CPB Memorandum

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Four views on Dutch clusters

This study captures four theoretical views on clusters and identifies several clusters by analysing detailed input-output tables, innovation surveys and data on business locations. Most clusters concern supply-demand clusters related to intermediate supplies, and regional concentrations of industries. Some supply-demand clusters are moderately concentrated in specific regions. Knowledge exchange through research partnerships hardly occur. However smaller companies, but also enterprises in chemicals and (electronic) machinery, often participate in information networks. Knowledge exchange with universities, research institutes and business seems to be less important. The prominent role of intermediate relations may induce potential market failures caused by exclusive but tying vertical relations. Knowledge exchange by regional information networks –particularly with external institutes– has not been successful so far.

1 Introduction

There is a mass of theoretical and empirical analysis –and thus literature– on clusters because clustering is often seen as an opportunity to improve productivity growth and higher economic welfare (see e.g. Porter,1988, and Roelandt et al. 1999a). However, in literature there is no general agreement on the definition of a cluster, and most investigators investigate (a) cluster(s) from different angles. Still, in most studies clusters entail some group of companies (mostly from different industries) and/or institutes that try to benefit from external advantages such as knowledge spillovers or regional proximity. This study will not confine to some (strict) definition of a cluster, but keeps the basic concept open in order to investigate and combine the various aspects which other researchers attribute to "clusters" and cluster formation.

This paper thus tries to tackle two main issues:

- what are the main (theoretical) concepts in current cluster-analysis, how can they be characterized and how do they relate to each other?
- which cluster(s) (concepts) actually emerge in the Netherlands, and to what extent do these clusters overlap?

The answers to these questions may be helpful for policy makers to improve their "cluster policy". For example, the theoretical background may help to pinpoint the goals of cluster policy, and to identify potential opportunities or threats/risks involved with clusters or cluster policy. The empirical observations may help to assess these potential opportunities or threats, and possibly lead to reassessments of cluster policy.

The next chapter describes an analytical framework with a concise taxonomy of different views and opinions on clusters. Actually, the taxonomy categorizes several typical views on the definition and characteristics, strengths and weaknesses, and policy implications of four cluster-concepts or types. The theoretical characteristics of these cluster concepts provide the base of five indicators which may help to identify and analyse real-world clusters.

Chapter three summarizes and analyses some relevant CBS data. More precisely, it computes the five indicators from CBS data on business locations, CBS input-output tables and CBS innovation surveys, and –whenever possible– combines these results to highlight the actual common points of the four cluster concepts.

Chapter four finally evaluates the main empirical results and compares them with the theoretical insights from the analytical framework. It ends with some conclusions and possible options for policy makers.

2 Analytical framework

Currently there are many and (seemingly) diverging studies and views on clusters. This section classifies the main concepts and underlying schools, their similarities and conflicts. The classification of theoretical schools partly originates from the taxonomy of Hagedoorn et al., 2000, discerning three theoretical concepts, i.e.

- information networks set by the school on strategic management (see e.g. Porter, 1998, Nooteboom, 1999), which combines the regional and innovative elements of networks of firms, institutes and government, but emphasizes the informality of clusters mostly because of the proximity of cluster participants
- regional clusters set by the school on regional economy (see e.g. Fujita et al., 1999, Krugman and Venables, 1996), focussing on regional agglomeration of firms into specialized clusters
- innovative clusters, set by the school of industrial organization/endogenous growth theory, investigating cooperative innovation and knowledge exchange by or between competitors (or suppliers and customers) on the product market

We like to add one additional concept, which originates from the empirical input/output analysis c.q. meso-cluster identification:

- "supply-demand clusters", related to intermediate supplies between firms, or forward and backward linkages in a value chain (see e.g. DeBresson 1996b)

The table below typifies the main views of these four cluster-concepts, specificly on the driving force and characteristics of clusters, their strengths and weaknesses, and relevant policy issues. Current research leaves some cells open, but we tried to fill these cells by insights and common sense (in italics). The table also refers to some empirical evidence for the hypotheses set by the theoretical schools. Various issues mentioned in this table are typically related to market imperfections investigated by the theory of industrial organization, and thus refer to potential imperfections of innovative clusters (see appendix A for a brief discussion). Actually, some cluster concepts refer to cooperation and exchange of information and knowledge between competing companies. Such cooperation and exchange may generate economic benefits, but may also entail tacit collusion and imperfect competition.

Table 2.1 Four cluster concepts

Supply-demand clusters (a)	Regional clusters (b)	Innovative clusters (c)	information networks (d)
Definition of cluster			
definition refers to **value chain**, supplier-user relations via **intermediate supplies** and **embodied knowledge transfers**	definition refers to **regional concentration/ agglomeration** of firms and employees in only a few industries	definition refers to (joint) **innovation** and **knowledge transfers** among **competitors** on product market	theoretical definition broad and vague but in case-studies more concrete, definition refers to regional **networks** of firms, labour, institutes and government
Driving force to cluster			
interaction between (technically) interdependent agents enhances more useful and better diffused innovations	agglomeration of firms to **reduce transaction costs** on trade between specialised regions, given forward and backward linkages and/or factor intensities (strong intra-industry trade and medium transaction costs foster clustering)	innovation to gain **competitive advantage** product market, e.g. by reducing production costs or opening of new segments	improvement of **competitive advantage** and **productivity growth** by knowledge spillovers and innovation reducing transaction costs and production slack, or improving match with customer preferences
Characteristics of clusters			
clusters based on **intermediate supplies**, because **specialization** entails increasing dependency on (informal) links in the **value chain**	clusters based on **regional agglomeration** of firms (and/or employees), relying on **trade** with other specialized regions	clusters based on ex post knowledge transfer (through **patents** and **licenses**) and/or ex ante transfer (**joint R&D**); success is much related to the extent of effective **knowledge protection**, and/or firms' **absorptive capacity** of spillovers	**network building** by informal and creativity/innovation directed contacts; **regional proximity** may help in network building/informal contacts; such networks may particularly refer to regional companies and institutes applying a similar technology
Size and structure of cluster			
meso-economic linkages between industrial sectors	mathematical models of two industries with many firms in two cities/ regions	formal models of few firms/ competitors in a single industry	regional but broad network of - leading companies, suppliers and customers in a value chain - firms in related industries using the same technology - universities, institutes and government on micro-economic level

Continuation table 2.1

Supply-demand clusters (a)	Regional clusters (b)	Innovative clusters (c)	information networks (d)
Theoretical foundation			
hypothesis that innovations are mainly embodied in intermediate supplies	**theoretical** equilibrium models (Fujita et al., Krugman and Venables)	**theoretical** models based on game theoretical concepts and/or endogenous growth theory (Kamien, Katz/Ordover, Aghion)	
Empirical verification and identification			
identifying clusters by **empirical** input-output analysis (Roelandt et al., DeBresson)	**benchmark** studies, comparing the performance of regional clusters (Carlsson and Braunerhjelm)	**econometric** studies testing theoretical hypotheses, **case-studies** to identify market failures (Audretsch and Feldman (relation with industry life cycle))	**case-studies**, analysing institutions, location and performance of clusters (Carlsson and Braunerhjelm, Boekholdt et al.)
Potential strengths of clusters			
- perfect match to customers' needs and preferences *- network externalities: use of complementary knowledge* *- economies of scale/scope by vertical specialization* *(- appropriability of knowledge and innovative results by upstream or downstream segments)*	- reduced trade/transaction costs - economies of scale by interregional specialization	- network externalities/ spillovers: use of complementary know how or common/public knowledge - economies of scale in R&D (- appropriability of knowledge and innovative results by non-participants)	- better monitoring (agency issue) by informal contacts - network externalities and spillovers, learning from other competences and public know-how - appropriability of R&D-results/ improved match between supply and demand - reduction of transaction costs - broad clusters ease entry/exit (low investments) and enhances innovative competition
Potential weakness of clusters			
- hold up problems (asset specificity) *- inflexibility and restrictive commitments (once involved in sunk investments)* *- exclusive vertical relations and market foreclosure*	*- potential mismatches between supply and demand across regions with different cultures*	- hold up problems (business stealing) - competitors may keep strategic know-how as tacit knowledge *- collusion on product market* *- inflexibility and embroidering on existing ideas and views*	*- asset specificity and hold up issues* *- tacit collusion on product market* *- inflexibility and embroidering on existing ideas and views*

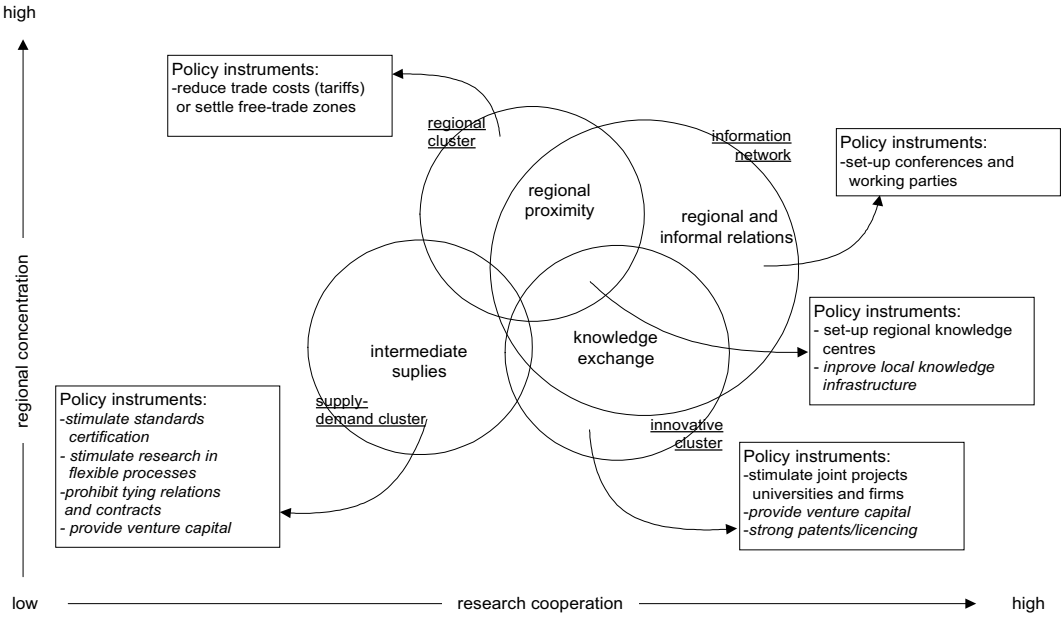
Continuation table 2.1

Supply-demand clusters (a)	Regional clusters (b)	Innovative clusters (c)	information networks (d)
Impact of emerging trends			
- ict technology and computerized information exchange alters market structure and competition by more productdifferentiation and larger buyer power and rivalry (see Porter)	- globalization and lower trade costs induce agglomeration of firms in specialized clusters	- *globalization and ict-technology eases unintentional leakage of knowledge, and strengthens competition*	- globalization may induce clusters to cross border - global ict communication is less effective in fostering informal but geographically bounded clusters with advanced supply- demand relations
Policy goals			
role of government: - identify relevant clusters - stimulate complementary/ vertical R&D cooperation - *remove vertical market failure by unfair competition through restrictive commitments and exclusive relations*	*role of government:* - *reduce trade barriers and enhance opening of markets*	*role of government:* - *remove market failures and opportunistic behaviour*	role of government: - identify and reinforce emerging and renewing clusters (i.e. do not create new clusters !) - create dialogue among participants - create competitive climate and optimal business environment - remove obstacles that impede innovation and productivity growth
Policy instruments			
- *stimulate standards/ certificates to reduce asset specificity* - *stimulate (research in) flexible production processes* - *prohibit tying relations/ contracts* - *provide venture capital*	- reduce trade costs (tariffs) or settle free-trade zones	- stimulate joint projects between universities and firms - provide venture capital (subsides) - *strengthen patent protection and stimulate licencing*	- set-up conferences, forums and working parties - set up (regional) knowledge centres

The table shows that the four different concepts have some similarities. Generally speaking, each type of cluster concerns a group of firms, employees, institutes and/or government that emphasizes to improve industry value added by reducing transaction cost or inefficiencies, and/or by creating new opportunities, including the explicitation of knowledge flows.

But these cluster concepts also complement each other in various ways (see figure 2.1). The school of strategic management provides the most comprehensive view on the characteristics and driving force of clusters, but particularly emphasizes the close and informal contacts/relations among participants in regional information networks. The other schools focus more on formal relations on a single aspect. Figure 2.1 positions each concept along the dimensions of regional concentration and research cooperation, and depicts their range and extent of overlap with other concepts. As the figure suggests, information networks contain most aspects related to innovative clusters, and some aspects of regional clusters.

Figure 2.1 A strong overlap in cluster-concepts but an overwhelming variety in policy instruments



Further, the four schools have different ways of analyzing clusters. The school analyzing supply-demand clusters put much emphasis on empirical and formal input-output research. The schools investigating regional clusters and innovative clusters base their arguments on theoretical models and verify them by econometric analysis, and use benchmark- or case-studies to highlight threats and opportunities of the respective clusters. Finally, the school of strategic management researching information networks relies on informal an qualitative analysis, often based on experiences and field research.

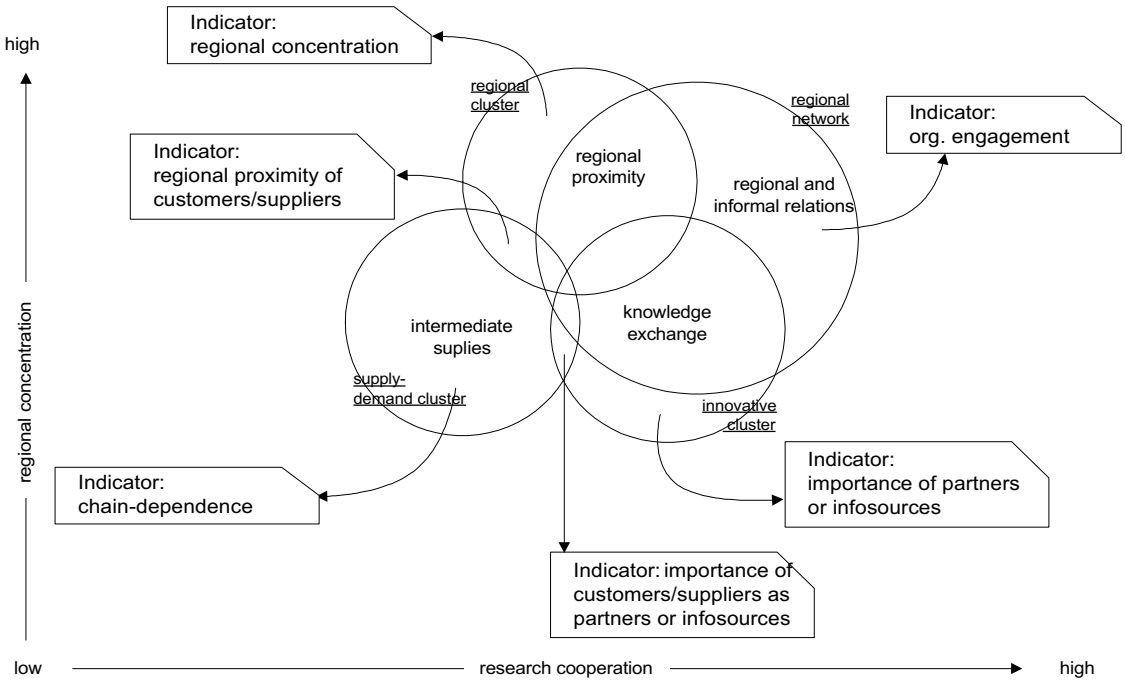
3 Empirical Results

To identify real-world clusters we first define several indicators based on the characteristics of the four cluster concepts in our framework. Section 3.2 will highlight significant supply-demand clusters identified in Hoen and Arnoldus, 2000. In Sections 3.3, 3.4 and 3.5 respectively investigate potential regional clusters, innovative clusters and (regional) information networks.

3.1 Indicators

We introduce six indicators that may help to identify and clusters on meso- or sectoral level, each indicator referring to the main characteristics of the respective cluster concept (mentioned in table 2.1). We thereby assume that meso-clusters are sufficiently representative for clusters on the micro- or company level. Figure 3.1 presents the indicators, table 3.1 provides some further explanation.

Figure 3.1 Cluster-concepts, their main characteristics and related policy instruments



Most of the indicators refer to industries at the level of the detailed input-output table (with 105 industries) or to sectors at a somewhat higher level (aggregation of only a few industries)[1]. Five of the six indicators can be derived from three main CBS-databases, i.e.:

- CBS-regional database on the number of establishments (see CBS Statline)
- CBS input-output table of 105 industries of 1998
- CBS Community Innovation Survey 1996 (see CBS, 1998, and CBS Statline) and CBS Innovation Survey 1998 (see CBS, 2000)

Note that by confining our research to these databases we can only identify domestic clusters.

Table 3.1 Main indicators of clusters

Concept	Indicator based on	Measured by[a]
supply-demand clusters (a)	chain dependence: - main intermediate supplies between industries	value of intermediate supplies
regional clusters within industries (b)	regional concentration: - share of number of establishments per COROP area in total number of establishments	regional Gini index
regional supply-demand clusters (a/b)	regional proximity of suppliers/customers: - main intermediate supplies between industries - share of number of establishments per COROP area in total number of establishments	combination of regional Gini indices and value of intermediate supplies
innovative clusters with external sources (c) or innovative supply-demand cluster (a/c)	importance of research partners[b]: - proportion of innovating firms cooperating with the respective type of company/institute	proportion of innovating firms
innovative information networks with external sources (c/d) or innovative information networks with suppliers/customers(a/c/d))	importance of information sources[c]: - share of innovating firms which consider the source as important or very important	(supply/demand) information indices
(regional) information networks (d)	organisational engagement: - (number of) business organizations and technology centres	enumeration of organisations

[a] See appendix B for technical details
[b] I.e. firms and institutes within or outside the value chain
[c] I.e. firms and institutes within or outside the value chain, public sources

[1] For easy reference we assign the respective industries or sectors with the position/or line-numbers of the detailed input-output table. Appendix C gives a list with the line-numbers and a full description of each industry or sector.

The last indicator, the organisational engagement of industries, refers to the (number of) business organisations and their related technology centres, each joining the general employers-organisation VNO-NCW[2]. This indicator, however, could only be used in one particular occasion.

3.2 Chain dependence and supply-demand clusters

There is much empirical research on the identification of supply-demand clusters, also research conducted by CPB (see also Hoen, 2001) . The study of Hoen and Arnoldus, 2000, analyses various methods to identify supply-demand clusters. After thorough consideration the authors eventually proposed to use the "decomposability method" which discerns several clusters from the (detailed 105×105) input-output table. The method contains two basic steps

- remove those intermediate supplies that are less important and consider only the largest elements of the input output table to make the table decomposable
- decompose the table in subtables by simultaneous row and column permutations in order to combine those sectors which supply to each other but not to other sectors

Table 3.2 then mentions all clusters discerned from the 1998 input-output table. Some (parts of) clusters typically refer to the supply of typical but indispensable goods and services for the receiving industry:

- energy: companies extracting natural gas supply public utilities producing and distributing electricity and gas, particularly gas to farms in (glasshouse) horticulture
- (animal)nutrition (I): manufacturers of animal feed supply cattle farmers, which on their turn deliver cattle to slaughters and milk to dairy factories
- construction (I): manufacturers of building materials supply constructors
- chemicals: petrochemical companies supply to upgrading chemical companies
- travelling : airline companies offer airline seats through travel agencies
- media: advertising agencies buy paperwork from printers or advertising space from publishers and radio/television
- communications and banking: telecom companies provide indispensable communication and connection services related to bank transactions, post offices deliver bank account statements

[2] See www.vno-ncw.nl.

Table 3.2 Identified meso supply-demand clusters

Cluster 1: energy	Cluster 6: trade
02 Horticulture	63 Retail trade
08 Crude petroleum and natural gas production	62 Wholesale trade
50 Electricity generation (public utility)	66 Freight transport by road
51 Gas distribution (public utility)	80 Exploitation of other real estates
	114 Trade margins and transport charges
Cluster 2: (animal) nutrition	
03 Livestock breeding	Cluster 7: financial services
05 Landscape gardening and agricultural services	77 Insurance
10 Slaughtering and meat-processing industry	78 Auxiliary financial services
13 Manufacture of dairy products	
14 Manufacture of compounded animal stock feeds	Cluster 8: travelling
	70 Aviation
Cluster 3: chemicals	74 Travel agencies
28 Manufacture of chemical organic products	
30 Manufacture of petrochemicals	Cluster 9: media
	25 Printing and publishing industry
Cluster 4: construction	86 Advertising agencies
34 Manufacture of building materials	101 Culture, sports, recreation, radio and television
54 Building construction	
55 Ground work, hydraulic engineering, road construction	Cluster 10: communications and banking
57 Building completion	75 Post and telecommunications
85 Engineers and architects	76 Banking
Cluster 5: cars	Cluster 11: public waste disposal
60 Car retail trade	91 Public administration, local
81 Renting of movables	100 Waste disposal and cleansing services (public)

Source: Hoen and Arnoldus, 2000

Other (parts of) clusters are related to specific services, e.g.:

- animal nutrition (II): companies in agricultural services supply firms in livestock breeding
- trade (II): companies exploiting non-residential estates rent commercial property to retailers
- public waste disposal: local governments contract waste disposal to affiliated semi-public companies
- construction: architects and engineers, but also companies in site preparation, building completion and machinery renting are contracted by general building constructors, particularly in large projects[3]
- financial services: insurance agents selling contracts of insurances companies

[3] See particularly CPB,1999.

The last two cases are related to the contracting of side activities by large enterprises to smaller specialized companies. The latter companies are often dependent on the enterprises, but not the other way around.

Note further that the trade cluster (cluster 6) emerges from the statistical treatment of trade margins raised by wholesale and retail traders and transport margins by haulage companies. The flow of goods from manufacturers via wholesale traders to retailers and transported by haulage firms, may not be perfectly visible by the input-output table but may still refer to a physical supply-demand cluster.

Few famous "clusters" could not be identified, and are thus missing in table 3.2. Actually, Hoen and Arnoldus have also identified a metal cluster –containing basic metal industry and manufacture of metal products–, but only in earlier years[4]. They have never identified some (metal-)electronics "cluster", or clusters related to the supply of metal scrap and/or aviation services.

Further, several manufacturing industries –and to an increasing extent service sectors– can be involved in an international supply-demand cluster. We know, for example, that the Dutch chemical basic industry exports three-quarters of its total sales to foreign enterprises. However, it is very difficult to find out if and to what extent industries are dependent on foreign suppliers or customers, and are thus involved in international meso-clusters. There are no statistics that can help to identify the type (final consumer or company), the industry and the origin of the main foreign customers[5]. The import-matrix can reveal the originating industry of the most important foreign suppliers, but not their country of origin.

3.3 Regional concentration and proximity of regional clusters

To determine the regional concentration of industries in COROP[6] areas we calculated for each industry a Gini-index of the number of establishments in 1999 (similarly to Audretsch and Feldman, 1996, see appendix B for detailed explanation). These Gini-indices can be easily

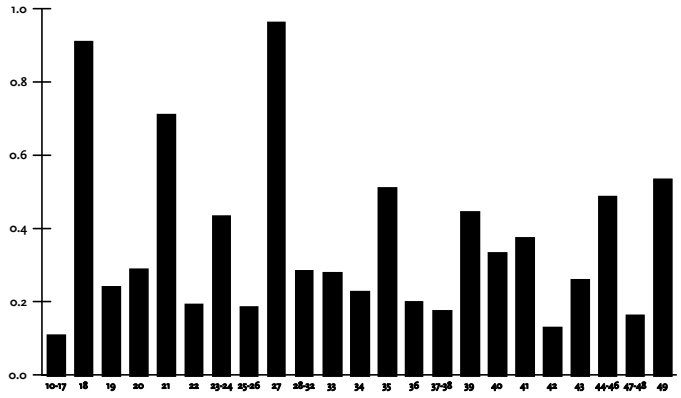
[4] Detected with 52×52 input-output matrices of 1969, 1975, 1980 and 1985, but not anymore with the with 52×52 input-output matrices of 1992 and the with 105×105 input-output matrices of 1998.

[5] The OECD-dataset only offers data on Dutch products exported to each other OECD country.

[6] The COROP classification is a statistical classification designed by the Coordinating committee Regional Research-programme (in Dutch: Coördinatiecommissie Regionaal Onderzoeksprogramma). The COROP areas divide the twelve Dutch provinces into 40 areas and three subareas. The COROP classification matches with the NUTS-III classification, a classification which is often used within/by the European Union.

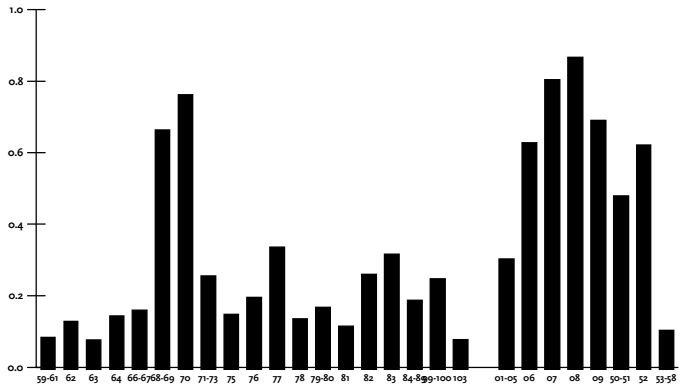
adjusted for regional differences in the size of economic activity[7]. A large Gini-index points to a strong concentration of establishments in (a few) region(s). The distribution of Gini-indices (with industries classified according to the detailed input-output table, see figures 3.2 and 3.3) reveals that the services sectors are less regionally concentrated than the other sectors.

Figure 3.2 Gini-index of regional concentration in the manufacturing sector[a]



Source: CBS Statline
[a] Industries are designated by their row number of the detailed input-output table; see appendix C for full description.

Figure 3.3 Gini-index of regional concentration in the services sector and other industries[a]



Source: CBS Statline
[a] Industries designated by their row number of the detailed input-output table; see appendix C for full description.

[7] Omitting the adjustment does not substantially change the outcomes. Actually, most Gini-indices then increase, particularly those for the industries in the services sector. However, the industries with the highest Gini-indices then remain the same.

The mining industry, the metalectro industry, the transport sector and the traditional industries (fishing, tobacco-processing industry[8] and the leather(ware) industry) are the most regionally concentrated industries. Table 3.3 presents more details on the location of these industries[9].

Table 3.3 Regional concentration

Industry		Gini index	Main COROP-area's[a]
06	Forestry and hunting	0.63	Veluwe (Achterhoek, Arnhem/Nijmegen, south-east NBrabant)
07	Fishing	0.80	north NHolland, Flevoland, Zeeland
08	Crude petroleum and natural gas production	0.87	north NHolland, IJmond, The Hague, Rijnmond
09	Other mining and quarrying	0.69	Arnhem/Nijmegen
18	Tobacco processing[b]	0.91	particularly Overijssel
21	Leather(ware) and footware	0.71	central NBrabant
23-24	Paper, paperware and cardboard	0.43	–
27	Petroleum processing[b]	0.96	particualarly Rijnmond
35	Basic metal industry	0.51	(south-east NBrabant, north Limburg)
39	Office appliances and computers	0.45	Utrecht (south-east NBrabant)
41	Audio-, video and telecom-appliances	0.37	south-east NBrabant
44-46	Other transport equipment	0.49	(Rijnmond, south-west Friesland)
49	Recycling	0.53	(west/south-east NBrabant)
50-51	Public energy supply	0.48	(Utrecht, Rijnmond)
52	Water supply and distribution	0.62	Amsterdam
68-69	Sea- and inland shipping	0.66	Rijnmond, southeast SHolland
70	Aviation	0.76	Amsterdam/Schiphol (Rijnmond,Utrecht)
70%-percentile of the Gini-index		0.37	

Source: CBS Statline (data), CPB (computations)

[a] We selected those industries for which the regional Gini-index exceeds the 70%-percentile of the Gini-indices of all industries, and subsequently those COROP areas for which the share of total establishments exceeds 10% (between brackets 8%).

[b] The formal condition for the tobacco processing industry and the oil processing industry is somewhat misleading due to few number of establishments.

The theory behind regional clusters argues that high transport or transaction costs may reinforce the agglomeration of companies to specific areas. However, the actual transportation or transaction costs can hardly be derived from the input-output table. The reason is that these costs may not only refer to identifiable costs related to transportation by haulage firms, but also to the non-decomposable trade and transportation margins within companies. The proximity of

[8] The strong concentration in the tobacco-processing industry may be connected to the low number of establishments (in total 30 in 1999).

[9] We selected those industries for which the regional Gini-index exceeds the 70%-percentile of the Gini-indices of all industries, and subsequently those COROP areas for which the share of total establishments exceeds 10%(between brackets 8%).

suppliers and/or customers may be a much better indicator for the regional clustering of firms, and can be detected by combining regional data with input-output tables.

Appendix D presents a comprehensive table which combines the regionally concentrated industries from table 3.3 with the main locations of the main suppliers and customers (table D1)[10]. It suggests that only three regionally concentrated industries *significantly* belong to an identified supply-demand cluster, i.e. the energy cluster:

- public utilities in Utrecht may benefit from the arrival points of natural gas in the IJmond;
- public utilities in the Rijnmond may benefit from the nearby location of gas arrival points in port of Rotterdam, but also from nearby customers in horticulture (Westland)

Four regionally concentrated industries are only partly dependent on their suppliers and/or customers, e.g.:

- fishing: the fishing industry, which (of course) is regionally concentrated in coastal area's, is moderately dependent on suppliers of diesel fuel in the petroleum industry and its customers in the fish processing industry
- metal scrap: firms in southeast N.Brabant recycling metal scrap may benefit from the proximity of manufacturers of basic metals in southeast N.Brabant or north Limburg
- basic metal: companies in basic metal are somewhat concentrated in southeast N Brabant and north Limburg, but are only dependent on customers in the dispersed metal products industry
- electronics: the companies in the electronics industry, and particularly the manufacturing of audio-, video- and telecom appliances, are mostly concentrated in southeast N.Brabant (Philips!) and Utrecht, but only moderately dependent on other companies in the same industry

Another approach is to determine the location of industries belonging to some identified supply-demand cluster. Appendix D also contains a table which sets the locations of industries within a supply-demand cluster side by side (i.e. the locations of the respective industry and their main suppliers or main customers [11], see table D2). It reveals that three supply-demand clusters (energy, financial services, media) are regionally concentrated and two (chemicals, trade

[10] I.e. the main customers for which the intermediate supplies exceeds 10% of total sales of the respective industry, and the main suppliers for which the intermediate supplies exceeds 10% of total sales of the respective industry.
[11] See note 10.

(upstream part)) supply demand clusters only weakly concentrated. Actually, the appendix suggests that:

- energy: see above
- chemicals: firms producing chemical organic products may benefit from the proximity of petrochemical installations[12] in Utrecht or west N.Brabant.
- financial services: companies providing auxiliary financial services –mostly insurance agents– are particularly concentrated in the main cities, just near the insurance companies
- media: printing and publishing companies are more often located in the Dutch main cities (particularly Amsterdam and Utrecht), just near the purchasing advertising agencies
- trade (upstream): whole sale traders and freight hauling companies are somewhat concentrated in the Rijnmond because many foreign (bulk) goods enter the Netherlands in the port of Rotterdam

So eventually we can find some evidence on the existence of regional (supply-demand) clusters in the Netherlands. Local clusters related to the supply of bulk products, particularly of metal scrap and natural gas and in less extent basic chemicals and metals, endorse the regional economic theory arguing that high transportation or transaction costs may turn into regional clustering. This argument thus seems to hold particularly for the processing of basic, bulk products.

The wholesale and transport sector is mainly concentrated around the mainports of Rotterdam and Schiphol. Other service oriented industries, such as advertising agencies, printing and publishing companies as well as insurance companies and -agents, are more often located in large and densely populated cities. Fishing and mining are tied to nearby natural resources, other traditional industries (tobacco and leatherware) are regionally concentrated because of historical reasons.

Remark that we implicitly assumed that a regional cluster concerns the location of companies *within* a particular COROP-area. The research of Rats focusses on the geographical location of 8

[12] Notice that we have only observations on the number of establishments for the entire chemical industry. However, these establishments are sufficiently enough concentrated to postulate this conclusion.

predetermined supply-demand clusters[13] in adjacent (zip-code) area's (see Rats, 2000)[14]. His results are partly similar to our results: the chemical cluster (chemical industry and petroleum industry) located in the Rijnmond, the media cluster (printing and publishing) located in Amsterdam, the metalectro cluster/industry located in east Netherlands, west and southeast N.-Brabant.

Regional clusters may not only benefit from reduced transportation cost, but may also generate new innovations that will be applied in other sectors. Based on existing empirical research, Hoen, 2001, concludes that "... (regional) clusters generally lead to more innovations, knowledge spillovers, faster diffusion of technologies and knowledge, and competitive advantage...".

The empirical research of Audretsch and Feldman, 1996, suggested that geographical concentration of production is significantly and positively related to transportation cost, but also to the availability of natural resources, skilled labour and/or tacit knowledge. However, strong geographical concentration of industries in a mature and declining phase of the industry life cycle raises the probability of innovative activity to disperse, hoping to find some "new ideas". The assertion of Audretsch and Feldman suggests that innovative activity and knowledge exchange –particularly in the mature basic chemical and metal industry– would disperse, not cluster. Whatever the case may be, the next section investigates to what extent innovative activities are clustered, and to what extent they can be related to supply-demand or regional clusters.

3.4 Research partnerships and innovative clusters

To develop new innovations, companies may get involved in settled R&D cooperation and knowledge exchange, such as in formal research programmes or research joint ventures. The CBS innovation surveys of 1996 (CIS-2) and 1998 provide some evidence on the importance of research partnerships. Table 3.4, drawn from this data set, reflects the proportion of innovating firms that cooperated in 1996 or 1998 with some of the various types of partners. It shows that companies in the value chain are the most important partners. External institutes, like consultants, research institutes and universities, are less important as research partners. Most partners are –not surprisingly– Dutch partners. This pattern has not much changed between 1996 and 1998.

[13] Based on supply-demand cluster analysis commissioned by the Ministry of Economic Affairs (see also v.d.Hove et all 1998).

[14] Actually, Rats first relates clusters to five dimensions, then determines for each area whether the industries belonging to some cluster satisfy at least three of the five criterions related to the five dimensions, and finally groups for each cluster the adjacent area's.

Table 3.4 Partners in innovative cooperation

	Total		Manufacturing		Services		Other industries	
	1996	1998	1996	1998	1996	1998	1996	1998
	In % of total number of innovating firms[a]							
Related companies[b]	15	13	13	14	17	14	10	8
Customers	11	11	14	13	10	10	4	8
Suppliers	11	11	11	13	12	12	8	7
Competitors	9	9	7	8	9	9	9	8
Consultants	5	7	6	6	4	8	5	5
Research institutes	5	6	7	9	4	5	4	6
Universities	5	6	6	7	5	5	4	5
Domestic partner	88	92	85	90	89	92	94	99
Foreign partner	39	34	52	27	34	32	18	53

Source: CBS Statline, CBS Kennis en economie 1998, CBS, Kennis en economie 2000

[a] I.e. 17193 companies in 1996 and 19381 companies in 1998 that indicated to perform some "innovative activities"

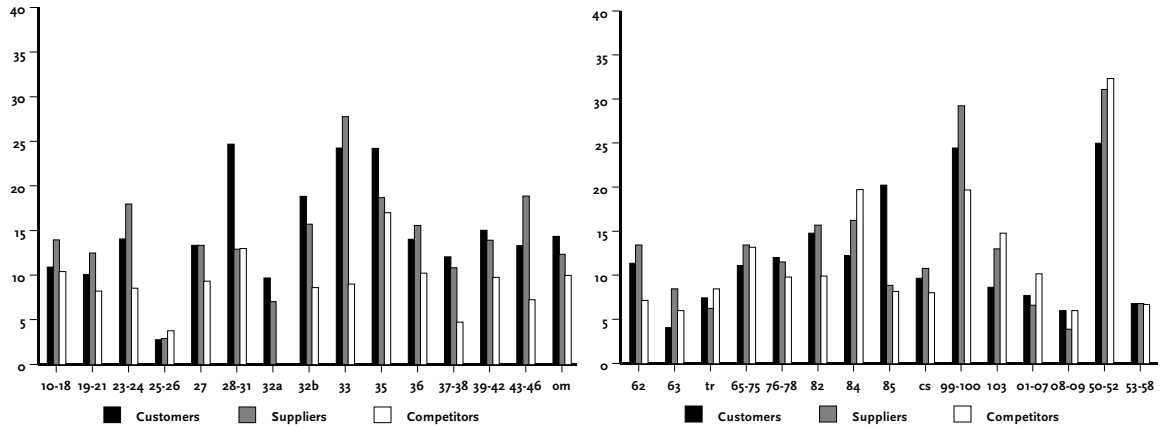
[b] I.e. parent, sister and or daughter companies within an enterprise. This information source does not refer to self-employed firms (36,2% in 1996, 31,7% in 1998) but is only relevant to the remaining innovating firms (63,8% in 1996, 68,3% in 1998).

R&D cooperation inside the value chain

Figure 3.4 presents more detailed figures on partnerships with customers, suppliers and competitors. It reveals that manufacturing firms mostly seek R&D cooperation with suppliers and customers, and in a less extent with competitors. This confirms the theory suggesting that firms consider business stealing by competitors as a serious threat (see section 2 and appendix A for theoretical references). Enterprises in the basic (chemical and metal) industry particularly aim at collaboration with customers. Companies in printing/publishing, but also in agriculture and construction, hardly involve in research partnerships. This may be due to their lack of capacity to contribute to extensive joint research projects.

Regarding the services sector and other industries, the 1998 survey reveals that only technically related service companies (not surprisingly) seek for R&D cooperation. For example, engineers and architects cooperate with various sorts of customers, waste disposal and utility companies cooperate with customers, suppliers and competitors. The 1996 survey, however, suggests that only commercial services companies –and in less extent providers of auxiliary financial services– would involve in R&D partnerships. These diverging observations refute any hard conclusions on R&D partnerships in the service sector and other industries.

Figure 3.4 Partnerships[oo] of manufacturing[a], services[o] and other industries inside the value chain (1998)



[oo] In percentage of total innovating firms. Industries are designated by their row number of the detailed input-output table; see appendix C for full description.

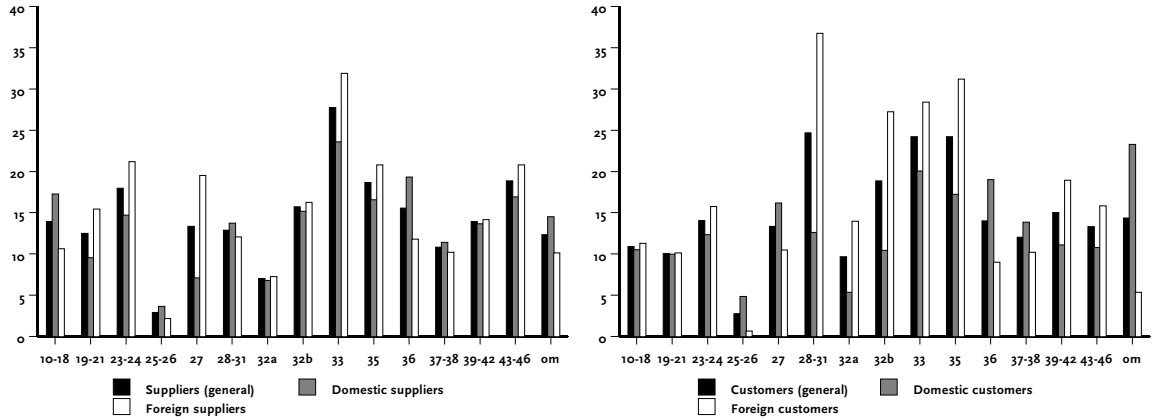
[a] Industry 32a: pharmaceutical industry
32b: other chemical final product industry
om: other manufacturing
(combination of industries 22,34,47-49)

[o] Industry tr: trade
(combination of industries 59-61,64)
cs: commercial services
(combination of industries 79-81, 86-89)

Based on the export and import shares figure 3.5 makes a further distinction in partnerships with domestic/foreign customers or suppliers. Actually, we weighed the proportion of innovating firms with customers as a partner with the (complement of the) share of imports in total use to obtain the proportion for foreign (domestic) customers. We similarly weighed the proportion of innovating firms with suppliers as a partner with the (complement of the) share of exports in total sales to obtain the proportion for foreign (domestic) suppliers. By this method we implicitly assume that for research partnerships each **individual** foreign customer (supplier) is equally important as each **individual** domestic customer (supplier).

Figure 3.5 suggests that the companies that mostly cooperate with other firms are rather internationally oriented. These firms may typically search for cooperation with foreign customers (probably “colleague-multinationals” in other countries).

Figure 3.5 Partnerships of manufacturing industries[a] with customers and suppliers separated (1998)



[00] In percentage of total innovating firms. Industries are designated by their row number of the detailed input-output table; see appendix C for full description.

[a] Industry 32a: pharmaceutical industry
32b: other chemical final product industry
om: other manufacturing
(combination of industries 22,34,47-49)

Table 3.5 finally relates the major partners inside the value chain with the major branches that supply to or purchase from the respective industry[15]. The research partnerships in the chemical industry may relate to the (somewhat regional) chemicals supply-demand cluster. Manufacturers of basic metal products would have domestic research partners in the purchasing metal products industry, but section 3.2 signaled only a weak strong supply-demand cluster with these two industries. Relating the customer/supplier research partnerships with the data from the input output table also suggests that manufacturers of paper, paperware and cardboard would have some R&D-partners in the food industry (supply of packing material), but this seems intuitively unlikely. So generally, table 3.5 reveals that the research partnerships between customers and suppliers only occasionally coincide with significant supply-demand clusters.

[15] We selected those industries for which the share of innovators with customers as partners exceeded (in 1996 and in 1998) the 70%-percentile of the shares of all industries, or similarly for innovators with suppliers as research partner. For each selected industry we then choose the main *domestic* customers for which intermediate supplies exceeds 10% of total sales, and the main *domestic* suppliers for which intermediate supplies exceeds 10% of total use (between brackets the IO-industry number of the respective customers/ suppliers).

Table 3.5 R&D partnerships within the value chain[a]

Industry		Share of innovative firms having partnerships in 1998 with						
		customers			suppliers			competitors
		general	domestic	foreign	general	domestic	foreign	
23-24	Paper, paperware and cardboard	14	12 (10-18)	16	18	15	21	9
28-31	Chemical basic products	25	13 (30→28)	37	13	14	12	13
32b	Other chemical final products	19	10	27	16	15	16	9
33	Rubber and plastic processing	24	20	28	28	24	32	9
35	Basic metal	24	17 (36)	31	19	17	21	17
70%-percentile		14	19	11	16	19	12	11

[a] Between brackets the main industries of domestic customers (for which intermediate supplies exceeds 10% of total sales) and domestic suppliers (for which intermediate supplies exceeds 10% of total use); only domestic customers and suppliers outside the own industry are included.

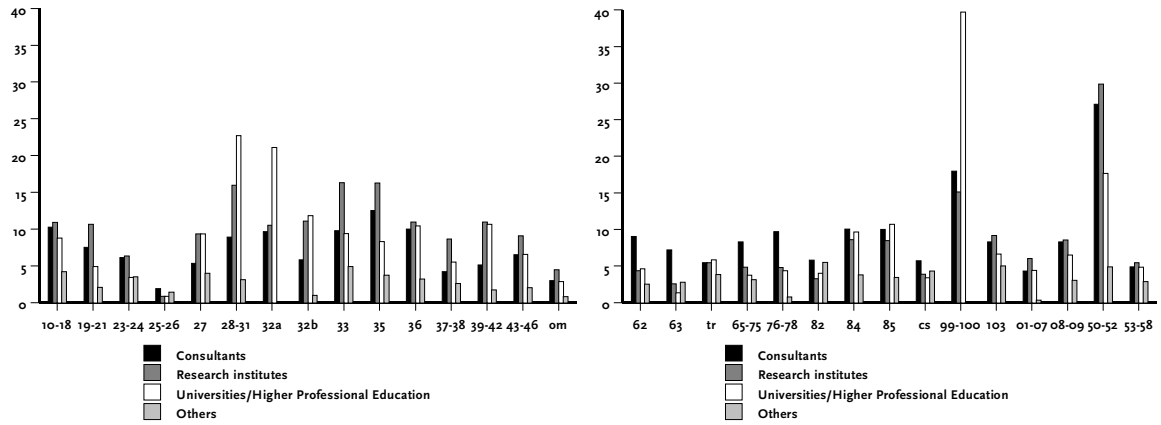
R&D cooperation with external partners

Besides other companies in the value chain, firms may also involve in formal research partnerships with external institutes. For example, companies may give their name as a potential user in a STW-project, i.e. a research project of some university in which users are consulted, and possibly provide "substantial" (financial) support in exchange for the (exclusive) right to use the research results (see STW (2000)). The STW-programme is set up improve knowledge exchange between universities and companies.

Figure 3.6 presents the proportions of innovating companies that have R&D-partnerships with various types of external partners. It shows that almost 40% of all companies in waste disposal, and about 18-25% of the companies in public utilities and chemicals have partnerships with universities and higher vocational education institutes. Almost 30% of the utility companies and about 15 % of the waste disposal companies cooperate with research institutes and consultants. Companies in the basic metals and rubber and plastic-processing industry mostly cooperate with research institutes.

The relatively high quantity of research partnerships in the basic chemical and metal industry somewhat confirm the assertion that the innovative activity in the mature basic industries would disperse (see also section 3.3 and Audretsch and Feldman,1996). The observation that the printing and publishing industry hardly cooperates with external partners underlines our assertion that smaller companies prefer occasional knowledge exchange above settled R&D-cooperation.

Figure 3.6 Partnerships[oo] of manufacturing[a], services[o] and other industries with external partners (1998)



[oo] In percentage of total innovating firms. Industries are designated by their row number of the detailed input-output table; see appendix C for full description.

[a] Industry 32a: pharmaceutical industry
32b: other chemical final product industry
om: other manufacturing
(combination of industries 22,34,47-49)

[o] Industry tr: trade
(combination of industries 59-61,64)
cs: commercial services
(combination of industries 79-81, 86-89)

Location of research partners

The CBS survey of 1998 also provides some information on the location of research partners. Table 3.6 reveals that the proportion of innovating firms with Dutch partners is (not surprisingly) somewhat higher than the proportion of companies with foreign partners.

More important, only partnerships with Dutch suppliers and customers seem to be (slightly) regionally bounded. We must be careful to combine the figures for the range of 0-10 km with those for the range of 11-50 km[16], but it seems that the suppliers and customers with which the innovating firms cooperate are more likely to be located within a range of 50 km. Other types of partners seem to be more uniformly distributed. For the foreign partnerships the cooperative customers and suppliers are more likely located at *larger* distances[17]. Cooperating pharmaceutical companies (30% of all 36 innovating companies) even have all foreign partners at more than 500km.

[16] If we would do so, then we would double count the companies with partners in the (sub)range of 0-10km and with partners in the (sub)range of 11-50 km. However, we do know that the figures for the range of 0-50km must be between the highest of the figures of both subranges and the sum of the figures of both subranges.

[17] The statistical caveat for the combining the lower subranges in case of domestic partnerships similarly holds for combining the lower subranges in case of cooperation with foreign partners.

Table 3.6 Location of research partners

	Total	Range in the Netherlands (in km)				Range in foreign countries (in km)				
		Total	37163	11-50	0-50	50+	Total	0-50	51-500	0-500	500+
	In % of the 4865 innovating companies with partnerships										
Total	100	92.4	33.7	45.9	46-80	61.2	52.2	7.4	18.9	19-26	30.8
Partners in value chain	89.1	82.6	32.8	43.7	44-77	57.9	46.5	6.5	18.7	19-25	28.1
related companies[a]	61.1	56.2	28.8	31.1	31-60	40.3	38.1	5.3	18.1	18-23	25.6
customers	50.3	48.9	23.1	28.4	28-51	35.5	30.4	4.7	13.4	37273	18.5
suppliers	53.2	50.3	21.8	29.8	30-52	37.4	30	4	13.7	14-18	18.3
competitors	42.2	41.5	18.6	25.4	25-44	30.2	22.8	4.7	9	37147	11.8
External partners	50	48.7	21.3	28.2	28-49	37.1	30.5	6	12.1	37242	16.3
consultants	33.2	32.4	15.6	19.6	20-36	24.7	19.1	4.3	8.3	37232	9.7
research-institutes	30	29.4	14.2	17.9	18-32	22.8	20	4.2	8.1	37232	10
universities	26.6	26	13.1	15	15-28	19.2	18.1	3.6	7	37201	9.3
Other partners	14.5	14.2	6.6	4.5	37201	7.6	9.5	1.9	1.9	36982	5.4

[a] I.e. parent, sister and or daughter companies within an enterprise. This information source does not refer to self-employed firms (31,7% of 4865 innovating companies with partnerships in 1998) but is only relevant to the other firms (68,3% in 1998).

3.5 Occasional sources of information and information networks

Occasional information exchange may particularly relate to (regional) information networks. Table 3.7 presents the main results from the CBS innovation surveys on the importance of several sources of information to companies. It reveals that innovating firms consider other companies inside their value chain as important sources, but designate less value to external advisors and public institutes. Regarding the information carriers, they often use professional literature and visit exhibitions. Most innovating companies, except those in the pharmaceutical industry, hardly use patents as a source of information.

The table also reveals that innovating companies use computer-info more often as a source of information. This observation only refers to 1996 and 1998, but with the rapid growth in using the Net computer-info has certainly become more important later on.

Table 3.7 Importance of sources of information

	Somewhat important		Important		Very important	
	1996	1998	1996	1998	1996	1998
	In % of total number of innovating firms[a]					
Own company	12	13	38	40	37	29
New staff	-	22	-	23	-	5
Concern/related companies[b]	10	9	15	13	9	6
Customers	25	28	32	27	11	8
Suppliers	29	30	31	26	9	6
Competitors	30	29	26	23	6	5
Consultants	21	19	12	15	2	3
Research institutes	16	13	9	9	2	2
Universities	12	12	6	5	1	1
Innovation-centres	12	9	6	5	1	1
Business-organisations	-	29	-	19	-	3
Patents	8	7	3	3	1	1
Computer-info	16	24	9	12	2	3
Professional literature	33	36	31	25	6	5
Exhibitions	33	-	26	-	5	-

Source: CBS Statline, CBS Kennis en economie 1998, CBS, Kennis en economie 2000

[a] I.e. 17193 companies in 1996 and 19381 companies in 1998 that indicated to perform some "innovative activities"

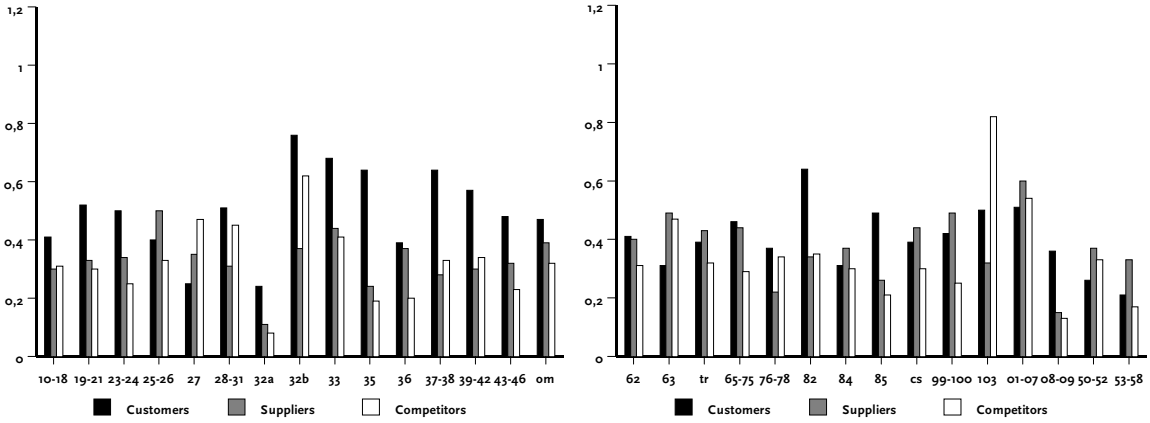
[a] I.e. parent, sister and or daughter companies within an enterprise. This information source does not refer to self-employed firms (51,5% in 1996, 35,7% in 1998) but is only relevant to the remaining innovating firms (48,5% in 1996, 64,3% in 1998).

Sources inside the value chain

The importance of customers and suppliers as sources of information may widely differ across industries. We can highlight these differences by computing for each industry and source a weighted information index[18]. Figures 3.7 and 3.8 present the information indices of customers, suppliers and competitors for the manufacturing industries, the services sector and the other industries.

[18] These information indices are calculated from the shares of innovating companies that consider the respective source as important or very important (double counted) (see appendix B for more details).

Figure 3.7 Information-indices of sources in value chain[oo] for manufacturing[a], services[o] and other industries (1998)



[oo] Industries are designated by their row number of the detailed input-output table; see appendix C for full description.

[a] Industry 32a: pharmaceutical industry
32b: other chemical final product industry
om: other manufacturing
(combination of industries 22,34,47-49)

[o] Industry tr: trade
(combination of industries 59-61,64)
cs: commercial services
(combination of industries 79-81, 86-89)

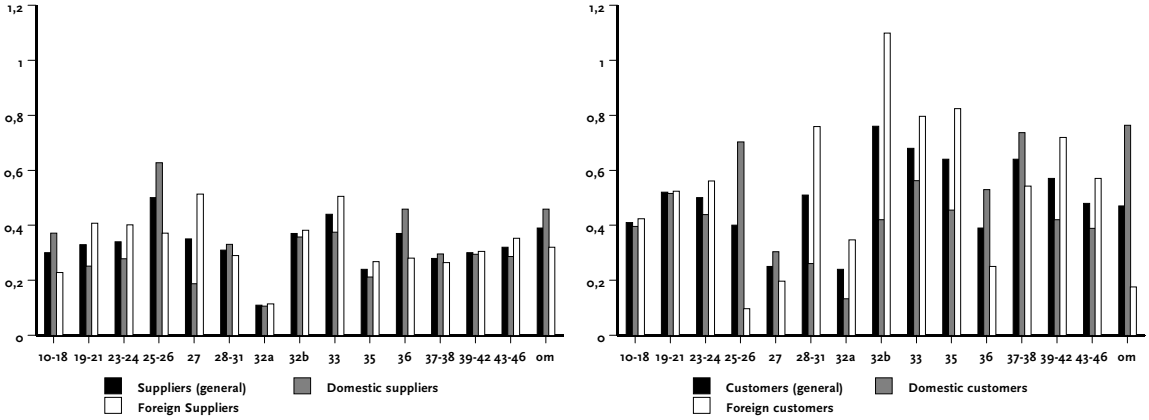
Figure 3.7 shows that manufacturing firms value information sources inside the value chain more diverse than service companies. Still, most manufacturers consider customers as the most important source of information. Pharmaceutical companies, however, designate low importance to any other company in the value chain. The only outliers in the services sector concern the computer service companies which also put much value on customer information, and cleaning and personal service companies which consider competitors as a major source.

Finally, companies in the mining industry (both oil/gas and other minerals) assign low value to information from competitors and suppliers. The latter observation is not surprising because mining stands at the beginning of any value chain.

Figure 3.8 highlights the information flows from foreign and domestic companies separately. Actually, we weighed the general supplier information indices with the (complements of the) share of imports in total use to obtain the information indices of foreign (domestic) customers, and the general customer information indices with the (complements of the) share of exports in total sales to obtain the information index of foreign (domestic) suppliers. By this method we implicitly assume that each **individual** foreign customer (supplier) provides the same level of information as each **individual** domestic customer (supplier).

The results of figure 3.8 suggest that particularly foreign customers of other chemical final products and plastics industry, basic metals and electric appliances, transport equipment are more important sources than the domestic customers. Dutch customers are more essential in the machinery and recycling industries, and of course in the domestic oriented industries (printing and publishing industry and manufacturing of furniture and building materials). The differences in importance between foreign and domestic suppliers, however, are quite modest, except for the printing and publishing industry and the petroleum industry.

Figure 3.8 Separated information-indices of customers and suppliers[oo] of manufacturing industries[a] (1998)



Industries are designated by their row number of the detailed input-output table; see appendix C for full description.

[a] Industry 32a: pharmaceutical industry
32b: other chemical final product industry
om: other manufacturing
(combination of industries 22,34,47-49)

The research of v.d. Hove et al., 1998 (see also Roelandt et al.,1999c) somewhat confirms the observations on the manufacturing and construction sector. This research provides some insight in the knowledge flows embodied in intermediate supplies, and the innovation styles of various supply-demand clusters[19]. It concludes that the chemical and metalectro (supply-demand) cluster are knowledge intensive and specialised suppliers for innovations in other clusters, suggesting that these two clusters or sectors are highly customer-oriented. The construction cluster is a

[19] Based on earlier research, v.d. Hove et al. discern (among other clusters) a Dutch chemical supply-demand cluster (IO industries 27-33), a Dutch metalelectro supply-demand cluster (IO industries 35-46) and a Dutch construction cluster (including IO industries 34, 53-57, 79-80).

highly absorptive cluster with a relatively low R&D effort and thus much dependent on their suppliers for innovations.

Table 3.8 Sources of information inside the value chain[a]

Industry	Information index 1998 of customers			suppliers			competitors
	general	domestic	foreign	general	domestic	foreign	
01-07 Agriculture, forestry and fishing	0.51	0.64[b]	0.38	0.6	1.03 (14)	0.17	0.54
25-26 Printing and publishing	0.40	0.70 (25,86,tr[c])	0.10	0.5	0.63	0.37	0.33
28-31 Chemical basic products	0.51	0.26 (30→28)	0.76	0.31	0.33	0.29	0.45
32b Other chemical final products	0.76	0.42	1.1	0.37	0.36	0.38	0.62
33 Rubber and plastic processing	0.68	0.56	0.80	0.44	0.37	0.51	0.41
37-38 Machinery and home appliances	0.64	0.74	0.54	0.28	0.3	0.26	0.33
39-42 Electrotechnical industry	0.57	0.42 (60)	0.72	0.3	0.29	0.31	0.34
63 Retail trade	0.31			0.49 (cs[d])			0.47
tr[c] Hotels and catering, car sales	0.39			0.43 (om[e])			0.32
82 Computer service companies	0.64			0.34			0.35
cs[d] Commercial services	0.39			0.44			0.30
99-100 Waste disposal/cleansing	0.42			0.49 (91)			0.25
70%-percentile	0.50	0.53	0.69	0.39	0.37	0.38	0.34

[a] Between brackets the main industries of domestic customers (for which intermediate supplies exceeds 10% of total sales) and domestic suppliers (for which intermediate supplies exceeds 10% of total use); only domestic customers and suppliers outside the own industry are recorded.
[b] Main domestic customers IO-industries 2,(supplied by 5),10,11,13,21
[c] Hotels and catering, car sales, combination of IO-industries 59-61, 64
[d] Commercial services, combination of IO-industries 79-81 and 86-89
[e] Other manufacturing, combination of IO-industries 22,34,47-49

Table 3.8 relates the major sources of information inside the value chain with the industries of the respective suppliers or customers[20]. It shows that some (regional) networks coincide with identified supply-demand clusters:

[20] We selected those industries for which the customer information exceed in 1996 and 1998 the 70%-percentile of all information indices across industries, or similarly for the supplier information indices. For each selected industry we then selected the main *domestic* customers for which intermediate supplies exceeds 10% of total sales, and the main *domestic* suppliers for which intermediate supplies exceeds 10% of total use (between brackets the IO-industry number of the respective customers/suppliers).

- (animal) nutrition: cattle farms (and companies in other agriculture) may consider their main supplying animal feeds companies, their main purchasing slaughters and manufacturers of dairy products as a main source of information
- chemicals: manufacturers of organic chemicals may be informed by (other) petrochemical companies about product characteristics
- media: printing and publishing companies may get important (marketing) information from their advertising agencies, but perhaps also from car retailers hotels and catering services, car retailers
- waste disposal: companies in public waste disposal seem to consider local governments not only as their (single) main customer, but also an important source

Only the chemicals and media clusters are (somewhat) regionally concentrated (see appendix D, table D.2).

Finally, the combination of the two data sets would also suggest that

- retailers (general) would obtain substantial information from companies in commercial services
- electrotechnical companies might use some information and specifications issued by car retailers
- car sale companies, hotels and catering services would consider manufacturers of wood, building materials, furniture or recycling companies as important sources

The latter two assertions, however, are very unlikely.

So eventually we may argue that particularly most smaller companies such as cattle farmers, printing/ publishing companies and retailers get their information only from few other supplying or purchasing industries[21]. Larger firms in manufacturing industries obtain some information from different domestic customers, but most information from their main customers in other countries.

External sources

Besides the sources inside the value chain, companies may also obtain knowledge and information via external sources. Figure 3.9 presents the most important external sources. The most salient result is that companies in the service sector and the other industries (except construction) rely more often on information from consultants and business organisations than

[21] V.d. Hove et al., 1998, argue that the agrofood supply-demand cluster is quite autarkic regarding innovative activities.

the companies in the manufacturing sector[22]. The results for business organisations are somewhat striking, because the widely dispersed service sector is represented by less business organisations. Actually, from the 158 business organisations affiliated with the general employers organisation VNO-NCW, 75 organisations represent some manufacturing industry, while only 52 organisations represent the services sector[23].

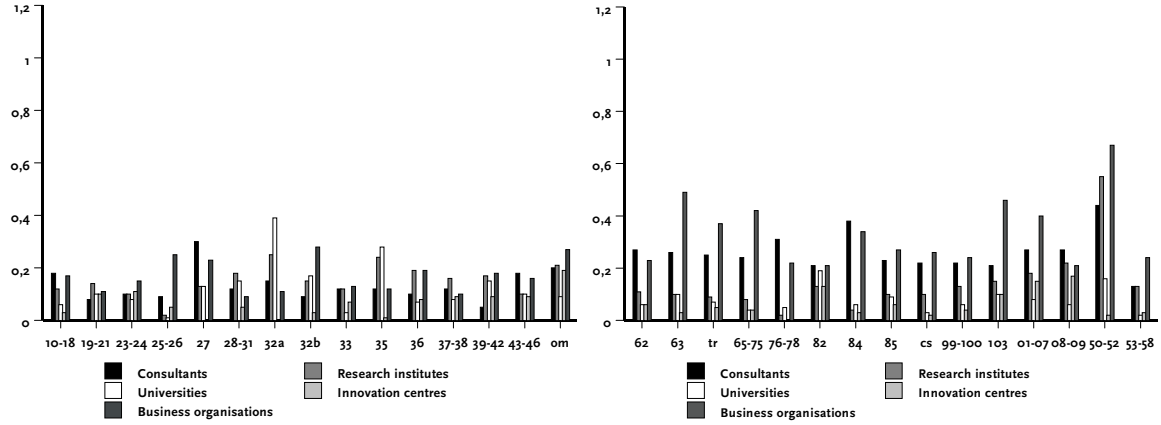
Further most business technology or innovation centres, often affiliated with one or a few business organisations, refer to the manufacturing industry (but they can still be "visited" by companies of other sectors). These innovation centres, however, play only a minor role in the (occasional) information exchange (see table 3.7).

Regarding specific industries, figure 3.9 indicates that utility companies heavily lean on information from business organisations and knowledge from universities and other research institutes. Pharmaceutical companies and manufacturers of basic metals and computer service offices more frequently turn to universities and other research institutes. Since pharmaceutical companies designate the lowest value to sources inside the value chain, we may conclude that these companies are the most external oriented companies in acquiring knowledge and information.

[22] Except petroleum-processing companies, and manufacturers of paper(ware)/cardboard and other chemical final products.

[23] See the website of VNO-NCW, www.vno-ncw.nl.

Figure 3.9 **Information-indices of external sources[oo] for manufacturing[a], services[o] and other industries (1998)**



[oo] Industries are designated by their row number of the detailed input-output table; see appendix C for full description.

[a] Industry 32a: pharmaceutical industry
32b: other chemical final product industry
om: other manufacturing
(combination of industries 22,34,47-49)

[o] Industry tr: trade
(combination of industries 59-61,64)
cs: commercial services
(combination of industries 79-81, 86-89)

4 Discussion and conclusion

Empirical identification

Before drawing some general conclusions from the empirical search for clusters, we like to highlight two main caveats or assumptions which might affect the outcome:

- the number of identified clusters depend very much on the used identification method, the selection criterions and the industry aggregation level
- we assumed that the importance of specific customers or suppliers as a research partner or source of information is proportional to the share of the respective intermediate supplies in total sales or total use.

Nevertheless, the most straightforward conclusion is that relations inside the value chain are also important in regional clusters, innovative clusters and information networks. Actually, section 3.4 and 3.5 revealed that companies consider customers, suppliers and competitors more important as research partners or sources of information than other external institutes, like consultants, research institutes and universities. The only but most salient exceptions are pharmaceutical companies and companies in public utility and waste disposal companies.

Table 4.1 Identified clusters inside the value chain

Cluster name	based on cluster type or -concept			
	supply-demand cluster	regional cluster	innovative cluster[a]	information network[b]
energy	X	X		
animal nutrition	X			
chemicals	X	X	X	X
construction	X			
cars	X			
trade	X	(X)		(X[c])
financial services	X	X		
travelling	X	(X)		
media	X	X		X
communications/banking	X			
public waste disposal	X			X
fishing	(X)	X		
metal scrap	(X)	X		
basic metal	(X)	X	X	
electronics	(X)	X		

[a] I.e. significant research partnerships with other partners inside the value chain
[b] I.e. significant information networks with other partners inside the value chain
[c] Information exchange from companies in commercial service towards retailers.

By analysing and combining several CBS-data sets we could identify several clusters of different types[24]. Table 4.1 summarizes the main clusters that are identified in previous chapters (see tables 3.2, 3.5, 3.8, D.1 and D.2 in appendix D). Table 4.2. presents the separate industries which are regionally concentrated or are involved in significant information networks or research partnerships, but could not be related to some main suppliers or customers in other industries (see tables 3.2, 3.5, 3.8).

[24] We only had a few statistical problems, such as differences of data sets in industry classification and in years.

Table 4.2 Identified industries with cluster characteristics

Industry... which is (involved in)	regionally concentrated	research partnerships[a]	information network[b]
09 other mining/quarrying	X		
18 tobacco processing	X		
21 leather and footware	X		
23-24 paper(ware) and cardboard	X	X	
27 petroleum processing	X		
32b non-pharmaceutical chemicals		X	X
33 rubber and plastic processing		X	X
37 machinery			X
39 office appliances and computers	X		
44-46 other transport equipment[c]	X		
50-51 public energy supply[c]	X		
52 water supply	X		
59-61,64 hotels/catering and car sales[c]			X
68-69 sea- and inland shipping[c]	X		
70 aviation	X		
82 computer service			X
cs commercial services[c]			X

[a] I.e. significant research partnerships with other partners inside the value chain
[b] I.e. significant information networks with other partners inside the value chain
[c] The combination of these IO-industries were considered as a single industry in the underlying data set.

So from the empirical analysis we may conclude that

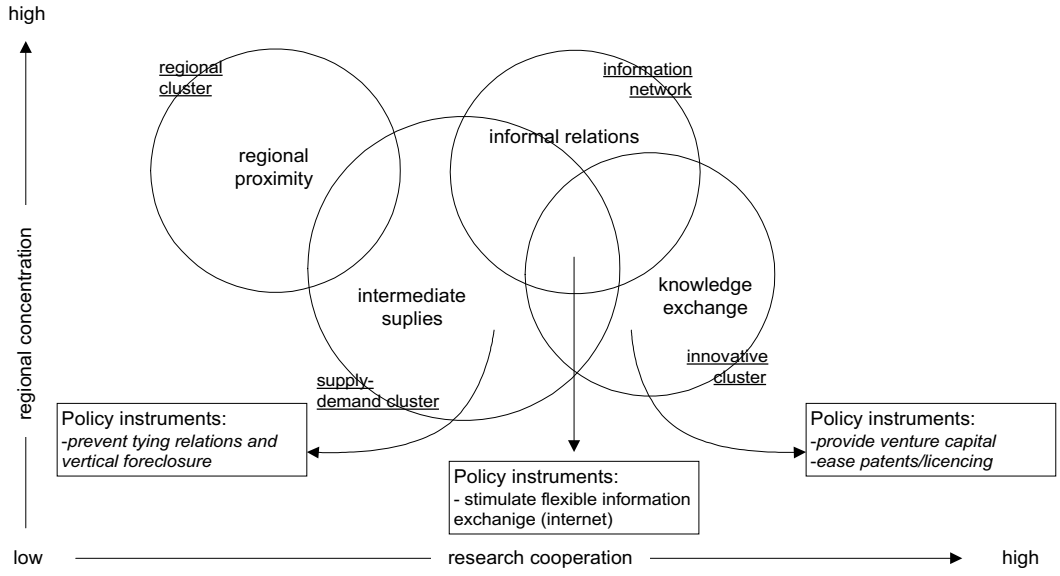
- most clusters concern supply-demand relations or regional concentrations of industries
- regional clusters are often related to intermediate supplies of basic materials, or to external factors like density of population, natural resources or historical background
- innovative clusters or research partnerships of companies within the value chain occur only occasionally; the only innovative clusters refer to large multinationals in basic materials
- information networks of companies within the value chain are particularly relevant for (regional) supply-demand clusters and individual industries with smaller companies, or for (international) enterprises in chemicals, machinery and electronics.

The most comprehensive and emerging clusters are chemicals and media, followed by energy and (public) waste disposal. The companies in these clusters have strong supply-demand relations, significantly exchange knowledge and information through information networks or research partnerships, and are probably concentrated in a few particular regions.

The empirical results differ in various ways from the theoretical conclusions. The mutual relations of the four cluster concepts as described in section 2 should therefore be adapted while policy instruments should be re-assessed. Actually regional proximity of cluster partners matters

only for few supply-demand relations, at least in the small Netherlands. Further, while the theory suggested that information networks have a prominent role in clustering, in reality supply-demand relations seem to play a key role in the clustering of firms. In this respect the scheme in figure 2.1. changes somewhat to the scheme in figure 4.1.

Figure 4.1 Repositioning of cluster concepts and reshape of policy options



Analytical assessment and policy options

According to theory (see section 2), strong supply-demand relations may not only entail economies of scale/scope by vertical specialization, but may also internalize positive externalities related to complementary knowledge exchange and (thus) improved match between supply (products offered) and demand (customers' needs). Indeed, in several industries companies consider main customers or suppliers as an important source of information and thus operate in information networks.

Strong supply-demand relations, however, may also end up in exclusive but tying relations, indulging inflexibility and embroidering on existing ideas, and possibly vertical foreclosure and exertion of monopoly power. Stimulating flexible information exchange on customers' needs and product specifications, e.g. by standard order systems on the Net, may help to reap the benefits from specific information exchange without the potential threat of tying relations.

Only about 10 to 15 % of the innovating companies – mostly in highly concentrated industries– operate in research partnerships with other companies. This may be due to potential free riding,

hold up problems related with asset specificity, and in case of competitors may also be due to the threat of business stealing. If joint research projects are fruitful or even necessary, policy makers can stimulate such projects by arranging venture capital to overcome hold up issues, and/or strengthen intellectual property rights (more patents and licences).

Small innovating companies, like companies in agriculture and printing/publishing, seem to prefer occasional information exchange via information networks. In this way they can easily learn from other competences and public knowhow, and thus benefit from spillovers and network externalities related to knowledge exchange.

The theoretical school on strategic management (e.g. M.E. Porter) suggests that regional proximity of partners or sources may help in making informal contacts and network building. However, we could only occasionally relate identified information networks to specific area's, or regional concentrations of companies to information networks or research partnerships. This suggests that regional proximity is not particularly relevant for information/knowledge exchange[25]. Regional proximity thus only seems relevant for industries supplying basic products with high transportation costs, or for industries dependent on external factors (historical background, density of population, location or natural resources).

Note that this study does not consider the availability of human capital. But Fujita et al. 1999 indicated that the agglomeration of human capital in specific area's (for example near universities) may induce companies to settle down in such area's, possibly such as the electronic industry in southeast N. Brabant. In this report we only searched for (geographical) clusters in which companies are directly related via networks with other companies or institutes.

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[25] The empirical research of Kerste and Muizer, 2001, confirm that knowledge exchange is related with vertical customer/supplier relations, but neither provides hard empirical evidence that knowledge exchange within regional clusters are typically related to the proximity of other cluster partners.

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Appendix A Explanation and illustration of strengths and weaknesses

Obviously the main driving forces of clusters are one of the respective potential strengths[26]. But other potential strengths may also exist because of positive externalities that indulge from technical or institutional/organizational settings, for example:

- appropriability of innovative results on other segments (see Aghion and Howitt, 1996):
  the total benefits of research is larger if the R&D results are applied on a larger scale (which maximises total wealth) in stead of the smaller scale which maximises only the profits of the innovating firm (knowledge transfer in one direction)
- network externalities and spillovers:
  use of complementary know how of other firms, or use of public knowledge of institutes (all articles, knowledge transfer in *two* directions)
- economies of scale in R&D (see e.g. Smulders and v.d. Klundert, 1995):
  more firms will more benefit from research than a single firms, since higher sales revenues can better cover exogenous research cost and risks

Apart from these main types, some archetypes of clusters have other cluster-specific strengths.

Competition may stimulate companies to innovate in order to gain (international)competitive advantage, possibly within clusters. However, product market competition and opportunistic behaviour may bring along several weaknesses that frustrate the success of clustering[27].

Generally speaking, competition and opportunistic behaviour may induce various types of hold up problems:

- business stealing:
  participants are reluctant to contribute or invest in common projects because they fear that their investments help competitors on the product market (see Katz and Ordover, 1990) or provoke free riding by other participants (see Kamien et al., 1992); firms may then even opt to focus on firm-specific research, thereby curtailing outgoing spillovers but also abstaining from incoming spillovers (see Kamien and Zang, 2000)

[26] If the purpose would not be a potential strength, then clustering of the respective archetype would be useless.
[27] The school of input/output clustering suggests that vertical clusters is a perfect third way to benefit from cooperation and mutual knowledge exchange without the potential threats engendered by horizontal competition. However, even vertical relations are plagued with various competitive distortions.

- (creative destruction (see Aghion and Howitt, 1996):

  a research firm attaches no weight to the benefits that accrue beyond its invention, because future innovations based on the current invent make the latter obsolete; from the societal point of view the research firm may be more reserved to invest in R&D)

Further, there is a widespread fear that (horizontal) innovative clusters of competing firms end up in product market collusion.

Vertical clusters may also result in various types of market foreclosure, since exclusive vertical contracts or relation specific investments may result in monopolization of downstream and/or upstream segments. Actually, downstream firms with close relations to upstream firms are more willing to invest in such a relation than non-related downstream firms (and vv., see Bolton and Whinston, 1993). Further, monopolization in the upstream segment (e.g. by technological competitive advantage) may eventually result in monopolization of the downstream segment (by boycotting or price squeezing) (and vv., see Hart and Tirole, 1990).

Finally, emerging trends and institutional changes may intensify the strengths or weaknesses of clusters, and thus affect their success or failure. For example, globalization and opening of markets by reducing import tariffs and other trade barriers may enhance clustering and specialization in countries (see Frujita et al. 1999). Globalization may also intensify the appropriability of innovative results, but also monopolization of regional input markets.

Application of the ICT-technology may ease the diffusion of knowledge, but also intensify business stealing if the (use of) knowledge not sufficiently protected. ICT also intensifies competition, and thus its positive and negative effects on innovation and innovative clusters.

Appendix B Explanation of indices

This appendix fully describes the indices used to identify regional clusters, innovative sluters and innovation networks. We used two general index-types, i.e.

- Gini index: for some dimension the variable of some industry will be compared to the variable of each other industry
- class index: for some dimension split up in several classes[28] the variables per class are weighed by some index-number and then add up to a total of all classes

We used an (adapted) Gini index for the regional concentration of establishments and a class index for the importance of sources of information.

Regional Gini index

The regional Gini index compares the number of establishments in some region with the numbers of establishments in other regions. Since regions have different of economic activity we first adjusted the number of establishments per region for the economic importance of that region.

Now if the (adjusted) number of establishments in some region is fa beyond the number of establishments in other regions, then the Gini index will be high. If the total (adjusted) number of establishments is equally distributed across the county, then the Gini index will be low.

So the full explanation Regional Gini−index (RG_t) entails:

If $y_{t,g}$ the number of of establishments of industry t in area g
y_t the total number of establishmentsof industry t in the Netherlands
n the total number of industries
and $x_{t,g}$ the share of the number of establishments in area g
in the total number of establishments of industry t in the Netherlands,
adjusted for regional differences in the size of economic activity

$$\text{so with } x_{t,g} = \frac{y_{t,g} / y_t}{\sum_t y_{t,g} \Big/ \sum_t y_t},$$

[28] For example the share of companies that consider a source less important, important or very important, or the share of supplies in total sales between 5-10%, or 10% and more.

we obtain $RG_t = \dfrac{\frac{1}{n(n-1)} * \sum_h \sum_g \left| x_{t,h} - x_{t,g} \right|}{2 * \frac{1}{n} * \sum_g x_{t,g}} = \dfrac{1}{2(n-1)} \dfrac{\sum_h \sum_g \left| x_{t,h} - x_{t,g} \right|}{\sum_g x_{t,g}}$.

Notice that $0 \leq RG_t \leq 1$, and the higher RG_t, the stronger the (relative) regional concentration of industry t, taking account with the regional differences in economic acitvity (see also Audretsch en Feldman, 1996) .

Information index

The information index captures the overall importance of the respective source of information. Actually, we define the information index ($I_{t,g}$) as the class index on the share of companies that consider some source as important or very important:

If $y_{t,g,h}$ the proportion of all innovating firms in industry t which consider the source of informantion g as
- somewhat important ($h = 1$)
- important ($h = 2$)
- very important ($h = 3$)

w_h the weight or index - number of the valuation, with $w_h = \begin{cases} 0 \text{ if } h = 1 \\ 1 \text{ if } h = 2 \\ 2 \text{ if } h = 3 \end{cases}$

then we obtain $I_{t,g} = \sum_h w_h y_{t,g,h}$

Notice that $0 \leq I_{t,g} \leq 3$, and the higher the index the more important that source of information for the respective industry.

Appendix C Industry classification

Description with IO-number

01 Arable farming
02 Horticulture
03 Livestock breeding
04 Other agriculture
05 Landscape gardening and agricultural services
06 Forestry and hunting
07 Fishing
08 Crude petroleum and natural gas production
09 Other mining and quarrying
10 Slaughtering and meat-processing industry
11 Canning, preserving and processing of fish and shellfish
12 Canning, preserving and processing of fruit and vegetables
13 Manufacture of dairy products
14 Manufacture of compounded animal stock feeds
15 Manufacture of other food products
16 Coffee-roasting and tea-packaging companies
17 Beverage industry
18 Tobacco processing
19 Textiles industry
20 Clothing industry
21 Leather(ware) and footware
22 Wood, cork and plainting
23 Pulp, paper and cardboard industry
24 Paperware and corrugated cardboard industry
25 Printing and publishing industry
26 Reproduction of recorded media
27 Petroleum processing
28 Manufacture of chemical organic products
29 Manufacture of chemical inorganic products
30 Manufacture of petrochemicals
31 Manufacture of fertilizers
32 Manufacture of chemical final products
33 Rubber- and plastic-processing industry
34 Manufacture of building materials
35 Basic metal industry
36 Manufacture of metal products
37 Machinery industry
38 Manufacture of home appliances
39 Manufacture of office appliances and computers
40 Manufacture of other electrical machinery and appliances
41 Manufacture of audio-, video- and telecom-appliances
42 Manufacture of medical, measure and regulating equipment
43 Automobile industry
44 Shipbuilding and -repair
54 Building construction
55 Ground work, hydraulic engineering, road construction
56 Installation
57 Building completion
58 Renting og building- and demolition machinery
59 Car wholesale trade
60 Car retail trade
61 Car service companies and petrol stations
62 Wholesale trade
63 Retail trade
64 Hotel and catering industry
65 Public transport
66 Freight transport by road
67 Transport through pipelines
68 Sea-shipping
69 Inland shipping
70 Aviation
71 Services related to land transport
72 Services related to sea transport (pilotage services)
73 Services related to aviation
74 Travel agencies
75 Post and telecommunications
76 Banking
77 Insurance
78 Auxiliary financial services
79 Exploitation of residences
80 Exploitation of other real estates
81 Renting of movables
82 Computer service companies
83 Research and development
84 Legal, accounting and economic services
85 Engineers and architects
86 Advertising agencies
87 Employment agencies
88 Cleaning service of buildings
89 Other commercial services
90 Public administration, state
91 Public administration, local
92 Other public administration and social security
93 Defence
94 Scientific education
95 Private education
96 Other subsidized education
97 Health and veterinary services

Description with IO-number	
45 Manufacture of railway-, air- and spacecraft (equipment)	98 Public welfare
46 Manufacture of other transport equipment	99 Waste disposal and cleansing services (private)
47 Manufacture of furniture	100 Waste disposal and cleansing services (public)
48 Manufacture of other products not else mentioned	101 Culture, sports, recreation, radio and television
49 Recycling industry	102 Gambling industry
50 Electricity generation (public utility)	103 Other (personal) services
51 Gas distribution (public utility)	104 Housekeeping services
52 Water supply and distribution	114 Trade and transportation margins
53 Site preparation	

Appendix D Regional supply-demand clusters

The first table below (table D.1) extends table 3.3 of geographically concentrated industries with their main suppliers and customers industries, and for all industries the main regions. More specificly,

- first we selected those industries with a regional Gini-index exceeding the 70% percentile
- then we determined the main customers for which the intermediate supplies in 1999 exceeds 10% of total sales, and the main suppliers for which the intermediate supplies in 1999 exceeds 10% of total sales
- finally we assigned those COROP areas for which the share of total establishments in 1999 exceeds 10% (between brackets 8%)

For comparison we also extended table 3.2 of industries belonging to some identified supply-demand cluster with their main suppliers and customers, and all the main regions of each respective industry (table D.2). More specificly,

- first we selected those industries that belong in 1998 to some supply-demand cluster identified in Hoen and Arnoldus,2000.
- then we determined the main customers for which the intermediate supplies in 1999 exceeds 10% of total sales, and the main suppliers for which the intermediate supplies in 1999 exceeds 10% of total sales
- finally we assigned those COROP areas for which the share of total establishments in 1999 exceeds 10% (between brackets 8%)

Table D.1 The location of mutually dependent industries [a] (Industries selected by regional Gini-index)

Industry...	mainly located in	...with main suppliers	mainly located in	...and main customers	mainly located in
06 Forestry and hunting (0.63)	Veluwe (Achterhoek, Arnhem/Nijmegen, southeast NBrabant)	48 Products not else mentioned 55 Ground work, hydr. engineering, road construction (0.10[b])			
07 Fishing (0.80)	north NHolland, Flevoland, Zeeland	27 Petroleum processing (0.96)	part. Rijnmond	11 Canning/processing fish and shellfish (0.11[c])	
08 Crude petroleum and gas production (0.87)	IJmond,Rijnmond, north NHolland, The Hague	–	–	51 Gas distribution (0.48[d])	(Utrecht, Rijnmond)
09 Other mining/quarrying (0.69)	Arnhem/Nijmegen	09 Other mining/quarrying (0.69)	Arnhem/Nijmegen	09 Other mining/quarrying (0.69) 34 Building materials (0.23)	Arnhem/Nijmegen
18 Tobacco processing (0.91)	particularly Overijssel				
21 Leather(ware) and footware (0.71)	central NBrabant				
23-24 Paper(ware)/cardboard (0.43)	–				
27 Petroleum processing (0.96)	particularly Rijnmond				
35 Basic metal industry (0.51)	(southeast NBrabant, north Limburg)			36 Metal products (0.20)	
39 Office appliances and computers (0.45)	Utrecht (southeast NBrabant)				

Table D.1 The location of mutually dependent industries [a] (Industries selected by regional Gini-index)

Industry...	mainly located in	...with main suppliers	mainly located in	...and main customers	mainly located in
41 Audio-, video and telecom (0.37)	southeast NBrabant	41 Audio-, video and telecom (0.37)	southeast NBrabant	41 Audio-, video and telecom (0.37)	southeast NBrabant
44-46 Transport equipment excl. automobiles (0.49)	(Rijnmond, southwestFriesland)				
with 45 Other transport equipment		–	–	65 Public transport (0.16)	(Rijnmond)
49 Recycling industry (0.53)	(west and southeast NBrabant,)	–	–	35 Basic metals (0.51)	(southeast NBrabant, north Limburg)
50-51 Public energy supply (0.48[d])	(Utrecht, Rijnmond)				
with 50 Electricity generation		50 Electricity generation (0.48[d])	(Utrecht, Rijmond)	50 Electricity generation	(Utrecht, Rijnmond)
51 Gas distribution		08 Crude petroleum and gas production (0.87)	IJmond,Rijnmond, north NHolland, The Hague	02 Horticulture (0.30[c])	
52 Water supply/distribution (0.62)	Amsterdam				
68-69 Sea- and inland shipping (0.66)	Rijnmond, southeast SHolland				
70 Aviation (0.76)	Amsterdam/Schiphol (Rijnmond, Utrecht)			74 Travel agencies (n.a.)	

Source: CBS Input-output table 1999, CBS Statline (regional data)

[a] Between brackets the regional Gini-indices of the respective industry

[b] Gini-index of total construction

[c] Gini-index of total food industry

[d] Gini-index of public energy supply

[e] Gini-index of total agriculture and hunting

Table D.2 The location of mutually dependent industries in supply-demand clusters [a]

Industry in cluster...	mainly located in	...with main suppliers	mainly located in	...and main customer	mainly located in
Cluster 1: energy					
02 Horticulture (0.30[f])	–	–	–	–	–
08 Crude petroleum and gas production (0.87)	IJmond,Rijnmond, north NHolland,The Hague	–	–	51 Gas distribution (0.48[b])	(Utrecht, Rijnmond)
50 Electricity generation (0.48[b])	(Utrecht, Rijnmond)	50 Electricity generation (0.48[b])	(Utrecht, Rijmond)	50 Electricity generation (0.48[b])	(Utrecht, Rijnmond)
51 Gas distribution (0.48[b])	(Utrecht, Rijnmond)	08 Crude petroleum and gas production (0.87)	IJmond,Rijnmond, north NHolland,The Hague	02 Horticulture (0.30[f])	–
Cluster 2: (animal) nutrition					
03 Livestock breeding (0.30[f])	–	14 Animal stock feeds (0.11[g])	–	10 Slaughtering/meat proc. (0.11[g])	–
				13 Dairy products (0.11[g])	–
05 Landscape gardening and agricultural services (n.a.)	–	–	–	02 Horticulture (0.30[f])	–
				03 Livestock breeding (0.30[f])	–
10 Slaughtering/meat proc. (0.11[g])	–	03 Livestock breeding (0.30[f])	–	–	–
13 Dairy products (0.11[g])	–	03 Livestock breeding (0.30[f])	–	–	–
14 Animal stock feeds (0.11[g])	–	–	–	03 Livestock breeding (0.30[f])	–

Table D.2 The location of mutually dependent industries in supply-demand clusters [a]

Industry in cluster...	mainly located in	...with main suppliers	mainly located in	...and main customer	mainly located in
Cluster 3: chemicals					
28 Chem. organic products (0.28[d])	(Utrecht, west NBrabant)	30 Petrochemicals (0.28[d])	(Utrecht, west NBrabant)	–	–
30 Petrochemicals (0.28[d])	(Utrecht, west NBrabant)	–	–	28 Chem. organic products (0.28[d])	(Utrecht, west NBrabant)
Cluster 4: construction					
34 Building materials (0.23)	–	–	–	54 Building construction (0.10[h])	–
54 Building construction (0.10[h])	–	54 Building construction (0.10[h])	–	54 Building construction (0.10[h])	–
55 Ground work, hydr. engineering, road construction (0.10[h])	–	55 Ground work, hydr. engineering, road construction (0.10[h])	–	55 Ground work, hydr. engineering, road construction (0.10[h])	–
57 Building completion (0.10[h])	–	–	–	54 Building construction (0.10[h])	–
				79 Exploitation of residences (0.17)	Amsterdam (Utrecht)
				85 Engineers and architects (0.19[c])	(Amsterdam)
85 Engineers and architects (0.19[c])	(Amsterdam)	85 Engineers and architects (0.19[c])	(Amsterdam)	85 Engineers and architects (0.19[c])	(Amsterdam)
Cluster 5: cars					
60 Car retail trade (0.08)	–	–	–	–	–
81 Renting of movables (0.12)	(Rijnmond)	–	–	–	–

Table D.2 The location of mutually dependent industries in supply-demand clusters [a]

Industry in cluster...	mainly located in	...with main suppliers	mainly located in	...and main customer	mainly located in
Cluster 6: trade					
62 Wholesale trade (0.13)	(Rijnmond, Utrecht)	–	–	114 Trade/transport margins (n.a.)	–
63 Retail trade (0.08)	–	–	–	114 Trade/transport margins (n.a.)	–
66 Freight transport by road (0.16[e])	(Rijnmond)	–	–	114 Trade/transport margins (n.a.)	–
80 Exploitation other estates (0.17)	Amsterdam (Utrecht)	–	–	63 Retail trade (0.08)	–
114 Trade/transport margins (n.a.)	–	62 Wholesale trade (0.13)	(Rijnmond, Utrecht)	–	–
		63 Retail trade (0.08)	–		
		66 Freight transport by road (0.16[4])	(Rijnmond)		
Cluster 7: financial services					
77 Insurance (0.34)	Utrecht (Amsterdam)	78 Auxiliary financial services (0.14)	(Rijnmond, Utrecht)	–	–
78 Auxiliary financial services (0.14)	(Rijnmond, Utrecht)	–	–	77 Insurance (0.34)	Utrecht (Amsterdam)
Cluster 8: travelling					
70 Aviation (0.76)	Amsterdam, Schiphol (Rijnmond, Utrecht)	–	–	74 Travel agencies (n.a.)	–
74 Travel agencies (n.a.)	–	64 Hotel/catering industry (0.14)	(Amsterdam)	–	–
		74 Travel agencies (n.a.)	–		

Table D.2 The location of mutually dependent industries in supply-demand clusters [a]

Industry in cluster...	mainly located in	...with main suppliers	mainly located in	...and main customer	mainly located in
Cluster 9: media					
25 Printing and publishing (0.19)	Amsterdam (Utrecht)	25 Printing and publishing (0.19)	Amsterdam (Utrecht)	25 Printing and publishing (0.19)	Amsterdam (Utrecht);
				86 Advertising agencies (0.19[c])	Utrecht (Amsterdam)
86 Advertising agencies (0.19[c])	(Amsterdam)	25 Printing and publishing (0.19)	Amsterdam (Utrecht)	62 Wholesale trade (0.13)	(Rijnmond, Utrecht)
		86 Advertising agencies (0.19[c])	(Amsterdam)	86 Advertising agencies (0.19[c])	(Amterdam)
101 Culture, sports, recreation,	(Amsterdam)	–	–	101 Culture, sports, recreation,	(Amsterdam)
radio and television (0.11)				radio and television (0.11)	
Cluster 10: communications/banking					
75 Post/telecommunications (0.15)	(Amsterdam, Rijnmond)	–	–	–	–
76 Banking (0.20)	Amsterdam	–	–	–	–
	(Rijnmond, Utrecht)				
Cluster 11: public waste disposal					
91 Public administration, local	–	–	–	–	–
(0.17[i])					
100 Waste disposal and cleansing	Rijnmond (Amsterdam)	–	–	91 Public administration, local	–
services (public) (0.25[k])				(0.17[i])	

Source: CBS Input-output table 1999, CBS Statline (regional data), Hoen and Arnoldus 2000 (classification in supply-demand clusters)

[a] Between brackets the regional Gini-indices of the respective industry

[b] Gini-index of public energy supply

[c] Gini-index of other commercial services

Table D.2 The location of mutually dependent industries in supply-demand clusters [a]

Industry in cluster...	mainly located in	...with main suppliers	mainly located in	...and main customer	mainly located in
[d] Gini-index of total chemical industry					
[e] Gini-index of total transport on land					
[f] Gini-index of total agriculture and hunting					
[g] Gini-index of total food industry					
[h] Gini-index of total construction					
[i] Gini-index of total government and social security					
[k] Gini-index of private and public waste disposal and cleansing					