success of the company's strategy. Overall, reduction in employment can be a sign of healthy restructuring.[8]

During the transition process the unemployment rate increased to 14.4 % in 1997 (Raiser/Sanfey 1998).[9] From 1991 until 1997 Slovenia lost 160,000 jobs in manufacturing. Part of these people were early retired, the greater part are registered unemployed, some of them found employment in the service sector or in public administration. This practice of early retirement lead to a highly unfavourable relationship between active population and retired population (1.5 against 1) causing heavy problems for the pension system.

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7 The two-sided χ^2-test between change in employment 1994 – 1996 and innovations shows an asymptotic significance level of 0.698, with Pearson's coefficient being 0.720 and 2 DF; for expected change in employment and innovations, the asymptotic significance level worsens to 0.817 with a coefficient of 0.404 and 2 DF.

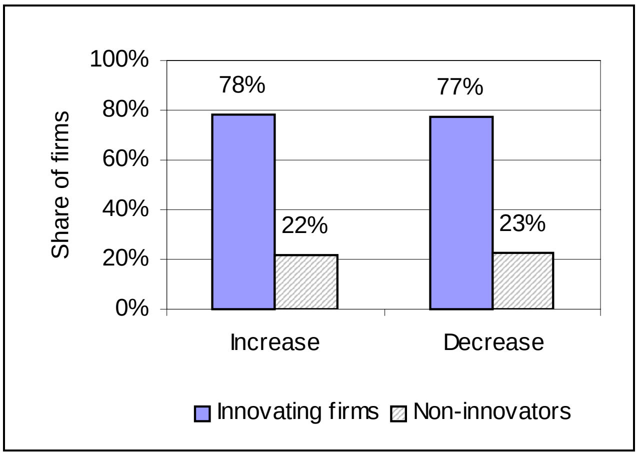
8 Note: There is neither a statistical significant relation on the kind of innovation – new processes or new products – on the employment changes expected in the near future or experienced between 1994 and 1996. The same results from the non-parametric correlation analysis with Spearman-Rho using the change of employment 1994 to 1996 as a metric instead of an ordinal variable.

9 In contrast to this figure, the employment rate according to ILO methodology amounts only to 7.1 % in 1997 (Clement 1998: 85).

3.2.6 Sales development

If the relative success of innovating firms in comparison to the non-innovators is looked at, the increase of sales during the same year does not show a different at first sight.

Figure 9: Increase in sales 1994 - 1996



However, there is a statistical significant relationship between process innovations introduced during 1994 to 1996 and an increase in turnover in the same period (based on a Chi-square test). Those companies which achieved to modernise or replace their outdated capital stock and work organisation inherited from the former system were economically more successful.[10]

The better performance of innovating firms becomes even more clear when looking at the size of increase in turnover which shows a significant higher average of increase in sales for innovating firms.

Table 14: Sales development 1994 – 1996 in Thousand DM

	Mean	Median
Innovating firms	3,468	324
Non-innovators	1,142	439
Total	2,955	595
T-Test		
T	2.978	
Two-sided significance	0.003	
degrees of Freedom	338	

[10] The same significant relationship can be found in the non-parametric correlation analysis using Spearman-Rho on a level of 1 %, based on the change in turnover between 1994 and 1996 as a continuous variable.

3.2.7 Summary of structural characteristics

The main differences in structural characteristics as discussed above are summarised in Table 15. As both the T-Test and the non-parametric test confirm, there is a significant difference in the structural variables between innovating firms and non-innovators.[11] Significant differences between innovating firms and non-innovators can be found in number of employees 1996, sales 1996, absolute number of staff employed in R&D, share of R&D personnel and share of employees holding an academic degree. While the first variables representing the structural characteristics of the manufacturing firms in the sample and differences across sectors have been explained in detail above, the variables referring to the innovation input are the focus of the next chapter.

Table 15: Structural characteristics of innovating firms and non-innovators

	Innovating firms (Mean)	Non-innovators (Mean)	T-Test	Non-parametric Test: Kolmogorov-Smirnov-Z
Age	33.3	27.8	1.278 (0,203)	1.073 (0.200)
Employees 1996	279.0	106.0	*2.538 (0.012)	**2.521 (0.000)
Sales 1996 (Mio DM)	24.4	8.4	*2.200 (0.028)	**2.513 (0.000)
Sales per employee (thousand DM)	92.7	90.4	0.164 (0.870)	1.308 (0.065)
R&D personnel	9.7	1.0	**2.785 (0.006)	**4.814 (0.000)
Share of R&D personnel of total staff in percent	6.3	1.6	**8.319 (0.000)	**4.794 (0.000)
Share of employees w. university degree in percent	7.9	4.0	**2.946 (0.003)	**1.745 (0,005)

Note: According to the Levene Test the T-Test has been performed assuming unequal variances for age, sales per employee and share of R&D personnel of total staff.
Significance in brackets, with significance on the 1 % level ** and significance at the 5 % level *.

[11] Although the T-Test assumes normal distribution, the procedure is robust against deviations.

3.3 Innovation input

The relation between innovation input and innovation output is rather complex as studied in modern innovation theory. In addition to a number of input factors, the management of the innovation process is of prominent importance. Innovation can be understood as an interactive process between various individuals and departments within the firm but also extending interaction to external co-operation partners. The interactive nature of the innovation process requires the incorporation of market needs right at the beginning of the process and foresees continuous feed-back between different stages of the development process (Kline/Rosenberg 1986).

Therefore, the understanding of the innovation potential of an industry has to rely not only on input factors but should include organisational characteristics of the innovation process as far as possible. However, most statistical surveys concentrate on the collection of quantitative data describing the input factors into the innovation process. Indeed, the possibilities to gain comparable data on qualitative factors is much more limited. Starting from the traditional analysis of quantitative indicators such as highly skilled labour, R&D personnel and R&D expenditure, the following analysis attempts to reveal also the factors related to the management of the innovation process.

Table 16: Highly skilled labour
(Employees holding an academic degree)

No.	Sector		Employees with academic degree	Share of employees with academic degree
1	Food products, beverages and tobacco	Mean Median	12.9 4.5	5.1 4.7
2	Textiles, clothing	Mean Median	7.0 3.3	4.2 1.4
3	Wood, paper and printing	Mean Median	9.5 2.0	7.2 2.4
4	Chemical products and plastics	Mean Median	16.3 6.5	7.8 6.7
5	Metal processing	Mean Median	7.6 1.0	4.7 3.8
6	Mechanical engineering, vehicles	Mean Median	8.7 2.0	5.7 3.6
7	Electrical and optical equipment	Mean Median	22.4 5.0	12.9 5.8
Σ	Total	Mean Median	11.9 3.0	7.0 3.7

The employment structure differs considerably across sectors. A higher number of employees holding a university degree can be found in the electrical and optical equipment industry and to a less degree in the chemical and plastics sector. The differences in the share of employees with a university education across sectors are statistically significant at the 1 % level.[12]

Table 17: Share of R&D personnel and R&D intensity by sector in percent

No.	Sector		R&D intensity (R&D expenses as share of sales)	Share of R&D personnel
1	Food products, beverages and tobacco	Mean Median	3.8 2.0	3.8 1.7
2	Textiles, clothing	Mean Median	2.4 1.0	3.7 1.2
3	Wood, paper and printing	Mean Median	2.0 1.0	2.8 2.8
4	Chemical products and plastics	Mean Median	2.6 2.0	4.9 3.8
5	Metal processing	Mean Median	5.2 2.0	3.9 2.1
6	Mechanical engineering, vehicles	Mean Median	4.1 3.0	6.9 4.2
7	Electrical and optical equipment	Mean Median	6.5 5	9.9 5.7
∑	Total	Mean Median	3.8 2.0	5.2 2.6

R&D personnel constitutes an important part of the human capital of firms and their innovation potential. Even more than a skilled workforce and employees with a university education, R&D personnel represents a pool of knowledge and organisational routines in the chase of not only improved products and processes but also mayor innovations. A high average share of R&D personnel can be found in the electrical and optical equipment industry (9.9 %) and in mechanical engineering and vehicle production (6.9 %). As shown in previous chapters, the first two are also among the sectors with highest export share (see Figure 7).

In total, in the manufacturing sector there are about 150 R&D units having on average 10 employees. R&D departments of industrial firms were in many cases absorbed in everyday operation of running and maintaining technological equipment and have, with very few exceptions, suffered serious financial and personnel cuts (Stanovnik 1998)

Measured as share of R&D expenses of turnover, the R&D intensity is relatively high in the electrical and optical equipment industry with 6.5 % on average. R&D intensity

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12 This is shown by a one-way ANOVA, given the restriction that the assumption of homogeneity of variances is violated.

is also above average in metal processing (5.2 %) and mechanical engineering (4.1 %). Surprisingly, companies in the chemical and plastics sector invest only relatively little in R&D with an average share of 2.6 % of sales. This is supported by other studies since the two major pharmaceutical companies (Krka and Lek), which spend 5.6 % of their sales for R&D, are an exception among the companies in this sector. However, their investment is only half of the OECD average in the pharmaceutical industry.

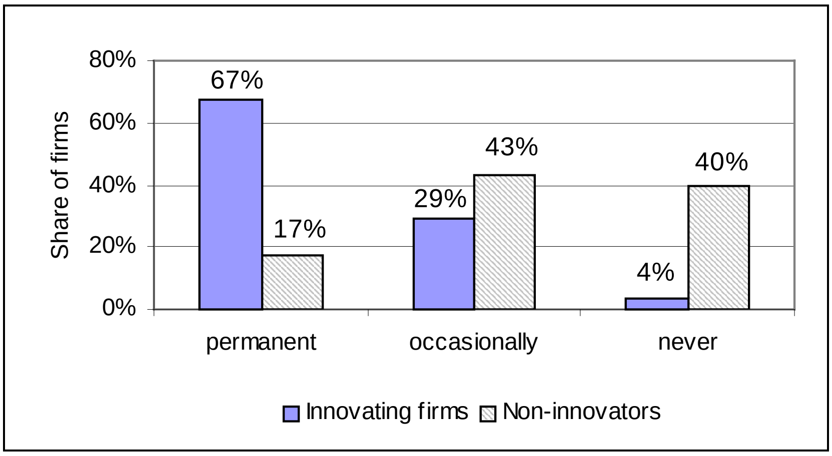
Table 18: R&D intensity of manufacturing firms

Type	R&D as share of sales	Number of firms	Percentage
Low-tech	0 – 3.49	247	67.1
Medium-tech	3.50 – 8.49	75	20.4
High-tech	8.50≤	46	12.5
Total		368	100.0

In the sample, two thirds of manufacturing companies are low-tech firms (67.1 %), 20.4 % invest as medium-tech companies between 3.5 % up to 8.5 % of their turnover in R&D while the remaining 12.5 % can be classified as high-tech companies.

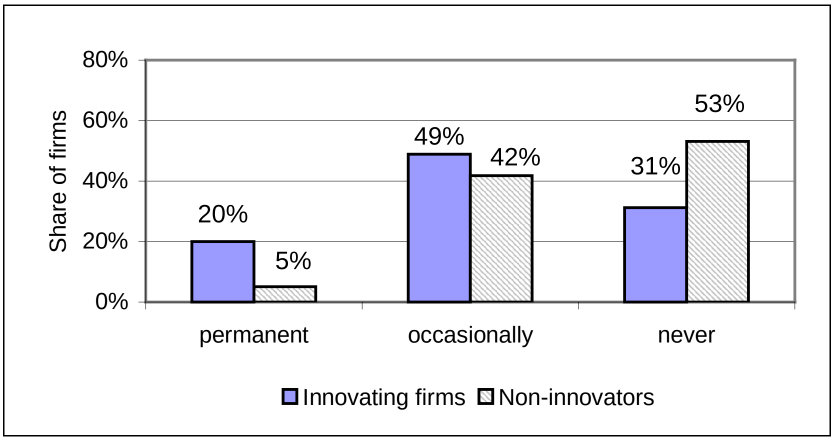
In addition, companies were asked about the regularity of their research and development activities. If innovation can be understood as a continuous search process for new products and processes in order to gain and maintain competitiveness, the continuity of development activities plays a decisive role.

Figure 10: Continuity of development



A share of 67 % of innovating firms carry out development activities permanently, 29 % occasionally and only 4 % never. Among firms which have not innovated during 1994 until 1996, 17 % carry out development work but without attaining results, 43 % of non-innovators perform development occasionally and 40 % never. As can be seen from Figure 11, 20 % of innovating companies in the sample carry out research permanently and almost half (49 %) on an occasional basis. One third (31 %) do not perform any R&D. This reflects the structure of innovations in many manufacturing industries. While innovations consist to a large extent of improvements of existing products and processes, those with a higher degree of novelty and technological advance relying on new technological knowledge amount to the smaller share of all innovations. This underlines the importance of development work for innovations. The data suggest that those firms carrying out development permanently have established some kind of innovation management procedures.

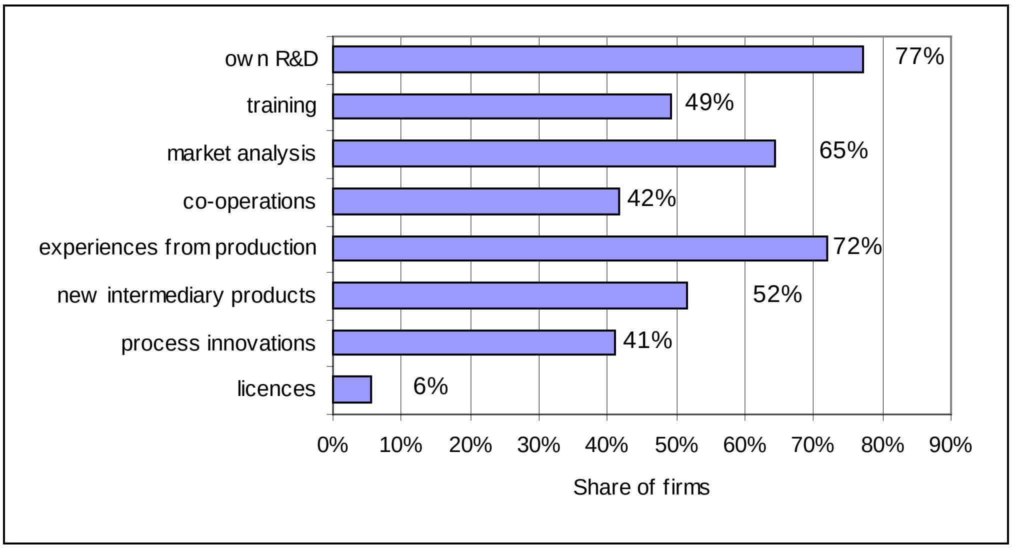
Figure 11: Continuity of research



The relatively high number of enterprises which do not innovate but perform development as well as research occasionally, is striking and hints at a very inefficient organisation of their innovation process, lack of resources to commercialise or innovation attempts without strategy.

The next section examines the preconditions for innovations (Tables 19, 20 and Figures 12, 13) and sources of innovation (Figure 14) differentiating between process and product innovations.

Figure 12: Preconditions for product innovations (ranked as important or very important by innovating firms)



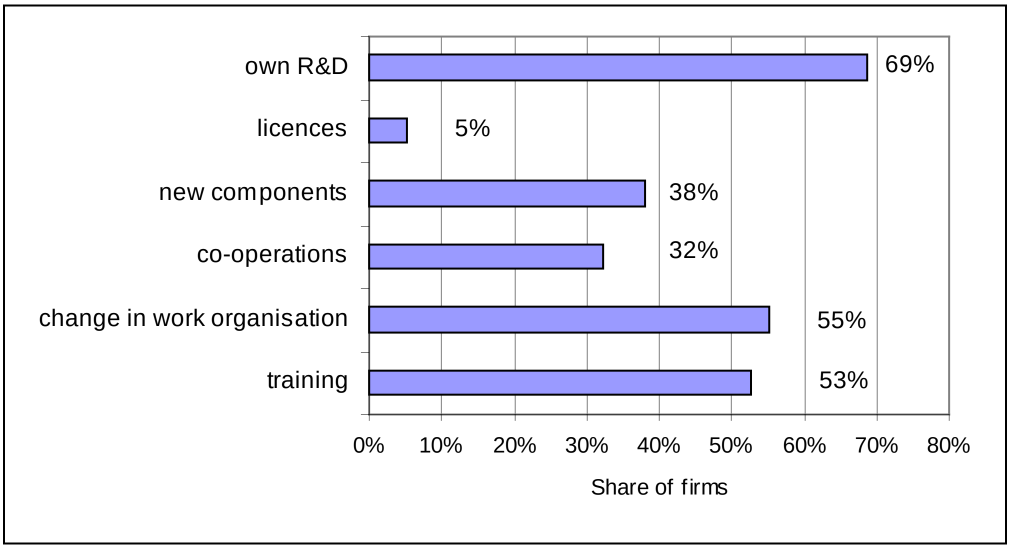
Internal sources are ranked as most important preconditions for product and process innovations. In the case of product innovations, own R&D and experiences out of the production of similar or predecessor products are evaluated as important or very important by 77 % and 72 % of innovating firms. This is also confirmed by Kendall-W which takes into account the respective ranks attributed to the mix of preconditions (non-parametric test for dependent samples). Market analysis is evaluated as third important precondition, since 65 % of companies see it as important or very important. On the other side this means that 35 % of Slovene innovating firms do not consider market analysis as important which is striking, given the most crucial phase of an innovation is often commercialisation. Only 42 % of innovating firms rank external co-operations as important or very important.

Table 19: Importance of factors for product innovations (Kendall-W-Test)

Importance	Important factors for product innovations	Mean rank
1.	Own R&D	6.04
2.	Experiences from production	5.52
3.	Market analysis	5.35
4.	Training	4.68
5.	New intermediary products	4.41
6.	Process innovations	4.12
7.	Co-operations	4.10
8.	Licenses	1.78

Manufacturing firms in Baden show a comparable pattern in the evaluation of preconditions for product innovations, experiences from production as most important factor with 93 % of answers are followed by internal R&D (87 %) and market analysis (79 %). In spite of a comparable sequence of priorities, the important factors are named by a considerably higher percentage of innovating firms (Koschatzky/Traxel 1997).

Figure 13: Preconditions for process innovations (ranked as important or very important)



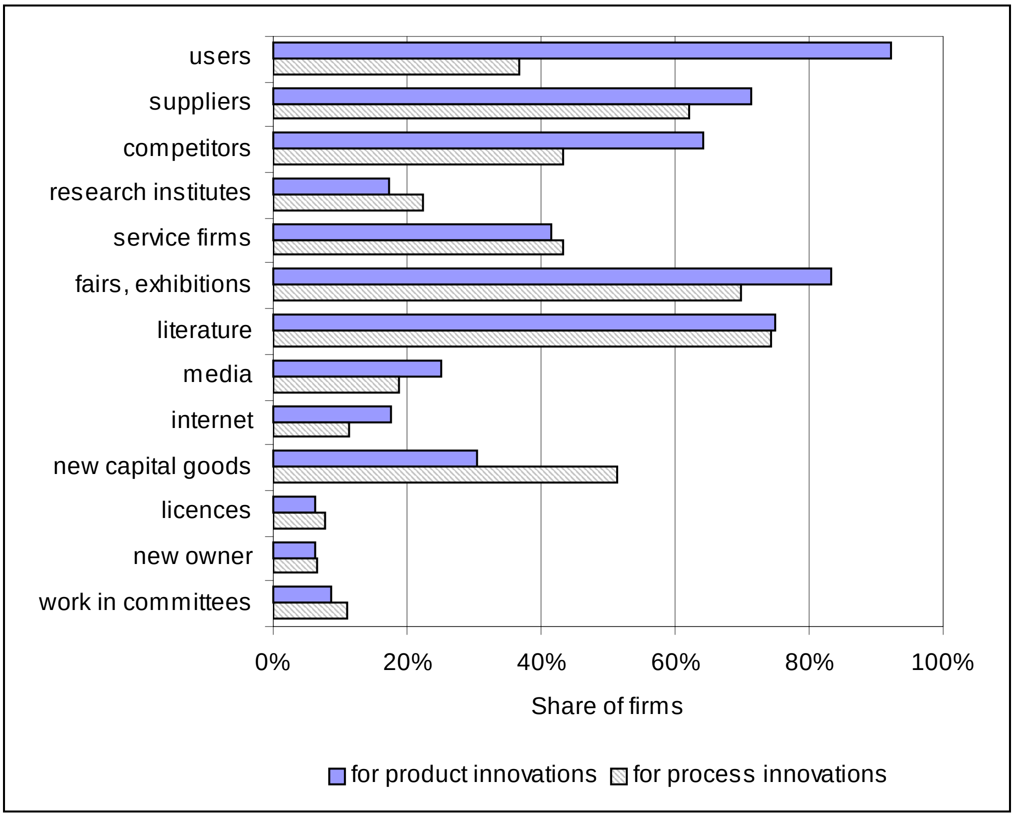
Most important preconditions for process innovations in Slovene manufacturing firms are again own R&D with 69 % of important or very important evaluations, new components (38 %) and change in work organisation (55 %), as revealed by Kendall-W (Table 20). Training of the workforce closely follows on the fourth rank and then external co-operations as precondition of penultimate importance. The Baden sample ranks as most important preconditions training, change in work organisation and internal R&D (Koschatzky/Traxel 1997). The relative importance of internal R&D in the Slovene survey can be interpreted as a legacy of the former system in which innovation management – especially in larger firms – relied to a great extent on internal R&D departments and dedicated experts ("innovators"). The relative importance of new components reflects the ongoing process of replacing outdated technologies and equipment and restructuring.

Table 20: Important preconditions for process innovations (Kendall-W-Test)

Importance	Important preconditions for process innovations	Mean rank
1.	Own R&D	4.58
2.	New components	4.17
3.	Change in work organisation	3.78
4.	Training	3.75
5.	Co-operations	3.14
6.	Licences	1.59

The sources of innovation-relevant information are closely linked to the preconditions described above. Companies replied which information sources they used without differentiating between important or very important channels.

Figure 14: Sources of innovation-relevant information



Most important information sources for product innovations are users (92 %), fairs and exhibitions (83 %), literature (75 %), suppliers (71 %) and competitors (64 %). The prominent place of users could be expected as they articulate demand. There is a relatively high importance of rather passive and informal transmission channels such as fairs, exhibitions and literature.

The information sources for process innovations are also striking, since literature, fairs and exhibitions rank with 74 % and 70 % of answers more important than interaction with suppliers (62 %) and new capital goods (51 %). Like for product innovations, passive and informal transmission channels are much more used for process innovations, although they are associated only with limited opportunities for the transfer of know-how and experiences. The literature on knowledge and innovation distinguishes between tacit knowledge on the one side, which can only be transferred via direct interaction and learning processes, and codified knowledge on the other side (Polanyi 1958; David/Foray 1995). Codified knowledge tends to be publicly available and typically is the sort of knowledge found in specialised literature. As for process innovations the transfer of tacit knowledge and experiences can be of high importance, the interaction with suppliers is likely to be much more effective than the other indirect, informal and passive sorts of information sources.

The role of new capital goods for process innovations could be expected, given the need to replace equipment and technologies. It indicates the ongoing investment process. Service firms are used as information source by 41 % and 43 % of firms for product and process innovations respectively. While the importance of research institutes as information source in the innovation process is roughly half of service firms, their technological knowledge is utilised by a share of 22 % of innovating companies for process innovations.

3.4 Innovation output

After the introductory chapter 3.1 has presented the basic figures of the innovative behaviour of Slovene manufacturing companies in the sample, the following analysis focuses on contents, aims and impacts of product and process innovations.

An indicator for the realisation of product innovations is the share of new products of total sales volume; in this definition, products are classified as new when introduced into the market within the last three years.[13] Almost one third (31 %) of companies having performed product innovations during 1994 – 1996 earn more than 50 % of their total sales from the new products. This can be interpreted as a high commercialisation success. Another third (33 %) earns between 10 and 25 % of their turnover from new products. In only 15 % of companies the share of new products of sales is below 10 %.

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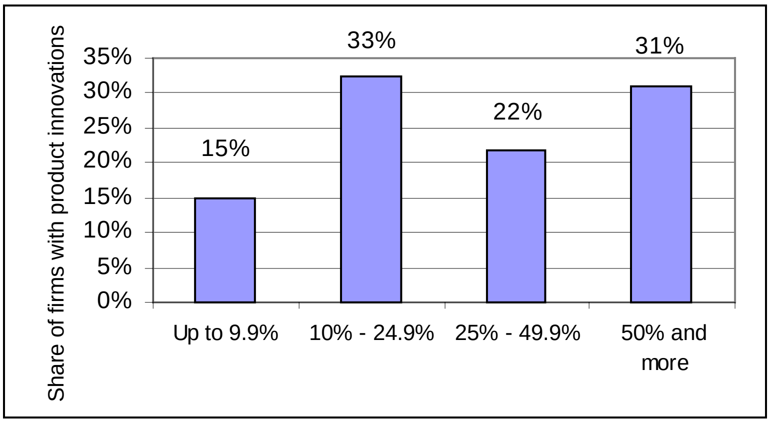
[13] It should be noted that new products might not only be the result of own innovation activity but can also be purchased by other firms (re-selling).

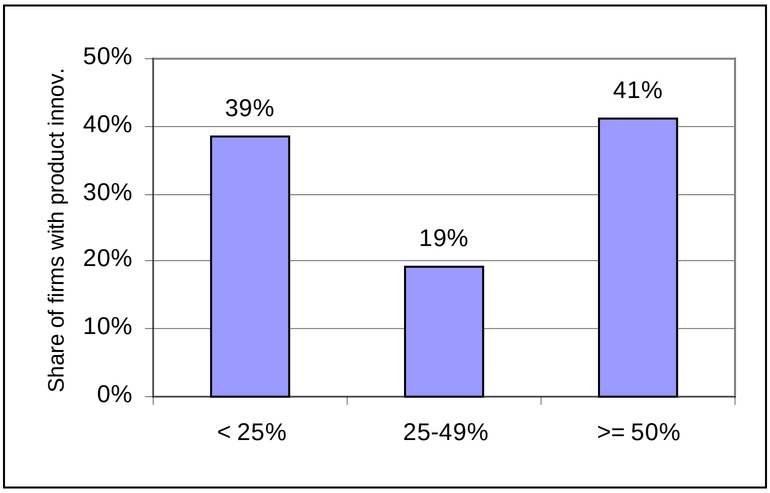
Figure 15: Sales from product innovations as share of total sales



With an average share of sales from product innovations of 35.7 % (median 25.0 %) the share of new sales is approx. ten percent higher than in Baden with 27.8 % (Koschatzky/Traxel 1997). In Saxony, on the other hand, new products contribute to about 40 % of total sales (Fritsch et al. 1996). This high share is an indication for product renewal and for the need to innovate under changing competitive situation.

The degree of novelty and possibly the technological content of innovations is indicated by the share of completely new developments compared to improvements of existing products as a share of all reported product innovations. 42 % of firms with product innovations reported that half or more than half of their product innovations were completely new developments. Almost the same share of companies (38 %) have less than a quarter of their product innovations completely newly developed but they mainly rely on improvements of existing products.

Figure 16: Share of completely new developments of product innovations



The duration of the product life cycle indicates the dynamics in the introduction of new products or processes. Against an increasingly rapid technological development and the emergence of new technologies, rapid response to changing markets and short lead times are a precondition for competitiveness. There is a share of 16.5 % of manufacturing firms which is acting on the market in a highly dynamic way and whose product life cycle is below 2 years. However – as Table 21 shows – this does not necessarily mean a sound and successful innovation strategy, but can also reflect an ad hoc strategy: Among those firms with very short product life cycles, the share of firms without product innovations is much higher (29.9 %) than the share of innovating firms (12.1 %). The Chi-square test reveals that firms with product innovations are very strongly represented in the class of 2 to 5 years product life cycle.[14]

Table 21: Product life cycle (percentage)

Length of product life cycle	Firms with product innovations	Firms with process or no innovations	Total
less than 2 years	12.1	29.9	16.5
2 – 5 years	28.9	20.8	26.9
more than 5 years	59.0	49.4	56.6
Total	100.0	100.1	100.0

The majority of firms (56.6 %) report a product life cycle of more than 5 years. However, a similar share of companies with a product life cycle of more than 5 years can be found in parts of Baden (Koschatzky/Traxel 1997).

Also the duration of the product life cycle across sectors reveals a rather long period until the introduction of new products in almost all sectors, the average product life cycle in the sample amounts to 11.4 years (median 7.0). Only in textile and clothing production and in the wood, paper and printing industry, there are a high number of firms with much shorter product life cycles, as revealed by the relatively lower median. This can be explained by the higher relevance of fashion for the production of clothes or furniture.

14 There is a statistical significant relation between product innovations and duration of the product life cycle at the 1 % level (with Pearson’s Chi-Square of 13.507 %, 2 DF). No significant relation between product life cycle and age of the firm can be found.

Table 22: Product life cycle across sectors

No.	Sector		Product life cycle (in years)
1	Food products, beverages and tobacco	Mean Median	15.5 10.0
2	Textiles, clothing	Mean Median	4.4 2.8
3	Wood, paper and printing	Mean Median	14.1 5.0
4	Chemical products and plastics	Mean Median	16.5 10.0
5	Metal processing	Mean Median	12.3 10.7
6	Mechanical engineering, vehicles	Mean Median	10.9 10.2
7	Electrical and optical equipment	Mean Median	8.1 6.0
∑	Total	Mean Median	11.4 7.0

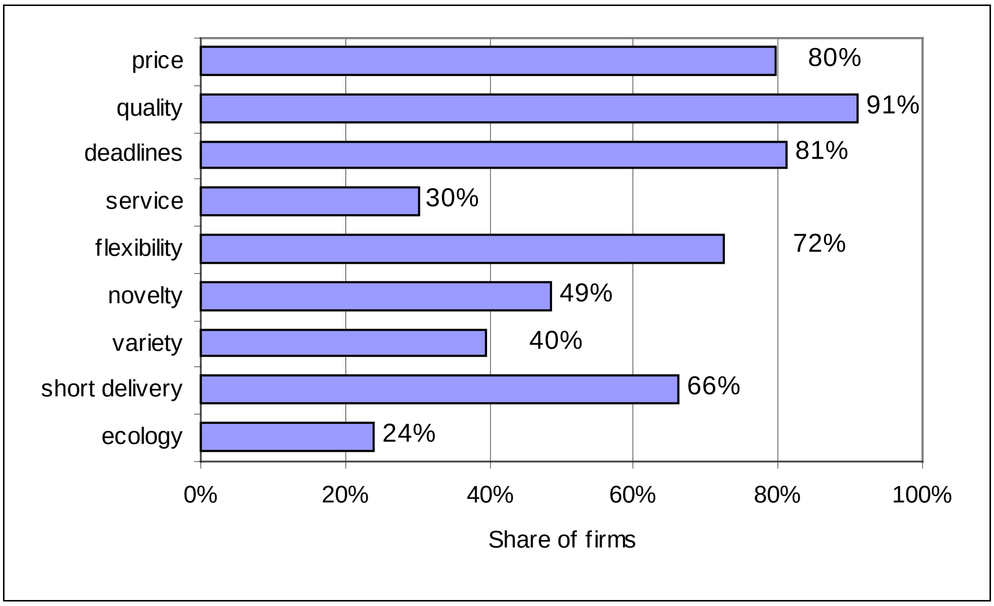
The manufacturing firms with product innovations in the sample ranked the importance of success factors for sales of their products as follows: Quality and the timely delivery of products are evaluated as the most important success factors, with 91 % and 81 % of firms evaluating these factors as important or very important.

Table 23: Success factors of firms with product innovations (Kendall-W-Test)

Importance	Success factors	Mean rank
1.	Quality	7.21
2.	Compliance with deadlines	6.35
3.	Price	6.08
4.	Flexible response to customers needs	5.59
5.	Short delivery time	5.45
6.	Novelty of products	4.29
7.	Large product variety	3.73
8.	After sales service	3.27
9.	Ecology	3.04

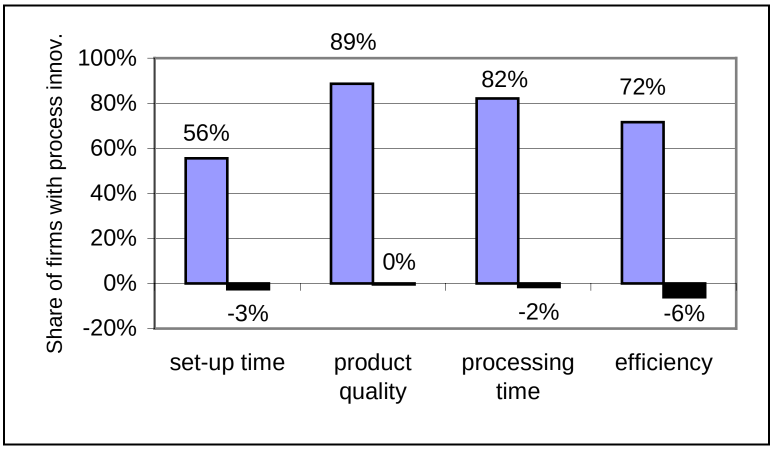
Price features as third important factor (80 % of answers). This is assumed not to reflect the situation of a typical transformation economy but of an industry that cannot compete by low prices because of favourable labour costs (see also above). However, the success factors which become increasingly important in advanced market economies such as after sales service or ecological aspects seem to be still of very low importance from the perspective of Slovene manufacturing firms.

Figure 17: Success factors evaluated as important or very important by firms with product innovations



In comparison to product innovations, the impact of process innovations is much less quantifiable as increased sales or cost reductions often cannot be attributed to a specific measure or cannot be traced in the companies' internal accounting system.

Figure 18: Improvements because of process innovations



As could be expected because of quality problems due to previously under-performing technology, product quality was the main impact of process innovations, 89 % of firms with process innovations report improved or very improved product quality. Process innovations leading to improved quality is likely to be accompanied by a reduction of the duration of the production process and an increase in efficiency in energy use and material input. These figures reflect the satisfaction of companies and success of performed process innovations.

Patents feature among the most frequently output measures of innovations. More than the "soft" differentiation between improved or newly developed products by companies themselves, patents allow for the evaluation of technological advance and novelty according to a more objective yardstick.

Table 24: Patent activities of Slovene firms during last three years

Number of patents	Percentage
no patents filed	89.6
1 patent	3.9
2 – 5 patents	5.6
6 and more patents	1.0
Total	100.0

In the sample, 10.4 % of Slovene manufacturing firms have applied for patents. Out of 41 firms, a considerable share applied for patents at international patent offices such as PCT, the European patent office and the patent office of the United States. This reflects technological developments which meet international technological standards. For all international patent offices, the highest share of submitted patent applications originate from the electrical and optical equipment industry and the wood, paper and pulp industry.

Table 25: Distribution of patent activities during past three years

Patent office	Number of firms	Number of patents
Slovene patent office	37	96
PCT	10	17
European patent office	18	26
Patent office of the U.S.	3	6
Total	41	145

However, it has to be taken into account that the Slovene patent office has only come into function quite recently which influences the number of applied patents filed nationally.

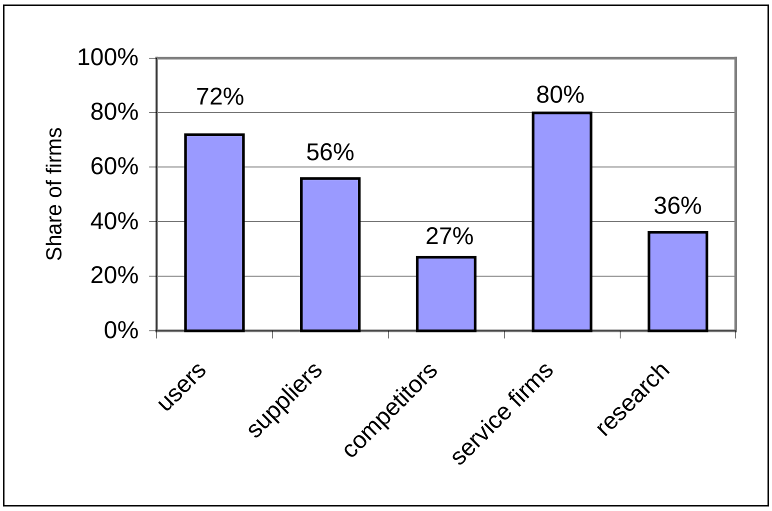
4. Innovative co-operations

The theoretical literature emphasises co-operation between different actors of the innovation system as a means to realise innovation potentials. Networks are assumed to facilitate the open exchange of information leading to interactive learning capabilities, the reduction of uncertainty and increase in flexibility to adopt to market changes (Grabher 1993; Camagni 1991). Close interactions between suppliers and users are especially effective for product innovations in manufacturing (Andersen/Lundvall 1988; Lundvall 1992). In the case of more traditional industries like in the Third Italy, e.g. textiles, leather products and tiles, the clustering of small firms is more effective to react to market changes and use buffer capacities and the creativity of the network of a heterogeneous lot of firms on different stages in the production process (Pyke/Sengenberger 1992; Pyke/Beccatini/Sengenberger 1990). Increasingly, the role of intermediate organisations to stimulate the formation of regional networks is emphasised (Cooke 1996). Networks mostly rely on interpersonal contact and informal linkages, but they sometimes manifest and also include more formal agreements. These types of network relationships bear diverse opportunities for learning and innovation.

This theoretical framework guides the following analysis. The focus will be on the assessment of existing co-operations between Slovene manufacturing firms in the sample and various external partners. Determinants of the propensity to co-operate will be identified. Then the different degrees of exchange intensity and associated opportunities for learning, innovation and thus realising innovation potentials will be analysed. As the identification of networks, which are not only bilateral links between companies but a whole texture of multilateral relations, will be difficult at this stage of analysis, this will be left to further analysis and case studies.

The manufacturing firms in the sample reported a relatively high share of co-operations with various partners. It should be noted, that they were explicitly asked for relations beyond normal business activities which were relevant for innovations. A share of 80 % of firms co-operate with service companies, 72 % with users, 56 % of firms with suppliers, 36 % with research institutes, universities and transfer organisation and 27 % with other firms which are potential competitors. The propensity to co-operate with all kind of partners is highly dependent on the innovative performance of the firms. The Chi-square test reveals a significant relation between co-operation with all groups and performance of innovations respectively at a level of 1 %.

Figure 19: Co-operation between manufacturing firms and various partners



The co-operation between manufacturing firms and suppliers, users and research institutes is strongly influenced by their size – as revealed by Chi-square test on the 1 % level for the co-operation with users and research institutes and on the 5 % level for collaboration with suppliers (Table 26, next page). While 73 % of all small firms with up to 19 employees co-operate with their users, this ratio declines in the case of firms with 20 to 99 employees to between 57.5 % and 60.0 %. Larger firms co-operate considerably more up to a share of 89.8 % of companies with 500 and more employees (Figure 20).

Again, a higher share of companies with less than 20 employees co-operate with their suppliers than firms with up to 99 employees. The ratio of co-operating firms reaches 67.3 % of firms in the group of firms with 500 and more employees.

The interaction with research institutes increases very clearly with company size. The share of companies in the lower size classes up to 99 employees which co-operate with science ranges from 14.9 % to 20.0 %. Among larger companies with 100 up to 249 employees and with 500 and more employees, 57.8 % and 71.4 % co-operate with research institutes, universities and transfer institutions.

In general, it can be assumed that smaller companies often do not have the financial resources and personnel capacities in order to engage in intense co-operations. This is rather a question of the critical mass that has to be reached in order to perform complex joint innovation projects than the share of qualified people, since there is no statistical significant correlation between share of employees with academic education and number of employees. This lack of resources is especially relevant for co-operations with research institutes and universities. On the contrary, the relatively high rate of very small companies co-operating with their suppliers and users illustrates the need for access to external resources which cannot be provided in-house. Reasons for the relatively lower propensity to collaborate of firms between 20 and 99 employees – especially with suppliers and users – need further investigation.

Figure 20: Size specific co-operation patterns with users, suppliers, science

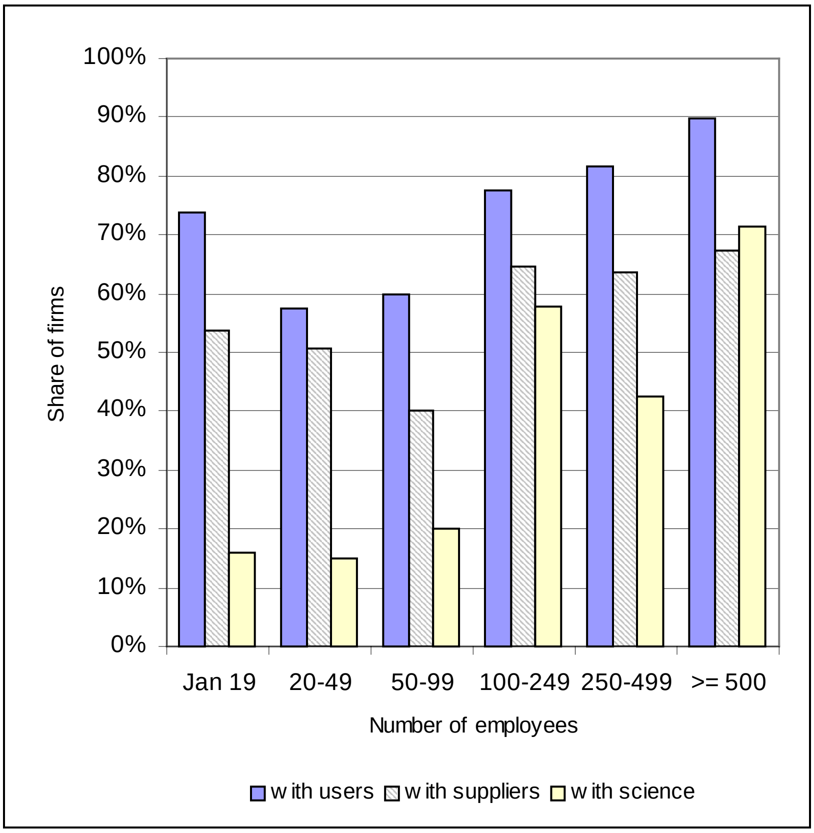
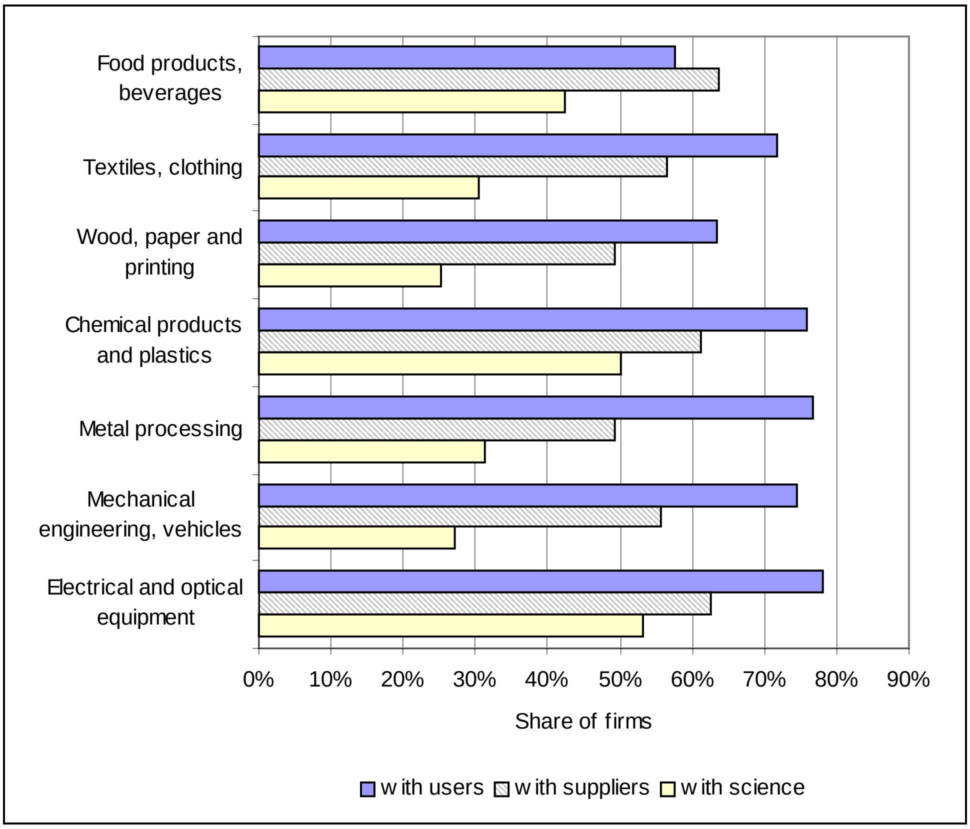


Table 26: Relation between company size (number of employees) and co-operative behaviour

Variable	χ^2 Pearson	Degrees of freedom	Asympt. significance
Co-operation with users	24.416	5	0.000
Co-operation with suppliers	14.433	5	0.013
Co-operation with science	84.620	5	0.000

Co-operation with users is in all sectors of higher importance compared to links with suppliers or research institutes – e.g. in the case of the electrical and optical equipment industry 78 % of firms co-operate with users; interactions with users are to a slightly less degree important in consumer near industries such as food and beverages (58 %) and wood, paper, printing (63 %). Co-operations with suppliers are most important in food production (64 %), electrical and optical equipment (63 %) and chemical and plastics sector (61 %). As also has been pointed out by Pavitt (1984), these are supplier dominated industries. Food production can be characterised as a carrier industry.

Figure 21: Sector specific co-operation patterns with users, suppliers and science



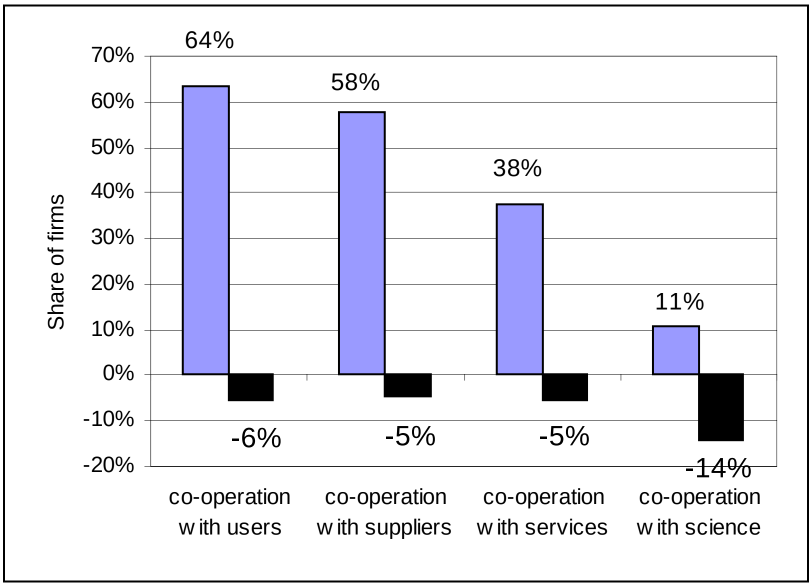
Co-operation with research institutes and universities is especially important in the electronics industry (67 %) and in chemical and pharmaceutical products (68 %).[15] As for these branches key technologies such as information technology and biotechnology, which are rapidly developing and are in the case of biotechnology science-based, are crucial, the high importance of co-operation with research institutes and universities in order to gain access to new scientific knowledge could be expected.

Almost two thirds of firms (64 %) reported an increase in innovation-relevant co-operations with users, 58 % of firms an increasing co-operation with suppliers since 1990. This illustrates the change of industrial relations compared to the former economic system. The decline in co-operation with research institutes and universities as reported by 14 % of firms is also striking. In the former system, the co-operation with science was partly obligatory and did not always lead to successful industrial innova-

15 Note that the percentages refer to a more disaggregated classification of sectors than displayed in the figure.

tion. The decline could partly be explained by a dissatisfaction on the side of firms but possibly also by the heavy budget cuts for R&D in companies since the start of the transition.

Figure 22: Change in co-operation with different partners since 1990



Summary of structural characteristics of co-operating firms

The following table summarises the structural characteristics of firms which co-operate with other partners in the innovation process and of firms without co-operations.

Table 27: Structural characteristics of co-operating and non-co-operating firms

	Co-operating firms (Mean)	Non-co-operating firms (Mean)	T-Test	Non-parametric Test: Kolmogorov-Smirnov-Z
Age	32.2	29.8	0.287 (0.776)	0.653 (0.787)
Employees 1996	250.4	43.5	1.956 (0.051)	**2.301 (0.000)
Sales 1996 (Mio DM)	22.1	4.5	1.533 (0.126)	**2.251 (0.000)
Sales per employee (thousand DM)	92.2	92.3	-0.005 (0.996)	1.171 (0.129)
R&D personnel	8.2	0.7	**5.094 (0.000)	**2.678 (0.000)
Share of employees w. university degree	2.7	2.2	*2.090 (0.044)	*1.446 (0.031)
Share of R&D personnel of total staff	5.4	2.6	*2.090 (0.044)	**2.349 (0.000)
R&D expenditure (thousand DM)	4.0	1.8	1.993 (0.054)	**2.906 (0.000)
Share of turnover in Slovenia	52.6	75.6	**-4.163 (0.000)	**1.832 (0.002)

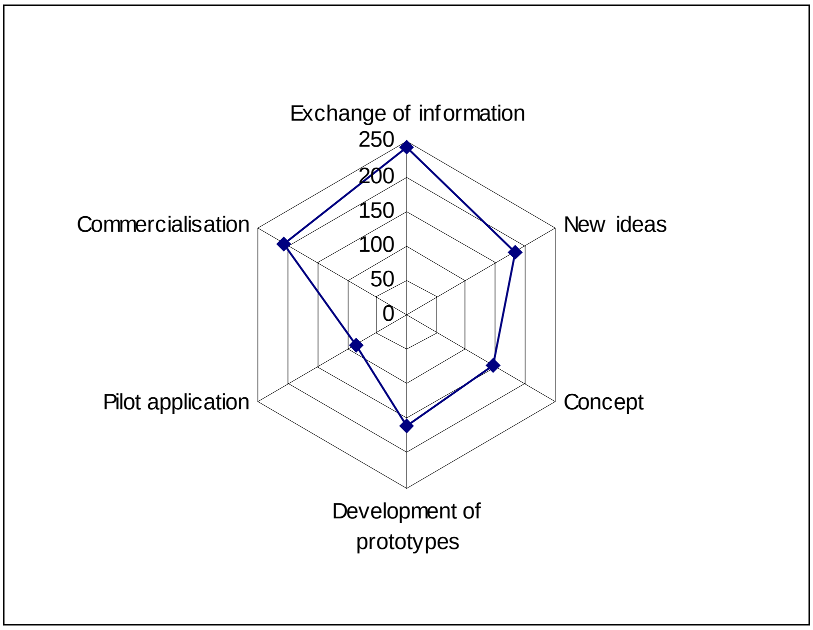
Note: According to the Levene Test, homogeneity of variances can be assumed for the number of employees and sales 1996. For all other variables, the T-Test for unequal variances has been performed.
Significance in brackets, with significance on the 1 % level ** and significance at the 5 % level *.

Age and sales per employee have no statistical significant impact on co-operative behaviour. The propensity to co-operate is influenced by variables describing firms' size, innovation input and export share. As discussed above, larger firms are in a better situation for co-operation because of human capacity and financial resources. Employees with higher education and even more so R&D personnel are an important precondition in order to benefit from innovation-relevant co-operations in the form of appropriating external knowledge and actively engaging in interactive learning processes with external partners: Internal and external sources of knowledge have to be understood as complementary. A high share of sales in Slovenia, in contrast to a stronger export orientation, have a statistical negative impact on co-operations. Export oriented companies tend to engage more often in co-operations. This could be partly explained by the underlying fact that innovating firms tend on the one side to be more export-oriented and on the other side also engage more often in co-operations than non-innovators.

Co-operation across different stages of the innovation process

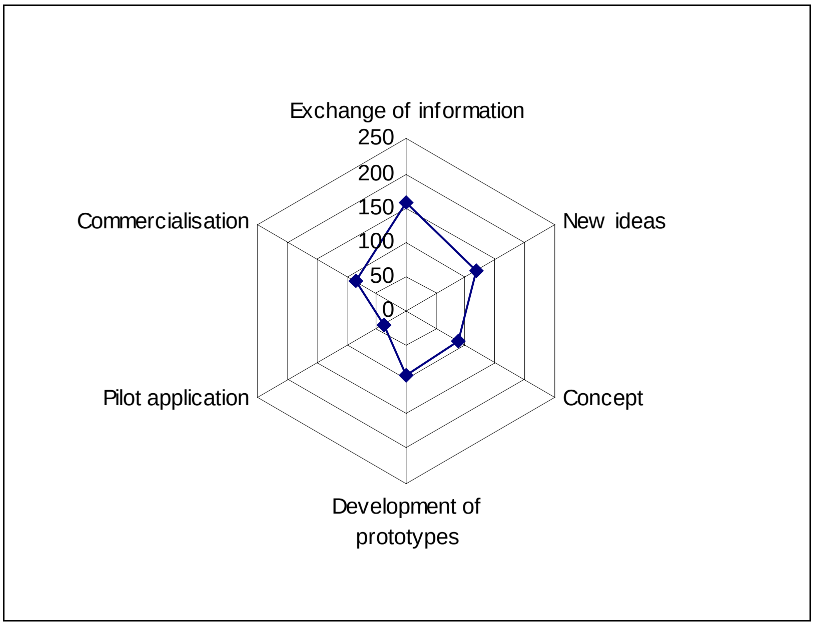
After examining the existence of co-operative linkages with various partners, the next section focuses on the intensity of co-operations. As could be expected, most firms prefer rather informal interactions such as exchange of information, generation of new ideas and concepts while the share of firms engaged in intensive co-operative development of prototypes or pilot applications is considerably less.

Figure 23: Co-operation with users



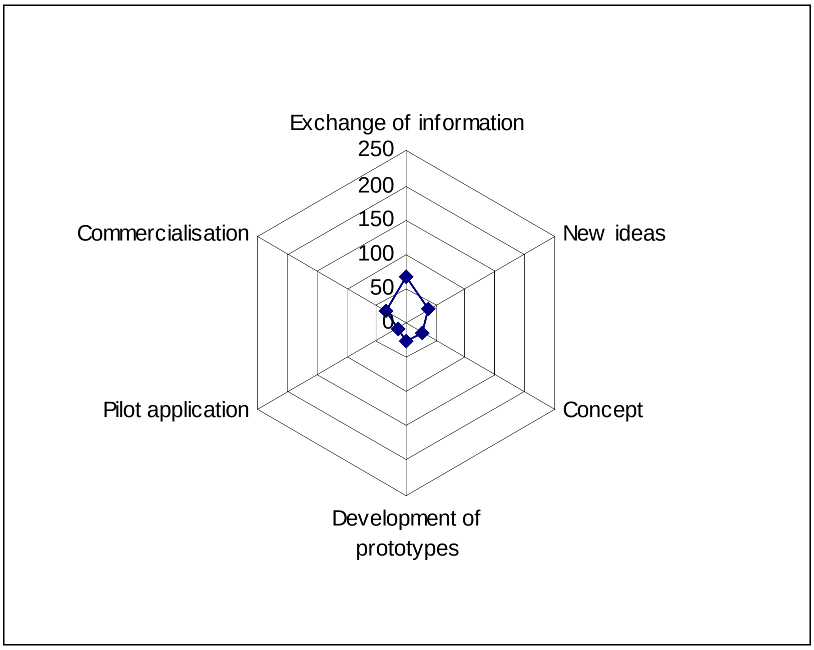
As already mentioned, 72 % of companies report innovation related co-operations with users, their pattern of interaction is as follows: While 58.2 % of these firms co-operate with users intensively or very intensively in the exchange of information, this decreases to 43.5 % of firms for the development of new ideas and to 34.6 % in the development of new concepts. 38.7 % of co-operating firms report intensive or very intensive co-operation with users in pilot application. While the low percentage of firms of 20.4 % who do pilot applications together with their users is surprising, the relative importance of interactions in the commercialisation phase (49.1 %) could be expected.

Figure 24: Co-operation with suppliers



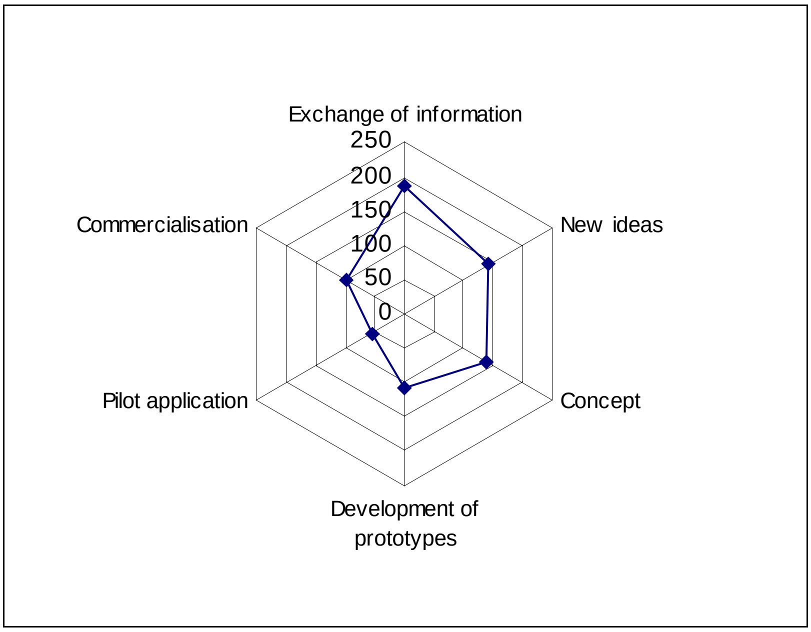
In the sample, 56 % of firms report supplier co-operations. 38.0 % exchange information with their suppliers: The share of firms who co-operate intensively or very intensively in the phase of the development of either new ideas or concepts with their supplier declines to 27.9 % and 21.1 % respectively.

Figure 25: Co-operation with other companies



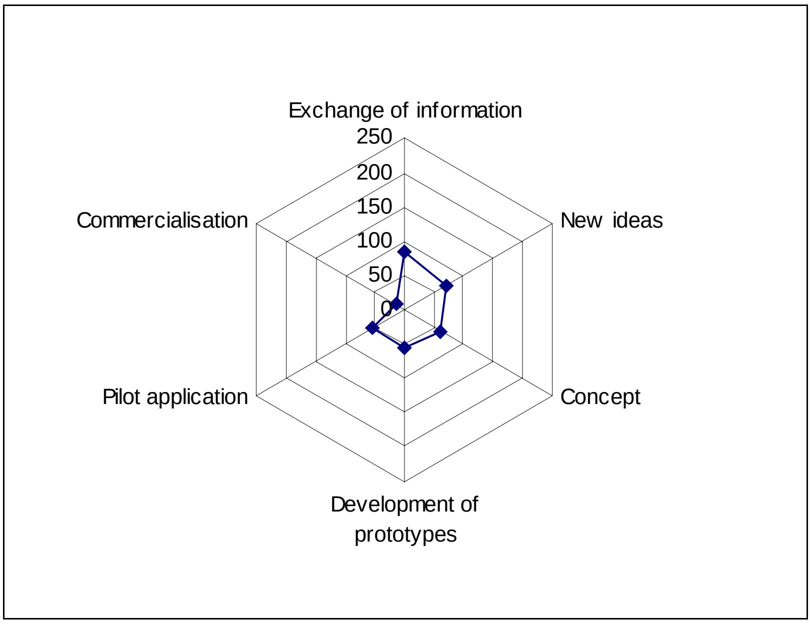
The co-operation with other companies is not developed, with 27 % they are the least requested co-operation partners. One possible reason can be seen in the fear of disclosing sensitive information to potential competitors. Instead, many companies seem to monitor their potential competitors' behaviour very well from a distance, since competitors have been mentioned as an important information source for innovations earlier on (see Figure 14). In the cases of exchange with potential competitors, the highest share of firms (16.4 %) report intensive or very intensive co-operation on the level of exchange of information. This lack of horizontal co-operation between companies reinforces the assumption that co-operative linkages are mostly vertical between users and suppliers.

Figure 26: Co-operation with service companies



Service firms are the most common co-operation partners of manufacturing firms. Firms co-operate with business supporting service firms mostly in the first phases of innovation process – namely in the exchange of ideas (44.5 % of firms) and the development of new ideas (34.1 %) until the development of the concept for the innovation (33.1 %). One quarter (25.7 %) of firms co-operating with services do this in the development of prototypes. 23.6 % of companies work intensively or very intensively together with services in the commercialisation of products. Business supporting services are in the area of software developing and consulting, tax advisors and auditors, management consultants, market research institutes and advertising agencies as well as engineering and planning bureaux, architects and testing bureaux.

Figure 27: Co-operation with universities and research institutes



The co-operation pattern with research institutes, universities and transfer organisations differs considerably from vertical network relations. Only 36 % of firms co-operate in the innovation process with research institutes or universities. The exchange of ideas holds – like in all other relations – with 20.4 % of firms the first place. In comparison, the importance of the research sector in the development of ideas and concepts declines to 16.9 % and 14.9 %. A share of 13.2 % and 12.2 % of firms co-operate intensively or very intensively in the development of prototypes and pilot applications. The intensity of co-operation with research sector declines steadily over the phases of the innovation process up to only 3.6 % in the commercialisation phase.

5. Framework conditions

The institutional framework affecting firms' innovative performance and co-operation behaviour consists of legal regulations and their enforcement in the areas of corporate law, foreign trade, banking, taxes, privatisation but also out of commonly accepted business practices, the innovation climate and previous experiences. More specifically, public policy such as support schemes, especially for innovations can set important incentives. As it would go beyond the scope of the present analysis to review all facets of the business environment in Slovenia, the following section gives a short overview of supporting measures for innovative enterprises. The pattern of the privatisation scheme has already been discussed in previous chapters.

The Ministry for Science and Technology (MZT) which was founded in 1991 is in charge of policy-setting, design and implementation of programmes for R&D. Partly because of an influential scientific community, the dominating concept is the financing of academic research: Basic research traditionally absorbs the majority of all budgeted funds for science and technology (Stanovnik 1998, 101). In addition, severe budget constraints led to a decline of resources for science and technology in recent years.

Slovenia has a very diversified research landscape with five types of research organisations: the Academy of Sciences and Arts, universities, independent research institutes in the public sector, research organisations in the private non-profit sector and research departments in enterprises (Kosmac 1996). The Academy of Sciences consists of 14 institutes with the focus on Slovenian language, history, ethnology and the arts, they are financed by MZT up to 90% of their budget. The country has two universities, the University of Ljubljana (25.000 students) and the University of Maribor (12.000 students) with a high concentration of research facilities and staff in the capital. In addition to the 38 research organisations belonging to the educational sector, another 50 research institutes are independent.

Since 1991, the innovation support infrastructure has been developed. Several information networks have been established, such as ARNES Academic and Research Network in 1992 and IZUM Institute of Information Sciences in 1992 (Kosmac 1996). The government finances the establishment of technology parks and technology centres. Furthermore, an European Relay Centre founded in 1996 aims at disseminating European-wide scientific results for application in the Slovene industry. In 1997, the National Innovation Agency was established with the help of PHARE funds. Its task is to link research institutes, universities and specialised organisations with technological demands from industry.

Since 1991 the Slovenian government has also introduced several schemes for promoting technological development in industry. Industrial research in the pre-competitive and near-market areas is subsidised, with special bonus for co-operations between manufacturing firms, but also between industry and science. Furthermore, financial support schemes to facilitate employment of Ph.D.s in industry have been introduced. Slovenia is also a member of EUREKA. From the year 1999 the country will have equal access to the programmes of the European Commission, namely the 5th framework programme.

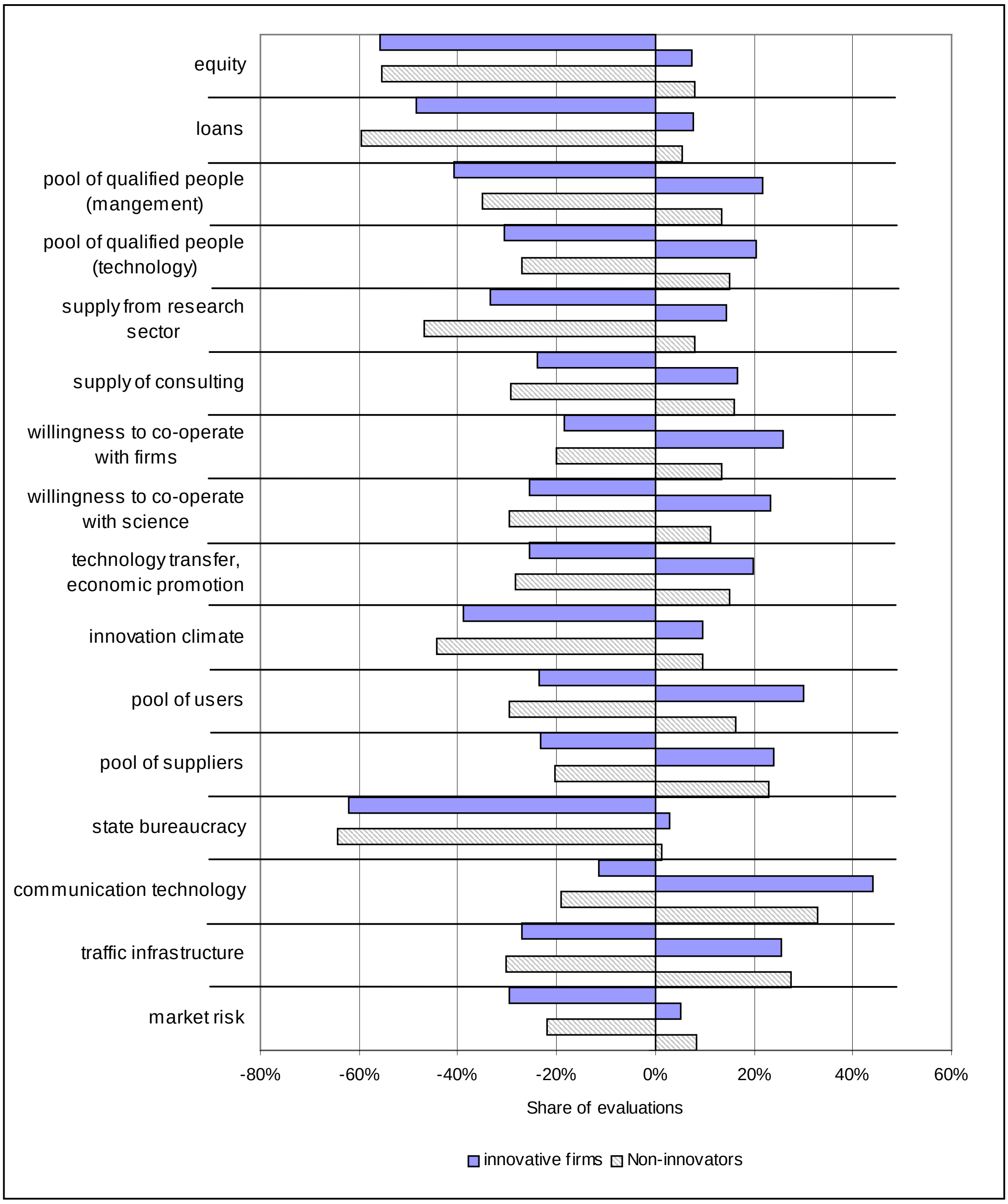
In addition to the programmes and initiatives from the Ministry of Science and Technology, other Ministries such as the Ministry for Small Businesses and Tourism and activities of the Chamber of Commerce play an important role for the development prospects of Slovene manufacturing firms. In 1995, a new concept of the support network for small businesses was designed: The Slovenian Business Development Centre as a public institution is the main co-ordinator of a network of regional centres of business assistance.

The availability of loans or equity to finance innovations is very limited. Banks are rather hesitant and high interest rates often cannot be paid from the profits of research and development projects. There is only an underdeveloped venture capital market in Slovenia (Bross/Walter 1998). The Technology Development Fund of the Republic of Slovenia (TRS) which was founded in 1994 (Ministry of Science and Technology of the Republic of Slovenia 1995) meant a source of financing for technology oriented companies by equity capital or loans. While the set-up of the fund was promoted by PHARE, its expansion was financed by funds from privatisation. In 1997, the Fund has been integrated in the Slovenian Development Agency which has the main task to re-structure the remaining enterprises in the hands of the state.

After this brief background, the following analysis starts with an overall evaluation of framework conditions by the manufacturing firms in the sample before looking at the perception of public policy programmes from the perspective of firms.

Overall, firms evaluate financing opportunities as very bad, both regarding equity and loans. A problem of the privatisation process was that a huge part of enterprises did not raise fresh equity capital through the privatisation process. It can be observed that non-innovating companies are more pessimistic about credit access (60 %) than the innovating ones (55 %). The evaluation of the labour market is rather ambiguous, while a share of both innovating and non-innovating firms evaluate the possibility to recruit qualified personnel as good, a high share is more pessimistic, especially re-garding employees with management skills.

Figure 28: Evaluation of framework conditions for innovation



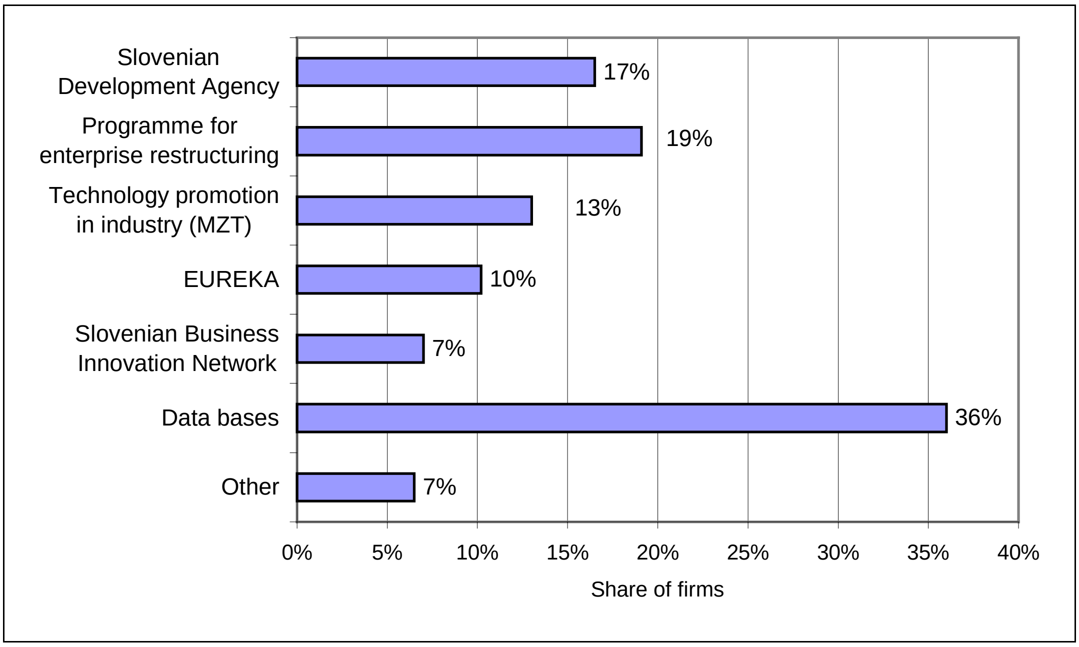
Paradoxically, especially a high share of non-innovating firms is pessimistic about the supply of technological knowledge from the research sector (47 %). Both innovating firms and those without innovations evaluate the innovation climate very badly (39 % and 44 % respectively). The performance of the state bureaucracy is evaluated the worst among all framework conditions for innovations (62 % and 64 % by innovating and non-innovating firms). Although a similar perception could be assumed also in advanced market economies, the situation in a transition economy might be considerably worse, since public administration only has to built up functioning measures of a decentralised market economy and establish new procedures. Indeed, bureaucratic hindrances are very much in the availability of business premises, approval for construction works etc.

The communication infrastructure is evaluated very positive. Also the market risk does not seem to be a problem for Slovene firms which marks an important difference to the almost all other Central and Eastern European Countries.

Summarising, only for four framework conditions the sum of positive evaluations exceeds the negative responses: These relate to the preconditions for innovation- supporting co-operations. All other factors are in sum evaluated as barriers to innovation.

More than one third (36 %) of the manufacturing companies in the sample used public data bases. A share of 19 % of firms were promoted by the Programme for enterprise restructuring podjetij and 17 % used the programmes of the Slovenian Development Agency, which are not especially targeted towards innovating firms but towards firms in the restructuring and privatisation process in general.

Figure 29: Percentage of firms which used public assistance

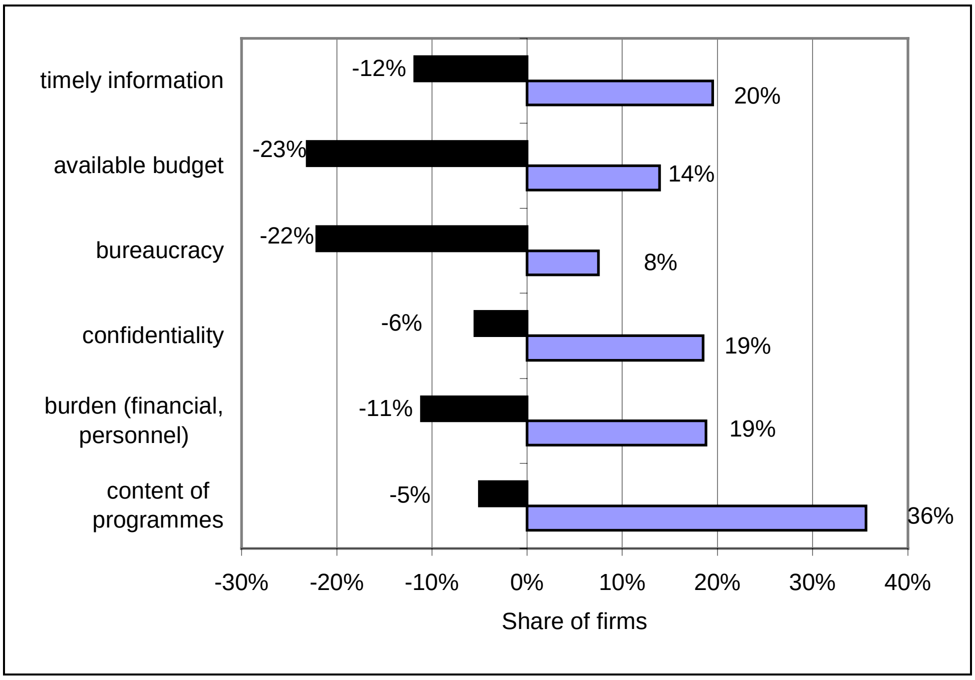


The technology programmes of the Ministry of Science and Technology promoted 13 % of manufacturing firms in the sample. Also a relatively high percentage of firms engaged in the European applied research initiative EUREKA which shows that those firms were not only able to manage international research and development co-operations, but are also requested partners on behalf of other European companies and research institutes. However, EUREKA does not provide any direct funding opportunities. The Slovenian Business Innovation Network was used by only 7 % of firms.

The contents of the programmes are viewed positively by 36 % of responding firms. Companies evaluate the necessary financial and personnel resources and the timeliness of information ambiguously, though more companies are satisfied than upset.

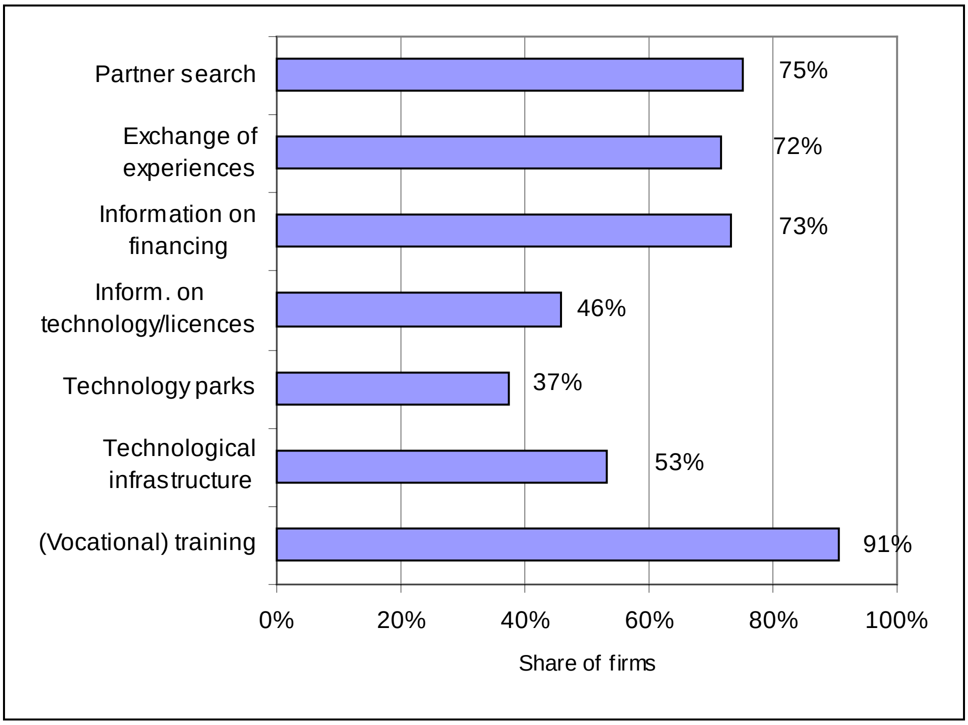
The greatest problems are seen in bureaucracy and available budget. The administrative procedures associated with public promotion schemes are viewed negatively by 22 % of companies, 23 % of firms evaluate the available budget for public promotion of industry as too low, which is indeed a real problem.

Figure 30: Evaluation of public promotion schemes



The manufacturing firms in the sample also ranked their priorities for possible additional promotion schemes. Training, especially vocational training is the priority of public support for innovation: 91 % of firms evaluate this as important. This reflects the need for reorganisation of the innovation process in companies and the necessity of new skills compared to the former system. The second priority hold measures which aim at reducing the transaction costs in helping companies to find partners, informing them about financing and promotion opportunities and establishing fora to exchange experiences: These measures are named by 75 % to 72 % of companies.

Figure 31: Public policy measures seen as important or very important



Measures which are related to the further development of the technological infrastructure are clearly of lower priority; however, still half of the companies name such as important. Concluding, the expressed need for public support of innovations is directed towards soft factors and the functioning of the innovation system. To a less degree companies feel that there are not enough scientific or supporting organisations in their region or in Slovenia.

Table 28: Priorities of public policy measures

Importance	Promotion measures	Mean rank
1.	(Vocational) training	5.50
2.	Brokerage: finding partners	4.53
3.	Information about financing and promotion schemes	4.36
4.	Organisation of exchange of experiences	4.24
5.	Development of scientific and technological infrastructure	3.40
6.	Information about state of technology, licences	3.22
7.	Foundation of technology parks	2.75

6. Summary

The survey of development and innovation potentials in the Slovene manufacturing industry is among the first extensive studies in economies in transition. It aims at complementing more quantitatively oriented statistical exercises. On the one hand, new results on innovation and co-operation patterns of Slovene firms are presented. On the other hand, various insights on the transition process shine through this first analysis.

According to their self-assessment, an unexpected high share of Slovene manufacturing firms innovated, i.e. introduced product and/or process innovations between 1994-1996. This high share of innovations reflects the need for reorientation after the loss of traditional markets and for modernisation of outdated capital stock and over-staffed work organisation. As revealed by share of sales from product innovations, share of completely new developments versus incremental improvements, high awareness for quality and exports to western markets, especially EU member states, innovations seem to be a success factor of Slovene firms. Specific sectors could be identified according to their above-average performance.

However, due to the ongoing restructuring process in industry, there could not be found a clear running causation of innovative performance and economic success and employment effects – still, too much turbulence prevails in the sector. This is underlined by a high share of firms adjusting by ad hoc strategies to market needs. The not completed restructuring in industry can be seen from the still quite high share of socially owned companies in the sample by end 1997.

The analysis of the innovation input as pointed out the relevance of both internal innovation capabilities and external co-operation. Especially the regularity of development activities seems to be important for innovations. However, the relevance of internal R&D in the sense of "technology push" still seems to be overevaluated. So – while the share of firms co-operating especially with users and suppliers is unexpected high at first sight – the share of intensive co-operation in core phases of the innovation phase is much lower. Consequently, modes to transfer relevant tacit knowledge and engagement in interactive learning processes seem to be underdeveloped by far. Especially the use of the research infrastructure is very low.

These patterns as well as the firms' evaluation of the framework conditions for innovations show that despite restructuring efforts since 1991, the innovation system has not been developed far enough. While several new organisations have been established – especially to enforce the technology transfer –, the links between the various actors and sectors – industry, research and policy – are not yet functional. Besides lack of capital for innovative projects the overall innovation climate is seen as not favourable.

This inertia can partly be attributed to the legacy of the old system but also to the instability of actors' relations in the transformation phase. This is also clearly expressed by the firms' needs for further promotion measures.

References

Acs, Z; Audretsch, D. (1993): Innovation and firm size: the new learning, in: International Journal of Technology Management, Special Publication on Small Firms and Innovation, p. 23-35.

Andersen, E.; Lundvall, B.-A. (1988): Small National Systems of Innovation Facing Technological Revolutions: An Analytical Framework, in: Freeman, C.; Lundvall, B.-A. (Ed.) (1988): Small Countries Facing the Technological Revolution, Pinter Publishers, London, New York, p. 9-36.

Backhaus, A.; Seidel, O. (1997): Innovationen und Kooperationsbeziehungen von Industriebetrieben, Forschungseinrichtungen und unternehmensnahen Dienstleistern: Die Region Hannover-Braunschweig-Göttingen im interregionalen Vergleich. Hannoversche Geographische Arbeitsmaterialien, 19-1997. Universität Hannover: Hannover.

Bross, U.; Walter, G.H. (1998): Development Prospects of the Czech Venture Capital Market. Assessment and Starting Points for Policy Measures, Stuttgart: Fraunhofer IRB Verlag.

Camagni, R. (Ed.) (1991): Innovation networks: spatial perspectives, London: Belhaven Press.

Clement, H. (1998): Slowenien, in: Bundesministerium für Wirtschaft (Ed.): Wirtschaftslage und Reformprozesse in Mittel- und Osteuropa - Sammelband 1998, Bonn, p. 81-89.

Cooke, P. (1996): The New Wave of Regional Innovation Networks. in: Small Business Economics, Vol. 24, p. 272-294.

David, P. A.; Foray, D. (1995): Accessing and Expanding the Science and Technology Knowledge Base, STI Review, No. 16, OECD, Paris.

Fritsch, M. (1990): Zur Bedeutung des kleinbetrieblichen Sektors für die Regionalpolitik. In: Berger, J.; Domeyer, V.; Funder, M. (Hrsg.): Kleinbetriebe im wirtschaftlichen Wandel. Campus: Frankfurt a.M., New York, p. 241-268.

Fritsch, M.; Bröskamp, A.; Schwirten, C. (1996): Innovation in der sächsischen Industrie. Erste empirische Ergebnisse. Freiberger Working Papers 96/13. TU Bergakademie: Freiberg.

Grabher, G. (1993) (Ed.): The embedded firm - on the socioeconomics of industrial networks, London: Routledge.

Grabher, G.; Stark, D. (Ed.) (1997): Restructuring Networks in Post-Socialism: Legacies, Linkages, and Localities, Oxford: Oxford University Press.

Harter, S. (1997): From "Third Rome" to "Third Italy"? Economic networks in Russia, Research Papers in Russian and East European Studies, Centre for Russian and East European Studies, The University of Birmingham.

Kline, S.; Rosenberg, N. (1986): An Overview of Innovation, in: Rosenberg, N./Landau, R. (Ed.): The Positive Sum Strategy, Washington D.C. National Academy Press, p. 275-305.

Komac, M. (1996): Technologiepolitik unter den schwierigen Bedingungen eines Transformationslandes (Beispiel Slowenien), MOEL Working Paper No. 47, FhG-ISI, Karlsruhe.

Koschatzky, K.; Traxel. H. (1997): Entwicklungs- und Innovationspotentiale der Industrie in Baden. Erste Ergebnisse einer Unternehmensbefragung, Arbeitspapier Regionalforschung Nr. 5, ISI: Karlsruhe.

Kosmac, D. B. (1996): Review of Changes in the National Science and technology Policy of the Republic of Slovenia (1993 - 1996), Ljubljana, mimeo.6

Lundvall, B.-A. (1992): Introduction, in: Lundvall, B.-A. (Ed.): National systems of innovation: towards a theory of innovation and interactive learning, London: Pinter Publishers.

Ministry for Science and Technology of the Republic of Slovenia (ed.) (1995): Science and Technology in Slovenia, Ljubljana.

Muller, E. (1997): Entwicklungs- und Innovationspotentiale der Industrie im Elsaß, Arbeitspapier Regionalforschung Nr. 8, Karlsruhe: FhG-ISI.

Muller, E., Gundrum, U., Koschatzky, K. (1994): Horizontal review of regional Innovation Capabilities. Final Report to the European Commission, DG XIII-D, ISI: Karlsruhe.

OECD (1997): Oslo Manual. Proposed guidelines for collecting and interpreting technological innovation data, Paris: OECD/Eurostat.

Pavitt, K. (1984): Sectoral Patterns of Technical Change: Towards a Taxonomy and a Theory, in: Research Policy, Vol. 13, p. 343-73.

Polanyi, M. (1958): Personal Knowledge: Towards a Post-Critical Philosophy,, London.

Pyke, F.; Becattini, G.; Sengenberger, W. (Ed.) (1990): Industrial districts and inter-firm co-operation in Italy, Geneva: ILO Publications.

Pyke, F.; Sengenberger, W. (Ed.) (1992): Industrial districts and local economic re-generation, Geneva: ILO Publications.

Raiser, M.; Sanfey, P. (1998): Statistical review, in: Economics of Transition, vol. 6, 1998, p. 241-286

Slovenian Economic Mirror (SEM) (1999): January, Ljubljana: IMAD, http://www.sigov.si/zmar/arhiv/og0199/aogl0199.html.

Stanovnik, P. (1998): The Slovenian S&T transition, in: Meske et al. (ed.): Trans-forming Science and Technology Systems – the Endless Transition, Amsterdam: IOS Press, p. 98-107.

Stanovnik, P; Kavas, D. (1998): Innovation and SMEs in the Slovenian Economy during the Transition. Paper delivered at international WAITRO seminar "Best Practices to Strengthen the Capacity of Research and Technology Organisations to Facilitate the Development of SMEs", Warsaw, 13-14 October 1998.

Stanovnik, P; Lapornik, M. (1994): Privatisation in Slovenian and the Restructuring of Manufacturing Industries, Paper presented at the international conference "The Path to Economic Development", Budapest, 4-5 May 1994.

Statistical Office of the Republic of Slovenia (SURS) (1998): Research & Develop-ment, Science & Technology, Rapid Reports, 17 March 1998, No. 76, Ljubljana.

Walter, G.H.; Bross, U. (1997): The Adaptation of German Experiences to Building Up Innovation Networks in Central and Eastern Europe, in: Koschatzky, K. (ed.): Technology-Based Firms in the Innovation-Process. Management, Financing and Regional Networks, Physica: Heidelberg, p. 263-286.

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