CREATING A COHERENT DESIGN FOR CLUSTER ANALYSIS AND RELATED POLICIES

THE AUSTRIAN "TIP" EXPERIENCE

MICHAEL PENEDER (WIFO)

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EINE KOOPERATION DES ÖSTERREICHISCHEN INSTITUTS FÜR WIRTSCHAFTSFORSCHUNG UND DES FORSCHUNGSZENTRUMS SEIBERSDORF

EINE INITIATIVE DES BUNDESMINISTERIUMS FÜR WIRTSCHAFTLICHE ANGELEGENHEITEN UND DES BUNDESMINISTERIUMS FÜR WISSENSCHAFT UND VERKEHR

Abstract

This paper intends to bring the Austrian **tip** experience to the focus group on *"Cluster Analysis & Cluster Policies"* within the OECD National Innovation Systems (NIS) Project. A short and concise demonstration of our activities and perspectives taken is provided along the following dimensions: conceptualisation, methodology & data problems, empirical research, and cluster oriented policy.

To sum up, cluster analysis (a) helps to define priorities within the given set of policy instruments; (b) is highly responsive to the particular needs exhibited in the systemic feedback mechanisms at the micro level, and (c) rarely lends support to big government initiatives, but instead emphasises e.g. the important role of eliminating regulatory barriers and distortions, creating complementary educational institutions, or marketing business locations with internationally perceptible competence profiles.

1. Introduction

The Austrian innovation research programme **tip** (*"technology, information, policy consulting"*) acts as major vehicle to promote the cluster perspective in Austrian technology policy. By the provision of a long term commitment and a stable research environment, considerable experience on cluster analysis has been accumulated over the past few years. This paper tries to sum up the basic knowledge and insights gained so far during this process.[1]

From the beginning the cluster approach played a constituent part of the **tip** programme in 1992. Initiated by the popularity of *Michael Porter*'s "*Competitive Advantage of Nations*" (1990), political decision-makers demanded a similar tool to be available for their purpose. But despite its popularity, Porter's notion of clusters left several conceptual and even more methodological questions open (*Peneder*, 1994). What followed was a process of integrating alternative approaches and dimensions, among them the work of *Adam Jaffe* (1986, 1989) on patent activities; rediscovering the fundamental theoretical sources of *Alfred Marshall* (1920) and their modern revitalisation by *Paul Krugman* (1991). Finally an overall programme design was created, which tried to match analytical claims as well as practical limitations of data in a coherent manner.

The Austrian "tip" Research Programme:

tip is a research and consulting programme which started in 1992 and is based on an initiative of the Austrian Federal Ministry of Science and Transport and the Austrian Federal Ministry of Economic Affairs. **tip** is carried out by the Austrian Institute of Economic Research (WIFO) in cooperation with the Austrian Research Centre Seibersdorf (FZS). WIFO is in charge of directing and managing the programme. **tip** produces information and recommendations relevant to Austrian technology policy, based on analyses of technological change and its impact on the national system of innovation at the macro level (enterprises, public and private institutions and their interactions), the meso level (structural analyses of the Austrian economy) and the micro level (analyses of firm behaviour).

This paper intends to bring the Austrian **tip** experience to the focus group on *"Cluster Analysis & Cluster Policies"* within the OECD National Innovation Systems (NIS) Project. A short and concise demonstration of our activities and perspectives taken is provided along the following dimensions:

- conceptualisation,
- methodology & data problems
- empirical research,
- cluster oriented policy.

[1] This paper benefits from a number of precious inputs by the author´s colleagues within the **tip** team, most notably *Kurt Bayer*, *Gernot Hutschenreiter*, *Leonhard Jörg*, *Norbert Knoll*, *Hannes Leo*, *Fritz Ohler*, *Wolfgang Polt* and *Katharina Warta*. Nevertheless the author remains responsible for the overall interpretation and the selection of supporting arguments and illustrative examples. The usual disclaimer applies.

2. The Cluster Concept

2.1 Density

Clusters are not unique to economics, but also and more frequently appear e.g. in statistics, music or the computer sciences. In its literal and most general meaning a "cluster" is simply defined as a *"close group of things"* (*The Concise Oxford Dictionary*, 1982). Thus the synonymous notions of *"density"*, *"relative nearness"* and *"similarity"* lie at the very heart of the cluster idea. *A priori*, "closeness" or "similarity" is not restricted to any particular dimension (geography, technology, or social characteristics, etc.) or limited by any specific scale. Consequently, both have to be chosen exogenously to fit the question under investigation.

2.2 Marshall´s Cluster Hypothesis

In economics, the cluster concept usually implies a further step from the literal meaning of density by reference to a particular hypothesis, which states that the geographic agglomeration of economic activity may cause improved technological or economic performance of the units engaged (see e.g. *Hutschenreiter*, 1994).

The cluster hypothesis in its economic sense is based on *Alfred Marshall* (1920), who explained the development of industrial complexes by the existence of *positive externalities* within agglomerations of interrelated firms and industries. These externalities are caused by three major forces: (a) knowledge spillovers between firms[2], (b) specialised inputs and services from supporting industries[3], and (c) a geographically pooled labour market for specialised skills[4] (see also *Krugman*, 1991).

Using modern terminology, Marshall's cluster hypothesis basically states the existence of *dynamic complementarity* within a system of interdependent economic entities that influences specialisation patterns in production: for the reasons given above, innovation and growth in one of the economic units can exert positive impulses for innovation and growth in other parts of the system as well. Therefore, a cluster of industrial complexes as a whole is expected to perform better than the sum of its individual units in case of a more scattered distribution. It is worthwhile to note that this idea considerably extended conventional economic

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[2] „*When an industry has thus chosen a locality for itself, it is likely to stay there long: so great are the advantages which people following the same skilled trade get from near neighbourhood to one another. The mysteries of trade become no mysteries; but are as it were in the air, and children learn many of them unconsciously. Good work is rightly appreciated, inventions and improvements in machinery, in process and the general organization of the business have their merits promptly discussed: if one man starts a new idea, it is taken up by others and combined with suggestions of their own; and thus it becomes the source of further ideas*" (Marshall, 1920, IV, x, 3)

[3] „*Again, the economic use of expensive machinery can sometimes be attained in a very high degree in a district in which there is a large aggregate production of the same kind, even though no individual capital employed in the trade be very large. For subsidiary industries devoting themselves each to one small branch of the process of production, and working it for a great many of their neighbours, are able to keep in constant use machinery of the most highly specialized character, and to make it pay its expenses, though its original cost may have been high, and its rate of depreciation very rapid.*" (Marshall, 1920, IV, x, 3)

[4] „*Again, in all but the earliest stages of development a localized industry gains a great advantage from the fact that it offers a constant market for skill. Employers are apt to resort to any place where they are likely to find a good choice of workers with the special skill which they require; while men seeking employment naturally go to places where there are many employers who need such skill as theirs and where therefore it is likely to find a good market.*" (Marshall, 1920, IV, x, 3)

wisdom, that relied solely on exogenous *comparative advantages* or *internal economies of scale*, respectively, to explain specialisation and concentration of economic activities.

Marshall´s analysis does not stop at that point, but gives equal weight to two fundamental economic causes that work against too highly specialised industrial locations: (a) Differentiated skills within the local labour markets also call for a certain spread of skill requirements and associated sectoral structures.[5] (b) A differentiated sectoral composition within a location also offers a greater spread of risks associated with exogenous shifts in demand or input prices which are specific to individual industries.[6]

2.3 "Organic" Economic Systems

From the beginning, the Austrian **tip** approach was driven by Marshall's hypothesis of positive externalities within dense economic structures. A closer focus on the "organic", evolutionary properties of interrelated units within industrial complexes may be a fruitful extension for future research.

Alfred Marshall's cluster hypothesis applies with reference to the agglomeration of independent decision making units. This means that the agglomeration as a whole is not covered by a single hierarchical command and control structure between different sub-units within "large" enterprises or conglomerates. The rationale for the latter is based on economies of scale and scope as opposed to external economies of clustered firms. Although some similarities may seem apparent, the dynamic properties of innovation, diffusion and adaptability to changes in the economic environment must be expected to differ considerably in the two types of organisational structures.

Building upon the property of *interdependent but organisationally independent* decision making units, industrial clusters can be understood as *"organic" economic systems*, where the principles of evolutionary complexity apply. Thus, the main interest of research will be directed towards the manifold feedback mechanisms within the system, the inherent potentials for (a) variety creation and innovation, (b) cumulation and growth as well as (c) the inherent scarcities causing competitive pressure.

3. Methodology and Data Problems

3.1 Input-Output Analysis

The Input-Output Analysis is often regarded as the most desirable methodological approach to detect and quantify interdependencies among different industries because of its direct use of flow data. Although IO tables are based on material flows, it can plausibly be assumed that these economic interactions also enhance the probability of complementary flows of (embodied) technical knowledge.

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[5] „*On the other hand a localized industry has some disadvantage as a market for labour if the work done in it is chiefly of one kind, such for instance as can be done only by strong men. ..[T]he remedy.. is found in the growth in the same neighbourhood of industries of a supplementary character.*" (Marshall, 1920, IV, x, 3)

[6] „*A district which is dependent chiefly on one industry is liable to extreme depression, in case of a falling-off in the demand for its produce, or of a failure in the supply of the raw material which it uses. This evil again is in a great measure avoided by those large towns or large industrial districts in which several distinct industries are strongly developed. If one of them fails for a time, the others are likely to support it indirectly; and they enable local shopkeepers to continue their assistance to workpeople in it.*" (Marshall, 1920, IV, x, 4)

The major obstacles to the use of Input-Output Analysis in the Austrian case has been the lack of recent IO tables. At the beginning of **tip** in 1992, the most recent official Austrian IO table dated from 1976. Currently, the latest table was compiled in 1983. An IO table for 1988 has been compiled at WIFO but is too highly aggregated for the detection of cluster relations. A more recent official table covering 1993 on a 3-digit level (about 230 industries) is expected to be available in the near future.

3.2 Cluster Screening

Statistics offers a big repertoire of analytical techniques to detect inherent regularities and similar patterns within multivariate data sets. The following techniques can be particularly helpful in the context of research on cluster phenomena (*Sharma*, 1996):

- *Principal Component Analysis* can serve to reduce the number of dimensions by creating new and uncorrelated variables as linear combinations of the original variables. Thus the detection of similarities and relative nearness of observations can be facilitated.
- Applied for a similar purpose, *Factor Analysis* additionally identifies the common factors which have been responsible for the correlations among variables in the first instance.
- *Cluster Analysis* produces a classification scheme of individual observations, depending on their relative similarity or nearness to an array of different variables. The basic idea is one of dividing a specific data profile into segments by creating maximum homogeneity within and maximum distance between groups of observations.
- Finally, *Discriminant Analysis* can be used to explore the different properties of these groups as well as integrate new observations into a classification scheme.

Within the **tip** programme, statistical cluster analysis has been applied most extensively for the screening of occurring patterns and the mapping of patent activities (*Hutschenreiter*, 1994) as well as trade performance by sectors (*Peneder*, 1995). Input-output data and factor analysis occasionally have been applied in cluster case studies (*Jörg-Bayer-Hutschenreiter,* 1996).

3.3 Case Studies

Case Studies provide the most flexible approach to link cluster-related phenomena with particular policy recommendations. Interviews and questionnaires allow tailoring the general research design perfectly to the individual objectives and providing valuable micro data (including interrelations within the cluster). Consequently the main drawback from a methodological point of view lies in the heterogeneity, the high dependence on intuition and accordingly the lack of comparability of the individual studies. The major drawback from a practical point of view is the enormous need for research capacity and therefore the high costs which are involved.

One of the most significant practical experiences within the *tip* programme has been the rather low extent of "economies of learning by doing" in carrying out these case studies. Because of the heterogeneity of institutional frameworks, technological regimes and strategic settings within different clusters they have been much lower than was anticipated at the beginning.

3.4 Data Problems

In short, the major data problems of relevance to cluster analysis can be summarised as follows:

1. Any kind of *interrelational data* is extremely difficult to obtain in general. In Austria this situation is aggravated by the lack of recent Input-Output tables.

2. Any use of statistical data is restricted by the *dependence on official classification systems*, which have not been designed to cover flow relationships between different industries. The prospects for regrouping the official classifications to suit the purposes of cluster research in a significantly better way are dampened by the lack of interrelational flow data (especially current IO tables).

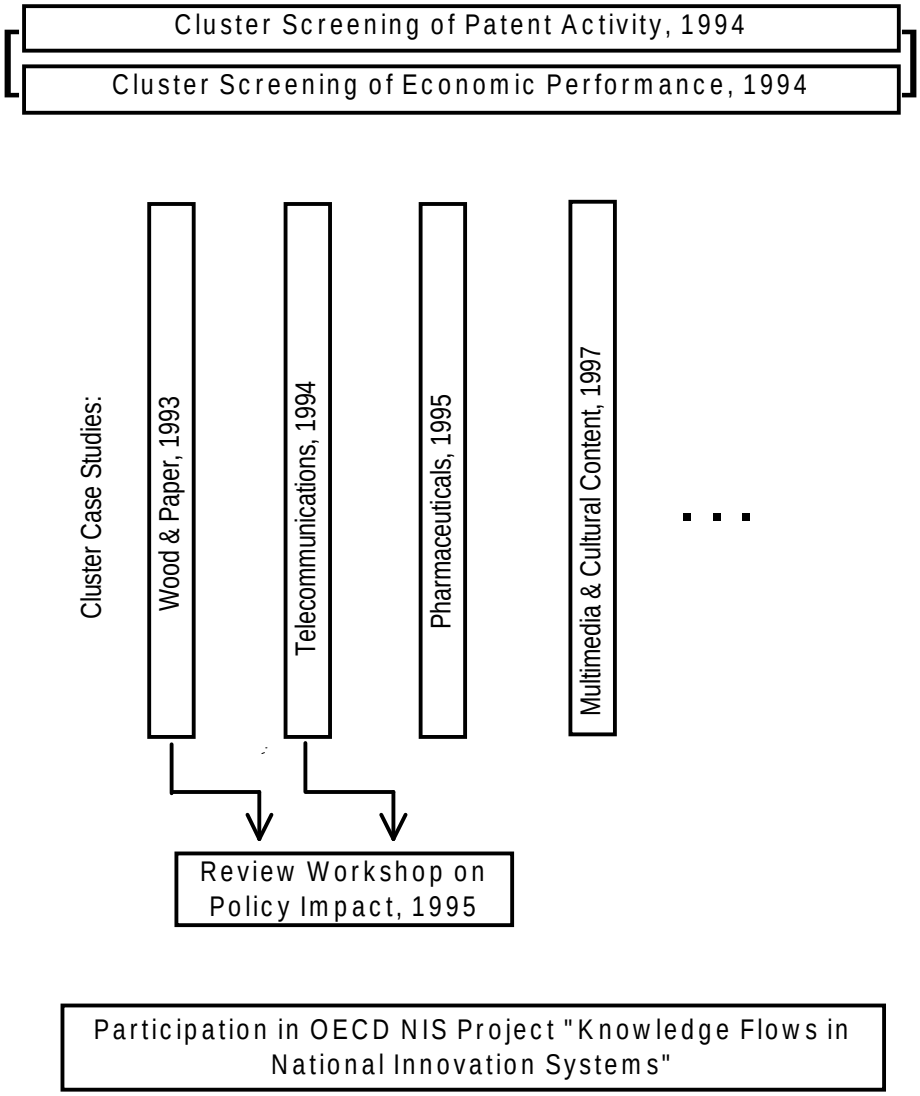
3. In principle, the most flexible instrument to detect flow relationships are interviews and questionnaires within a narrowly targeted cluster case study. But results may be seriously distorted by the fact that knowledge spillovers in the sense of Marshall's cluster hypothesis to a large extent *depend on implicit knowledge*. Economic agents may profit from these flows, but in most cases will not become aware of their actual impact. To extract this kind of information in interviews and questionnaires more properly, our current techniques certainly have to be refined in the future.

4. Empirical Research

4.1 General Programme Design

Cluster analysis represents only a portion of the overall **tip** programme. *Figure* 1 tries to sum up the major cluster-related studies and the intended logic of the programme design. In the beginning, the lack of current IO tables forced us to concentrate on the detection of general patterns and "dense locations" within certain dimensions of technological and economic performance. The overall goal of this screening for relevant clusters was to draw a map, which helped to define priority areas for the following case studies. In the subsequent periods, important areas of economic or technological activity were selected for individual cluster case studies. Beginning with a study on industries related to wood and paper as common resource, the telecommunications sector, the pharmaceutical industry and currently the potential cluster at the interface of multimedia and cultural content have been analysed. With regard to the cluster case studies on "wood & paper" and telecommunications a policy review workshop was organised as well. Finally, **tip** participation within the OECD NIS project can be regarded as an activity which extends the cluster related research agenda.

Figure 1: The **tip** Cluster Research Programme Design



4.2 Cluster Screening

4.2.1 Technological Clusters (Hutschenreiter, 1994)

Technological clusters in Austrian manufacturing were identified on the basis of the patents from Austrian firms in the years 1987-1991 classified in terms of the patent classes of the International Patent Classification ("technologies"). Applying a procedure of statistical cluster analysis, the patenting Austrian firms were combined into groups exhibiting similar patent structures. Externalities which are potentially present in clusters of this kind include pooled labour markets, shared research and training facilities, the division of labour in the core technologies of the cluster, etc.

The findings visualised technological clusters including the number of applicant firms and patents. From the bird's eye's perspective, the following groups of technological clusters may be discerned:

- *electrical – electronics – telecommunications,*
- *transportation,*
- *construction – housing,*
- *skis – ski boots – sports equipment,*
- *pharmaceuticals – chemicals*.

The cluster analysis resulted in a contingent technological panorama of Austrian manufacturing including innovative small and medium-sized enterprises with the following features:

⇒ Comparatively small technological niches play a relatively large role. Given the industrial structures of Austria, niche strategies appear to be rational. It has to be noted, however, that the technological and *a fortiori* the economic value of patents is virtually unknown.

⇒ Larger enterprises with diversified patenting activities tend to be isolated and are not attracted by any cluster. This may reflect both overly diversified activities as well as simply their own narrow home market.

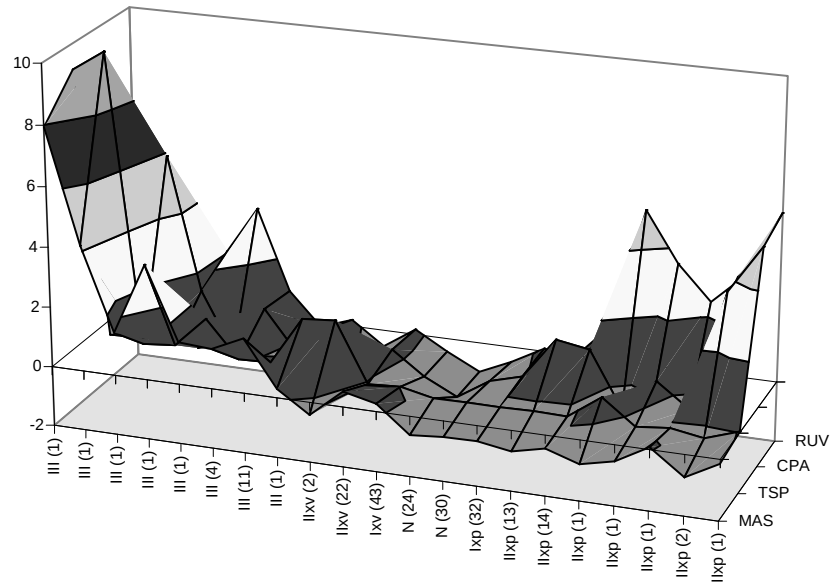
⇒ The clusters of firms typically consist of just a handful of enterprises. The opportunities to reap positive externalities are therefore limited. Strengthening the evolution of technological clusters may be a basis for technology policy.

4.2.2 Economic Performance (Peneder, 1994, 1995)

Porter's influential study on the competitive advantage of nations inspired a methodologically extended work on Austrian data. But in contrast to Porter's analysis, competitiveness has been determined endogenously by means of statistical cluster techniques. Avoiding his "cut-off" approach, "well" and "badly" performing industries have been the objects of analysis. The resulting cluster centres constitute the typical pattern of competitiveness for the chosen trade indicators, while the classifications produce a "map" of Austrian industrial export performance. In a nutshell, the results showed (i) that "clustered" industries generally are rare in the case of Austria, (ii) that a considerable portion of them is located in declining sectors, and (iii) underlines the importance of transnational links (as opposed to narrow national boundaries) for the formation of successful industries.

Taking care of the quantitative (volume dependent) as well as the qualitative (price dependent) dimension of competitiveness, trade performance has been measured by four variables: international market shares (MAS), revealed comparative advantage (TSP), relative position in export prices (RUV) and revealed comparative price advantage (CPA). The overall profile of Austrian industrial performance for 1992 is shown in *Figure* 2. The panorama results from a three-step clustering process, which aggregated 208 SITC product classifications to 21 clusters and grouped them according to their relative nearness in the performance variables. Using this "map", the position of any single industry relative to others can be identified. The only effort it takes is to look up the appropriate number of the 21 clusters with which it is classed in the relevant tables of the original publication.

Figure 2: Panorama of Austrian Industrial Performance 1992



Source: Peneder, 1995

The different performance levels, which have resulted from the clustering procedure, are interpreted as follows:

- *Level N*: "non-performer",
- *Level Ixp*: badly performing industries with an average position in export prices,
- *Level IIxp*: industries competing in small niches of the product spectrum, characterised by high price levels but low export volumes,
- *Level Ixv*: industries competing on behalf of their "low cost & low price" position, and modest success in terms of export volumes,
- *Level IIxv*: industries performing well, mainly in terms of market shares,
- *Level III*: "champions" performing best in terms of quantity as well as quality.

Industries belonging to Level III are mainly spread around the sectors of *materials & metals*, *forest products*, *transport* and *textiles*. In the area of basic industries an internationally successful cluster grew out of rich endowments of wood and covers *simply worked wood*, *chipboards* and *wood manufacturers* as well as *paper and paperboard*. The production of *internal combustion piston engines* is one of the most successful areas of Austrian industrial activity. Besides the innovative capacity of some of the Austrian manufacturers, this extraordinary performance is mainly due to successful transnational links to the international automotive industry.

4.3 Cluster Case Studies

4.3.1 Wood & Paper (Bayer-Ohler-Peneder-Polt, 1993)

The wood & paper cluster occupies a special position within the Austrian economy, due to the fact that it covers a complete value chain ranging from the raw material to the highly processed final product. With the sustainable raw material wood available locally, a tradition of crafts and industries has developed over centuries that provides the foundation for modern production processes and product developments. The wood & paper cluster is interlinked only in terms of products and processes, but not with regard to organisation and property rights.

The subject of the study is not a single technology, a single company or a single business line, but rather an industrial complex in the sense of horizontally related or vertically linked companies and characterised by a range of interactions. The purpose of this point of view is to observe as a whole the intricately interwoven parts of the cluster in its processes, in terms of its production, services, customers and public regulation bodies, and in this way to highlight the numerous interdependencies and spillovers between its parts as a focus of research and economic policy. This holistic view is intended to produce political decisions that offer sector-crossing integral solutions. In order to indicate economic interdependencies, an input-output analysis was used and a material flow analysis, performed by the Austrian Central Statistical Office, was introduced.

The wood & paper cluster as such counts among those sectors of the Austrian industry that are low on research and innovation input. In the saw mills, all innovation concentrates on process innovation, while product innovation dominates in the wood-working and paper industries. Both sectors obtain their technological progress primarily from outside (mostly from the machine and chemicals industries). An essential cluster-internal adaptation activity is then performed by the intelligent design of the production layout. Technological progress is primarily incremental and determined mainly by the development of generic technologies (chiefly microelectronic applications such as sensor and CIM technologies). In recent years, the impetus for technological innovation has been found to come mainly from environmental standards. In large areas, production processes are characterised by a high degree of mechanisation and automation. As a consequence, labour costs tend to decrease in importance while concentration processes – fuelled by the increasing capital intensity – continue (especially among saw mills). Summarising the situation, the study describes this cluster's innovation system largely at "balance at a low level".

The analysis produced numerous starting points for economic policy measures to strengthen the innovation and market performance of this cluster. Here, we are limited to sketching the general approaches (table 1): technology, structure, ecology, standardisation, education and training. These fields need to be co-ordinated in order to achieve the maximum possible effect.

Table 1: Selected Recommendations for Strengthening the Industrial Complex of "Wood & Paper"

	Umbrella Project "Wood Processing" Initiative on Energy–Wood–Paper Awareness, Programme Programme Management and Marketing, Management of Research and Development					
	Technology	Structure	Ecology	Standards	Education & Training	Innovation
Saw mills		Promote forward integration	Energy-generating disposal	Fire protection standards	College course on "saw mill engineering"	
Wood construction	Strengthening C technologies	Public demand	Environmentally compatible construction materials and binders	Building codes, fire protection standards, quality standards	Courses for wood construction environmental balance	Compound materials wood
Production of boards	Cooperative R&D		Binders, coatings, disposal	Environmental standards quality standards		Boards made of wood substitutes bending-resistant boards
Furniture production	C technologies design	Increase production depth public procurement	Disposal design	Quality	Training for "wood engineer" re-skilling	Improve system idea
Paper production and processing	Cooperative R&D	New business segment: energy supply	Chlorine-free bleach waste water de-Inking	Emission standards		New paper grades

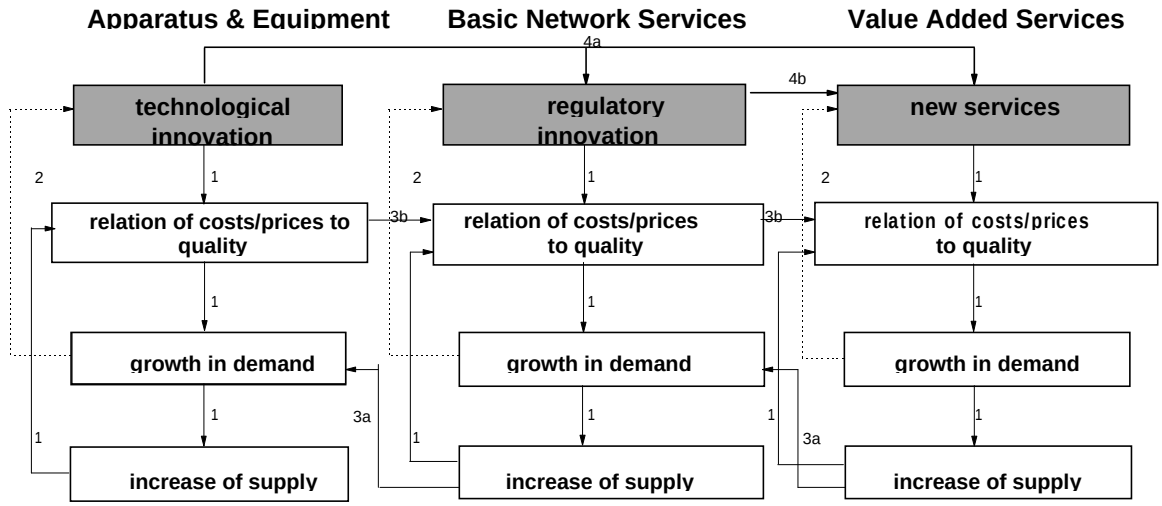
Source: Bayer-Peneder-Ohler-Polt, 1993

4.3.2 Telecommunications (Leo-Peneder-Knoll-Ohler-Latzer, 1994)

The cluster case study on telecommunications provides a comprehensive exposition of the evolution of major technical trajectories, changes in international regulatory regimes and the Austrian policy network. Moreover, the strategic options for the Austrian telecommunications cluster – comprised of hardware suppliers, the national PTO and new value added services – are examined in view of the new legal, technical and competitive environment which these actors have to face.

Technical and regulatory innovations have led to a process of profound change in the field of telecommunications worldwide. In the short- and medium term necessary changes are going to result in major adjustment costs, mainly for the PTO. In the long run, however, rising productivity and higher utility levels for users are expected to lead to considerable welfare gains for the economy as a whole.

Figure 3: Impulses for Innovation and Growth within the Telecommunications Cluster



NB: Different intensity of lines in the chart does not indicate differences in the intensity of dynamic complementarities.

Source: Leo-Peneder-Knoll-Ohler-Latzer, 1995.

In order to define priority areas for policy measures, the inherent dynamic complementarities and the associated mutual impulses for innovation and growth within the telecommunications cluster have been analysed schematically. Figure 3 illustrates the presence of vertical *pecuniary external economies* via dynamic forward and backward linkages between and within the three cluster components. These linkages arise from a circular relationship in which the decision to invest in large-scale production depends on the size of the market, while at the same time the size of the market depends on the amount of investment. The *forward linkages* stem from cost reductions or quality improvements for potential downstream users because of innovation and growth in an upstream industry. The *backward linkages* stem from economies of scale which are enabled by growth of the downstream industries. Thus economies of scale are the essential criterion for the existence and economic relevance of these pecuniary external economies (*Krugman*, 1995). In the case of the telecommunications cluster economies of scale are particularly significant because of the large outlays for R&D as fixed investment (apparatus and equipment) as well as considerable network externalities (basic network services and value added services).

As technological innovation in the field of hardware suppliers was considered to be the major driving force for the dynamic development of this sector, the lack of complementary regulatory innovation and organisational adaptation was identified as the major barrier to further growth.

The report stated that Austria is still short of well established specific telecommunications policies. Policy measures directed at the telecommunications sector are largely determined by other areas (e.g. fiscal policy or the accession to the European Union). Pressures towards reform are being exerted from outside but its

implementation is slow. A detailed examination led to the following recommendations directed at Austria's *telecommunications policy*, partly fulfilled in the meantime under pressure from EU legislation:

1. The gradual *increase of competition* through accelerated opening-up of markets.
2. Liberalisation also requires accompanying *organisational changes in the Austrian PTO*:
   - separation of the Austrian PTO from public administration;
   - telecommunications services, postal services and coach services, operating under the national PTO, should be split to form separate companies;
   - limiting contributions to the national budget to taxes and the distribution of dividends;
   - instruments for financing activities to cover services provided in the public interest (universal service obligations) have to be developed.
3. To face the rising challenge, regulatory bodies have to be staffed with additional resources in terms of skills and economic as well as managerial expertise.

In contrast to telecommunications policy in general, the scope for a sector-specific, national *technology policy* in the field of telecommunications has been considered as extremely limited for a number of reasons:

- Most firms supplying telecommunications equipment, systems and components are part of multinational enterprises, and for that reason are largely limited in their ability to decide autonomously on matters of overall strategic importance.
- Development and manufacturing activities of Austrian suppliers are largely dispersed and therefore it is nearly impossible to identify common inter-firm priority areas in R&D.
- The globalisation of competition enhances the importance of R&D projects conducted at the European rather than national level.

Under these conditions, technology policy must be mainly focused on the provision of a *supportive framework for R&D activities*. More specific recommendations for technology policy measures directed at the telecommunications sector have been summarised as follows:

1. An investigation into the *R&D potentials of research institutions* (universities as well as others) and their complementarity with industrial production, service providers and specific applications in Austria was considered necessary;
2. projects of national telecommunications policy must focus on the upgrading of networks and services to enable better provision of user-specific applications; and
3. the focus of public support through subsidies or other measures should be placed on *applications* rather than on specific technologies or firms.

4.3.3 Pharmaceuticals (Jörg, Bayer, Hutschenreiter, 1995)

The production of pharmaceuticals in Austria accounts just for the relatively small share of approximately 2% of overall industrial value added in 1992. However, the vigour of its growth has been impressive: its share both in

total value added and in the total number of industrial employees has doubled since 1980. The Austrian pharmaceutical sector is exposed to two major global changes in its economic and technological environment:

1. Competitive pressure on pharmaceutical companies has increased due to the escalating cost of developing new drugs in recent years accompanied by the increased market shares of "generica" (i.e. reproduced drugs after their patent protection has expired). Reducing the economic appropriability of successful innovations, this development has made it harder for research-intensive companies to recuperate their initial R&D outlays.

2. A new technological window has opened in the form of new biotechnologies, which have now become one of the pharmaceutical industry's most important sources of innovation.

Within the Austrian pharmaceuticals industry, two types of companies can be identified:

- The first group includes a small number of large science-based companies with strong international focus. They are almost all owned by foreign multinational enterprises based in Germany and Switzerland.

- The second group – mainly of Austrian ownership – is made up of small and medium-sized companies, which concentrate their innovation activities mainly on the improvement of established products and focus largely on the domestic market.

Innovation within the Austrian pharma complex is concentrated on a small number of players. As far as the private sector is concerned, three quarters of all research expenditure in the pharmaceutical business sector is spent by the three largest companies. Furthermore, the five companies with the largest innovation capabilities are all subsidiaries of multinational pharma companies.

Trying to track the typical knowledge flows within the pharma industry, the study identified a largely "insular" attitude to R&D. Although strong links between universities and the larger firms do exist, inter-firm cooperation and knowledge spillovers via personal mobility are poor. One explanation for this lack of information flows within the NIS is due to the fact that the Austrian pharma "cluster" can at best be labelled an "incomplete" one. The group of start-ups especially in the new biotechnology area is almost completely missing. Access to competence to biotechnology can only be achieved by cross-border cooperation. In addition, knowledge spillovers are hindered by the fact that cooperation strategies of the major players in the Austrian field are determined and constrained by their foreign-based headquarters.

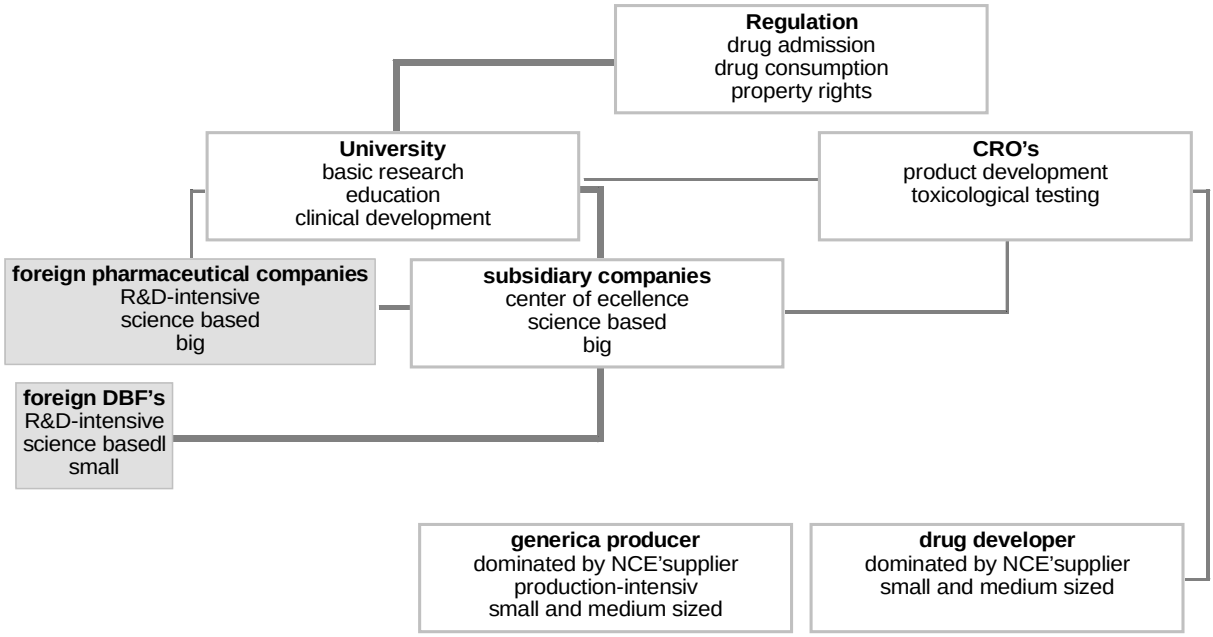
Finally, the study put forward a number of policy recommendations which could be implemented to strengthen knowledge-related ties within the sector. Among others, attention was directed on the following policy variables:

1. There are shortcomings in the public discussion of the importance of the pharmaceutical and biotechnology sector. A dialogue on the following two focus subjects should be initiated in order to provide momentum and strength to this debate:

– current and future role of the pharmaceutical types of therapy as compared to other treatments available in the health care system;

– the role of biotechnology as a specific branch of R&D also in the pharmaceutical industry.

Figure 4: Intensity of R&D cooperation within the incomplete Austrian pharma cluster



CRC.. Contract Research Organisations, DBF.. Dedicated Biotechnology Firms, NCE.. New Chemical Entities

Source: *Jörg-Bayer-Hutschenreiter*, 1995

2. In the pharmaceutical field, many researchers at universities and – even more – at the company level are recruited from abroad. Employing international specialists should not be frustrated by problems with residence and work permits.

3. In Austria, the right to exploit patents from university research rests with the public authorities rather than the scientists or their departments. Offering scientists a share in these rights would generate a strong incentive to improve the patent rate achieved by university research.

4. To increase the transfer of knowledge from universities to the business sector a special focus on biotechnology and pharmaceuticals within a *"seed-financing"* programme was proposed along with complementary measures to enhance access to *venture capital*. The rationale for this focus stems (a) from the fact that a strong scientific competence base was detected in these fields, and (b) that new *spin-off firms* could enhance the dynamic performance within the "cluster" well beyond the current impulses from existing cooperations.

5. A special marketing scheme to attract pharmaceutical and biotechnology companies is proposed. Vienna as a business location in particular offers considerable capacities for complementary research in biotechnology and pharmaceuticals.

4.3.4 Multimedia and Cultural Content (Warta-Knoll-Peneder, 1997)

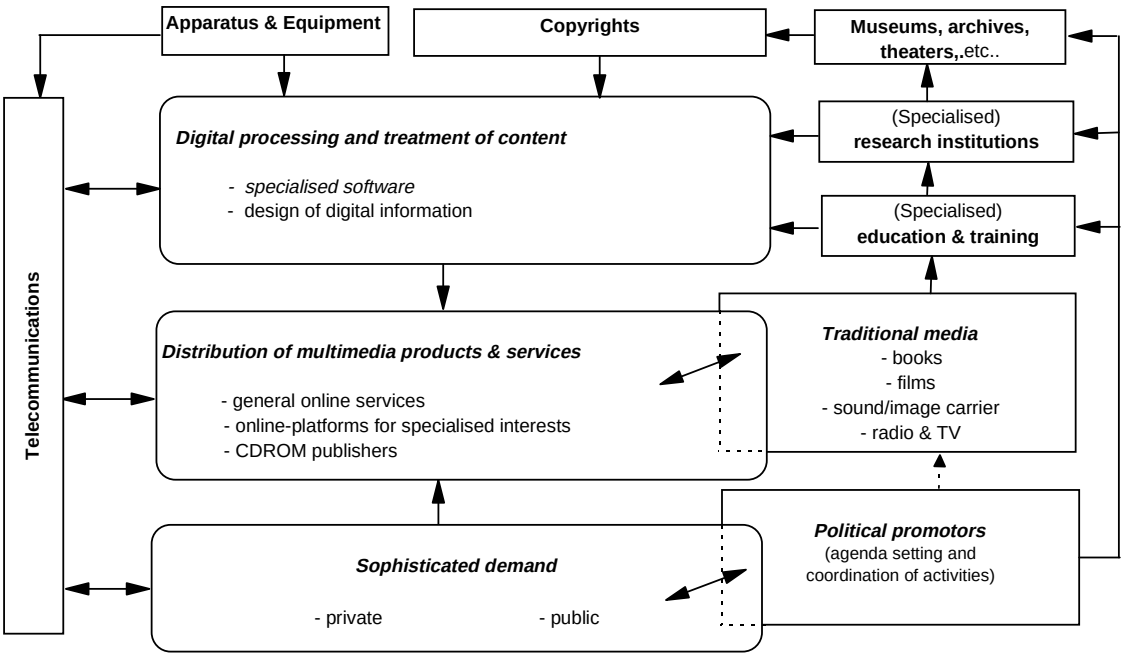
At the present stage of development the notion of an Austrian multimedia cluster is merely fictious. As a consequence the investigation concentrates on the question whether and under what conditions a new cluster could emerge from the combination of multimedia technologies and cultural content. The basic motivation is based on the view that the multimedia industry is a potential vehicle for structural change in the Austrian economy: the interplay of numerous innovations in the information and communications technologies produces new markets and promises additional incomes and jobs in their multimedia application. Contrary to the progress in the pure information and communications technologies (data processing, transaction services, etc.), the new multimedia applications generate hardly any fears of rationalisation through the substitution of work and employment. But instead, by their combination of image, film, text and sound, they create new characteristics and additional requirements for activities associated with the processing of information.

The study starts with the hypothesis that in order to position itself successfully in "electronic space", Austria needs to bundle its resources under common objectives. The combination of multimedia and cultural contents is perceived as a special opportunity to furnish Austrian suppliers with a separate and internationally identifiable profile.

The empirical results of a comprehensive survey of companies and detailed proposals for policy-makers will be discussed in greater depth in a separate contribution. At this point, only the basic essence of the conclusions shall be outlined: Some competitive advantages stemming from assumed "relative abundance" of cultural content as well as the geographic proximity between customers, suppliers and partners for cooperation are generally acknowledged in the interviews and a complementary survey among companies engaged in multimedia services and products. This nevertheless will not suffice to turn Austria into an attractive multimedia location as long as the following barriers for a more dynamic growth path remain prohibitively high relative to alternative business locations: excessive telecommunication rates, inadequacies in the telecoms infrastructure and as a consequence a lack of international networking in general. Additional problems are also encountered by multimedia suppliers with regard to tapping sources for R&D-support and venture capital.

A special competitive advantage may exist in form of the basically large pool of qualified labour: Unlimited and free access to the universities, in addition to other factors such as the numerous cultural activities of international renown in Vienna, Salzburg, Graz and Linz, has produced a surplus of labour interested in working in the arts. This potential has so far been largely ignored because the labour market is not able to offer commercial activities to complement such qualifications. Offering complementary education directed at multimedia technologies and skills may activate at least some parts of these human capital ressources, at the same time offering employment to otherwise abundand labour.

Figure 5: Functional Components Within the Cluster of Multimedia & Cultural Content.



Source: Warta-Knoll-Peneder, 1997

The basic message to policy makers could be summarised as follows: Even though its excellent foundation of human resources for multimedia professions would provide Austria with the main prerequisite for utilising existing market potentials, it is not expected to realise them, given the current terms of reference, in particular the continuing lack of competition in the telecoms and TV markets. A policy that attempts to nurture the sector exogenously by subsidies and government contracts would necessarily fail, given the current situation. On the other hand, hope may be derived from the fact that these barriers are parameters that can be shaped by policy. Nevertheless, the large economies of scale that are existing signal that the time factor plays a major role in the potential evolution of a new cluster: if the market starts to consolidate after the initial innovatory phase, opportunities for endogenous growth of an internationally competitive Austrian multimedia cluster can be lost within a few years.

5. Cluster Oriented Policy

As has been noted in the introduction, the notion of clusters and cluster policy became a popular item in the Austrian policy debate following Michael Porter's publication at the beginning of the 1990s. In sharp contrast to its popularity, its particular policy implications are less than clear. The following points, mostly based on popular conceptual confusions, may sum up the major difficulties in translating refined and generally appreciated analysis into operational policy:

1. The *first misunderstanding* is based on the erroneous belief that the cluster approach offers a *particular policy instrument*. It offers a different *perspective* instead, which enables better understanding of the dynamic potentials for growth within an industrial complex. Interpreted that way, its major contribution is better orientation for policy-makers to get their priorities right.

2. The *second misunderstanding* is caused by the confusion of cluster policies with some kind of national *"picking-the-winners strategy"*. Popular demand for identifying the most promising industries to concentrate public support on too often ignores the crude measurement techniques involved in structural analysis. Cluster analysis by its very nature means taking a closer look at complementarities within given or potential economic structures. In this way it helps to define priorities in regional development programmes or to fine-tune the supply of public research and educational institutions. But this must not be mistaken with a general "picking" and public funding of presumed "winners".

3. To avoid a third misunderstanding, cluster analysis does not necessarily lend support to politically marketable *large-scale government initiatives* or the creation of new support schemes. Instead the emphasis is often on a series of coordinated small schemes to correct for barriers and distortions in the economic and political environment.

The outcome of cluster analysis typically supports the following kind of recommendations to industrial and technology policy:

⇒ improving the design of *regulatory framework conditions* (e.g. through the elimination of regulatory distortions which usually act in favour of well established industries and to the detriment of new and therefore smaller innovative industries);

⇒ filling institutional gaps by means of launching or supporting *"Coasean" institutions* which trim transaction costs through the provision of institutional platforms for experimentation and cooperation as public goods;

⇒ creating complementary *human capital* through government spending on education; and

⇒ raising *public awareness* of potential opportunities especially with regard to new technologies via dissemination of relevant information.

⇒ triggering demand pull effects by means of *public procurement* (critical masses, high quality standards);

⇒ setting priorities for focused *R&D support* schemes; and finally

⇒ using the cluster notion as instrument for the focused *marketing of business locations*, thus providing an internationally perceptible profile to potential investors and further strengthening the cluster by attracting an inflow of foreign direct investment.

While some of the points mentioned above refer to the common set of innovation policy instruments, the final argument of "clusters" as useful instrument for the focused marketing of business locations deserves special attention. The *Styrian "automotive cluster"* is a particularly instructive example in this case (*Steiner-Jud-Pöschl-Sturn*, 1996): Built upon high level performance of local enterprises in motor technology (piston engines) and gear units a successful agglomeration of related companies covering assembling as well as special automotive components has gathered in this south-eastern province of Austria. Creating a sort of „brand name" for the

business location by means of the cluster notion proved to be a helpful instrument to attract further foreign direct investment.

Another example of cluster oriented policies is a special initiative of the Austrian Industrial Research Promotion Fund which focuses on the whole industrial complex of wood processing. In the field of telecommunications the cluster approach and the according emphasis on systemic feedback mechanisms strengthened the call for liberalisation and abolition of the many regulatory distortions which handicap new services and technologies.

Cluster oriented policy in Austria also played an important role in the formation of a new type of technical colleges, ranging from information & communication technologies, to engineering skills or specialised training for wood manufacturers as well as the professional management of tourism. The impressive growth of these „Fachhochschulen“ during the past few years considerably strengthens the links between the educational system on the one hand and the requirements of local businesses for specialised skills on the other.

In addition, the expert proposal for the governmental concept on technology policy (*WIFO-ARCS-JR*, 1996) featured the cluster hypothesis very prominently. Maybe even more important, the general awareness of the cluster idea has considerably risen over the past few years, thus fueling and partly steering the many less spectacular day-to-day decisions of the responsible policy agents.

To sum up, cluster analysis (a) helps to define priorities within the given set of policy instruments; (b) is much more responsive to the particular needs exhibited in the systemic feedback mechanisms at the micro level than any sort of crude “picking-the-winner strategy” would be, and – according to the experience of the Austrian **tip** programme – (c) rarely lends support to big government initiatives, but instead emphasises e.g. the important role of eliminating regulatory barriers and distortions, creating complementary educational institutions, or marketing business locations with internationally perceptible competence profiles.

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