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The State of a Regional Innovation System in Styria:
Conclusions and Policy Proposals

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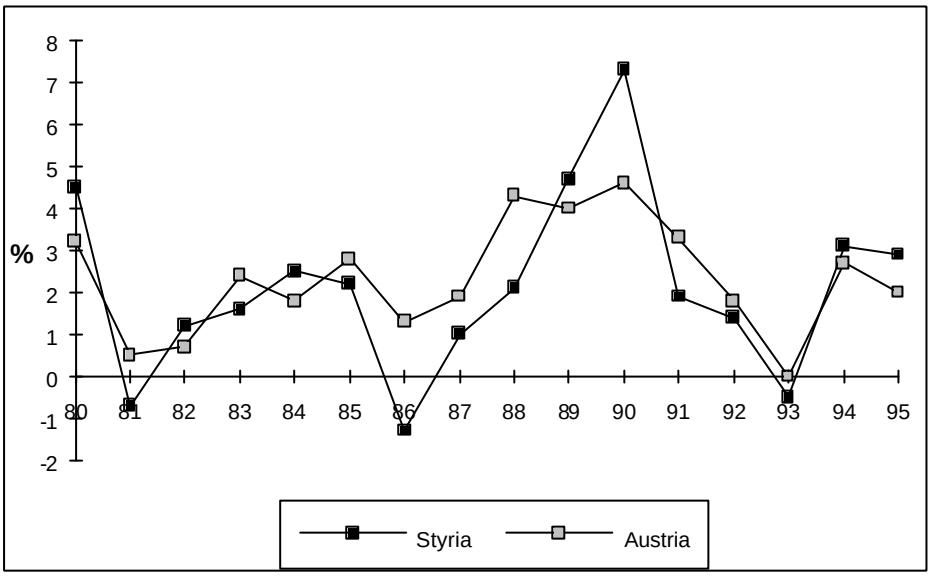
1 The economic development in Styria

The Styrian economy, specialized in basic industries such as mining, iron and steel, metal products, wood and paper, represents an old industrial core region of Austria. However, since the sixties the region's GDP growth rate was in most years slower than that of the rest of Austria, the strong orientation to basic industries being one of the underlying reasons.

Figure 1: Rate of change of the GDP (compared with the previous year) in Styria and Austria

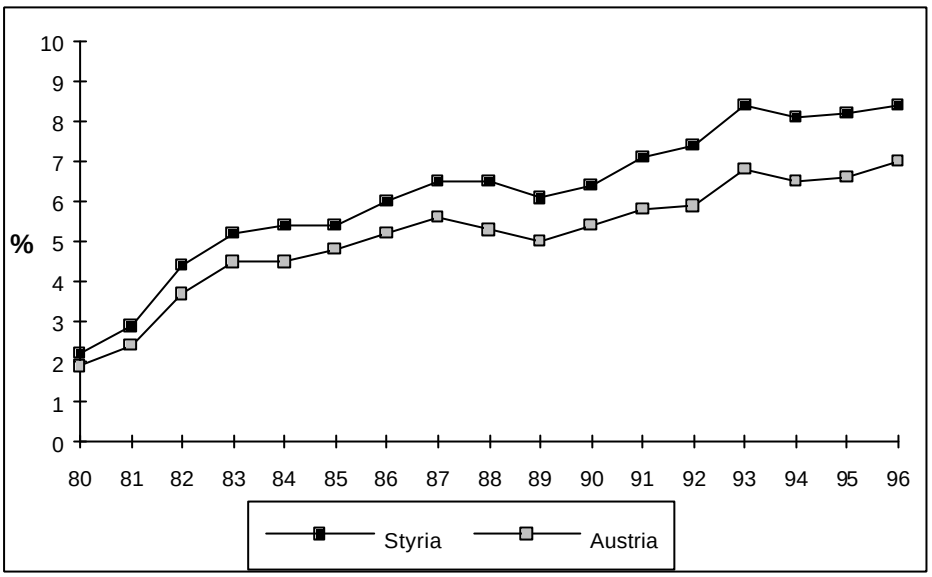


Source: WIFO Monatsberichte

Since 1980, in three years the economic activity in Styria was negative. In these years the recession was always more serious in Styria than in Austria. In most years, however, the rate of change was positive. Especially in the period from 1987 to 1990, Styria experienced a regional boom, clearly surpassing the Austrian performance. After decreasing growth rates until 1993, the region saw a considerable recovery in 1994 and in 1995.

In contrast to the more or less positive development of GDP since 1980, the rate of unemployment has continously risen in both Austria and Styria. The increase in Styria, however, has been higher than in Austria. Total employment grew from about 330 000 in 1970 to about 400 000 in 1994, but the growth was slower than in the rest of Austria and the major increase already took place in the seventies. In the same time, Styria's total labour force expanded from about 350 000 in 1971 to 450 000 in 1994, creating more demand for jobs than the regional economy could supply. The problem was reinforced in the eighties when some of the leading industries, such as steel, were hit by a severe crisis.

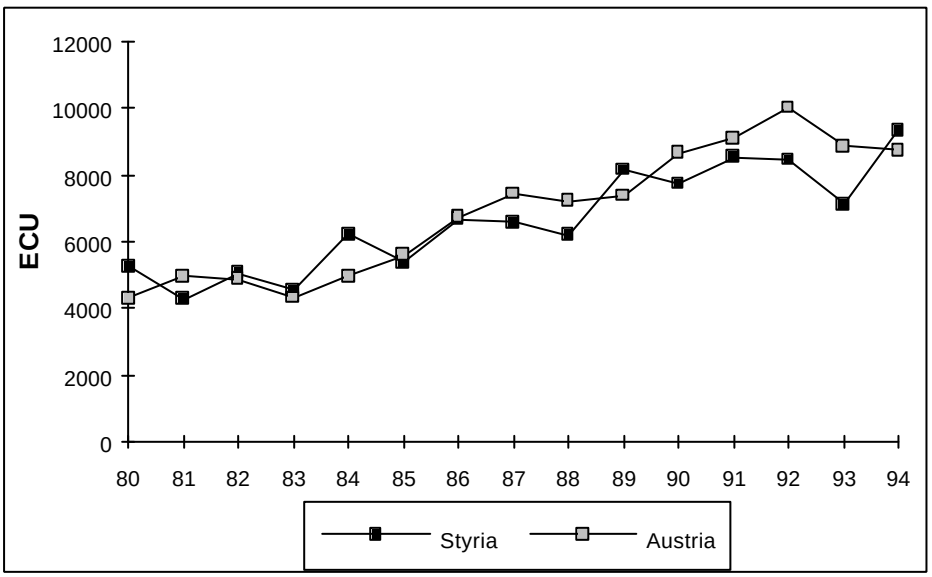
Figure 2: Rate of unemployment in Styria and Austria



Source: AK, Wirtschafts- und sozialstatistisches Taschenbuch

For most years during the eighties, the investments per employee were very similar in Styria and Austria, both time series showing a rising trend until the early nineties. Since then the relative investment has been falling in Austria. In Styria, however, it recovered after a sharp decrease in 1993 remarkably in the following year, surpassing the Austrian investment activity.

Figure 3: Investment (in the manufacturing sector) per employee in Styria and Austria



Source: ÖSTAT, Industriestatistik

The sectoral structure of the Styrian economy has changed in this period of time according to the general trend – a decrease in the relative importance of manufacturing and an increase in the share of the service sector. However, the decrease of the manufacturing sector in Styria has only been small, from 24.0% of the regional GDP in 1981 to 22.2% in 1992. It still holds a higher share than in Austria (19.5% in 1992). Due to its overall importance in the Styrian economy, the manufacturing sector has a

major impact on regional growth. In terms of employment the sector still grew in the seventies. Since then, however, employment fell by about 1/5, from 102 000 in 1980 to 82 000 in 1992. Major losses occurred between 1985 and 1988 and since 1990 mostly due to the restructuring of state owned basic industries.

In Styrian manufacturing, basic industries are dominating: ferrous and non-ferrous metals, metal and steel products, paper, wood products, leather and shoes. A recent study[1] investigated cluster structures in Styria. Based on a sectoral approach the authors identified three clusters of outstanding importance: metal/steel and materials, wood/paper and vehicles/transport. In this context, it has to be mentioned that due to the use of sectoral data, they have to be interpreted more in the sense of potential than actual clusters. **Metal/materials** is the oldest and largest of these clusters. It consists of 155 firms, provides 23 300 jobs and contributes about one third of Styrian industry sales. The production of iron and steel still dominates. After a severe crisis in the seventies due to massive surplus capacities, the sector has been restructured in the form of splitting up the large state owned conglomerates and privatizing them. Some of these now independent firms have regained their competitiveness in the nineties partly through a concentration on core businesses and reinforced innovation. **Wood/paper** is a traditional, resource based cluster in Styria, covering a wide (vertical and horizontal) range of products. It comprises timber processing, paper (and related products), furniture, related machinery, etc. There are 395 firms in this cluster employing 11 000 persons. They account for one fifth of Styrian industry sales. The cluster is growing and shows a good export performance. Nevertheless, it is confronted with strong competitive challenges, forcing many companies to move into higher value added-segments of the value chain[2]. **Vehicles/transport** is the strongest growing cluster in Styria, and there are 37 firms with 7 800 employees at present. It comprises the manufacturing of car and rail systems and components. With regard to vehicles, Styrian firms are either suppliers of components, ranging from simple parts to complex subsystems (e.g. transmission, motor), or assembly plants (e.g. Chrysler-Steyr). The vehicle-sector is the primary target of the Styrian "cluster policy". At the national level this sector was supported with the intention to reduce the balance of trade deficit through increased subcontracting by Austrian firms.

In addition to these sectoral features, **ownership and organizational characteristics** of the Styrian economy are relevant for its development. Due to the nationalization of basic industries (mining, iron and steel) after the second world war, there was an outstanding high share of state owned enterprises in Styria (27% of industrial employment in 1989, another 13% were employed in firms owned by public banks). In the sixties and seventies also parts of down-stream activities such as steel products, machinery and vehicles came under state control through vertical integration and mergers.

The state owned firms had a major impact on the Styrian economy in the postwar period. The search for economies of scale through vertical and horizontal integration was the dominant strategy in the sixties and seventies. It was accompanied by a concentration of headquarters in Vienna. As a consequence many plants in Styria were under external control and very often had lost planning, R&D

[1] Fabris, W. et al.: Wirtschaftsleitbild Steiermark. Vienna, 1995

[2] Bayer, K. et al.: Zwischen Rohstoff und Finalprodukt. Wettbewerbsfähigkeit des Wirtschaftsbereichs Holz-Papier. Vienna, 1993

and marketing/distribution functions, i.e. those responsible for the monitoring of markets and technology. The late seventies saw the state owned firms in a severe crisis and in the eighties they underwent restructuring. They were partly privatized, partly they regained some of the dispositive functions in a process of organizational decentralization. Often restructuring resulted in severe losses of jobs and also in plant closures.

Reflecting processes of globalization and European integration, foreign firms became more important in Styria in the 1980s. In 1989 they were holding 21% of employment. Major foreign investors are active in the vehicle industry (Chrysler, Magna), in the electrical industry (Philips, Bauknecht) and in electronics (Siemens).

Regarding innovation previous studies for the late 1980s have shown that a lower share of plants was engaged in innovation activities in Styria than in Austria.[3] However, there were also signs of catching up since total expenditure for innovation had increased much stronger between 1985 and 1990 in Styria (from 2,6% of the sales to 3,9%) than in Austria (from 2,7% to 3,3%). Similarly, Styrian firms showed a stronger increase in R&D expenses than the rest of Austria. In Styria, relatively more firms were engaged in process innovation than in Austria. Furthermore, innovations were frequently based on existing technology and often had the character of incremental change, exploiting existing trajectories instead of new ones.

2 Methodology

The sample of the firm survey and the firm interviews:

From the relevant population, comprising all manufacturing and producer service firms, the sample used for the survey was defined in a way to cover companies, either belonging to relative important Styrian industries, having a long tradition in the region, or being more active in product and process innovations. The Austrian innovation survey 1990[4] provided the relevant data on expenses for innovation, research and development. After having defined these manufacturing industries, we added to the sample such producer services which are relevant for the companies' innovation activities. The share of the industries which were covered by the survey (wood/paper, metal/steel, metal products, machinery, electro and electronics, transport equipment) accounts for 74% of manufacturing employment in Styria.

With regard to the interviews, the sample was drawn from the survey and it should cover a reasonable range of firms of different size and innovativeness. Considering the small number of interviews (15), the sample was restricted to the industries metal/steel, machinery, automobiles and electro/electronics.

[3] Steiner, M. et al.: Technologiepolitisches Konzept Steiermark. Graz, 1996

[4] Leo, Hannes, Palme, Gerhard and Volk, Ewald: Die Innovationstätigkeit der österreichischen Industrie. Technologie- und Innovationstest 1990. Vienna, 1992

The structure of the sample is presented in the following table:

Table 1: Structure of the survey and interview samples (1)

	Total	Size (1)			Indus try (2)					Mf	Serv
		<50	?50, <200	?200	Wo/Pa	Ma	Me/St	El	Auto		
SURVEY:											
Total dispatched	806									407	399
Respondents	107	53	21	27	13	17	24	17	9	66	41
Response rate (%)	13.3									16.2	10.3
Representativeness share in % (3):		<50	?50, <500	?500							
Sample		3.4	27.7	68.9	8.4	23.6	28.3	11.7	24.3		
Region		10.9	53.3	35.8	14.6	14.4	30.6	16.5	11.6		
INTERVIEWS:											
Firms	15	3	3	9	1	4	4	4	3	13	2

(1) Number of employees. As far as the calculation of the representativeness of the sample is concerned, the size categories of the ÖSTAT-database had to be used.

(2) Wo/Pa = Wood/paper, Ma = Machinery, Me/St = Metal/steel, El = Electro/Electronics, Auto = Automobiles, Mf = Total manufacturing, Serv = Producer services

(3) Manufacturing only. It has to be considered that, in contrast to the categories of the regional database which are mutual exclusive, the categories of the sample are overlapping.

The comparison of the distribution of industries between the respondents' firms and the Styrian economy could only be done for manufacturing. The necessary data for the service sector is not available. Compared to the distribution of the selected industries, machinery and vehicles are overrepresented, wood/paper and electro/electronics are underrepresented. Metal/steel is quite adequately represented. The comparison of the size distribution of the respondents' manufacturing firms with that of the Styrian manufacturing sector shows that the largest size class is overrepresented, the medium and small ones are underrepresented. Due to the fact that in the service sector small-sized companies dominate, companies belonging to this category are more relevant in the total set of data than it appears in table 1.

In the case of the interviewed firms, the bias is even stronger. Metal/steel- and electro/electronics-firms are underrepresented, whereas machinery- and especially automobile-companies are overrepresented. The sample has also a bias towards larger firms (four companies having more than 1000 employees, while only six have less than 100). This bias is not only due to the small number of interviews which could be conducted, but also to a low willingness of small and less innovative companies to accept interviews.

The investigation of the innovation support infrastructure in Styria:

In total, 18 organizations were contacted and finally 16 interviews could be made. These 16 organizations belong to the following categories of innovation support functions:

- **Science**: Industrial Liaison Office at the University of Leoben, Industrial Lisaison Office at the Technical University Graz, Institute for Electronics at the Technical University of Graz, Joanneum Research - Department of technology consulting, Institute of Metal Works at the University of Leoben
- **Training**: "Wirtschaftsförderungsinstitut Steiermark" (WIFI), Industrial Liaison Office at the University of Leoben, Industrial Lisaison Office at the Technical University Graz, Institute for Electronics at the Technical University of Graz, Training Centre Fohnsdorf, Institute of Metal Works at the University of Leoben, Labour Market Services (AMS), Technikum Joanneum (HEI)
- **Technology transfer**: Industrial Liaison Office at the University of Leoben, Technology Transfer Centre Leoben (TTZ), Regional Consulting Obersteiermark (ÖAR)
- **Funding**: Styrian Economic Development Agency (SFG), Styrian Technology Park (STP), A.i.Z. - Aichfeldcentre (providing infrastructure), APS - European Programmes for Technologies and Training (only information function of European funds)

The evaluation of the university system in terms of their science, training and technology transfer functions is very complex. We contacted the industrial liaison offices which are responsible for public relation and contacts to companies as well as one institute of each university.

3 Competitive position and innovation of the survey firms

What are the main competitive advantages and strategies of Styrian firms and to which extent are they based on innovation? The following table gives an overview on these aspects and shows also the recent challenges and reactions of the firms:

Table 2a: Competitive advantages and strategies of firms:

Positive answers and mean importance (*)

Competitive advantages:	% yes	mean	Strategies of competition:	% yes	mean
Quality	99.1	4.07	Skills of employees	96.3	3.62
Innovativeness, tech. standard	97.2	3.83	Internal R&D	83.2	3.34
Time of delivery	97.2	3.68	Marketing	82.2	2.87
After sales service	93.5	3.58	Organization of production	71.0	3.14
Price	83.2	2.28	Cooperation with European firms	59.8	2.81
User friendly products	66.4	2.61	Cooperation with national firms	47.7	2.45
Environmental advantage	64.5	2.48	Cooperation with regional firms	45.8	2.35
			Owning patents/licenses	45.8	1.84
			Cooperation with firms outside Europe	34.6	2.16

(*) 0 = of little importance ? 5 = very important

Innovation and technology related items

Table 2b: Challenges and reactions:

Positive answers and mean importance (*)

Challenges:	% yes	mean	Reactions on challenges:	% yes	mean
Price competition	95.3	3.95	Cutting cost	96.3	3.52
Rapidly changing demand	95.3	3.42	Intensified internal R&D	89.7	3.24
Personnel costs	94.4	3.99	Faster product development	86.9	3.40
Speed of technological change	94.4	3.11	Organization restructuring	82.2	3.24
Increasing quality requirement	93.5	3.40	Cooperation with firms in R&D and innovation	75.7	2.50
New competitors arising	92.5	2.74	Cooperation with firms in marketing	72.9	2.44
Cost of product development	87.9	3.10	Subcontracting	71.0	2.65
			Outsourcing	70.1	2.33

(*) 0 = of little importance ? 5 = very important

Innovation and technology related items

It can be seen that innovation, R&D and the technological capacity rank high both with reference to present competitive advantages and strategies of competition. These factors are also very important

reactions on challenges to the companies. Additionally, technology- and innovation-related challenges are not the most serious ones which confirms the impression that firms tend to assess their technical capability to be a very important strength. Nevertheless, some items on special aspects of innovation show that there are also weaknesses: User friendly products, products which are especially designed to perform better according to environmental standards and the protection of inventions through patents and licenses are of relatively little importance. The latter need not indicate a low innovativeness but is more likely due to the high share of customer specified products (e.g. machinery) and services (e.g. engineering) in the sample.

The following tables present data of the firms which have participated in the survey. The first table shows that there are considerable differences between size classes and industries with respect to their innovative performance:

Table 3: Innovativeness of firms of different size classes, industries (*) and in foreign ownership

(share in %)

		Sm	Me	La	For	Wo/Pa	Ma	M/eSt	El	Auto	Serv
Total survey sample n = 107	100%	49.5	19.6	25.2	15.9	12.1	15.9	22.4	15.9	8.4	38.3
Firms without innovations n = 26	100%	65.4	11.5	11.5	7.7	11.5	0.0	11.5	7.7	7.7	50.0
Firms which have introduced											
product innovations n = 69	100%	46.4	21.7	31.9	17.4	11.6	21.7	24.6	20.3	10.1	30.4
products new to the market n = 50	100%	48.0	18.0	34.0	18.0	10.0	24.0	22.0	22.0	10.0	34.0
process innovations n = 44	100%	31.8	25.0	36.4	20.5	13.6	15.9	31.8	13.6	9.1	22.7
processes new to the market n = 21	100%	33.3	33.3	33.3	9.5	19.0	9.5	28.6	9.5	9.5	23.8

(*) Sm = Small (<50 employees), Me = Medium (?50, <200 emp.), La = Large (?200 emp.), For = Foreign owned, Wo/Pa = Wood/paper, Ma = Machinery, Me/St= Metal/steel, El = Electro/Electronics, Auto= Automobiles, Serv = Producer services

Regarding firm size it can be seen that small firms are less innovative with respect to any investigated category than the average. Medium-sized firms have relative more process innovators, and an average share of product innovators. The most innovative firms in all categories, however, are the large ones. Companies in foreign ownership are relatively more frequent in process innovations, but this is restricted to the adoption of already existing technologies.

With regard to industries, the most active product innovators are firms belonging to machinery and electro/electronics. In contrast, metal/steel-firms are more inclined to process innovations. The service sector is less active in technological innovation, regardless of the category. Non-innovative firms, thus, are concentrated in the group of small firms and in the service sector.

It is important to consider the fact that a relatively large share of Styrian firms has weak preconditions for innovation. The most relevant aspects in this context are the high share of dependent subsidiaries

and a product range which is dominated by standardized products. According to the survey data, 15% of all responding firms are little or not innovative due to dependency on their headquarters. These subsidiaries are restricted to manufacturing only without strategic functions like R&D. From the 33 subsidiaries in the survey sample, 9 have no competence at all to do R&D at the location. Further 7 subsidiaries performed this function only on a very low level. As a consequence, 27% of the investigated subsidiaries are mere manufacturing or assembling plants without R&D and further 21% have only very few competences to innovate on their own. This result is confirmed by the interviews. Both cases of dependent subsidiaries had no competence to innovate. Even if one considers the fact that there are differences in the degree of dependency, it can be concluded that the status of being a subsidiary tends to impede innovative activities significantly. In addition, the share of standardized products (66% of the sales of the manufacturing survey firms) reduces the innovative performance of firms in the region.

Styrian firms have relative high R&D budgets (table 4). As expected, the R&D-budgets (in % of sales) are higher in the case of innovators than on average. There is some R&D which did not result in innovations in the past 3 years, but the budget level is very low. Surprisingly, the R&D-rates are higher in the case of process innovators than in the case of product innovators. And firms introducing products or processes which are new to the market have higher rates than those firms which innovate only with reference to the company. With the exception of non-innovators and adopters of processes new to the market, all rates have increased between 1990 and 1995.

Table 4: Innovativeness and level of R&D performed (R&D-budgets in % of sales)

	Average relative R&D-budget in % (1)		Relative frequency 1995: (%) (2)		
	1990	1995	budget = 0	budget ? 5%	budget > 5%
Total survey sample	8.95	9.31	10.3	43.9	26.2
Firms without innovations	2.39	1.82	31.3	43.8	25.0
Firms which have introduced					
product innovations	9.38	10.01	5.8	50.7	31.9
products new to the market	11.45	12.45	4.0	48.0	36.0
process innovations	12.18	12.32	4.5	50.0	27.3
processes new to the market	13.21	13.13	0.0	52.4	28.6

(Each category's number of cases from the first to the last row: Av. rel. R&D-budgets 90 and 95: 60, 10, 43, 30, 26, 12; Rel. frequency 95: 86, 16, 61, 44, 36, 17)

(1) Includes only those firms with data both for 1990 and 1995.

(2) All firms belonging to the respective category (see table 3), difference to 100% due to missing values.

In this context it has to be mentioned that especially services, but also electro/electronics firms have very high rates. As far as services are concerned, it is obvious that, because a large part of their business is due to customer specified projects, the estimates of expenditures for development are high, which leads to high R&D-rates (14.5% in 1995). As table 3 shows, this does not correspond with their

relatively weak innovative performance. With the exception of electro/electronics (where large R&D-budgets (11% in 1995) are plausible), the R&D rates in manufacturing are significantly lower, ranging between 2.3% (wood/paper) and 4.4% (automobiles) in 1995.

The right hand side of table 4 shows that innovation without any R&D is very rare. Approximately half of the innovators spend up to 5% of their sales on R&D. Especially large budgets are more frequent in the case of product than process innovators.

Table 5: Innovativeness and employment growth or decline of firms, 1995 against 1990 (*)

	Change of employment:	Number of firms	Change in absolute terms	Change in relative terms (% of 1990)
Total survey sample	90 < 95	37	+ 1095	+ 26.4
	90 = 95	8		
	90 > 95	29	- 4045	- 26.4
Firms without innovations	90 < 95	9	+ 52	+ 10.8
	90 = 95	1		
	90 > 95	4	- 33	- 4.3
Firms which have introduced				
product innovations	90 < 95	26	+ 906	+ 28.0
	90 = 95	7		
	90 > 95	21	- 3885	- 27.9
products new to the market	90 < 95	19	+ 807	+ 29.1
	90 = 95	4		
	90 > 95	16	- 3338	- 27.6
process innovations	90 < 95	17	+ 805	+ 34.8
	90 = 95	2		
	90 > 95	15	- 3197	- 27.8
processes new to the market	90 < 95	11	+ 406	+ 40.8
	90 = 95	1		
	90 > 95	5	- 1066	- 31.4

(*) Due to the fact that the data do not allow for distinguishing between missing 1990 values and newly established firms (after 1990), only firms with data both for 1990 and 1995 are included.

Innovators perform better in terms of relative employment growth than non-innovators (table 5). Surprisingly, the highest growth in relative terms applies to the process innovators. Nevertheless, in absolute terms, job losses surpass new jobs significantly in all categories except of the non-innovators. In the case of process innovators, firms which have adopted technologies which are only new for the company and not for the market concentrate obviously more on rationalization, reducing personnel

through more effective technologies. Those firms, however, which have introduced very advanced technologies, not yet widely used, show a clearly better development. Nevertheless, job losses still surpass new jobs, but the negative balance is much smaller. In addition, their rate of employment growth is by far the highest of all categories.

These results might lead to the interpretation that there is a positive correlation between innovativeness and job creation. Nevertheless, the cases of the non-innovators show that job losses may be avoided in the short run with little or no innovation. Because of the fact that there are only very few observations with no innovation at all, these data have to be used cautiously. The survey results are not unambiguous in this respect. But the general situation of employment is clearly negative. Job losses normally surpass new jobs, even in the innovative sectors of the Styrian economy. If it is considered that at least some of the firms with data only for 1995 have been founded after 1990, the balance should be less negative. This applies especially to the more advanced process innovators (the last category of table 5).

Another indicator of competitiveness is the turnover per employee:

Table 6: The average turnover per employee (in 1 000 ECU) of firms with data on sales for both 1990 and 1995

	Turnover per employee	
	1990	**1995**
Total survey sample	165.4	147.4
Firms without innovations	92.6	74.9
Firms which have introduced		
product innovations	187.4	160.2
products new to the market	216.8	175.6
process innovations	105.4	140.1
processes new to the market	102.7	124.2

(Each category's number of cases from the first to the last row: 67, 13, 49, 35, 30, 14)

It can be seen that innovators have clearly higher productivities than non innovators. The highest productivity appears in the case of product innovators, but only the process innovators have been able to increase their performance within the past five years. The most remarkable increase can be seen in the case of the "simple" process innovators. This again supports the above interpretation that in this category the strategy to replace labour by capital is predominant. From these data it becomes clear that the relatively good employment performance of non innovators (table 5) is obviously due to labour hoarding, a strategy which cannot be maintained in the long run.

4 The innovation model of Styrian firms

In the following section we will describe the typical innovation pattern in Styrian companies. We have seen above that there are considerable obstacles to innovation for Styrian firms such as the lack of autonomy (high share of dependent subsidiaries) and a high share of standardised products (chapter 3). On the other hand, the survey also shows that only 24% of the firms had not introduced any innovation within the past three years and that the vast majority is at least slightly active in innovation. For this large part of innovative firms, the following innovation pattern can be found:

? Innovation activities are mainly incremental.
? Most business strategies are market niche oriented.
? Innovation projects are mainly stimulated and specified by customers.
? Most innovative activities follow closely traditional technological trajectories.
? Companies are frequently inward oriented, showing low willingness to cooperate with other firms.
? Specialization of the firms makes it difficult to find compatible business partners for cooperation.
? If a company undertakes innovation cooperations outside the value chain then predominantly with universities.
? The pattern of innovation partners varies with industry, innovativeness, ownership and firm size.

The following two chapters describe the results in detail. As far as data are available, both sources are used, the relevant survey data and the information from the interviews for additional or deeper interpretation.

4.1 The companies' general innovation model

? Incremental character of innovation:

Based on the interviews we find that most of the firms are incremental innovators. Improvements of certain technical features of the firms' products predominate requiring only minor developments. For this purpose, the application (or recombination) of existing knowledge is normally sufficient. Incremental innovators do not exclusively rely on existing knowledge, but it is only a small part of their innovation activities for which they generate and apply new knowledge. It concerns only their most advanced innovation projects. In general, the relative importance of new knowledge is clearly lower than that of already existing know-how. This is further confirmed by the fact that basic research within companies is very rare. If basic knowledge is necessary, it is mainly transferred from universities, both in the form of cooperations and subcontracting.

The high and low ends of "innovativeness" are not strongly represented in the interview sample. There are no radical innovations in the narrow sense of a new trajectory. If the term is used in the sense of providing new functions based on the application of new knowledge which leads to some kind of a "submarket" in a larger, already established market, only one firm can be found which matches this criterion. At the lower end there is one firm which is only engaged in product modification. Three of

the interviewed companies have to be considered as non-innovative.

The survey data are not supportive for the assessment of the technical content of innovations. Due to this fact, the results of the interviews are the main source for the interpretation of the technological content and the reach of innovations. Only the relatively low share of process innovators compared with the more frequent product innovators – only 41% of the firms have adopted new technologies and only 20% belong to the group of early adopters having introduced a technology, not widely used in their industry at that time (see table 3) – gives some support for the argument that innovation is mainly incremental, because for more far reaching innovations, new technologies are nearly compelling.

? Market niche orientation:

The interview partners frequently expressed their interest in focusing their business activities on small market niches. The majority of them follows the strategy to offer highly specialized products in order to gain a strong (monopoly-like) position in a usually very small market. Innovation is considered very important to gain such a highly specialized market position. It is seen as an effective measure to offset the cost disadvantage (especially with regard to labour costs) in Styria. Ten of the interviewed firms try to remain in such monopolistic or oligopolistic small markets. Only four companies are active in unambiguously competitive markets.

That the market niche strategy is not only a specific feature of the very small sample of interviewed firms can be seen, if some data of the survey are interpreted in this context (see table 2): The high price level is seen as a serious weakness of Styrian firms. The price of the products is the competitive advantage of least importance and one of the strongest challenges for the company (the other one is the closely related item "personnel costs"). Therefore it is very important to avoid strong competition, especially via the price of the products. One strategy to do so is to focus on small market niches. That Styrian firms frequently focus on such niches is further supported by the result that the survey firms considered the danger of new competitors of relatively low importance. Within their market niche, they feel safe from competition.

The market-niche strategy and the corresponding view on innovation leads to a serious danger of lock-in: The perspective is restricted to a very small market and only few special customer needs. There is little or no interest in different markets, informations from beyond the own niche are often neglected. Innovation is understood in a rather conservative sense: To defend the quasi-monopoly against potential competitors. The concentration on the traditional market easily results in commercial and technological isolation.

? Dominant role of customers:

According to the interviews, customers are extremely dominant as sources of innovation impulses. They are not only more important than any other external partners but also surpass frequently the importance of internal innovation sources. In all interviewed companies, customers were considered at

least equally important as ideas from inside the company. The dominance of customers is further confirmed by the survey. 51% of all firms are dependent on one or few customers, whereby the most important customer accounted for 40% of the sales on average.

Of course, the extent of dependency on customers' needs and demands varies. In the case of some interviewed firms the objective to reduce the risk that an innovation cannot be sold is so restrictive that it leads to a strict self-constraint to the customer demand. The majority does not react in such an extremely passive way on the customers' conceptions, but nevertheless, their own contribution is still less important. Only a minority of the firms in the interview sample is engaged in active screening of the markets, looking for emerging trends and changing demand patterns. They actively and systematically try to find business opportunities on their own. Still, their customers remain the primary source of initiating innovation. Only a single company is regularly developing prototypes completely based on own conceptions. This is the only firm which definitely ventures into new developments without sticking closely to their customers' needs. The general impression of the interviews is that the firms' innovation activities tend to be very close to the market. Innovations being more distant to commercialization occur only in a few firms.

The dominant role of the customers' needs implies that it is not sufficient to simply raise the performance of a product to a new level or to the state of art. Most respondents said that their innovation had to be an optimal solution between high performance and low price or low costs of operation. In many cases it was definitely more important to find an innovative solution which reduces the customer’s costs than to apply the technically best solutions which are available at present. Efficiency is the primary objective of innovation. How it is to be achieved differs between the companies: longer product life, possibility to use cheaper inputs (e.g. recycled materials), higher productivity (the same output with less input) often through lower energy requirement, better reliability, etc.

It is surprising that not a single of the interviewed firms referred to universities (or science in general) as an important source of initiating innovation. Considering their quite significant importance as cooperation partners (see 4.2), this is a rather unexpected result. Obviously, universities and other research organizations are primarily used as subcontractors which have to solve a clearly defined problem. This is a contradiction to the claim of many companies that these cooperations are regularly interactive.

The customers' dominance can also be seen by interpreting some of the survey data presented in table 2: A short time of delivery and an effective after sales service are competitive advantages on which the firms rely strongly. The relative importance of these advantages shows the close relation to the customers. In addition to that, the survey shows that customers belong to the most important sources of information on innovation:

Table 7: Positive answers and mean importance (*) of sources of innovation related information

Sources of information:	% yes	mean
Conferences, exhibitions, fairs	93.5	3.18
Customers	92.5	3.46
Journals, technical literature	92.5	3.37
Suppliers	90.7	2.82
Universities	61.7	1.88
Industry associations	50.5	1.37
Consultants	48.6	1.27
Technology transfer agencies	41.1	1.11

(*) 0 = of little importance ? 5 = very important

If one considers that contacts to customers play a very important role at fairs and similar events, the strong role of customers is unambiguous. But the data imply a further information: The relevance of applied technical know-how, frequently exchanged informally between engineers on conferences or acquired by reading relevant literature and journals, is similarly high. Finally, it can be seen that – contrary to the result of the interviews – suppliers also have a relevant role.

The interview results and the survey data lead to the conclusion that customers determine to a large extent the firms' innovation activities. Because of their dominant role in initiating an innovation, the room for really new ventures is often very small. Innovation is in most cases restricted to find new, more efficient solutions for problems defined by the customer or needs presently apparent on the market. Own initiatives which could lead to entering into or create new markets are very rare. The great importance of external determination by the customers in shaping innovation clearly leads to the danger of lock-ins, of following established trajectories, of losing the competence and motivation to create something really new. This could result (or might have resulted already) in a dichotomous situation, where the potential to innovate (primarily technological knowledge) is clearly greater than the actual output of innovation.

Only three of the interview partners noticed that the customer dependency actually cause problems for their own innovation activities. Two companies complained about the often narrow customer focus, not willing to pay for far reaching innovations, which restricts innovative solutions to mere incremental improvements, whereas wider technological steps would have been possible. Another company referred to "non-disclosure-agreements", which prohibit the further selling of an innovation to other firms than the customer. The clear majority of the interview partners did not see any disadvantage in the dependency on their customers.

Customer dependency is problably more common in the case of customer specified production. Because of the fact that this is more frequent in the sample than in the Styrian economy, it might be that the dominant role of the customer and its consequences on innovation are somewhat overrepresented here.

? Concentration on traditional trajectories:

Based on the interviews, we find that innovative activities predominantly follow the prevailing technological trajectories in Styria – metal, steel, mining and machinery (electrical machinery and transport systems being especially important). This means that improvements in the performance of existing products are most important. Only in two cases entering a new market (offering products which were at least new to the company) was the consequence of innovation. In all other cases innovations were intended to hold or to improve the competitive position in the same market. The results of the survey suggest that new markets might be a more frequent consequence of innovative activities (see also table 3). 47% said that they had introduced products new to the market. But this does not mean that they have engaged in a new technological trajectory. For a new trajectory, process innovations are compelling. But only 41% of the firms have adopted new technologies, most likely only rarely belonging to new trajectories. This is supported by the low share (20%) of adopters of technologies which are new to the market. Due to the fact that the survey data do not allow for an unambiguous interpretation, the results of the interviews are the main source for the further interpretation of the technological content of innovations.

For the purpose of incremental improvements of the technical features of the firms' products, it is mostly not necessary to generate new knowledge. The application or recombination of existing knowledge is often sufficient. Usually, the largest part of an innovation project is based on standard solutions or components and the part which incorporates real innovations is clearly smaller. Most companies' innovation activities do not require basic research. Basic research which could lead to new trajectories is very rare in the sample of the interviewed firms. If basic knowledge is necessary, it is mainly transferred from universities, both in the form of cooperations and subcontracting. But also in these cases the required know-how remains within the traditional engineering activities of the firm. Only in one case, technical knowledge, accumulated in the past in the field of motor development, led to entering a new market - medical instruments. The specific know-how which could be applied to the new field had been accumulated in measurement technologies.

This impression is further confirmed by the fact that the plans for innovative activities in the future are mostly conservative. Seven of the interviewed companies will not change the extent of R&D and innovation. In some cases it has to be considered that the R&D-intensity is already quite high, so an increase of the R&D-budgets (without a similar expansion of the whole company) is difficult to achieve and may hamper profitability. Nevertheless, there are five firms which plan to increase their innovation activities. The ways to achieve that goal differ: recruiting new employees for R&D, establishing an R&D-center, internal reorganization without additional employees, using external innovation related services (while restricting the own role to innovation management) and engaging in publicly funded research projects. Referring to the firm survey, the share of firms not planning to expand its R&D-activities, is even larger: Only 27% intended to increase their efforts, 69% refused to do so (only 4% were undecided). In addition to that, the survey shows that between 1990 and 1995, the relative R&D-budgets (in % of sales) increased on average only slightly from 9.0% to 9.3% (based only on those firms with data both for 1990 and 1995). The strongest increase occurred in the category

of companies having introduced products which are new to the market (see table 4).

In general, there is the impression that most firms are more or less satisfied with their innovative performance. If there is any expansion of R&D planned at all, then mostly with regard to inputs (more R&D-personnel, higher budgets). But is is never explicitly planned to venture into new markets or new technological fields. Innovation activities appear to stick very close to the prevailing development path, not exhausting the full potential of its accumulated experience.

4.2 External partners in the firms' innovation process

? Inward orientation:

In general, external partners are of relatively little importance for both the survey respondents and the interview partners. According to the survey (see table 2), we find that cooperating is neither an important strategy to sustain the competitiveness of the firm nor a frequent reaction on challenges to the company. If there are cooperations, they concentrate on the European scale, partners within the region only rank third. The content of cooperations is most frequently on R&D and innovation, marketing following suite.

Table 8: Positive answers and mean importance (*) of cooperation as firms' strategy of competition and reaction on challenges

Strategies of competition:	% yes	mean	Reactions on challenges:	% yes	mean
Cooperations with			Cooperation with firms		
regional firms	45.8	2.35	in marketing	72.9	2.44
national firms	47.7	2.45	in R&D and innovation	75.7	2.50
European firms	59.8	2.81			
firms outside Europe	34.6	2.16			

(*) 0 = of little importance ? 5 = very important

The main reason for the low importance of external partners in the innovation process of companies seems to be the strong reliance on internal capabilities for competitive success:

Table 9: Positive answers and mean importance (*) of reasons to avoid innovation cooperations

Reasons to avoid cooperations:	% yes	mean
Internal solutions preferred	62.6	3.66
No suitable partner available	57.0	3.26
Risk of losing know-how	57.0	3.20
Risk of revealing cost structures	53.3	2.26
External solutions too expensive	43.9	2.13

(*) 0 = of little importance ? 5 = very important

This impression has been clearly reinforced in the interviews. The arguments explaining the low willingness to cooperate belong to two categories. Often the interview partners gave the impression that they consider the internal capabilities as superior to external ones, seeing no benefit from cooperating. Also, cooperations are considered inadequate in a competitive situation. Considering the frequently claimed market niche strategies, this is rather surprising. There seems to be rather a basic distrust between companies, no matter if there is actual competition or not. It is a widespread mentality to keep sensitive information within the firm and to avoid passing it on to other companies, even if there is no real danger of losing valuable information to a competitor.

? Incompatibility of business activities:

Cooperations are also rare due to the fact, that suitable partners are often not available (table 9). This problem was frequently mentioned in the interviews, especially referring to the region. For many firms Styria is simply too small to find adequate partners since – due to the dominance of the market niche strategy – most firms are highly specialized. It was often claimed that there is a basic willingness to cooperate with partners in the region but it is prevented by incompatible business activities. This has to be interpreted cautiously, because many of them also expressed the already mentioned strong inward orientation.

? Concentration on few innovation partners:

Inward orientation and a lack of suitable innovation partners lead, in general, to a weak use of external innovation partners with only few exceptions. The results of the survey are presented in the table below:

Table 10: Mean importance (*) of innovation partners, differentiated by spatial levels

n = 93	Styria	Austria	EU	Rest of world
Customer firms	2.03	2.51	2.97	1.58
Supplier firms	1.33	1.89	1.91	0.73
Universities	1.17	1.15	0.76	0.31
Research organizations	0.71	0.89	0.56	0.22
Technology transfer institutions	0.37	0.46	0.27	0.18
Consultants	0.68	0.84	0.63	0.31
(Venture) Capital	0.68	0.73	0.26	0.18
Subsidies	1.14	1.56	0.86	0.28
Trade associations	0.99	0.96	0.37	0.22
Training institutions	0.79	0.60	0.39	0.19

(*) 0 = not important ? 5 = very important

Mean importance ? 2.00

Mean importance ? 1.00 and < 2.00

The most important partners and spatial levels have been shaded. It is obvious that in general, external partners are not considered as highly important for the companies' innovation activities. Most of the values are between 1, indicating a low importance, and 0, indicating no importance at all.

The most important innovation partners for Styrian firms are the **customers**, especially those located in Austria and in Europe. This is no surprise, if one considers the dominant role of the customers, already described above. Because of the fact that the markets are predominantly located outside the region, primarily on the European scale, customers within the region play a relatively little role.

Based on the interviews, the cooperations with customers seem to be even more important as innovation partners than the survey data suggest. There can be no doubt that customers are more frequently and intensively involved than all other types of innovation partners. Nevertheless, there are differences between the companies in the sample. Not all of them consider their customers important as far as innovation is concerned, and in the case of those which do so, the importance varies.

Most of the interviewed companies collaborate continously with their customers during a common innovation project. The cooperation lasts for the whole innovation process until the product or service is finished. In most cases, the problem solution is developed interactively, the inputs and feedbacks of the customers being necessary or at least very helpful. Usually, there is a mutual exchange of know-how which is the predominant function of the cooperation. Other potential functions – risk-sharing, pooling of funds – are of negligible importance. Only in the case of the minority of the firms, the interaction is rather limited. For two firms, the customer's role is restricted to the specification of his needs. This is usually an interactive process, so the term "cooperation" is justified. But it is only a very short collaboration, taking place at the beginning of the firm's innovation process only. Afterwards,

both companies have no further interaction with their customers referring to their innovation activities.

Horizontal cooperations were mentioned only twice. This is partly due to competitive relations between companies, partly to incompatibility of their business activities. It has to be considered that the relations to other firms are often very complex. This became clear in one case when the interview partner referred to a situation, where the several roles of certain customers are difficult to disentangle. They are not only customers, but also formal partners in research projects and competitors at the same time. Their importance as innovation partners is high, but because of the also existing competitive relation, interactivity is always restricted by necessary considerations about secrecy. All that leads to a situation where the common type of cooperation is vertical.

The relationship with a certain customer has usually a low stability. The cooperation lasts only for a certain project. This is at least partly due to the fact that many of the interviewed firms are engaged in larger, customer specified projects (especially in machinery, but also in engineering). Such capital goods have usually a very long life time and there are long intervals for reinvestment, often longer than a decade. Therefore frequently activated contractual relationships with the same customer which could lead to a long term close partnership are very rare. The content of the contract and the size of the project determine in most cases the duration of the cooperation with a certain customer. The length of different projects and therefore also the length of the cooperation varies a lot, the shortest project mentioned was one month, the longest three years.

Besides customers (and to a lesser extent suppliers), only **universities** and providers of subsidies are relevant innovation partners and they are primarily located in Styria and Austria. Styria has a well developed academic infrastructure namely the Technical University of Graz, the University of Leoben and the large research organization "Joanneum Research" in Graz. The survey data indicate that many fields of this research fit quite well to the needs of Styrian firms and that they do take advantage of these institutions (see also chapter 5).

According to the interviews, the importance of universities as innovation partners seems to be even more important than the survey shows. To a smaller extent, the research organization "Joanneum" can be included in this interpretation. In this context, it is necessary to consider the fact that the selected firms are certainly not representative for the innovativeness of the Styrian economy in general. The sample is biased in favour of more innovative firms. Nevertheless, we find that scientific institutions in Styria play a very important role for at least a part of the regional economy. For nine of the interviewed firms, scientific institutions are important partners in the innovation process. For some of those firms, universities are even more important innovation partners than their customers. Only three companies consider them of little importance. And only for three companies, universities have no importance at all.

The university contacts of these firms are direct, no mediation is necessary. This explains, at least partly, the very low importance of technology transfer institutions. But even when their services are needed, the results are not always satisfactory. It seems that technology transfer institutions and universities are often quite narrowly oriented towards large firms and highly reputable projects. Because of this and different cultures in business and science, it is difficult for "lower-tech"-SMEs to

get into contact with universities.

Regarding the location, we find that regional universities are very important. Nevertheless, there are also many cooperations with universities elsewhere in Austria and abroad. Not a single firm is cooperating exclusively within Styria. But for all companies which generally engage in cooperations with scientific institutions, the Technical University of Graz and/or the University of Leoben belong to the most important partners.

Cooperations with universities are normally on an equal basis, but formalized. The relations comprise both cooperative and subcontracting elements, there are seldom pure forms. Most cooperations with science imply market relations. In nearly all cases two layers of a cooperative relation can be distinguished: A long term, personal, stable and informal basic relation and – building on this – several short term (mostly between one and two years) formal project relations. The basic partners (usually certain professors engaged in relevant research) do not change over a rather long period of time. The scientific partners actually working on projects (university assistents, students working on their dissertation with the firm) change more often. The collaboration with students is a frequent form of partnership. Because of the fact that firms are interested in maintaining the accumulated know-how of these persons, they frequently try to employ them after they have graduated.

Transfer or exchange of know-how is the most important benefit from science cooperations. As far as mutual exchange relations are concerned, basic knowledge is transferred from the university, applied know-how from the firm. But this is not the only type of cooperative relation. Many of the innovation-related services of universities in such cooperations can be better characterized as subcontracting, with little interaction between the two partners. In any case, the primary benefit for the firms is knowledge-transfer, the use of special equipment, available in universities, is clearly less important.

The intensity of cooperation is claimed to be high. There are frequent personal meetings (favouring regional institutions) which lead to collective learning. We find a contradiction in this claim, remembering the fact that the interview partners never mentioned universities as source of impulses for innovation. If the interaction is so close as stated by most interview partners, then more impulses from the university partners could be expected. This supports what has been mentioned above, that many of these cooperations are closer to a subcontract for a special innovation-related service than to an actual collaboration.

Besides universities (and other scientific institutions), only **providers of subsidies and research programmes** are, clearly less frequent and of less importance, mentioned in the interviews with firms. As far as subsidies are concerned, the national level is more important than the regional one. This can be explained by the fact that the main technology and innovation related funds (FFF, ERP, ITF; see chapter 6.2) are national institutions. EU-research programmes have been and are currently applied for by five interviewed firms. Three of them are also involved in research projects funded by the state of Austria. Most of the interview partners considered these projects quite important and interpreted the benefits in a positive way. These benefits were not only seen in the acquired funds for R&D (nevertheless the primary benefit), but also in the need to focus the own innovation ideas, to check their feasibility and to operationalize the activities. Otherwise these aspects are often not formulated

explicitly, probably leading to dead ends or excessive costs.

Generally speaking, the companies in Styria do not yet form a well established innovation network. Only parts of a fully developed innovation system can be identified at the regional as well as the national level. With respect to customers and suppliers as innovation partners, the relevant networks clearly reach beyond regional and national borders.

? Varying patterns of innovation partners:

Up to now we got the impression of a rather partial and generally not very strong innovation system in Styria. The question arises, if specific groups of firms differ with regard to their innovation partners. We have analyzed such differences by comparing the mean importance of each type of innovation partner for the following subsets of the survey respondents:

? Industries: wood/paper, machinery, metal/steel, electro/electronics, automobiles
? Size of the firms: small, medium and large
? Firms in foreign ownership
? Product and process innovators

Having compared the deviation between the means of the subsets and the means of the total sample, as far as the innovation partners are located in the region, we find that firms which are most active in cooperating with regional innovation partners belong to the wood/paper and the machinery industries and are medium-sized. In contrast, firms belonging to automobile manufacturing and firms in foreign ownership have only very few links in the region. Electro/electronics companies and large firms concentrate their regional links primarily on scientific partners. Two results are surprising: First, the metal/steel sector, a traditional industrial base of Styria, has relatively few links to regional partners. Second, innovators are hardly more active in cooperating with regional innovation partners than the whole sample.

In the following, the detailed results of this analysis are presented:

Table 11: Regional innovation partners of companies in selected industries: change of the means compared with all firms (see table 10)

within Styria	Wood/ Paper n = 12	Machinery n = 15	Metal/ Steel n = 20	Electro/ Electronics n = 15	Auto- mobiles n = 7
Customer firms	+ 0.72	- 0.37	- 0.23	- 1.17	- 1.32
Supplier firms	+ 0.33	+ 0.20	- 0.18	- 0.93	- 0.48
Universities	+ 0.08	+ 0.43	+ 0.18	+ 0.30	- 0.03
Research organizations	+ 0.46	+ 0.22	+ 0.09	+ 0.29	- 0.14
Technology transfer institutions	+ 0.38	+ 0.03	- 0.07	- 0.03	+ 0.21
Consultants	+ 0.57	+ 0.12	- 0.03	- 0.14	- 0.39
(Venture) Capital	+ 0.16	+ 0.12	- 0.58	+ 0.32	- 0.53
Subsidies	+ 0.28	- 0.34	- 0.09	- 0.14	+ 0.15
Trade associations	+ 0.01	- 0.32	- 0.14	- 0.19	- 0.70
Training institutions	+ 0.22	- 0.25	- 0.14	- 0.12	- 0.36

Mean importance ? 2.00
Mean importance ? 1.00 and < 2.00

A striking result is the intensity of cooperations of firms belonging to the **wood/paper-sector**. Their links with nearly all types of innovation partners in the region are far stronger than for the whole sample. The more intensive interaction applies not only to the region but to the level of Austria too. This means that this sector is more integrated into a regional as well as a national innovation system. An explanation might be the fact that Styria offers abundant timber resources, and has relevant firms and institutions. On the other hand, an important market of this industry is Austria.

For firms belonging to **machinery** the importance of customers as innovation partners within the region is rather low, reflecting the fact that their main markets are in Europe. In contrast, the regional suppliers are more important than for the whole sample. This can be explained by the existence of a large metal- and steel-sector in Styria. Due to the strong engineering knowledge-base in the region, the contacts to Styrian universities are quite intensive.

The other Styrian industry, traditionally based on regional resources, is **metal and steel**. We expected to find a similar importance of regional innovation partners than in machinery, but this expectation was not confirmed. Suppliers from the region are even less relevant. In contrast, the importance of suppliers located in Europe is higher. This surprising result indicates that the former importance of Styria as a mining area has more or less vanished. Today raw materials are purchased from other regions and countries and also innovation partners are located there. Beyond the value chain, the most important innovation partner is the University of Leoben, specialized in mining and materials. Nevertheless, its importance is less than we expected. Obviously, the fields of research are frequently not adequate for the specific needs of Styrian metal- and steel-companies.

Electro- and electronics-companies are acting on an international scale. Customers and suppliers within the region are nearly irrelevant. In contrast, Styrian universities and the research organization "Joanneum" have a higher importance for these firms than for the total sample. Nevertheless, cooperations with universities take also place on a similar level of intensity beyond the region.

A similar pattern emerges in the case of firms of the **automobile-sector**. They consider links to most categories of partners within the region of negligible importance. With the exception of technology transfer institutions and providers of subsidies, the mean importance of all innovation partners is low. In the case of customers this can be explained easily by the fact that most of the sales are directed towards the European and world markets. The same applies to the input markets, albeit to a lesser degree. Innovation-related cooperations within the value chain are therefore insignificant on the regional level. Providers of subsidies are more relevant than for the whole sample. This is a consequence of strong support of this sector by public institutions, not only regional ones but also those on the national level. Generally speaking, these results reflect the conditions of a globalized industry. International relations within and outside Europe are dominating, regional links are of little importance.

There is also a considerable variation of innovation partners between size classes:

Table 12: Regional innovation partners of small (1), medium (2) and large companies (3): change of the means compared with all firms (see table 10)

	Small	**Medium**	**Large**
within Styria	n = 45	n = 19	n = 25
Customer firms	+ 0.52	- 0.72	- 0.39
Supplier firms	+ 0.33	- 0.39	- 0.29
Universities	- 0.44	+ 0.51	+ 0.59
Research organizations	- 0.09	+ 0.08	+ 0.21
Technology transfer institutions	- 0.19	+ 0.32	+ 0.15
Consultants	+ 0.06	+ 0.53	- 0.40
(Venture) Capital	+ 0.06	+ 0.38	- 0.28
Subsidies	- 0.34	+ 0.54	+ 0.30
Trade associations	- 0.08	+ 0.54	- 0.19
Training institutions	- 0.07	+ 0.64	- 0.23

(1) Number of employees < 50; (2) Number of employees ? 50 and < 200;
(3) Number of employees ? 200

Mean importance ? 2.00
Mean importance ? 1.00 and < 2.00

In general, the resources available for innovation activities, are rather limited in the case of **small firms**. Therefore cooperations should have a higher relevance for them than for larger firms. Nevertheless, according to the data, this applies only to partners within the value chain but not to the

other ones. In the case of universities, "barriers" seem to exist, a fact often found in other studies too. In general, the scope of interactions of small firms is limited more to the region than it is the case for larger firms. The closer relations to customers and suppliers can be explained by the specific features of the innovation process of a small firm: Small modifications (incremental innovations) are more important, customized developments more frequent. Considering the scarce resources and the many obstacles for innovation small firms usually face, it is surprising to find that subsidies and other support is of little importance to them. This may be due to the fact that the existing support programmes are often not adequate for their specific needs. The pattern for small firms strongly resembles that of the service firms. This is due to the fact that both subgroups strongly overlap, i.e. many of the small companies in our sample are service firms.

In the case of **medium-sized firms**, we find the opposite pattern: Partners within the value chain are less important, partners outside more. It seems that these firms are the most intensively cooperating ones within the region. They use practically all relevant institutions to a clearly higher degree. Nevertheless, customers and suppliers as innovation partners are still more frequently located in Austria and in Europe.

The results for **large firms** are similar to those of the medium-sized ones. Nevertheless, the linkages to partners within the region are clearly weaker. They serve international markets, and this is also the level where they cooperate with customers and suppliers. Regarding interactions with universities, large firms are the most active ones. This applies to all spatial levels, but the increase in importance is highest in the case of the Styrian universities. Subsidies are important to them, primarily those offered by Austrian and EU-programmes. Regional providers of subsidies only rank third, but nevertheless they are more important for large than for small companies.

Finally, data on the importance of regional innovation partners for firms owned by foreign companies and for product and process innovators are presented in the following table:

Table 13: Regional innovation partners of companies in foreign ownership, and of product (1)- and process innovators (2): change of the means compared with all firms (see table 10)

within Styria	Foreign ownership n = 14	Product innovators n = 44	Process innovators n = 40
Customer firms	- 0.82	- 0.46	- 0.38
Supplier firms	- 0.55	- 0.01	- 0.01
Universities	- 0.67	+ 0.17	+ 0.25
Research organizations	- 0.50	- 0.28	- 0.09
Technology transfer institutions	- 0.37	+ 0.07	- 0.19
Consultants	- 0.46	- 0.09	- 0.25
(Venture) Capital	- 0.46	+ 0.05	- 0.18
Subsidies	- 0.43	+ 0.07	+ 0.09
Trade associations	- 0.56	+ 0.06	- 0.04
Training institutions	- 0.79	- 0.01	- 0.04

(1) Product innovators: Introduction of products new to the market during the last 3 years
(2) Process innovators: Introduction of new technologies during the last 3 years

Mean importance ? 2.00
Mean importance ? 1.00 and < 2.00

As expected, **companies in foreign ownership** have clearly fewer links to regional partners. The subsidiaries located in Styria are obviously dependent on their headquarters abroad. They do not have enough autonomy to do R&D on their own or to decide independently about cooperations. Interactions take place mainly within the group, external relations of the subsidiaries are of little importance.

In the case of **product innovators** the expected higher importance of customers as innovation partners was confirmed as far as the international level is concerned. Relations to customers located in Styria are less important, however. Again this has to be explained by the European and partly global direction of the firms' sales. As expected, universities are generally more important for this subset than for the rest, which applies to all spatial levels. Interestingly, product innovators do not consider relations to regional partners being significantly more important than other firms do.

The situation is similar in the case of **process innovators.** Surprisingly, universities are more important than in the case of the product innovators (especially in Styria), whereas technology transfer institutions are less important. This can be explained by the fact that a significant share of the process innovators has introduced relatively advanced technologies (see table 3) for which collaboration with universities providing adequate scientific knowledge is more important than the applied know-how of technology transfer institutions which is required for the adoption of already existing technologies.

5 Innovation support in the region

Styria has various institutions performing relevant support functions for the companies' innovation activities. The four categories of support functions which will be described in this chapter are:

? Science
? Training and education
? Technology transfer
? Funding and infrastructure

In each of these categories of innovation support functions, there are institutional actors located in Styria.

5.1 Science

A considerable share of Austria's technological science is located in Styria. It consists of two universities (Technical University of Graz and University of Leoben) and a non-university research organization (Joanneum Research)[5]. The Technical University of Graz has five faculties covering a broad range of basic and applied fields of technical research. The University of Leoben is located in upper Styria ("Obersteiermark"), specialized in mining, metallurgy and materials. The following table gives an overview of some characteristics of these two regional universities:

Table 14: Research and education at Styrian universities

Styrian universities:	Departments	Scientific staff	Research projects	Students
Technical University of Graz (total number)	69	536	538	12 530
Faculty of technical sciences	22	33.6%	38.1%	16.7%
Faculty of mechanical engineering	13	22.0%	29.2%	32.6%
Faculty of civil engineering	15	18.7%	11.9%	17.2%
Faculty of electrical engineering	10	14.9%	10.6%	15.3%
Faculty of architecture	9	9.3%	10.2%	18.3%
University of Leoben (total number)	33	180	no data	2 200

In a addition to the universities, a major Austrian research organization "Joanneum Research" is also located in Graz. It has 300 employees and it is one of the two most important non-university research organizations in Austria (the other one being the Austrian Research Centre Seibersdorf). It is owned by

[5] There is a second university located in Graz (Karl Franzens University) with some fields of research being relevant for a regional innovation system (e.g. economics). But it is of relatively little importance compared to the other two universities and will not be further described in this chapter.

the federal state ("Land") of Styria. It receives public funds from the "Land" as a basic subsidy, but due to its focus on contract research, generates significant income on its own too. The scientific activities of Joanneum Research predominantly take place in the form of contract research, both with private enterprises (41%) and public authorities (45%) in Austria. Only 14% of the contracts are international.

The fields of research of these organizations mirror the traditional trajectories prevailing in Styria: mechanics (e.g. combustion engines), construction (e.g. tunnels), electrical machinery (e.g. locomotives), and mining technologies. But in addition to them, we find many fields which belong to new trajectories (e.g. electronics, telecommunication and information technologies, advanced materials). Most research projects at the **Technical University of Graz** which can be attributed to new trajectories are performed at the faculty of technical sciences. Nevertheless, there is still a considerable research activity in traditional trajectories too at this university. This is especially true of the faculty of mechanical engineering with most projects dealing with process engineering and combustion engines.

Since 1993 Austrian universities have the possibility to establish internal research centres with separate budgets. It is intended to allow researchers to focus on recent fields of innovation for a longer period of time. At the moment, there are eight special research focusses installed in Austria, four of them at the Technical University of Graz (bio-catalyses, electroactive elements, optimization and control and bio-membranes).[6] Usually, there are several institutes of the university involved in such projects, together with various international partners and additional EU-funding. For some specific tasks Austrian companies are involved in these projects as cooperation partners.

In contrast to the relatively large Technical University of Graz, the **University of Leoben** is small and highly specialized in fields of research based upon or related to mining, a traditional sector of the Styrian economy. Nevertheless, the research activities comprise both traditional and new trajectories. They cover fields of research like oil exploration, metallurgical engineering, advanced materials, applied geo-sciences, environmental engineering and recycling.

The highest relative importance of new trajectories can be found in the case of **Joanneum Research**. Its main research fields are electronics and information systems, geo sciences and environment, statistics, systems analysis and energy.

Interpreting the diversified research activities of Styrian universities is a difficult task, but it can be concluded that there are significant scientific activities which can be attributed to new trajectories. There is some potential for business-science cooperations beyond the traditional Styrian technological trajectories. Nevertheless, research activities belonging to the latter ones have still much weight in the research scene of Styria.

The scientific institutions described above are intensively cooperating with firms. Applied research in

[6] The university itself is obliged to cofinance these special research focusses. The bio-catalyses research focus was the first Austrian research focus, initiated as a three year project which was evaluated after the first period. The result of the evaluation was very positive with regard to the quality of the research. Accordingly the project has been prolonged to another three years.

cooperation with firms is one important strength of the scientific infrastructure. In 1991/92 the Technical University of Graz was involved in 96 research projects which were financed and contracted by manufacturing firms. 33% of these contract partners were located in Styria, 40% in the rest of Austria and 27% in a foreign country. 41 university departments were involved in cooperation projects with Styrian companies. In the case of the University of Leoben we find two types of cooperations with firms: Applied research contracts are relatively frequent with companies in the field of materials. This has been a market niche for several specialized small firms. In contrast, results of basic research are addressed more to large firms in basic industries. Confirming the results of the firm interviews, face-to-face contacts are considered important by the scientists. In general, cooperation is based on personal contacts and depends strongly on trust and knowledge of each other's field of work.

Finally, the **"Christian Doppler laboratories"** have to be mentioned in the context of business-science cooperations. These laboratories were originally founded to support basic research of universities which was related to the fields of activities of the "Austrian Industries" (AI) conglomerate. They were financed by the Austrian ministries and the AI. In 1989 the laboratories were reorganized and gained more independence. Research is now organized as a continous cooperation with enterprises aiming at the development of new products and processes. External experts are controlling the transfer of the results. Nine "Christian Doppler laboratories" are located in Styria, five of them at the Technical University of Graz and three at the University of Leoben.

The interaction between scientific institutions within the region is quite important in Styria. There are numerous common research projects of Styrian scientific institutions. But sometimes the links are far closer: Often the same persons are working both at the Technical University of Graz and Joanneum Research or at one of the Christain Doppler Laboratories and the respective university. In fact, the most important scientific research partner of the Technical University of Graz is Joanneum Research. Since the research fields of Joanneum Research are similar to those of the Technical University of Graz there are intensive contacts between these two organizations including staff exchange. The positive side effects of these close relations are the bilateral quality control and the increase of the technology transfer potential. The negative effect, however, is the danger of a "personal" lock-in.

5.2 Training and education

In Styria the full range of training and education levels is covered. The last gap – higher education institutes – has been filled just recently. In the following, we will focuse on the three most important types of training institutions as far as skills are concerned which are especially relevant to the innovativeness of the Styrian economy:

- universities
- higher education institutes
- vocational training and retraining

In addition to the research function, already described above (see 5.1), Styrian **universities** are of course very important training institutions. The Technical University of Graz has more than 12 000

students. The most frequented faculty is mechanical engineering. In contrast to the leading position of the faculty of technical sciences regarding scientific staff and research projects, it has clearly less students. Interpreting these differences, it has to be considered that some faculties have more teaching obligations than other ones, depending on the curricula of the studies. Nevertheless, students seem to concentrate more on the studies attributed to the traditional than the new trajectories. The University of Leoben is much smaller (2 200 students), due to its specialization on mining and related technologies (see table 14).

In 1995 the **higher education** organization "Technikum Joanneum" was founded and started its teaching programme in September 1996. It is now in the process of establishing links with several Styrian manufacturing firms. There are five courses – industrial economics, industrial electronics, industrial design, construction management and automotive engineering – with the aim of educating and training students with a strong focus on practical relations with firms during their studies. The main difference to universities is the permanent integration of companies into the teaching programme. Students are involved in practical work in the companies. Therefore companies have a significant influence which and how skills are taught.

With regard to **vocational training and retraining** there are several institutions located in Styria:

The chamber of commerce (WK) includes a vocational training organization, the "Wirtschaftsförderungsinstitut" (WIFI). It provides training programmes in the field of management, languages, business administration, information technologies and technical sciences in particular for SMEs. Additionally, it organizes a "Fachakademie" which is similar but not equivalent to a higher education institution. The WIFI is not only engaged in training, but, in its function as an affiliated organization of the chamber of commerce, it provides also specific services for entrepreneurs. The WIFI is in contact with innovative firms providing information about new technologies and methods of production organization. For giving small and medium-sized enterprises assistance in finding cooperation partners, the WIFI is directly involved in the ENTERPRISE programme, a specific SME-oriented initiative of DGXXIII. Additionally, it offers a special service which consists of the evaluation of the commercial potential of innovations.

The "Berufsförderungsinstitut" (BfI) is a national education and training organization oriented on the labour force. It provides services and qualification programmes for sectors and areas such as metal, electronics, information technologies, wood, transport, commercial businesses, languages, marketing, health, tourism, etc. The BfI is an organization under the influence of the Austrian trade union and the chamber of labour, representing the labour side in the Austrian system of "social partnership". The BfI follows a customer-oriented approach with 16 district offices and 9 specific training centres. This decentralized organization guarantees a widespread supply of services without much travel-expenses and additional costs for the participants.

The Labour Market Service (AMS) Styria provides training and qualification programmes for unemployed and acts as a job agency. In 1994 the national organization AMS has been decentralized through the establishment of regional and local offices. The AMS Styria has now more autonomy but is also forced to raise additional funds through projects. In this context, the European Social Fund

(ESF) has become very important for the activities of the AMS Styria (e.g for a special programme to improve the management skills of higher qualified employees). The AMS services comprise training of unemployed (accounting for the largest share of the AMS-budget), subsidies for people confronted with special problems to find jobs, consultancy, further training (retraining) of employees to prevent unemployment and direct support for job entry. The latter three categories account only for 30% of the AMS-budget. The services of AMS clearly focus more on short-term reduction of unemployment than on long-term provisions to avoid unemployment.

The three organizations described above are parts of national institutions. But there is also a specific regional institution, the Training Centre Fohnsdorf (SZF). This organization was founded in 1972 in the "Obersteiermark" in order to support the restructuring of this area which has been confronted with a severe structural crisis primarily in the metal/steel-industry. It is providing specific training programmes for adults, mainly unemployed, enhancing their skills with respect to new technologies. Due to its local focus, its importance for the whole region of Styria is rather limited.

In general, the training and education sector in Styria is dominated by national organizations, reflecting national interests and trends. It is only SZF that is a specific Styrian actor. It might be that the newly founded HEI "Technikum Joanneum" will be more influenced by regional and local actors, especially companies. This could contribute to a more region-specific technology support for the Styrian economy. But at present, it is too early for an asessment.

It seems that there are too similar offers of too many training organizations in Styria. This is not a specifically Styrian problem, but a consequence of the Austrian system of the "social partnership" between capital and labour. Often there are institutions engaged in the same activities, but organized separately by the chamber of labour (or the trade union), the chamber of commerce and maybe also by the state of Austria. This redundancy applies for example to the two training organizations WIFI and BfI. In other cases this system leads to organizations equally influenced by all the "social partners". This applies to the AMS. The AMS Austria is officially privatized since 1994. Nevertheless, the "social partners" are still present in the board of management, still determining the activities of this institution.

5.3 Technology transfer

The public technology transfer system in Styria consists mainly of the industrial liaison offices at the two technical universities in Graz and Leoben and the Technology Transfer Centre Leoben (TTZ). In addition to these three institutions, there are several incubation centres. But they have primarily been established to support start-ups, technology transfer does not belong to their explicit functions. Therefore they will be described in the following chapter (5.4) as providers of infrastructure for young firms.

The **industrial liaison offices** of the Technical University of Graz and the University of Leoben are service institutions of these universities. They are engaged in public relations, provide information on research activities and mediate the transfer of technological know-how. As far as technology transfer is

concerned, each liaison office is primarily engaged in the commercialization of research performed by the respective university. This is clearly more important than in the mediation of contacts to universities and scientific knowledge in general.

Technology transfer via liaison offices is concentrated on high-tech which corresponds to the scientific activities of the universities. They are not adequate mediators of technical know-how for the large number of "lower tech" firms. Industrial liaison offices function primarily as coordinators of networks of technology suppliers at the universities and the receiving companies. Usually they are actively participating in these transfer projects focusing on the management of these projects.

The offices are not only passively reacting on firms' inquiries, but also try to stimulate cooperations. In 1993 the liaison office of the Technical University of Graz initiated a large technology transfer project between the university and the local industry. A total of 78 firms were contacted in order to trigger cooperation projects with departments of the university. This initiative was quite successful. Several cooperation projects could be started, mostly in form of thesis or dissertation projects. Most of the contaced firms never had contacts to universities before.[7]

In general, the contacts of the liaison offices are concentrated on the localities of the respective universities. The office of the Technical University of Graz has most of its links to firms in this urban area. Nevertheless, the contacts are not restricted to the closer surroundings. In the case of the liaison office at the University of Leoben, about 40% of the cooperating firms are located in Styria, 40% in other regions of Austria and 20% in foreign countries. Transboarder cooperations are not actively aspired.

The **Technology Transfer Centre Leoben** (TTZ) was founded in 1986 in the "Obersteiermark" as a response to the steel crisis in the eighties. The original task of this institution was to give firms assistance in restructuring their organization and production, and to increase the quality of products and processes. It is organized as a network of three partners. Two of them are regional institutions (the liaison office of the University of Leoben and a private regional development consultancy organization), the third one is a major Austrian research organization (the Austrian Research Centre of Seibersdorf) which is located in another part of Austria. The TTZ is therefore influenced by different interests – national/regional and public/private. It is controlled by several national and regional actors (federal ministries, the "Land" Styria, the City of Leoben and the partner organizations). The network has to be financed mainly by projects. Nevertheless, there is additional funding by the Austrian Ministry of Science and Traffic.

The TTZ has two focus areas: technology transfer and economic and management consultancy:

a) Technology transfer activities comprise stimulating technology-related personal contacts, organizing information campaigns and initiating common transfer projects. The TTZ has provided more than 2 000 primarily technical consultancies since 1987, concerning product and process development, automatization, environmental technologies and quality control. Approximately a quarter of these

[7] In 1996 the project was prolonged. Again, the response rate to the inquiries of the liaison office was high.

primary consultancies were followed by specific technical consultancies. Technology transfer usually consists of both technical equipment and technical know-how. The TTZ mainly provides research capacities of its own affiliated partners, the research centre Seibersdorf and the University of Leoben. This direct mediation works as long as the demanded knowledge is part of the core fields of these two organizations. In case of a lack of available competence, the TTZ mediates contacts to other universities or research institutions in and outside the region. Companies using the transfer services of the TTZ are mainly located relatively close to it, in the Styrian subregion "Obersteiermark".

b) Management consultancy is targeted on two categories of firms, start-up firms and already established firms, the services being differentiated according to their specific needs. Management consultancy is less important than technology transfer. Since 1987 less than 500 projects could be realized. Most of the consultancies concerned funding (39%), "standard" management consultancy (e.g. on marketing, organization, controlling) was clearly less important (19%). The TTZ is also involved in the EU common initiatives KMU, Adapt, Employment and RESIDER.

To summarize, we find that the technology transfer institutions in Styria are quite narrowly focused regarding the location of their customer firms: the urban area of Graz and the "Obersteiermark". This applies also to the TTZ, in spite of the fact that it has intensive (organizational) links on the national level. It seems to be necessary to increase the technology transfer network both with regard to the Styrian clients, receiving transfer services, and with technology providers on the national and international level.

It was surprising to find that no representative of a technology transfer organization considered the role of private profit-oriented companies in offering innovation support services. Potential redundancies or unnecessary competition with the private service sector is obviously of little relevance for them. Nevertheless, there are engineering and consultancy companies in Styria which offer more or less comprehensive technology transfer services. One example could be found even in the very small interview sample: It is a small engineering company which offers the new service (new with regard to the Austrian market) of a technology transfer exchange, mediating between universities, independent inventors and companies concentrating on the commercialization of the inventions. Currently, no other company or public institution (at least in Styria) offers an equally comprehensive service. Nevertheless, the competitive advantage is not so big as this market niche position seems to indicate. This is due to the fact that there are many semi-public institutions (e.g. technology transfer agencies) which offer certain parts of this service which is sufficient for many potential technology transfer partners. This, of course, reduces the company's market potential. The potential for profit-oriented technology transfer services should not be overestimated. There is certainly a need for publicly funded or supported service organizations. But their activities should be concentrated exactly on the deficits resulting from market failures in order to use the scarce public funds most efficiently.

5.4 Funding and infrastructure

In this chapter we will describe two support functions which are intended to improve the preconditions of innovation in Styria: fund raising and provision of infrastructure. These functions of the regional innovation support system are performed by the following institutions:

? Provider of subsidies (loans and grants) – SFG
? Providers of relevant infrastructure – incubation centres within the framework of the "Styrian Technology Park" (STP)

The main regional institution providing **subsidies** for Styrian firms is the Styrian Economic Development Agency (SFG). It was founded in 1991 as an independent, semi-public regional development agency, owned, controlled and financed by the "Land" government. The SFG has the task to improve the conditions for economic development in Styria and its subregions and to support disadvantaged areas. The SFG performs this task through the support of innovative projects (which applies to research institutes as well as firms with new productions), the support of firms in economic crisis and the stimulation and coordination of projects designed to support underdeveloped subregions of Styria. This leads to a wide range of activities concerning regional development, start up of new firms, firms in the growth phase, technology transfer, attraction of investment, technology centres, incubators and training[8]. Innovation support is only one of many functions. As a consequence, the available funds are distributed among numerous support projects which impedes a concentrated strategy to support significantly the few projects which are the most promising ones. There is no clear information how many of the supported projects have been intended to upgrade the firms' technological level or the capactity to innovate. This lack of explicit goals regarding the technical content of projects to be supported certainly reduces the effectiveness of the support activities as far as technology and innovativeness are concerned. Nevertheless, due to the fact that the largest share of the subsidies is provided to growing firms, which are likely to belong to the more innovative companies in Styria, it can be assumed that the activities of the SFG have a reinforcing effect on the innovativeness of Styrian firms, even if the funds available for this purpose are rather limited.

A likely deficit of the funding activities of the SFG is the strong focus on direct grants. It can be assumed that the effectiveness of the support measures could be raised, if more complementary instruments like credit allowances lowering the interest rates of loans would be applied.

The Styrian Technology Park (STP) represents in fact a system of **incubation centres**. The STP functions as an incubator for start-up firms supporting them with infrastructure services and consulting. It is financed by the SFG. The original intention to establish specialized technology centres did not work as expected. The main reason for that is a lack of demand in those specific technology fields whereas there was demand in technology fields outside the original focus area. As a consequence we find a technological mix in those technology centres. The term "technology park" is therefore misleading because of a lack of explicit technology orientation. At present, the technology park

[8] Geldner, N.: Evaluierung der steirischen Wirtschaftsförderung. Studie des Österreichischen Instituts für Wirtschaftsforschung im Auftrag der Steirischen Wirtschaftsförderungsgesellschaftm.b.H. Vienna, 1995

consists of four different centres (in brackets the original technology focus):

? Technology Park Graz (electronics)
? Technology and Marketing Centre Grambach (marketing, design and product development)
? Technology and Training Centre Niklasdorf (laser technology, new materials)
? Technology Centre Kapfenberg (laser processing, construction of industrial sites)

Only one centre, Niklasdorf, has more or less adhered to its original special focus. Apart from companies being active in laser technology and materials, there are also a "Laser Centre" (performing relevant research) and a related training centre (run by the WIFI).

6 Regional policy in the national and European context

6.1 Regional technology policy

The regional government of Styria has quite comprehensive competences for regional technology policy. This is due to the fact that in Austria any "Land" government is responsible for the general economic and social development of its region. But there are limits to the autonomy of the regions. As far as infrastructure is concerned, there is a very complex distribution of specific competences between the state of Austria and the regions. A further restriction results from the fact that the distribution of the financial resources clearly favours the national level. The financial resources for own support activities of the "Land" governments are rather limited.

The regional policy concerned with technology and innovation seems to be based on the assumption that the main deficit in the region is due to a lack of interaction between firms and innovation support organizations and a lack of coordination between those. But the performance and usefulness of the existing support system, the involved actors and their functions is not questioned. Therefore the regional technology policy focuses on existing structures without considering alternative models.

Accordingly, the main activities of the regional technology and innovation policy are concentrated on the coordination of existing elements. A central part of the "Styrian Technology Policy Concept" deals with the Styrian enterprise support system for innovation and relies primarily on coordination efforts between the support organizations. In the following we present some current policy activities:

? "Wirtschaftspark Obersteiermark" (since 1995): This is a network of actors established both by a regional (SFG) and a national institution (the association for industrial policy (GBI)). In addition to these two organizations, it consists of Styrian technology centres (Kapfenberg, Niklasdorf), other incubation centres, technology transfer organizations (TTZ), training institutions (SZF, Technikum Joanneum), and several local initiatives. The aim of this initiative is to link all institutions of the industry support infrastructure in this part of Styria to form a coordinated network. This network is intended to support the restructuring process in the "Obersteiermark" and to improve the

international competitiveness of the regional economy. The logic behind this initiative was the conclusion that there are enough support organizations in the "Obersteiermark", but that there is a lack of coordination between them and a lack of professional marketing. Communities where afraid of losing competences by initiating such a network, but finally the "Wirtschaftspark Obersteiermark" started in 1995.

? "Technologiepartner Steiermark": This initiative consists of a common Internet-homepage of 14 Styrian institutions (industrial liaison offices of the Styrian universities, Joanneum Research, WIFI, BfI, AMS, SZF, SFG, etc.) with the intention to give firms (SMEs) assistance in the field of innovation. Firms can ask for information about specific technological problems via Internet and the partners of this common project try to answer according to their competence within one week. This activity started in spring 1997 and is now in the test phase.

? "Innovationsassistent" (planned): This initiative intends to give firms the possibility to employ a specific expert for innovation (the so-called "innovation assistant"). There are different views of translating it into practice. Some organizations regard it as a labour market initiative for retraining unemployed academic personnel whereas others see it as an innovation support service where experts should give assistance to firms. The SFG supports a project for small and medium-sized enterprises where innovation assistants are affiliated in the firms for a specific period of time and give advice in innovation related fields and in project management.

Summarizing these activities we find that the regional technology and innovation policy is restricted to rather small-scale initiatives to improve the networking of existing innovation support institutions. The innovation assistant-project might be a more tangible support programme, but it has not been started yet and its effectiveness remains to be seen. Due to the fact that support organizations are in fact very numerous in Styria, the networking initiatives seem to be helpful. However, it has to be doubted, if they are sufficient to improve the effectiveness of the regional innovation support system.

At present, regional economic policy directs much attention to the establishment of clusters in Styria. It intends to upgrade the competitiveness of the Styrian economy and, therefore, it is also relevant for innovation policy. The cluster strategy is an important part of the "Styrian Technology Policy Concept". The formation of clusters in traditional sectors, such as materials and metals, wood and paper, vehicles and transport should be strengthened. An additional goal is the stimulation of new environmental activities forming a so-called "eco-cluster".

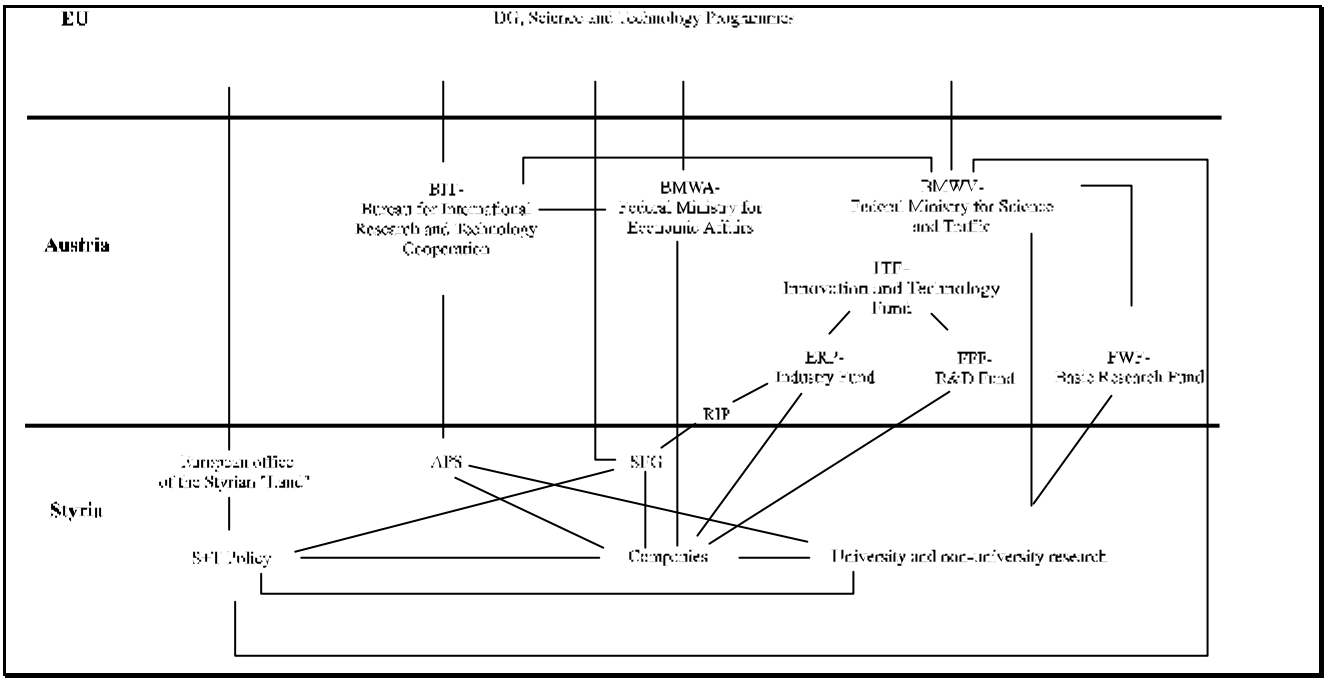
In contrast to these plans, the actual cluster-policy relies on a single industry – vehicles and transport. For the purpose to establish such a cluster in Styria the "ACStyria - Automobilcluster Styria" was founded by the SFG and a consulting company. It is a two year project which should be self-sustaining by 1999. The "ACStyria" is an initiative for supporting the vehicles and transport cluster with the help of political authorities, the SFG, the chambers, science and other institutions. It should function as a coordinator of the network of firms in the automotive sector and their suppliers. One of the first activities was the implementation of a company database which is available on Internet since June 1997. As far as it can be assessed today, we find that the strategy to strengthen clusters relies very much on attracting global players without considering seriously the technological level of their

production at the Styrian location. There is a danger that the attraction of foreign companies becomes more important that the technological upgrading of the regional economy.

6.2 Relations to the Austrian and European science and technology support system

The regional technology and innovation policy of Styria has strong connections to the related national policy. The latter one is in fact the decisive level regarding policy areas like science, technology and innovation. This is primarily due to the larger funding capacity, but also to nationwide acting institutions and the small size of the country. In contrast to the dominance of the nation state, links between Styria and the research and technology programmes of the European Union are clearly weaker and mainly indirect via national institutions. The following figure presents an overview about the most important relations of the region to other spatial levels:

Figure 4: Links of Styria to science and technology programmes of Austria and the EU



In Styria there are only three relevant mediators of contacts to and administrators of funds from the national and European levels: SFG, APS and the European office of the regional government of Styria. In the following paragraphs their interactions with Austrian and European institutions will be briefly described:

The SFG, as already described (see 5.4), is the main Styrian provider of subsidies. With reference to national funds for innovation support it is in charge of the administration of RIP-funds (described below). Nevertheless, the relations of Styrian companies or research institutions to the major Austrian S+T-programmes (ERP, FFF, FWF, ITF) are predominantly direct. The Austrian programmes designed to support research, development and innovation are dominated by four funds:

The FFF and the ERP are the dominant funds as far as R&D and innovation in companies is

concerned. The ERP is the biggest funding authority in Austria and performs, additionally, a coordinating function of the whole national funding system. It provides subsidies for a wide range of purposes, technology-oriented projects being only one of them. In 1996 the ERP provided 350 million ECU in the form of loans for the manufacturing sector. Styrian companies received 16% of this total, but only 4% of the specifically technology-oriented funds. In addition to its own financial resources the ERP administrates special funds for regional purposes. This programme is called "Regional Innovation Premium" (RIP). The RIP, a cooperative national and regional support instrument, provides funds for both material and non-material investment for innovation projects, which means that also educational and training projects (qualification support) and external expertise can be financed. In Styria companies can apply for this Regional Innovation Premium directly at the ERP fund or at the SFG.

In contrast to the "general-purpose" character of the ERP, the FFF is designed to promote and finance industrial research and innovation. In 1996 the total subsidies amounted to 122 million ECU (60% in the form of loans, 40% in the form of grants). 19 million ECU (loans and grants) were directed to projects in Styria. Compared to other regions of Austria, Styria received about 16% of the total subsidies, ranking third behind Upper Austria (23%) and Vienna (21%). The ITF supports innovation and technology projects of companies. It is not acting independently, but is administrated by the FFF and the ERP. The ITF has several technological and functional focus areas – information technologies, software technologies, energy and transport technologies, technology transfer and a specific programme on seedfinancing for "higher-tech" companies. In 1996 the ITF provided 11 million ECU for these purposes. The FWF is a funding programme intended to support basic research projects and it is therefore more relevant for universities than companies.

Comparing the subsidies for R&D and innovation between the national and the regional providers of funds, we find that the national institutions account for the bulk of the funds. In 1996 the amount of subsidies for Styrian organizations was 56 million ECU in the case of the ERP and 19 million ECU in the case of the FFF. The regional funds provided by the SFG are only 7 million ECU in 1994. But these rather limited funds are used predominantly for direct grants. In contrast, subsidies from national institutions concentrate on loans. If only the grants are considered in this comparison, then both values are nearly equal, the national grants directed to Styria being only little higher than the regional ones. It is the provision of loans (at favourable interest rates) which is lacking in the Styrian finance support system.

The most important public authorities with regard to science and technology in Austria are the ministry of science and traffic and the ministry of economic affairs. They are also the control boards for the S+T funds. Recently a specific funding programme for technology-oriented research – the so-called "technology billion" – was installed with a limited budget of 3 billion ATS (216 million ECU) for the next three years. The responsibilities for these and other funds, however, are in dispute since a major reorganization of Austrian technology policy is currently taking place.

Contacts of Styrian companies or research institutions to EU-programmes are mainly mediated via the Austrian Bureau for International Research and Technology Cooperation (BIT), as far as mediation is needed at all. The BIT acts as a central consulting and coordinating office, providing assistance for applications for R&D project funding. Its headquarter is located in Vienna. Additionally, it has four

regional offices, one located in Styria (APS). The regional offices are responsible for regional assistance, the bulk of the activities remain with the Austrian office, however. The BIT was established in 1993 and comprises all major actors in Austrian R&D. The BIT is the central service centre for all organizations interested in transnational research cooperation, R&D programmes of the European Union, EUREKA and other international programmes and initiatives. In addition to the BIT (APS), Styria has established a permanent representative office in Brussels which is responsible for providing information on and contacts to European funding programmes.

7 Problems and barriers with regard to innovation

7.1 The firms' perspective

In the interviews problems have been stated in a more focused way than in the firm survey. This means that as far as the interviews are concerned, problems concentrate on fewer types and are in most cases considered less serious than the survey data suggest. These differences can be explained at least partly by the different size structure of the survey and the interview samples. Smaller companies and their specific problems are more numerous in the survey than in the interviews. The problems have been categorized into four areas: fundamental barriers like the lack of autonomy and a standardized product range, R&D-manpower, funding of innovation activities and technology infrastructure (technology transfer). In all four subsections, both the interview results and the survey data will be used for interpretation.

? Fundamental barriers: lack of autonomy and standardized product range

The basic barrier "lack of autonomy" which implies a lack of competence to innovate appears in both the interviews and the survey and is relatively widespread. 51% of the respondents to the survey are lacking sufficient autonomy to be "fully innovative". This corresponds to some extent with the organizational status of these firms: 31% of the survey firms are subsidiaries, 16% are in foreign ownership. Additionally, a considerable number of firms strongly depends on their customers. The extent of dependency is highest in electro/electronics (65% are subsidiaries, 47% in foreign ownership), automobiles (44% subsidiaries, 33% foreign owned) and metal/steel (46% subsidiaries, 21% foreign owned). Regarding firm size, a lack of autonomy applies primarily to large firms (44% subsidiaries, 30% foreign owned). Accordingly, the highest mean importance of the barrier "lack of autonomy" appears in electro/electronics (2.85) and automobiles (2.22). Nevertheless, it is not restricted to those industries. It is also a serious problem in machinery (2.17), an industry with a dominant position of customers due to customer specified projects.

Another common feature of Styrian firms – the high share of standardized products in total sales – appears in the survey data. 66% of the manufacturers' sales are standardized products, 57% consider that a barrier to innovation. In contrast to this result of the survey, the problem of standardization was

never mentioned in the interviews. But this is mainly due to the very low importance of such products for those firms belonging to the interview sample.

Table 15a: Constraints on innovation activities

Positive answers and mean importance (*)

Constraints on R&D and innovation:	% yes	mean
Lack of autonomy	50.5	2.38
Standardized products only	57.0	3.07

(*) 0 = of little importance ? 5 = very important

? Education / training / specialized personnel:

Interpreting the interviews we find that most complaints concern deficits in manpower. But these problems are quite different in nature. In some cases the qualification of the R&D-personnel is satisfactory, but the department's staff is too small to be able to handle all interesting R&D-projects. There is not enough time available for undertaking all the innovation projects the firm is interested in and basically capable to deal with.

In general, there are only very few complaints which refer to the level of qualification. In most cases the know-how is considered satisfactory, especially with regard to engineers (university graduates) which are frequently assessed to be internationally competitive. Most complaints concern the small number of available persons of a certain qualification. Some firms cannot recruit enough experts with the adequate special know-how. But such highly specialized experts are not only missing within the region or the nation, but on the international scale too, where the firms have to compete with attractive foreign companies for a small pool of experts. The problem of a lack of available R&D-personnel is not restricted to the top qualification level only, but appears also at lower levels. This is a consequence of a lack of specialized training and education institutions capable to teach the necessary know-how for the specific requirements of the company.

The survey data show that the lack of time is more frequent and more serious for the respondents than the lack of available manpower. In general, the interview results are confirmed, but the importance of these problems seems to be higher for the survey firms.

Table 15b: Constraints on innovation activities (cont.)

Constraints on R&D and innovation:	% yes	mean
Insufficient management time	62.6	2.89
Recruiting skilled personnel	59.8	2.31

0 = of little importance ? 5 = very important

Medium-sized firms are most severly affected by manpower shortages, as far as insufficient time is concerned (3.56). With regard to industries, the highest importance is to be found in wood/paper (3.44), automobiles (3.29) and metal/steel (3.00). The lack of technical know-how is a less serious problem on average. It is most relevant in machinery (2.67), metal/steel (2.52) and electro/electronics (2.50) and large firms (2.64). But in general, there are only little differences between industries and size classes.

? Funding – subsidies / research programmes / venture capital / loans:

A surprising result of the interviews is that the lack of funds available for R&D was rarely mentioned as a barrier to innovation. Only three companies referred to this problem. In these cases, however, the restriction was considered serious. According to the survey it can be seen that the lack of R&D-funds is obviously more serious. It applies to a wider range of firms and is on average more important than it appears in the interviews.

Table 15c: Constraints on innovation activities (cont.)

Constraints on R&D and innovation:	**% yes**	**mean**
Research personnel too costly	67.3	2.97
Insufficient funding	67.3	2.92

0 = of little importance ? 5 = very important

The need for funds depends strongly on the industry and size-class a company belongs to. Most seriously affected by a lack of funds available for innovation are automobiles (3.50), machinery (3.42), services (3.27) and electro/electronics (3.14). The shortage is worst in small companies (3.27), it is far less serious in medium-sized (2.78) and large firms (2.61).

With regard to public research programmes, the interviews do not confirm the common complaint about such programmes that they are too expensive in relation to their benefits. Only one interview partner shared this opinion with respect to programmes of the European Union. In contrast to the interviews, 35% percent of the survey respondents complained about the process of applying for project funds being too bureaucratic and still 22% about too high costs of participation in publicly supported research projects.

? Technology infrastructure / technology transfer / information services:

Problems related to the technology infrastructure in the region are differently judged by survey respondents and interview partners. According to the survey there is obviously need for such services as can be seen from the following table:

Table 15d: Constraints on innovation activities (cont.)

Constraints on R&D and innovation:	% yes	mean
Insufficient information on sources of external know-how	63.6	2.34
Insufficient technical know-how	60.7	2.21
Insufficient information on market potentials / volumes	59.8	2.77
Insufficient information on customer needs	57.9	2.00
Accessing consultants / specialists	56.1	2.04

0 = of little importance ? 5 = very important

It is obvious that quite a lot of firms have deficits in information, both technical- and market-related. Deficits in market information are nearly as frequent as technology-related deficits and on average the most important informational problem. Focusing on the mediation of technical knowledge only is clearly insufficient.

Most affected by "insufficient information on external know-how" are electro/electronics (3.25), followed with a considerable distance by metal/steel (2.60) and machinery (2.55). Low-tech firms have problems to find project partners in science which normally do not offer adequate know-how for those firms' needs. In addition, the restriction to technical knowledge could be too narrow especially for small and low-tech firms, which often need more complex services combining technical know-how and management advice. Most seriously confronted with problems to get into contact with the technology transfer system are the medium-sized firms (between 50 and 200 employees). They are most affected by insufficient information on external know-how (3.00) and by difficulties in accessing consultants/specialists (2.56).

However, the impression of the interviews is that most companies simply do not need any technology support beyond market relations. Only a single interview partner referred to the technology transfer system in Styria. All the others did not consider it important. The only firm which tried to get into contact with a technology transfer organization gained a negative experience. It had the impression that small firms without high-tech-poducts are not appreciated as innovation partners by universities, but also by technology transfer agencies. In addition there was a slow response of these institutions. At least partly these problerms can be attributed to cultural factors and in particular the differences between business and science. The described problem became apparent in the case of a small company but it is not size-specific. The ability to establish a link between the two social systems "enterprise" and "scientific institute" has more to do with the qualification structure of a company’s staff than with its size only. Engineers with university education should have clearly less problems to communicate smoothly with researchers working at the university, especially if they have ever worked in R&D since leaving the university, than technicians without this experience. If the share of university trained R&D-personnel is high, the relations to universities are likely to function better. Besides that, most of the companies with close relations to science have a long tradition in cooperating with universities. There was enough time to create a "common language" and to solve communication problems.

There is an interesting variation of problems by firm size and sector. Both foreign owned and small and medium-sized firms are expressing more serious problems. Large companies and innovators, in contrast, do not see similarly pressing problems (see table 16).

Table 16: The three most serious problems and the mean importance of the most serious one (1), differentiated by industry, firm size (2), foreign ownership and innovativeness (3)

	Mean importance of the first rank problem	Problems ranked by importance:		
		First	Second	Third
Wood/paper	3.44	Management time	Cost of research personnel	Standardized products
Machinery	3.42	Funding	Information on market potential	Technical know-how
Metal/steel	3.05	Standardized products	Management time	Cost of research personnel
Electro/electronics	3.25	Information on external know-how	Standardized products	Funding
Automobiles	3.75	Cost of research personnel	Funding	Management time
Small	3.27	Funding	Cost of research personnel	Management time
Medium	3.56	Management time	Cost of research personnel	Standardized products
Large	2.79	Standardized products	Information on market potential	Technical know-how
Foreign owned	3.80	Standardized products	Autonomy	Cost of research personnel
Product innovators	2.97	Management time	Funding	Cost of research personnel
Process innovators	2.62	Standardized products	Funding	Cost of research personnel

(1) 0 = not important ? 5 = very important

(2) Small: employment < 50, Medium: 50 ? employment < 200, Large: employment ? 200

(3) Product innovators: Introduction of products new to the market during the last 3 years,
Process innovators: Introduction of new technologies during the last 3 years

If one looks at the kinds of problems, the following pattern emerges: The most frequent problems are the high costs of the research personnel, the standardized character of the products, the lack of management time and the lack of funds. Referring to the top rank only, standard products are most frequent, followed by the lack of time and of funds. Information related problems are rarely in the top ranks of the most serious problems, in spite of the fact that they are mentioned quite often as constraints on R&D and innovation (see table 15d).

The industry with the highest level of problems is automobiles. In this subset, problems related to funding are predominant (costs of research personnel and lack of funds available for innovation). Regarding firm size, the most seriously affected firms range between 50 and 200 employees. In this size class the two most important problems are both due to a lack of manpower (in the form of

insufficient management time and the inavailability of research personnel due to its high costs). Finally, firms in foreign ownership are concerned with very serious problems which reflect their frequently dependent position as manufacturing subsidiaries (standardized products and the lack of autonomy).

The subsets being least affected by problems concerning their innovation activities are large companies and – with regard to industry – metal/steel-companies. Product and process innovators are clearly less affected by problems than non-innovators. They have obviously found some ways to handle these difficulties leading to a lower level of importance. Still, they are confronted with problems such as time, standardized products, funding and costs of research personnel. The constraint "standardization" appears in the category of adopters of technologies which are new to the company but not the market. This result is in accordance with the finding in chapter 3 that these firms primarily use process innovations for rationalization of their production process, but not for new products.

Considering both the questionnaire and the interviews we come to the following conclusions:

1) Some problems, especially the lack of funds and deficits in the technology transfer system, are obviously more serious for a broader sample of the Styrian industry with a higher share of smaller firms than they were included in the interview sample. In the survey more kinds of problems are considered than in the interviews.

2) Problems having their source inside the firm are obviously more widespread in the broader survey sample than the narrower interview sample. The interview partners focussed more on external problems. In spite of the difficulty to clearly divide problems into external and internal ones, it can be said that internally caused problems are more important than the interviews suggest.

3) Problems are obviously easy to complain about in a written questionnaire, but often readjusted if it is talked about them directly. We find a tendency to broaden the array of problems and to attribute a higher importance to them in a questionnaire.[9]

7.2 The science and technology support organizations' perspective

As we found out in the firm survey, Styrian firms do not use the innovative support structure as much as they could, but why? From the perspective of support organizations this was due to the following problems:

[9] Comparing the questionnaires and the interviews of the firms included in both samples, the same persons expressed often significantly different estimates. Most (eight) interview partners focused on one or two kinds of problems, but considered by far more problems in the questionnaire. Five partners did not mention any problem in spite of the fact that he considered a lot of them in the questionnaire. Only one interview partner was consistent (interview and questionnaire without contradiction).

? Lack of information on the side of the firms:

Many interview partners argued with an information gap on the side of the firms. Due to a lack of time or human resources, particularly SMEs do not dispose of information about available organizations and grants. The interviewed organizations characterized most of the SMEs as "conservative" with respect to external contacts and cooperations – an explanation for the inactive behaviour and the existing information gaps.

Furthermore, SMEs, especially young firms, are afraid of exposing their own weakness in the course of consulting and cooperative projects. It might also be an obstacle that consultancy is frequently quite expensive. Getting information at workshops or presentations of the transfer organizations is in most cases not a common practice.

? High number of organizations without coordinated strategies:

A second problem seems to be the high number of organizations without coordinated strategies. Many of the institutions are acting independently from each other and there is also considerable competition between these institutions. The organizations are aware of this problem and they are starting to create common strategies like e.g. "Technologiepartner Steiermark" (see 6.1). Due to the fact that firms do not take the initiative, specific coordinated information campaigns would be necessary to communicate the importance of inter-firm cooperation and contacts. Some of the organizations are getting active in the way of initiating information workshops (e.g. STP and SFG) where newly established firms are able to present their products. Another strategy is the organization of so-called information days where organizations present best practice examples. But to reach firms requires first to know about them. It is necessary to build up common databases on innovators and interested firms which is accessible for all relevant technology and innovation support institutions in Styria.

? Lack of awareness, lack of trust between companies:

Most of the interview partners in organizations argued that cooperation is a possible solution for innovation constraints because firms could learn from each other through "learning by seeing". They think that firms are in general not aware of the importance of cooperating and in most cases there is a lack of trust and fear of potential competitors. Therefore, there is a need to increase consciousness in this respect. However, increasing trust and interest in the work of possible partners takes a long time.

With respect to the typical contact pattern, all types of organizations argued that the initiative of cooperation with firms has to be taken by the organizations themselves. The most frequent target group – the small and medium-sized firms – are rather reluctant to actively initiate cooperations. However, once the cooperation has been started, most firms are interested in further projects. Many organizations argued that they do not know enough about the firms, e.g. which firms are working on which technologies. The idea of building up a database is not a solution for making firms more active. But it is a tool for organizing information workshops or meetings where firms could establish contacts with

organizations and other firms and where they can receive information about the services and assistance the organizations could give.

7.3 Conclusions

1) The basic barrier of external dependency seems to be underestimated by the firms. It is clearly recognized only by manufacturing subsidiaries without R&D-competence. But autonomous firms rarely see the dependence of a dominant customer as a problem. Due to the fact that the prevailing strategies focus on market niches and on immediate reaction on special customer needs, these problems are not really reflected. Another common feature of Styrian firms which negatively influences innovativeness – the high share of standardized products in total sales – is more generally recognized. Two thirds of the manufacturers' sales (regarding the survey sample) are standardized and most of the respondents consider that a barrier to innovation.

2) Regarding R&D-manpower, the most serious deficits are seen in a lack of time to deal with all the potential innovation projects. Additional research personnel is frequently too expensive to remove these bottlenecks. On the other hand, the qualification level of the regional workforce is mostly considered satisfactory, especially regarding university graduates. There are only few problems mentioned, such as a lack of company-specific skills which are not part of the training programmes in regional institutions and, in some highly specialized cases, a lack of available top experts. It is not surprising that the general level of technical qualification meets the requirements of the firms, if one considers the fact that most companies follow technical trajectories with a long tradition in Styria.

3) The interviews suggest that there is nearly no need for external innovation funding.[10] In sharp contrast, the survey shows that there is need for additional funds for innovation, but this need varies with the firm size and the technological level. It is less serious in the case of large and "higher-tech" firms (overrepresented in the interviews) and more serious in the case of small and "lower-tech" firms.

4) The relevance of the regional technology support (transfer) infrastructure is very different, depending primarily on the technological level of the companies. There is nearly no need for support or transfer services in addition to the direct know-how-transfer from other institutions (especially customers and universities) in the case of "higher-tech" firms, following the traditional trajectories. It is probably more difficult for the few firms active in new trajectories to find partners in the region. But this is mainly due to a lack of companies, not necessarily to a lack of scientific research. To some extent, fields of research belonging to new trajectories (e.g. electronics, materials) are established at regional universities. Nevertheless, many of these firms cannot rely exclusively on regional scientific partners. If they try to establish contacts to foreign science partners, the technology transfer institutions seem to be of little help due to their focus on regional (or national) universities. The most serious deficits in the regional technology transfer system, however, clearly concern "lower-tech" firms. If they

[10] Reasons for low importance of funding as a problem the interviews may be the strong inward orientation of firms on the one hand (self financing) and the reliance on bank loans on the other. Firms are not willing to incorporate equity (venture) capital which could reduce the autonomy of the company. It is obviously only reluctantly talked about this in the interviews.

are looking for technology support, they frequently have problems to find project partners in science which normally do not offer adequate know-how for those firms' needs. In addition, the restriction to technical knowledge could be too narrow. Often more complex services, combining technical know-how and management advice, are needed. To some extent at least, one technology transfer organization (TTZ) is providing such services already, but it is strongly concentrated on a subregion of Styria ("Obersteiermark"). But in general, there seems to be a lack of such comprehensive technology support services – on the one hand covering the whole range from non-scientific to advanced technical know-how, and on the other hand combining technology transfer with management advice – in Styria.

Referring to the firms' view on barriers to or problems for their innovation activities, we get the impression that many characteristic features of the innovation model of Styrian companies are not considered as actual or potential threats to their innovativeness. There is little critical reflection regarding issues like dominant influence of customers, concentration on market niches, inward orientation, the lack of innovation cooperations with other companies than the customers, incremental progress in product (and process) development, and sticking to traditional technological trajectories.

Similarly, some possible explanations for the rather low use of the support services which concern own weaknesses were not mentioned by the technology transfer organizations – e.g. deficits or inadequacies of their services with regard to the demand of specific sectors, a lack of coordination with private service firms which are performing similar innovation support functions. The organizations' point of view concerning the problems which impede a more effective support system tends to blame the firms for being not sufficiently active in informing themselves about and using the offered support services. Nevertheless, it is conceded that there is a lack of coordination between the existing support organizations and that some services are not easily accessible. The process to eliminate some of these deficits has recently started, but it is too early to assess the effectiveness of these activities.

8 Designing for the future - policy proposals

Based on the findings of our analysis concerning innovation and interaction in the innovation process in the case of the Styrian economy, we will finally try to outline some proposals to improve the preconditions and the regional support infrastructure for innovation.

Framework for a regional innovation policy:

Due to the relatively small size and the predominance of the federal level regarding means for economic policy in Austria, activities at the regional level should have a complementary character. Regional innovation policy, therefore, should follow two priciples:

1) The basic design of regional programmes should be complementary to national and European programmes. The focus of the regional programmes should concern the specific needs and conditions of the regional economy as far as they are not met by national or European programmes. Regional

innovation support policies should be continuously coordinated with the respective policies on the higher spatial levels.

2) Public activities should concentrate on those services which are not at all or not sufficiently performed by specialized companies. Considering the scarcity of the regional financial capacity, it must be avoided to waste money because of unnecessary competition between public and private support services. Public support activities should always be designed to be complementary to private support services. However, many support activities are unlikely to attract profit-seeking companies. A large share of the support infrastructure will certainly remain with public institutions. In general, it is important to clarify, which support services are not (sufficiently) provided by commercial entreprises at present, which could be provided with reasonable stimulation, and which are likely to be never provided by service companies. The latter ones should then become the focus of the public support institutions.

Main policy goals for regional innovation support:

Based on the preconditions for a regional innovation support policy described above and interpreting the results of the surveys and interviews with firms and science- and technology-organizations in Styria, we propose the following goals for a Styrian innovation policy programme:

1) Stepwise widening of the technological perspective of the main actors regarding innovation in Styria. Traditional trajectories – primarily metal/steel, machinery (electrical, automotive and special purpose), wood/paper – are still dominating the Styrian economy. Therefore policy activities which help to build bridges to new trajectories (e.g. electronics, telematics, new materials) seem to be reasonable. Linking up to new trajectories should be based on the accumulated knowledge and practical experience in the traditional trajectories, however. The intention of support activities should be to stimulate or reinforce (primarily higher-tech) companies to gradually expand their innovative activities to new trajectories without losing their accumulated knowledge-base. Traditional trajectories may be still important for the development of a regional economy, but there is a danger of "lock-in" and the potential for durable growth in the long run is likely to be too limited.

2) Not just the technological, but also the organizational and management perspective of firms should be widened. Firms should become aware of new production and innovation models. All this leads to the conclusion that it is of crucial importance to enhance the systemness of innovation activities in the region. These relations should comprise all types of partners in a potential regional innovation system, companies and innovation support organizations. It is widely acknowledged that intensive interactions within a network of innovative persons or organizations ("innovative milieux") play an important role in enhancing innovativeness in a region. But under certain conditions networks also may become closed inhibiting rather than supporting innovation. Policy makers and support organisations, thus, should aim at keeping networks open in order to avoid a "lock-in". Openness can be achieved both inside the region by making entrance for "outsiders" easier and by linking regional actors deliberately to external networks (national and European networks, global cooperations).

Policy actions:

There are many potential ways to achieve the general goals described above. In the following, we will outline those actions which are, according to our opinion, the most effective ones.

1) Policy actions referring to the objective "bridges to new technological trajectories"

1.1) At present, **science in the region** (universities, Joanneum Research) is basically compatible with most companies' innovation activities, particularly large or high-tech firms. Companies are mainly active in fields of research and innovation projects which belong to the traditional technological trajectories in the region. To avoid a the emergence of a "lock-in" situation, it seems to be useful to provide special additional funds for research projects which link up to new trajectories but build upon the accumulated knowledge in the old ones. The regional science institutions are clearly less restricted to these traditional trajectories, even if they are still very important, than the firms. Therefore the scientific basis for linking up to new trajectories is available.

To make clear what is meant with the concept of building bridges to new trajectories, it is possible to refer to an example out of our interview sample: In this case the company has expanded its markets through applying the know-how in measurement technologies which it had accumulated in motor development to medical instruments. Measurement technology was the bridge from automobiles to medicine. Similar examples can be found in the metal/steel industry (development of new materials) or in the mechanical engineering/machinery industry (application of information technology/electronics).

Due to the relatively small amount of regional funds available for this purpose it is important to restrict public regional support for research and innovation activities to such specific projects. Such a support programme should be complementary to national and European R&D-programmes. Additionally, it should be guaranteed that the research and development project is performed at the location in the region.

According to the rather conservative view of many companies in Styria, it will likely be difficult to stimulate a significant number of companies to take part in such common R&D-projects. In contrast to the business sector, there will be probably no problems to find scientific institutions which are interested, due to the fact that many of them are already engaged in research belonging to new trajectories. Some possible ways to solve this asymmetry are:

? Organization of information meetings or seminars about innovations and research in new trajectories. These meetings should focus on areas which are new but related to current activities of Styrian firms. To avoid cultural frictions and a profusion of inadequate information, comprehensible only for members of the scientific community, these meetings have to be kept easy and straight.
? The bureaucratic and cost barriers of project applications should be reduced as far as possible, especially through adequate support services. Because of the fact that there is already an institution in Styria concerned with support for project applications for EU-programmes (APS), it would only

be necessary to upgrade this organization to be able to offer this additional service.

? Many firms are likely to be unwilling to take the risk of engaging in advanced R&D-projects. This barrier could be lowered if information about innovations, addressed to potential users, is mediated more effectively by certain distributors of information (e.g. EU-Innovation Relay Centres), because this improves the chances to commercialize an innovation. Styrian innovators should be supported in establishing contacts to such institutions.

? Support for R&D-projects should be granted especially for networks of companies. The reason for this is that such networks are more likely to comprise not only the few active innovators but also additional firms which would not have engaged in such advanced R&D-projects on their own.

1.2) Concerning the **complementarity of different spatial levels** certain priorities are required. Such a specialization of different science and technology programmes of the three spatial levels Styria – Austria – European Union could be defined according to the criterion "scope of application" (i.e. generic versus specific technological innovations). The following differentiation could be used:

? Generic technologies are best dealt with in national and European programmes. Generic technologies are widely applicable due to their basic character. Sectoral and spatial differences are of little relevance.

? Specific technologies are concrete derivations or applications of generic technologies, often forming independent trajectories of significant importance. The specific conditions according to which these technologies are developed can be sectoral or regional. They range from special know-how of the workforce to particular resource bases. As far as regional characteristics are decisive, specific technologies should be the primary focus of regional and national programmes.

1.3) According to the survey and interview results it has to be concluded that **technology transfer services** seem to be more or less irrelevant for high-tech firms which are active in traditional trajectories. Direct contacts to universities are usual for them. In the few cases where such companies want to establish new contacts, the activities of industrial liaison offices at the relevant Styrian universities should be sufficient for them. However, there is a smaller number of other high-tech firms, often relatively young, which are already active in new trajectories and which have more problems to find cooperation partners in science. Because of the fact that these firms will play an important role in the extension of the technology base in Styria, technology transfer institutions should design their services especially according to their needs. This implies that they would have to broaden their contacts to scientific institutions beyond the region, where these disciplines are better established. For these purposes the already existing technology transfer infrastructure has to be reorganized in a way that they become more independent from their present scientific partners in the region.

1.4) With regard to technology transfer the most serious deficit in the Styrian technology support infrastructure concerns the **needs of "lower-tech" firms**. These needs are not or insufficiently matched by the existing institutions. Low-tech firms, especially if they are small and medium-sized companies, lack frequently several capabilities to be innovative: technical know-how, management-know-how, qualified manpower, funds. With regard to these companies it is not enough to focus on technical support only. Often management advice is more important than technical advice. In addition,

scientific knowledge is in most cases irrelevant for them. The knowledge-level which most of these firms apply and need is usually "below" that produced in scientific institutions. To be effective, the whole range of the following functions has to be covered by technology support institutions for "lower-tech" firms:

? Mediation of adequate technical know-how. In the case of low knowledge-intensive technologies such know-how is far more frequently available from other firms than from universities. This means that most of this know-how has to be purchased, only in few cases it will be freely available. Therefore such a service has to include consultancy on market transactions like licensing.
? If there are very specific technological needs of a significant number of firms which are neither offered by science institutions nor by other firms, it might be even reasonable to establish small-scale specialized development centres with public support. They could be linked with the existing incubation and technology centres.
? Support for developing the required technologies by the firms themselves through technical advice.
? Management consultancy, especially concentrating on technology adoption and innovation management.
? The provision of temporary additional manpower for innovation through assistants, which is currently planned, might be helpful for some firms. But it remains to be seen, if temporary available specialists are accepted by the firms, and if the wide range of required know-how and skills can be effectively fulfilled by a few assistants.
? Mediation of access to funds for innovation-related investments and expenditures.

These services might be provided within the organizational framework of the existing incubation and technology centres. However, in order to perform this clearly more complex support function, major reorganizations seem to be inevitable. In the case of technology transfer organizations which are predominantly focused on the mediation of scientific know-how (the liaison offices and the TTZ), such a reorientation covering those functions is certainly difficult.

It is important that unnecessary competition between public organizations and business regarding technology transfer and support is avoided. Some of the mentioned services can be provided commercially. Only in the cases where there is no market or the offered services are not sufficient, public institutions should become active. Therefore the market of technology support services should be carefully screened before reorganizing the public support infrastructure.

1.5) The **regional training infrastructure** should be reorganized according to two objectives: On the one hand, the degree of differentiation and specializiation regarding the range of the skills covered by the training programmes should be increased and, on the other hand, parallel structures should be eliminated. The latter process sets free capacities in favour of the first process.

The differentiation of the training programmes available in the region should follow two objectives:

? Adding specialized skills which are required by regional firms and which are currently missing in the training programmes of regional institutions. In this context, it is necessary to consider the needs of the majority of the companies, not those of a few large firms.
? Introduction of those skills which are especially relevant for linking up to new trajectories (see 1.1 of the policy activities).

This means that any diversification of the training institutions must not follow the present needs of the firms only, but should also include such skills which are important for exploiting technologies belonging to new trajectories.

The differentiation of the skills offered by training institutions applies to several levels of qualification: In Austria, HEIs have been established only recently. So the specialization of universities (more oriented towards basic and general knowledge) versus HEIs (specialized in applied know-how) is still an open process. This offers the chance for universities to add more knowledge relevant for new trajectories to their training programmes. In contrast, the specific needs of the regional firms could become the main focus of the HEIs.

This increase in differentiation will be possible, if parallel structures of training programmes (especially in the case of vocational training and retraining) are eliminated. This will be very difficult, because of the strong influence of national actors and lobbies. But even if this process were successful, the coordination of the large number and several locations of the regional training institutions would remain a complicated task. Any reorganization designed to improve the level of differentiation has to consider the following restrictions:

? Covering all subregions of Styria equally with fully diversified training institutions is certainly impossible. Therefore, locational specialization is required. It seems to be a useful and achievable task of the regional authorities to provide some kind of mobility support for students and workforce (in the case of retraining) to offset the resulting deficits in the spatial coverage.
? It is necessary to resist the temptation to fulfill the skill requirements of the firms first and try to add some new skills afterwards. In such a case the latter purpose is likely to come off worst. A balanced approach, improving actual skill deficits as well as adding new skills relevant for new trajectories at a similar rate, is necessary. To offer all the specialized skills required by firms will be impossible anyway.

1.6) Especially for small and medium-sized firms it seems to be important to improve the **access to risk funds**, both in the form of venture capital and high-risk loans. Styria is by far too small to provide a significant share of such funds within the region, therefore support institutions should concentrate on the mediation of risk finance. With regard to venture capital, it is especially the European level which is important, because only at this level the pool of venture capital providers is large enough to find adequate partners. Providing information and establishing contacts is not sufficient, however. Consultancy services must also comprise advice, how to incorporate equity capital into the innovative firm. Public consultancy regarding information about sources of venture capital, how to become acceptable for external risk investments, and how to deal with temporary equity capital seems to be an

attractive service. It is not only the lack of available risk funds, but also the lack of interest in this form of funding and the lack of competence to use it, which impedes a broader usage of venture capital. Besides equity risk funds, risk loans might be an additional source of finance. Of course, banks are rather conservative with regard to high-risk loans. Nevertheless, some kind of limited guarantees provided by the region could be stimulating in this respect.

2) Policy actions to stimulate "innovation networks"

At present, the collaboration of Styrian companies with other organizations as far as their innovation activities are concerned is, in general, of little intensity. There are some exceptions – cooperations with scientific institutions in the case of "higher-tech" firms, cooperations with customers, as well as some other links. But they are not typical for the Styrian economy. Additionally, many cooperations are not close enough and not really interactive, to support the innovation process. Public support activities to stimulate such relations are therefore certainly necessary and they should focus on networks relevant for innovation. Networks face an inherent danger of "lock-in", impeding rather than supporting innovation. Therefore any support has to focus on the following special types and aspects of relations:

- Exchange of information on new technologies, innovative products and scientific progress as well as on new ways of organizing business and innovation
- Cooperation in R&D-projects
- Flexibility of partnerships to avoid dependency on dominant large firms
- External relations to keep the network open for inputs from outside

The stimulation of networks can be based on two strategies: coordination of the existing innovation support infrastructure and support for the formation of clusters.

2.1) The necessity to **coordinate the several public and semi-public institutions** which offer innovation support services to establish an efficient and easily accessible network of support organizations has been recognized already. In spite of the fact that the first activities have been started (see 6.1), most activities focusing on networks do not consider the nature of these networks. The characteristics of the networks are decisive for their impact on regional development. At present, the technological content and the share of innovation-related cooperations in such networks are not considered being of primary importance. However, there is not only a lack of relations within the regional innovation system, but there are also certain elements missing (see 1 above). Both aspects are not sufficiently recognized by the public institutions which are concerned with the regional economic and technology policy.

Once strategic considerations and objectives have been cleared, the activities to stimulate networking may not be so hard to implement as far as the intensification of the relations between support institutions which are already offering adequate services and companies are concerned. Establishing common information pools on regional support services and technology and innovation-related needs and offers of regional firms can be easily implemented without requiring lots of funds. These

continuously available sources of information could be reinforced by regular or occasional coordinated information campaigns on the same issues. It is very important for the effectiveness of the support organizations to reach a higher number of firms. This requires more visibility of and information about them and partly a more active approach of contacting the firms and identifying their respective needs. In addition, long-term oriented activities to reduce barriers on the side of the firms, enhancing their demand for external contacts and cooperations ("trust building") seem necessary. Besides the intensification of intra-regional relations, innovation policy has to take account of the growing internationalization of markets, firms and policies (e.g. EU-programmes). The Styrian regional innovation system must aditionally adopt the role of an effective interface between regional firms on the one hand and European/global actors on the other.

In the case of insufficient or missing elements of a regional innovation system, the necessary improvements (see 1 above) will be clearly more difficult to achieve. In this context the strong role of the national institutions impedes the autonomy of the regional actors in shaping a regional innovation system according to their specific needs. Nevertheless, there is still room for independent activities on the regional level.

2.2) **Clusters** can be a reasonable strategy to reinforce a regional innovation system, but we have to be aware that improved innovativeness is not at all a necessary outcome of the emergence of clusters. Clusters are only part of an innovation system, if innovative companies play a decisive role in it. Otherwise they tend to lock-ins. Therefore it is important that R&D leading to new trajectories is performed within the cluster and that the network is kept open to external partners (especially outside the region) in order to bring in new ideas, technologies and know-how. It is important that public support takes account of these aspects.

Apart from the degree of innovativeness of a cluster, politics should not only focus on one or few highly reputable clusters. At the beginning of a cluster strategy it might be reasonable to focus on those well known clusters such as automobiles in the case of Styria. There are already ongoing activities of local authorities (location policy, informal meetings, information activities) to support this cluster. Nevertheless, other clusters might broaden the basis for a regional innovation policy. In Styria there is some potential for materials/metal, machinery and wood/paper. Within some of those industries, there is only little complementarity between firms because of their highly specialized product ranges. Between certain firms belonging to different industries, however, there might be a larger potential for new clusters, even if they are not recognized at present (e.g. "metal/steel – materials – laser", "machinery – information technologies"). These other potential clusters should receive more attention in the future.

Therefore, before describing some support activities to establish clusters in the region, we have to stress the importance of checking the degree of innovativeness of a certain target cluster and the impact of cluster-formation on the innovativeness of the member firms. Considering this precondition for a successful cluster strategy (with regard to increase innovativeness), public institutions can support the process of cluster-formation in the following ways:

? Informal meetings focusing on information exchange to stimulate relations between existing but not yet interacting firms. Informal meetings to give regional firms access to information from outside the region.
? Easily accessible information systems about offers of and demands for cooperation projects.
? Support for investments necessary to shift production towards business activities being (more) compatible with activities in the network.
? Special support for innovators towards new trajectories if they cooperate with regional partners.
? Location policy concerned with the establishment of new firms in the region and the attraction of foreign investment.

Support for the establishment of new firms in the region can be and is already done in many ways (susidies, tax relieves, free or cheap infrastructure in incubation and technology centres). In the context of foreign firms, it has to be avoided that assembly plants are set up without any competence for R&D or innovation. There is the possibility that large foreign firms, even if not contributing to the regional technology- and knowledge-base, serve as "flagship" for an innovative cluster helping to produce some kind of "regional trademark". Nevertheless, there is an inherent danger in traditional location policy to result in large-scale, but at the same time dependent, regionally isolated, and little innovative manufacturing subsidiaries.

We are aware of the fact that our proposals are only briefly outlined and that there are many open questions and unsolved problems regarding the details. Nevertheless, we think that they provide a reasonable orientation for improving innovativeness of the Styrian economy, especially through networking. The proposals are particularly designed for the region of Styria, but some of them might be relevant in the case of other regions too, facing similar conditions and problems. At the end of our proposals we would like to add the following comments:

? All the proposed actions require only adaptations of the existing innovation and technology support infrastructure. This is due to the fact that the basic structure of such institutions in Styria is relatively good. Only in few cases really new institutions seem to be necessary.

? The focus on networking in pursuing the objective to improve the innovativeness of the Styrian economy appears to be reasonable, according to our findings. Confirming the results of other studies on these issues, most of the more innovative firms are in fact significantly involved in cooperations. Nevertheless, networks are established on several spatial levels. This means that the relative weight of certain elements of an innovation system is different on each level. In the case of Styria, the most important innovation partners within the region are scientific institutions. Therefore our proposals focus on them in particular. Improving the comparatively strongest elements of the innovation system on the level of the region must not lead to the negligence of other spatial levels, however. Customers and, to a lesser degree, suppliers are very important innovation partners. Frequently, they are located outside the region. This applies also to the primary sources of funds. The regional network has to be kept open to elements outside the region and relations to them have to be strived for.

? In general, the most difficult task to improve innovativeness through networking will be to raise awareness on these issues, both on the side of business and politics, and to come to clear objectives which are able to guide relevant activities, finding feasible AND effective compromises between often very different interests. Such objectives and actions cannot be formulated by policy makers "from above", however. All key actors, relevant firms and institutions, have to be involved. The role of policy is to stimulate a process of open discourse and communication on these issues as well as to stimulate the formation of platforms and the networking of actors in the region. Policy, thus, has more the role of a mediator of such processes rather than providing ready concepts and programs.

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