Innovative Clusters

Identification of value-adding
production chains and their networks
of innovation, an international studies

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Preface

You have just started reading my doctoral thesis, the conclusion of my academic education in Economics at the Erasmus University Rotterdam. This thesis is about clusters and their innovative behaviour, notions that have largely dominated my weekdays from October 1997 on. Apart from a 4-month interruption, I have been studying these subjects as a research student with the Ministry of Economic Affairs in The Hague.

Over the last few years, research on cluster analysis within the Ministry has focused on the OECD research project on National Innovation Systems, cluster analysis and cluster-based policy. This easily explains the fact that my thesis deals with clusters and National Systems of Innovation. Hopefully my thesis can be of any value to (some of) the other researchers in this line of work.

Special thanks go to my 'teacher in clusters' dr Theo Roelandt. He devoted a lot of time mentoring me during my period as a researcher with the Ministry. The interaction with Theo has made this project to what it is. I know what an amount of his patience this must have demanded… I'm also very grateful to prof.dr Jarig van Sinderen. Not only my boss at the Ministry of Economic Affairs, he also supervised this paper on behalf of the Erasmus University.

Uiteraard wil ik ook graag mijn ouders en mijn zus bedanken. Zij hebben mij altijd onvoorwaardelijk gesteund in alles wat ik ook maar meende te moeten ondernemen, en daar ben ik hen enorm dankbaar voor. Mijn collega's op het Ministerie van Economische Zaken, in het bijzonder op de directie Algemene Economische Politiek, wil ik hartelijk bedanken voor de steun die ze mij hebben gegeven, maar vooral voor de lol die we hebben gehad. De lunches, koffie-sessies, vrijmibo's en voetbalwedstrijden (altijd drie helften!) hebben er voor gezorgd dat ik me een beetje EZ'er zal blijven voelen. Last but not least gaat mijn dank uit naar de mensen die ervoor gezorgd hebben dat ik met pijn in mijn hart afscheid neem van mijn studententijd. Tegen mijn (oud)-huisgenoten uit Huize "de Vleeschmarkt", clubgenoten uit jaarclub Duimschroef en gewoon a-selecte vrienden zou ik willen zeggen: môgge lul!

Hessel Verbeek
Rotterdam/The Hague, August 1999

1 Introduction and research questions

This introduction will briefly discuss the two main topics of this thesis: clusters and National Systems of Innovation. We will also establish the link between these two. Once the context is clear, the research questions of this paper will be stated and the new elements of this approach will be highlighted. After the introductory part it's time to start digging deeper.

1.1 Clusters

The word 'cluster' is a much-used buzzword nowadays. It is used to address a wide variety of things. In economics, clusters have already become a familiar (yet still very heterogeneous) concept as well. Over the last decade, cluster concepts of all kinds have been an element of growing importance in the economic research agenda, at least in the Netherlands. The impact of the cluster concept (and the confusion surrounding it) can be illustrated by a search on the World Wide Web (the Internet) on June 28, 1999. Using the 'Internet search engine' AltaVista (internet address or URL: http://www.altavista.com) yielded no less than 758.190 Web pages that matched the query *cluster*, 10.813 pages that matched *cluster analysis* but only 52 pages that matched *cluster policy*. Of these 52 pages on *cluster policy*, there were 16 publications regarding terms of usage of a university computer network, 5 were referring to series of financial contracts and 15 pages concerned topics such as housing, education, astronomy and mathematics. Only 16 out of the 52 pages actually related to cluster policy in an economic sense while 8 of these 16 pages were publications by the Dutch Ministry of Economic Affairs. Apparently cluster policy is still in its infancy…
This search on the Internet illustrates the wide spread use and the confusion surrounding the term 'cluster'. The term is very much in fashion and used for a variety of things, most of the time not for economic concepts! Now what does the dictionary have to say?

*"**1** A **cluster** is **1.1** a number of things gathered close together in a small group, especially around a central point. **1.2** a number of things of the same type growing close together.*
***2** If things **cluster** together, they gather or are found together in a small group, especially around a central point."* (COLLINS COBUILD ENGLISH LANGUAGE DICTIONARY, 1987)

So the dictionary isn't very helpful either, it merely states that a cluster is a small group, which is not necessarily true in economic theory.
If we use the term cluster in an economic context only, we are still left with a confusion of tongues. As will be elaborated upon in chapter 2, two main cluster approaches can be identified:

Exhibit 1.1: the two main cluster approaches

- cluster approaches based on similarity; and
- cluster approaches based on interdependency.

Cluster approaches based on similarity start from the assumption that economic activity clusters because of its need for equal framework conditions (similarity in research, labour skills, specialised supplies etc. etc.). The approaches based on interdependency assume that economic activity clusters because dissimilar actors need each other's competencies in order to successfully operate and create innovations.

An example of a similarity-based cluster approach is the regional one. This approach focuses on similar economic activity concentrating in geographical space. The champions of the regional cluster approach are Alfred Marshall and Paul Krugman (MARSHALL, 1890; KRUGMAN, 1991). Because of its foundations in the traditional sector classification, the sectoral approach concentrating on Michael Porter's famous cluster notion is similarity-based as well (PORTER, 1990). Porter and his followers use the competitive advantages of nation-wide industry groups as the clustering yardstick in their highly standardised technique.

Based on interdependency is the production chain approach. It is often also called the 'filière'-approach, because Frenchmen Lafay and Montfort started studies in this field, calling the networks they found 'filières de production' (LAFAY ET AL., 1977; MONTFORT, 1983). The production chain studies focus on supplier-user relationships, be it of supplies of goods, services, technology, knowledge or of supplies of any other kind. This approach is in use with the OECD and the Dutch Ministry of Economic Affairs and it is also the approach we will follow. The policy definition is that clusters are economic networks of firms, knowledge producing agents, bridging institutions and customers, linked to each other in a value-adding production chain. The focus is on the linkages and interdependence between actors in the network of production when producing products and services and creating innovations.

Given the focus on the fact that these networks incorporate dissimilar competencies in order to

evaluated on its share in the total deliveries made by the supplier and to the user. If the delivery is substantial to both the supplier and the user a link between the two industries is established.
The upstream part of the input-output analysis follows the same routine as the downstream part; the difference being that instead of the maximum delivery made by each supplier now the maximum delivery made to each user is treated.
Combining the industry-links from the downstream and the upstream analysis enables drawing up directed graphs with arrows representing the links between the industries. Using these graphs the clusters are relatively easily identified.
Another computer algorithm was written in SPSS in order to analyse the data in the Community Innovation Survey. This survey describes how firms innovate while the algorithm is designed to assign scores on constructed measures of innovative behaviour. The independent measures are '*structural innovation*', '*knowledge transfer channels*', '*information sources*' and '*R&D networks*'. The measure '*innovation networks*' is a dependent of the other four measures, since it is a composite of these.
The measures of innovative behaviour are assigned to the identified clusters by linking industry group codes, thus resulting in an economy-wide mapping of clusters and the way they innovate. Up front it must be admitted, that although this approach is very promising, results are not completely dependent yet. Due to data limitations (partly incomplete, partly incomparable data) reliable conclusions about the correlation between cluster structure and innovative performance can't be drawn. Of course, this also affects the possibility and the use of drawing policy implications.
Despite the limitations, this still useful project adds new elements to research:

Exhibit 1.5: new elements in this paper

- the introduction of 'double thresholds' or 'double cut-off points' in the input-output analysis, meaning that in the upstream as well as in the downstream part of the cluster algorithm each potential link-establishing delivery is judged on its relative importance to both the supplier and the user;
- the treatment of industry groups that are difficult to classify as whether belonging to a cluster;
- the combination of input-output analysis and graph theory in cluster analysis, with I/O-analysis providing the data that are used to construct the graphs which identify the clusters;
- the use of the Community Innovation Survey in identifying measures of innovative behaviour might not be new in itself (DEBRESSON ET AL., 1997), more and new measures are developed which also incorporate more survey-information;
- the linking of cluster identification and measuring innovative behaviour, thus giving the research more relevance, especially in the context of the National Systems of Innovation approach; and
- the international benchmark aspect of the research.

After this introduction of the topics and the research questions, Chapter 2 ("*Clusters and National Systems of Innovation: theory and analysis*") will continue to discuss the different approaches towards clusters and National Systems of Innovation in more depth. This chapter will also (briefly) cover the consequences of these concepts for economic and industrial policy.
In the part dedicated to clusters, Chapter 3 ("*Cluster analysis with double thresholds, based on input-output tables*") will explain about the approach and algorithm applied in this thesis. The results of the cluster analysis for the analysed countries will be highlighted and compared in Chapter 4 ("*Results cluster analysis for 5 OECD-countries: Belgium, Denmark Finland, the Netherlands and Spain*").
The part on systems of innovation follows this same path by first explaining approach and algorithm in Chapter 5 ("*Analysis of styles of innovation, based on the Community Innovation Survey*") and then bringing forward the results of the analysis in Chapter 6 ("*Results styles of innovation for 3 OECD-countries: Belgium, Denmark and the Netherlands*").
Chapter 7 ("*Concluding remarks*") will cover the most striking results from this thesis from a bird's eye of view; this chapter also concludes the thesis.

2 Clusters and National Systems of Innovation: theory and analysis

What exactly is a cluster? Are clusters in themselves new to the economy, is the cluster concept new to economics or is it just a hype in economic literature to publish about clusters, cluster analysis and cluster policies? In fact, clusters and the cluster concept are not new at all. It's just that ever since Porter published *The competitive advantage of nations*, the concept of clusters has received a lot of attention in the public debate about industrial policy (PORTER, 1990). Despite all this attention, there seems to be no consensus about the definition of and approach towards clusters. According to Jacobs and De Man roughly three groups of (related) cluster notions can be distinguished (JACOBS & DE MAN, 1995):

- regionally concentrated industry;
- sectors or groups of sectors; and
- production chains.

But, as we stated in the first chapter, there are two more fundamental cluster bases, which we will keep bearing in mind during this chapter:

- cluster approaches based on similarity; and
- cluster approaches based on interdependency.

2.1 Regional clusters

The similarity-based regional cluster approach is an old one, in his *Principles of Economics* Marshall already mentioned 'industrial districts' (MARSHALL, 1890).
According to Marshall, the development of regional clusters went way back in time, because of the existence of competitive advantages:

"*The causes by which localized industries have been originated are various. But the chief of them have been physical conditions…Another chief cause has been the patronage of a court…Such natural advantages may themselves have stimulated free industry and enterprise: but it is the existence of these last, by whatever means they may have been promoted, which has been the supreme condition for the growth of noble forms of the arts of life.*"

According to Marshall, the main advantages of localized industries are innovative interactions between people, specialised supplies and a skilled labour pool. In other words, localized industries have similar needs with regard to framework conditions.
Porter touched on the subject as well, one century after Marshall's book was published. Krugman recently even up-dated Marshall's original concept (KRUGMAN, 1991).

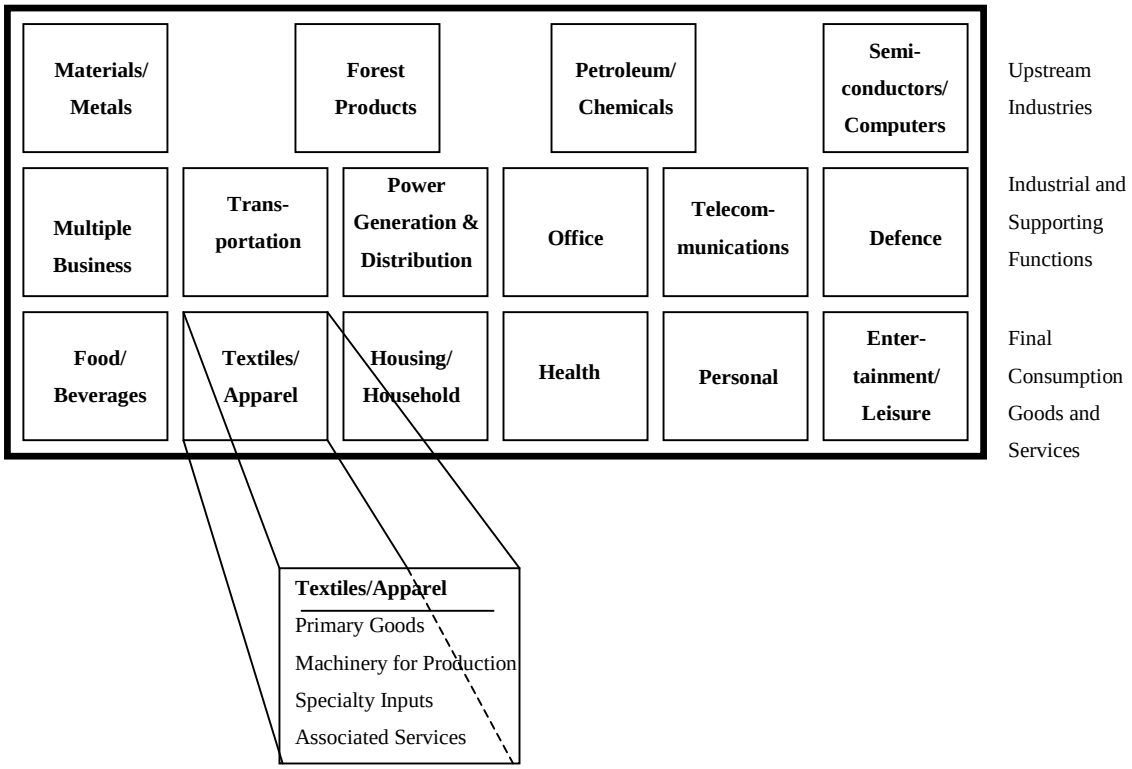
So industrial districts are still en vogue, although recent studies revealed some shortcomings. An analysis for the Netherlands shows large per cluster differences in geographical scale, structure and content (KUSTERS & MINNE, 1992), which could indicate difficulties in international comparison.

Another point of attention is the contrast in scale between regional clusters and their relevant markets. How useful is it really to look at a cluster from a specific regional viewpoint while the users are spread globally?

2.2 Sectoral megaclusters

Porter's 1990 book is the driving force behind the sectoral approach, which links sectors in megaclusters.

Exhibit 2.1: Porter's cluster chart



Source: PORTER, 1990

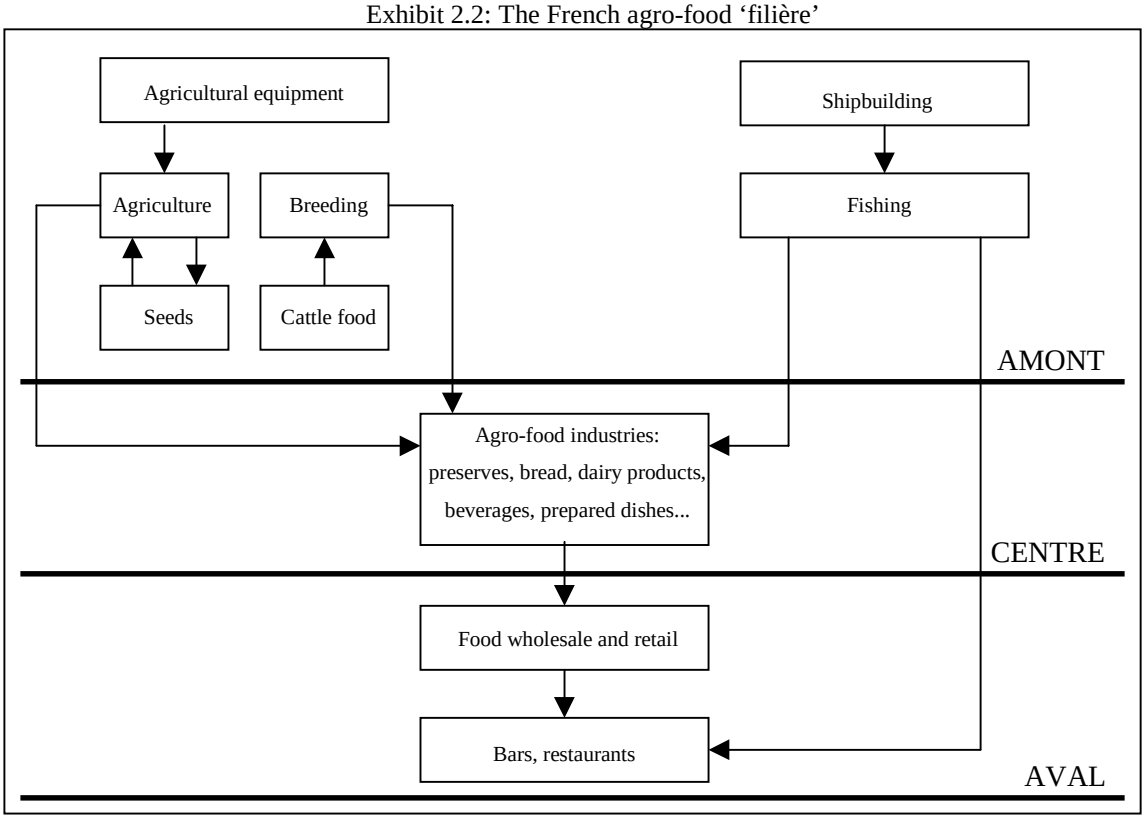
The similarity-based Porter approach is a standardised one, incorporating sixteen possible clusters, sub-divided in three industry groups (upstream, support, consumption) at four different levels (goods, machinery, input, services), per group and level dependent on similar framework conditions. Porter clusters on the basis of competitive advantages within industries. Each nation's cluster chart is constructed by identifying the industries that are successful in international trade, the measurement for success being significant exports or foreign direct investment.

Porter's cluster approach was a breakthrough, because it is standardised, ready-to-use and goes beyond traditional boundaries dividing sectors in primary, secondary and tertiary sectors.
The critique on this method focuses on the fact that it indicates what the specialisation patterns in a country are, but not what the networks are or what they look like.
The approach has been adapted world-wide. In the Netherlands, multiple Porter studies have been performed. In 1992 the most recent Dutch cluster chart was constructed (JACOBS ET AL., 1992).

2.3 Chains and networks

All the concepts in the chain or network approach have a common assumption: firms don't (successfully) operate in isolation. Firms are part of a larger entity of users, suppliers, competitors and other economic actors with network relations representing knowledge and production flows.
The so-called 'filière'-approach started in France, where Montfort started research (MONTFORT, 1983) and subsequently found nineteen French 'filières' (MONTFORT & DUTAILLY, 1983).
Montfort bases analysis on significant intermediary supplies as in input-output tables, and divides his analysis in an upstream ('amont'), a centre ('centre') and a downstream ('aval') part.

Exhibit 2.2: The French agro-food 'filière'



Source: MONTFORT, 1983

The French agro-food 'filière' is a good example of an integrated chain or network where users and suppliers interact and innovate in products and processes (albeit at a rather high level of

aggregation). This is an example of a very traditional, almost sectoral, network, without a lot of innovative sector combinations. Still, this network clearly has its base in mutual interdependencies rather than similarity.

Montfort's approach was adapted for the Netherlands by Roelandt, identifying six 'mega-filières' (ROELANDT, 1986), and by Witteveen, identifying ten 'mega-filières' (WITTEVEEN, 1997).

The main advantage this method has is the insight it offers: it not only shows what the clusters are, it also shows who the actors are and what the relationships between the actors look like.

The main critique on the 'filière' or production chain method is the fact that it is a quantitative approach, but that there is always the need for a subjectively called cut-off point. The cut-off point is the threshold for the intermediary supplies: is the quantitative intensity of a supply above the cut-off point then a link is established, is the quantitative intensity of a supply under the cut-off point however, no link is established.

But the 'filière' approach is not the only chain or network method (as illustrated in exhibit 2.3). However great the idea behind them is, the methods aiming at compiling technology flow matrices, innovative interaction matrices and triangularized matrices aren't useful in this thesis. Besides the difficulties in compiling them they have the drawback that they don't arrive at actually identifying networks, they merely show innovative interactions in a matrix format.

The methods developed by Feser and Bergman and Bergeron et al. aren't useful here either, for the simple reason that their foundation is similarity rather that interdependency. Looking at their foundations, the concepts of similarity-based clusters and National Systems of Innovation are incompatible. National Systems of Innovation have their centre of gravity in similar *and* dissimilar actors interacting in order to be innovative. The interdependency hypothesis of innovation is called like this for a reason…

Although the use of make&use tables is a refined version (mainly because of its lower aggregation level) of the Montfort/Roelandt/Witteveen 'filière' approach we will not follow this lead here either. The poor availability of data prevents this method from being useful for international studies, at the moment at least.

Because of its quantitative way of analysis, the way it offers insight and overview of the clusters found and last but not least the connection between the value-adding production approach and the concept of National Systems of Innovation this study will follow the lead of Montfort, Roelandt and Witteveen. This means trying to develop an input-output table based quantitative method to identify value-adding production chains of main users and main suppliers (useful for international cluster comparison and further analysis of innovation networks). The guiding cluster definition used will be:

"*Clusters can be characterised as being economic networks of strongly interdependent firms (including specialised suppliers), knowledge producing agents (universities, research institutes, engineering companies), bridging institutions (brokers, consultants) and customers, linked to each*

other in a value-adding production chain. The cluster approach focuses on the linkages and interdependence between actors in the network of production when producing products and services and creating innovations." (ROELANDT & DEN HERTOG, 1998)

Exhibit 2.3: network cluster concepts

Name	Method	Foundation	Data	Output
SCHMOOKLER, 1966	Compilation of intermediary technology flow matrix.	Interdependency	-	-
SCHERER, 1982	Compilation of intermediary technology flow matrix.	Interdependency	1974 R&D-expenditures and 1976-1977 patent data, USA.	Technology flow matrix, 41 rows (suppliers) x 53 columns (users).
MONTFORT & DUTAILLY, 1983	Linking supplier to its main user and user to its main supplier.	Interdependency	1981 I/O-table, 90x90 sectors, France.	19 clusters
ROELANDT, 1986	Linking supplier to its main user and user to its main supplier.	Interdependency	1977 I/O-table, 24x24 sectors, the Netherlands.	6 clusters
HANEL, 1994	Compilation of patent-weighted intermediary technology flow matrix.	Interdependency	1978-1989 patent data and input-output tables, Canada.	Patent-weighted intermediary technology flow matrices.
VAN DER GAAG, 1995	Linking supplier for its main product with products main user and linking user for its main product with products main supplier.	Interdependency	1991 make&use tables, 230 sectors x 650 product groups, the Netherlands.	9 clusters
DEBRESSON ET AL., 1994	Compilation of innovative interaction matrix.	Similarity	1981-1985 survey data, Italy.	43x66 innovative interaction matrix
DEBRESSON ET AL., 1994	Compilation of triangularized (innovative) activity matrix.	Interdependency	1981-1985 I/O-tables and survey data, Italy.	30x66 triangularized domestic requirement matrix
FESER & BERGMAN, 1997	Linking industries that have similar buying and selling patterns.	Similarity	1987, I/O table,478x478 sectors, USA.	23 clusters
WITTEVEEN, 1997	Linking supplier to its main user and user to its main supplier.	Interdependency	1993 I/O-table, 213x213 sectors, the Netherlands.	10 clusters
BERGERON ET AL., 1998	Constructing technology-industry table, linking industries and technologies united by proximity.	Similarity	1985-1990 patents by French firms in USA.	12 techno-industrial clusters

2.4 Different dimensions to different cluster approaches

Choosing the 'right' cluster approach is impossible. There is no right approach. There are however appropriate approaches, depending on your intentions. Besides the basic distinction between similarity and interdependency-based approaches there are of course still other dimensions. Each

approach incorporates certain dimensions, blended to get a resulting mixture suitable for a certain purpose. The following dimensions have been identified, where the distinction between similarity and interdependency-inclined dimensions are an addition of this thesis:

Exhibit 2.4: dimensions of different cluster approaches

- geographical (*similarity/interdependency*): spatial clustering in a production network or in a composite of production networks;
- horizontal (*similarity*): classical sector classification at a specific level of aggregation;
- vertical (*interdependency*): composite of production chains (supply networks and outsourcing networks), the strategically important question being: who within the network is the main cause of innovation?
- lateral (*similarity*): 'related' sectors with shared capabilities and the possibility of synergy;
- technological (*similarity*): (overlap with the lateral dimension) related technologies and technological characteristics that could link sectors;
- knowledge (*interdependency*): relationship to relevant knowledge infrastructure (education and research); and
- network quality (*interdependency*): nature and quality of co-operation between companies.

Source: JACOBS & DE MAN, 1995

Depending on the purpose one wishes to serve everyone should choose his or her own definition, matching the dimensions relevant in research or policy. Doing research on productivity and the regional textile cluster the industrial district approach would seem logical, just like when writing a thesis about clusters and National Systems of Innovation one should use the value-adding production chain concept!

2.5 National Systems of Innovation

Although there is little confusion about what is meant with the concept of National Systems of Innovation (less confusion than about the cluster concept anyway), there are several definitions specifying this concept. This doesn't come as a surprise, since the concept is only less than 20 years old. The original definition Freeman came up with in the mid-1980s has been modified and extended over time by several authors. A good overview of definitions of National Systems of innovation bas been compiled by the OECD:

Exhibit 2.5: definitions of National Innovation Systems

A national system of innovation has been defined as follows:

- ".. the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies." (FREEMAN, 1987)
- ".. the elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge ... and are either located within or rooted inside the borders of a nation state." (LUNDVALL, 1992)
- ".. a set of institutions whose interactions determine the innovative performance ... of national firms." (NELSON, 1993)
- ".. the national institutions, their incentive structures and their competencies, that determine the rate and direction of technological learning (or the volume and composition of change generating activities) in a country." (PATEL AND PAVITT, 1994)
- ".. that set of distinct institutions which jointly and individually contribute to the development and diffusion of new technologies and which provides the framework within which governments form and implement policies to influence the innovation process. As such it is a system of interconnected institutions to create, store and transfer the knowledge, skills and artefacts which define new technologies." (METCALFE, 1995)

Source: OECD, 1997b

As modern innovation theory is relatively young, the dominating view on innovations over the preceding decades has persisted fairly long. Schumpeter qualifies innovations as 'Neue Kombinationen' of existing knowledge and competencies (SCHUMPETER, 1942), with single companies being the motive force behind these re-combinations. These single companies are the so-called 'Schumpeterian heroic entrepreneurs'. Schumpeter argues that innovation and competitiveness benefit from a concentrated market structure and a large firm size. This would better enable the heroic entrepreneurs to re-combine knowledge and competencies. According to Schumpeterian economists this is because large firms with market power have (ROELANDT ET AL., 1997b):

- superior access to external capital;
- a better ability to pool and spread risks and to gain monopoly profits;
- economies of scale and scope in the production of innovation; and
- more possibilities to finance R&D out of their own resources and to appropriate the returns on innovation.

This view is contested by modern interactionistic innovation theory, because the interdependency hypothesis of innovation proves that successful and innovative firms seldom innovate alone and because there is plenty evidence that innovative interaction is pervasive in the economy

(DEBRESSON, 1996; DEBRESSON ET AL., 1997). Chris DeBresson, the champion of this hypothesis makes his point:

"*Any technique is necessarily a combination of different component elements - artefacts, competencies, procedures and organization. Therefore, any innovation is necessarily a recombination of such elements. Some elements may be new, others may not; but they all have to be made to fit together. Therefore any innovation of a new technique requires more than one component innovation; and this can only be brought about by dissimilar competencies. As no one organization can possibly keep internally all these dissimilar competencies, but tends to focus on similar competencies, innovation can only be undertaken through the collaboration of different enterprises.*" (DEBRESSON, 1999)

The increasing importance of and attention for national innovation systems has a major cause in an economic trend called 'alliance capitalism', being the co-existence of by globalisation and liberalisation sharpened competition with an increasing number of network relations and strategic alliances (DUNNING, 1997). The view of the OECD is in line with that of Dunning, relying on the interactionistic innovation theory and the National Systems of Innovation approach: innovation is an interactive learning process demanding knowledge exchange, interaction and co-operation between various actors in a network of production or value chain (OECD, 1997a). Alliance capitalism and innovative interactions cross sectoral borders, which demands a cluster concept does this as well. The value-adding production chain approach to clusters fits this demand.

2.6 Policy roles

Cluster policy basically is an industrial policy aimed at supporting existing or potential value-adding production chains and their environment rather than at companies. Since cluster policy is a relatively new profession, international comparison of policies doesn't yet lead to crystallized best practices. There are however elements of cluster policies that return in policies in many countries. But before comparing cluster policies internationally, first Dutch cluster policies will be discussed. With the growing acceptance of the existence of National Systems of Innovation the policy role for governments is changing. A fundamental question raised in the Netherlands in this matter is whether the government should have a role to play at all. After all, the rise and functioning of clusters and innovation is a process driven by market forces. A strong argument is that the government shouldn't interfere with the market forces indeed, but that it should make sure that the market forces are able to do what they are supposed to: industrial (cluster) policy should aim at nothing more than facilitating the smooth and dynamic functioning of markets. Governments

should thus focus on creating favourable framework conditions and reducing market imperfections (ROELANDT ET AL., 1997a).

In the formulation of Dutch cluster policy, rationales for the government trying to reduce or even remove market imperfections include the following:

Exhibit 2.6: Dutch rationales for government intervention targeting market imperfections

- Informational and organisational failures and externalities hindering the full realisation of synergies stemming from the interaction between actors in the innovation process. These synergies are an important factor in a country's production network competitiveness;
- The social rate of return on R&D-investments can in some cases outrun the private rate of return on R&D-investments; and
- Matching private needs with public funded research can boost the rate of return on investments in public R&D.

Source: ROELANDT ET AL., 1997a

For these reasons in the Netherlands the role of the government in industrial (cluster) policy is shifting from direct intervention to indirect inducement: being a facilitator of networking, a catalyst of dynamic comparative advantage and an institution builder, creating an efficient incentive structure to remove systemic and market inefficiencies in National Systems of Innovation (ROELANDT & DEN HERTOG, 1998).

Dutch cluster policy nowadays is based on three pillars:

Exhibit 2.7: Dutch cluster policy

- creation of favourable framework conditions;
- acting as a broker of supply and demand and provide strategic information; and
- being a demanding customer.

Source: MINISTRY OF ECONOMIC AFFAIRS, 1997

In OECD-countries in general the concept of National Systems of Innovation has influenced and changed the rationales for cluster policy in the 1990s. It is generally accepted that governments shouldn't only target market failures, but system imperfections as well. Boekholt and Thuriaux identified the following rationales as commonly used in industrialised countries:

Exhibit 2.8: Cluster policy rationales in industrialised countries

- government regulations hamper innovation or competitiveness of a particular cluster;
- SMEs do not grasp opportunities to improve competitiveness and innovation which could come from collaboration with other firms;
- firms, particularly SMEs, can not access or retrieve strategic knowledge when operating in isolation;
- firms do not utilise the expertise of (public) knowledge suppliers whereas knowledge suppliers are not sufficiently equipped to market their knowledge;
- existing or potential clusters lack identity and self-awareness which could improve their marketing;
- existing or potential clusters lack crucial components, which would increase synergy and competitiveness of the whole; and
- business services could be delivered more efficiently to groups of firms rather than to single firms.

Source: BOEKHOLT & THURIAUX, 1999

Looking at these rationales, one guiding principle is clear: in contrast with traditional economic and/or industrial policy, cluster policy has a fundamentally different rationale. In modern cluster policy in OECD-countries the focus is on network linkages and the network environment, instead of the individual firm.

With these rationales acting as a building block, four dominant cluster policy models can be observed: the National Advantage Model, the SME Networking Model, the Regional Development Model and the Industry-Research Link Model. The four models are elaborated upon in exhibit 2.10 (BOEKHOLT & THURIAUX, 1999). One note has to be made here, however.

In this classification, the National Advantage Model and the Industry-Research Link Model are regarded as the instruments of Dutch cluster policy. This might be true from a functional viewpoint, but it certainly isn't when looking at the destination of policy instruments.

Exhibit 2.9: distribution of Dutch cluster policy money over business size-classes (1997)

Employees	**Percentage policy money**
0 – 9	15%
10 – 49	19%
50 – 99	12%
100 – 249	12%
250 – 499	8%
500 – 999	8%
1.000 – 9.999	23%
10.000 – 24.999	0%
>25.000	3%

Source: SENTER, 1999

The cluster arrangements regarded here are the "Business related international technological co-operation programs" (BIT), the "Business related technological co-operation projects" (BTS), the "Economy, ecology and technology program" (EET), the "Credit arrangement development electronic services" (KREDO), the "Credit arrangement development environmental friendly products" (MPO), the "Subsidy feasibility studies SME" (SHP), the "Subsidy maritime research" (SMO), the "Subsidy environmental technology projects" (SRM), the "Credit arrangement technological development" (TOK) and the "Fiscal law on support of R&D" (WBSO), with the WBSO accounting for 66% of total policy money. The distribution of money from these policy arrangements over businesses in different size classes (58% of policy money ending with business with less than 250 employees) indicates that Dutch cluster policy might be related to the SME Networking Model more than to the National Advantage Model or the Industry-Research Link Model.

Exhibit 2.10: the dominant international cluster models

	Level	**Aim to improve**	**Typical action**	**Typical countries**
National Advantage Model	Mega/Meso	'National advantage' in certain sectors or value chains	Identify clusters and create supporting conditions.	Canada, Denmark, Finland, Sweden, Netherlands
SME Networking Model	Micro/(Meso)	SME-competitiveness	Increase interactions with 'external knowledge carriers' to compensate for lack of capabilities to innovate and learn from others.	Australia, New Zealand, Norway, USA
Regional Development Model	Meso/Micro	Attractiveness, economic performance and development of a region.	Stimulate business specialisation patterns by investments and networking initiatives.	Canada, Scotland (UK), USA, Wales (UK)
Industry-Research Link Model	Micro/(Meso)	Collaboration and networking between industry and research.	Creating 'critical mass' in emerging technologies by attracting research facilities, investors and firms.	Austria, Germany, the Netherlands

Source: BOEKHOLT & THURIAUX, 1999

Although the only right conclusion from this paragraph can be that the ideal cluster policy doesn't exist at all, or still has to be found yet, some points can be made. A valuable contribution in this respect was made by Richard Nelson when delivering the Tinbergen Lecture in Amsterdam (NELSON, 1999).

Nelson comments on the industrial policy debate between on one hand the pro-active industrial policy supporters and on the other hand the conservative policy supporters. The pro-activists seem fit specific public policy measures to support key industries while the conservatives feel that industrial policy is about 'getting the basics right'. According to Nelson, effective industrial policy is in general focused on creating favourable framework conditions instead of supporting individual firms or technologies. On the other hand, he claims that policies, regulatory structures and institutions are often sector specific. This doesn't mean, however, that government should involve itself in 'picking the winners', because of the unpredictability of external factors and of firm behaviour.

"*To recognize, explicitly, that effective policies and institutions need to be tailored and that one size shoe does not fit all means that it is not fruitful to think about industrial policies 'in general'. The proposition that how a policy will work depends on the firm themselves means that the development of an effective industrial policy has to involve an interactive process between these firms and relevant government agencies.*" (NELSON, 1999)

Knowing how Nelson feels about industrial policy and keeping in mind the policy definition of clusters as "value-adding production chains of firms, knowledge producing agents and customers, with a focus on the linkages and interdependence of the actors when producing and innovating", some policies seem more right than others.
The Regional Development Model to begin with is based on similarity rather than on interdependency, and therefore shouldn't be favoured. Furthermore you can wonder whether a regional approach is very appropriate in the context of the growing globalisation of markets and of networks of firms.
As for the interdependency-based National Advantage Model, the SME Networking Model and the Industry-Research Link Model: in a way the SME Networking Model and the Industry-Research Link Model are both tailored adaptations (at a different level) of the National Advantage Model. A combination of the National Advantage Model with one or both of these two models might just do the trick, by getting the basics right in the first place and then using more specific policies only where and when necessary…

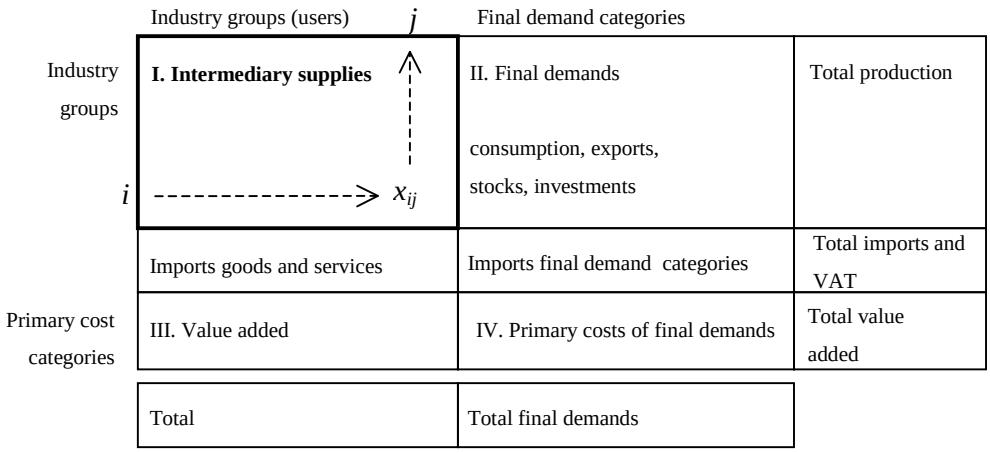
3 Cluster analysis with double thresholds, based on input-output tables

In this chapter, the workings of input-output tables will be explained first. After a brief introduction in the use of these matrices, the subject will shift to the cluster algorithm and graph analysis.

3.1 Input-output tables

In order to identify value-adding production chains within national economies, we analyse the intermediary supplies part of input-output tables. The intermediary supplies table incorporates all intermediary supplies made from supplying to using sectors. The purpose of cluster analysis is to identify strong use-supply patterns within these tables. Ideally, combining these use-supply patterns yields groups of industries that have close ties to each other within this input-output tables. These groups of industries are called value-adding production chains or clusters.
The intermediary parts of input-output tables are square, meaning that the number of rows equals the number of columns, meaning that all industry groups are both a supplier and a user in these tables.
To be clear, in exhibit 3.1, supply x_{ij} is a supply made by industry group i to industry group j.

Exhibit 3.1: Input-output table



Input-output tables have two different possible measurements: constant prices and current prices. Since current prices do best represent changes in relative price levels, they are the measurement that is to be favoured in input-output analysis.

3.2 The cluster algorithm

The cluster algorithm is based on earlier methods (MONTFORT, 1983; ROELANDT, 1986; WITTEVEEN, 1997) but has new, distinctive features of its own. These are partly brand new elements, and partly incremental improvements due to the fact that this algorithm was written in a

different computer language (GAUSS). Before elaborating on the algorithm, in specific the new elements, the mechanics of the program will be explained.

There are actually two programs, a program for downstream analysis and a program for upstream analysis. The downstream part is concerned with looking for cluster-linkages because of the intermediary supplies made *from* the supplier *to* the user, while the upstream part is dedicated to supplies made *to* the user *from* the supplier. A downstream cluster-linkage is established when the supply made by a particular supplier to its major user represents a relative value surpassing the arbitrarily set threshold value. An upstream cluster-linkage is established when the supply made to a particular user from its major supplier represents a relative value surpassing the arbitrarily set threshold value.

Exhibit 3.2: the downstream cluster algorithm

Downstream

- The I/O-table, the rows representing the suppliers and the columns representing the users, is loaded. The table is symmetric (number rows = number columns).
- The diagonal of the table is being reset to zero **(1)**.
- For each row, its row maximum (maxima) is (are) calculated **(2)**.
- For each row, its row sum is calculated **(3)**.
- For each row, its row maximum is divided by its row sum **(4)**.
- For each row, a test is run to see whether its first downstream coefficient (row maximum divided by row sum) exceeds the first downstream threshold value k1 that is set **(5)**.
- For each row maximum, its column sum is calculated **(6)**.
- For each row maximum, a test is run to see whether its second downstream coefficient (row maximum divided by column sum) exceeds the second downstream threshold value k2 that is set **(7)**.
- For each row maximum, it is checked whether it complies with the both tests (do the first and second downstream coefficients exceed the first and second downstream threshold values?!). If so, the supplier is linked with its major user **(8)**.
- Starting with the first row, there are several runs (using loops) through the matrix, looking for industry groups that are either directly or indirectly linked together. The linked industry groups together are downstream clusters **(9)**.
- Each downstream cluster is aggregated: all its row elements and all its column elements are aggregated **(10)**.
- A new iteration is performed on the aggregated matrix.

(1) $x_{ij} = 0$ for $i = j$;

(2) $\max x_i = 0$;

for $j = 1$ to $j = n$ do ;

if $x_{ij} > \max x_i$;

then $\max x_i = x_{ij}$;

(3) $\text{sum}x_i = \sum_{j=1}^{n} (x_{ij})$;

(4) $\text{coef}^1 x_{ij} = \max x_i / \text{sum} x_i$;

(5) $\text{coef}^1 x_{ij} > k^1$;

(6) $\max x_i = x_{ij}$;

$\text{sum}x_j = \sum_{i=1}^{n}(x_{ij})$;

(7) $\text{coef}^2x_{ij} = \max x_i / \text{sum}x_j$;

$\text{coef}^2x_{ij} > k^2$;

(8) if $\text{coef}^1x_{ij} > k^1$ and $\text{coef}^2x_{ij} > k^2$;

then $\{i, j\}$;

(9) $cluster^1 = \{\ldots\} = \varnothing$;

for i =1 to i = n and for j =1 to j = n do ;

if $x_{ij} = \{i, j\}$ and if $x_{qj} = \{q, j\}$;

then $cluster^1 = \{i, j, q\}$;

(10) if $cluster^1 = \{i, j, q\}$;

then for a = 1 to a = n and for b = 1 to b = n ;

$$\text{aggr}x^1_{ab} = \sum_{a=1}^{n}(x_{ai}) + \sum_{a=1}^{n}(x_{aj}) + \sum_{a=1}^{n}(x_{aq}) + \sum_{b=1}^{n}(x_{ib}) + \sum_{b=1}^{n}(x_{jb}) + \sum_{b=1}^{n}(x_{qb})\ ;$$

Exhibit 3.3: the upstream cluster algorithm

Upstream

- The I/O-table with rows representing suppliers and columns representing users is loaded into the program. The table is symmetric (number rows = number columns).
- The diagonal of the table is being reset to zero.
- For each column, its column maximum (maxima) is (are) calculated.
- For each column, its column sum is calculated.
- For each column, its column maximum is divided by its column sum.
- For each column, a test is run to see whether its first upstream coefficient (column maximum divided by column sum) exceeds the first upstream threshold value l1 that is set.
- For each column maximum, its row sum is calculated.
- For each column maximum, a test is run to see whether its second upstream coefficient (column maximum divided by row sum) exceeds the second downstream threshold value l2 that is set.
- For each column maximum, it is checked whether it complies with the both tests (do the first and second upstream coefficients exceed the first and second upstream threshold values?!). If so, the user is linked with its major supplier.
- Starting with the first column, there are several runs (using loops) through the matrix, looking for industry groups that are either directly or indirectly linked together. The linked industry groups together are upstream clusters.
- Each upstream cluster is aggregated: all its row elements and all its column elements are aggregated.
- A new iteration is performed on the aggregated matrix.

The upstream procedure in GAUSS is an exact copy of the downstream procedure, because in the beginning of the program the matrix is transposed. This way, the downstream procedure can be used for the upstream cluster identification.

Before the start of every single iteration the diagonal of the matrix should be reset to zero, because the focus of the analysis is inter-sectoral interaction. If the diagonal of the input-output table isn't reset to zero, a lot of industry groups will be linked to themselves, but unlinked to the rest of a

cluster. Exhibit 3.2, a 1993 comparison for the Netherlands, shows that there are large differences between the analyses when using either a table with a diagonal that is set to zero or a table with a diagonal that isn't.

Exhibit 3.4: 1993 I/O-comparison for the Netherlands, diagonal reset/not reset to zero

	Upstream linkages	Downstream linkages
Equal diagonal zero/non-zero	52	50
Only diagonal zero	21	15
Only diagonal non-zero	49	40

A new element in the algorithm and the biggest difference compared to earlier methods is the introduction of second downstream and upstream threshold values. The purpose of these second threshold values is to avoid linkages between industry groups where the relative importance of a delivery is relatively big to only one of the two involved industry groups, but relatively small to the other group. Exhibits 3.3 and 3.4 show some clear examples of this phenomenon for the Dutch 1993 I/O-table.

Exhibit 3.5: Lopsided downstream linkages, Netherlands 1993

Supplier	**User**	Percentage to supplier	Percentage to user
Forestry	Wholesale trade	60.0%	0.0%
Manufacturing footwear	Manufacturing office machinery, machinery n.e.c.	33.3%	0.1%
Manufacturing Footwear	Manufacturing electrotechnical equipment n.e.c.	33.3%	0.1%
Boarding-houses	Sand, gravel mining	100.0%	0.9%
Lodging n.e.c.	Education (scientific)	44.7%	1.6%
Repair consumer goods n.e.c.	Public corporations, social organizations n.e.c.	100.0%	0.2%
Air transport, air transport services	Retail trade	27.7%	2.1%
Services river transport	Banking	36.6%	0.4%
General, special hospitals	Municipalities	27.8%	0.7%
Cinematic organizations	Retail trade	40.9%	0.9%
Sports clubs, sports organizations	Manufacturing electrotechnical equipment n.e.c.	100.0%	0.0%

Exhibit 3.6: Lopsided upstream linkages, Netherlands 1993

User	**Supplier**	Percentage to user	Percentage to supplier
Fishing	Oil refineries, oil and coal industries	29.6%	1.2%
Sand, gravel mining	Electric light, power	15.3%	0.2%
Fish processing	Accountants, tax consultants	15.9%	0.4%
Manufacturing tailor-made clothing	Exploitation, trade office buildings	25.0%	0.1%
Sawing-mill industry	Education (scientific)	22.2%	0.0%
Sawing-mill industry	Electric light, power	22.2%	0.0%
Sawing-mill industry	Exploitation, trade office buildings	22.2%	0.0%
Manufacturing bricks, tiles	Oil, gas drilling and exploration	21.2%	0.4%
Hairdresser's, beauty farms	Exploitation, trade office buildings	20.7%	0.6%

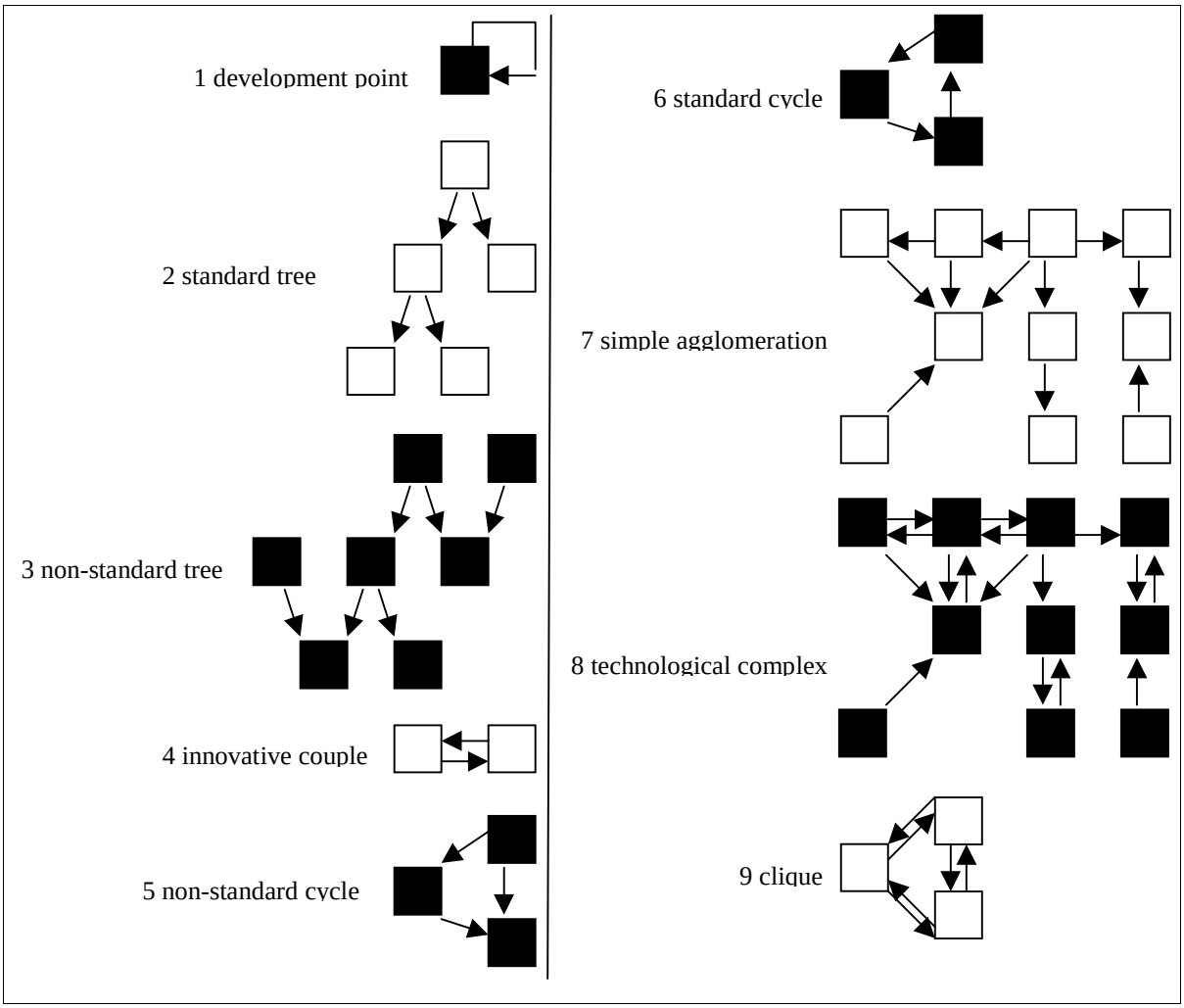
By introducing second downstream and upstream threshold values, these lopsided linkages are ruled out of the clustering process. This new element in cluster analysis is an important change compared to for example the work of Roelandt and Witteveen. Of course, the second threshold values are substantially lower than the first threshold values. After all, the first threshold values are used to test the maxima and the second thresholds aren't.

The choice of the magnitude of the thresholds is arbitrary: it's a process of trial-and-error. The researcher should make sure that the clusters are coherent and that the deliveries are sufficiently substantial. When the thresholds are set too low, you will get the effect that the entire economy is clustered into one huge national cluster. Thresholds too high, on the other hand, will cause clustering to be minimal because only a few linkages will occur. To a lesser extent, the same thing holds for the number of iterations as for the magnitude of the thresholds: not too high, not too low…

3.3 Graph analysis

Another new element in this cluster analysis is the central place taken by graph analysis. The use of graph theory to depict network relations originates in the social sciences, especially in sociology. Especially directed graphs are extremely useful for research involving networks with complicated, two-way network relationships. The nine elementary types of directed structures are, in order of increasing synergy level:

Exhibit 3.7: Nine types of directed graphs



Source: (LEMAY & DEBRESSON, 1988)

In this thesis, the linkages and the clusters from the cluster analysis are represented in directed graphs. Although their structure is often more complicated than the elementary examples shown above, these graphs do offer better insight into the cluster structure than a numerical or textual design could have done.

In this approach, all downstream and upstream links resulting from the first iteration analysis are drawn up in a large graph. Numbered nodes represent the different individual industry groups. A directed arrow represents a downstream linkage. A dotted directed arrow represents an upstream linkage.

Because of technical complications, it gets a bit harder in the following iterations. The problem is that certain downstream and upstream clusters have entangled, forming the resulting clusters the researcher is looking for. But the aggregations that are the focus in the next iterations are all still downstream and upstream aggregations. This causes that sometimes linkages will occur where only part of a cluster is involved. If this is the case, the linkage is not a clear-cut one.

The linkages resulting from the iterations after the first one are treated the following way:

Exhibit 3.8: rules used when drawing up cluster graphs

- individual industry groups that aren't linked already and that get a linkage to a clear-cut group of industry groups get are actually linked;
- individual industry groups that aren't linked already and that get a linkage to a group of industry groups that isn't clear-cut aren't actually linked, they are however shown in the cluster graph on a stand-alone basis;
- clear-cut groups of industry groups that get a linkage to another clear-cut group of industry groups get are actually linked;
- clear-cut groups of industry groups that get a linkage to a group of industry groups that isn't clear-cut aren't actually linked;
- clear-cut groups of industry groups that get a linkage to an individual industry group get are actually linked.

Industry groups that aren't linked in any of the iterations aren't included in the clusters. In the cluster approaches this thesis is most related to (ROELANDT, 1986; WITTEVEEN, 1997) these unlinked industry groups are actually allocated to what is considered the most relevant cluster. But in order to avoid ending up with a cluster chart that is more sectoral than cluster-oriented and because the research is about networks/chains, in this thesis the unlinked industry groups aren't allocated. These unlinked industry groups simply have downstream and upstream supply patterns that are too diffuse to be included in a cluster.

4 Results cluster analysis for 5 OECD-countries: Belgium, Denmark, Finland, the Netherlands and Spain

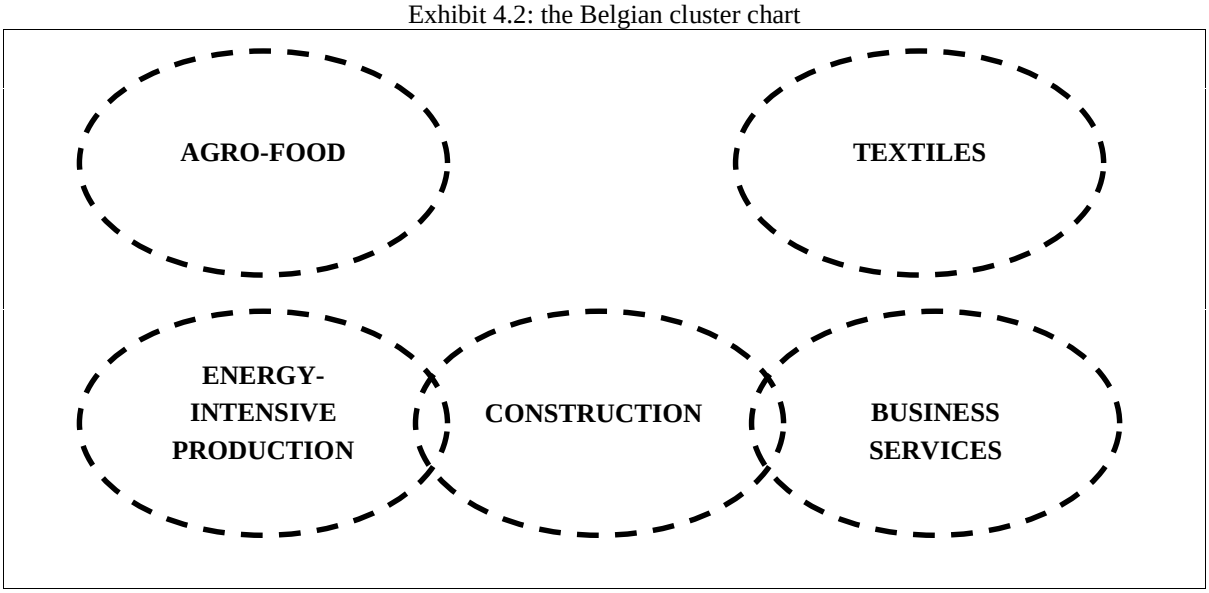
Exhibit 4.1: overview identified clusters

	COUNTRY	STRUCTURE	SECTORAL COMPONENTS
AGRO-FOOD	Belgium	Technological complex	Agriculture/food
AGRO-FOOD	Denmark	Technological complex	Agriculture/food
AGRO-FOOD	Finland	Technological complex	Agriculture/food/chemicals
AGRO-FOOD	Netherlands	Technological complex	Agriculture/food
AGRO-FOOD	Spain	Technological complex	Agriculture/food
CONSTRUCTION	Belgium	Technological complex (spokes centred around construction hub)	Construction/materials/transport/trade/ government/real estate
CONSTRUCTION	Denmark	Technological complex (spokes centred around construction hub)	Construction/materials/steel/metals/real estate
CONSTRUCTION	Finland	Non-standard cycle/technological complex	Construction/materials/steel/metals/mining/ real estate
CONSTRUCTION	Netherlands	Technological complex (spokes centred around construction hub)	Construction/materials/metals/instalment/real estate
CONSTRUCTION	Spain	Technological complex	Construction/materials/real estate
ENERGY-INTENSIVE PRODUCTION	Belgium	Technological complex	Energy/metals
ENERGY-INTENSIVE PRODUCTION	Denmark	2 separate chains	Energy; plastics
ENERGY-INTENSIVE PRODUCTION	Netherlands	Technological complex	Energy/chemicals/metals
INFORMATION and FINANCIAL	Denmark	2 chains; 1 agglomeration	Paper; printing/publishing; printing/ publishing/financial services/business services
INFORMATION and FINANCIAL	Netherlands	Technological complex	Publishing/printing/financial services/media/ communications/consulting
INFORMATION and FINANCIAL	Spain	Technological complex	Paper/financial services/business services
DISTRIBUTION	Denmark	Complex cycle/chain	Trade/transport
DISTRIBUTION	Finland	2 linked chains	Trade/transport; communications/transport
DISTRIBUTION	Netherlands	1 chain; 2 technological complexes	River transport; transport/warehousing; manufacturing/repair/rental equipment
TEXTILES	Belgium	Chain	Textiles
TEXTILES	Netherlands	Technological complex	Textiles
PUBLIC UTILITIES	Denmark	Tree	Government/communication/health
PUBLIC UTILITIES	Spain	Chain; technological complex	Transport/government/health; health/chemicals
BUSINESS SERVICES	Belgium	Technological complex	Services/chemicals/paper/water/financial services
CRAFTS	Denmark	Technological complex	Poultry/fur/textiles/fishing
FORESTRY	Finland	Technological complex/chain	Forestry/paper/wood
SERVICES	Finland	Tree	Business/services/textiles
PAPER	Netherlands	Technological complex (spokes centred around paper hub)	Paper
PUBLIC SERVICES	Netherlands	Technological complex	Government/health/organizations
ENERGY	Spain	1 chain; 1 technological complex	Energy/transport; energy
MACHINERY	Spain	Complex cycle/technological complex	Electrical/computer/iron/metals/equipment

In Appendix IIa up to Appendix IIe the cluster contents and cluster structure for every single cluster in every single country are showed in greater detail.

4.1 Belgium

Exhibit 4.2: the Belgian cluster chart



The Belgian AGRO-FOOD, ENERGY-INTENSIVE PRODUCTION, CONSTRUCTION and TEXTILES clusters will be discussed later on in this chapter when comparing them to their foreign counterparts.
The BUSINESS SERVICES cluster in Belgium, however, is unique. It is a fairly heterogeneous cluster with one common customer focus: businesses. The services industry acts as the clusters' focal point and is surrounded by the likes of chemicals/plastics, paper industries, water supply and financial services. It differs from the INFORMATION AND FINANCIAL clusters in other countries in that its focus is more industrial/business-like and the lacking of any informational services (such as communications, publishing or printing) in its cluster contents.
A Belgian study (PEETERS and TIRI, 1999), with some 'technical assistance' by the author of this thesis, using the same IO-data and the same algorithm found different results however. Differences in interpretation of the results of the computer algorithm cause some shifts in cluster structure. The contents of the total of the clusters and the underlying network linkages compare between the two cluster studies, but the allocation over the clusters differs somewhat:

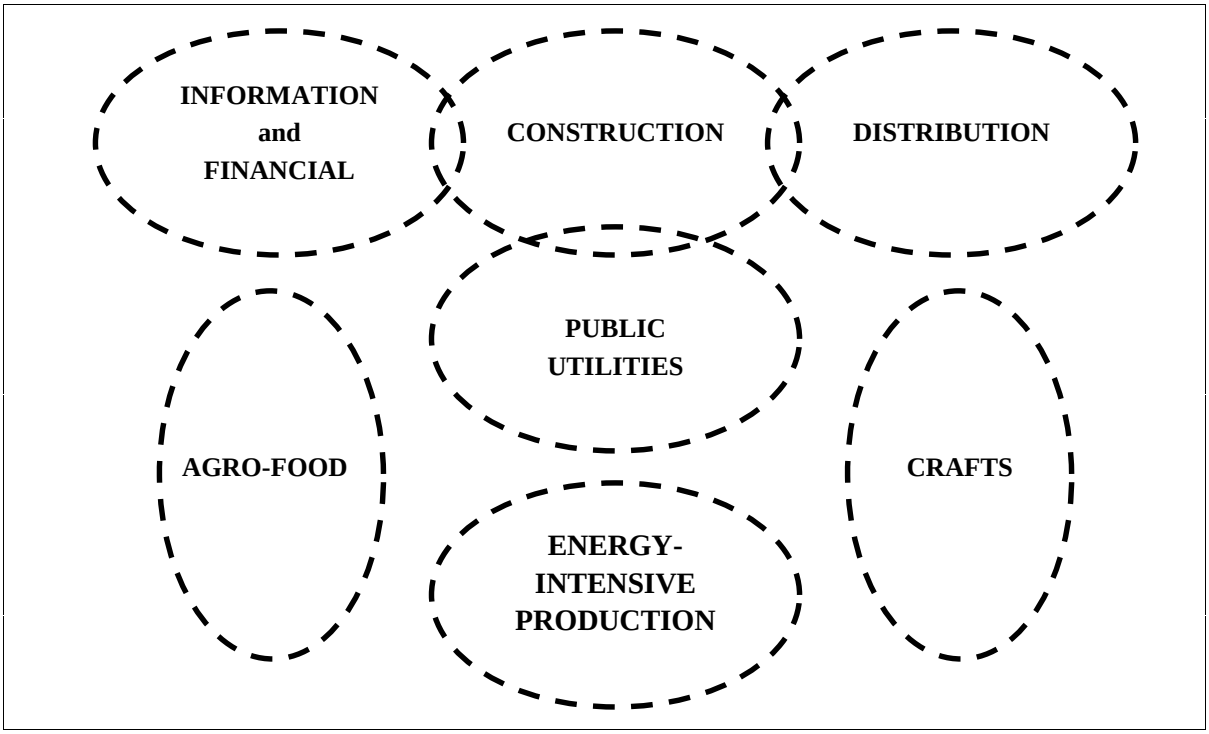
Exhibit 4.3: allocation differences Belgian clusters

Industry groups	PEETERS and TIRI (1999)	VERBEEK (1999)
Agriculture	**AGRO-FOOD**	**AGRO-FOOD**
Food	**AGRO-FOOD**	**AGRO-FOOD**
Construction	**CONSTRUCTION & METALS**	**CONSTRUCTION**
Energy	**CONSTRUCTION & METALS**	**ENERGY-INTENSIVE PRODUCTION**
Metals	**CONSTRUCTION & METALS**	**ENERGY-INTENSIVE PRODUCTION**
Chemicals	**CHEMICALS**	**BUSINESS SERVICES**
Transport	**TRANSPORT EQUIPMENT & DISTRIBUTION**	**CONSTRUCTION**
Trade	**TRANSPORT EQUIPMENT & DISTRIBUTION**	**CONSTRUCTION**
Textiles	**TRANSPORT EQUIPMENT & DISTRIBUTION**	**TEXTILES**
Government	**SERVICES**	**CONSTRUCTION**
Services	**SERVICES**	**BUSINESS SERVICES**
Paper	**SERVICES**	**BUSINESS SERVICES**
Water	**SERVICES**	**BUSINESS SERVICES**
Financial services	**SERVICES**	**BUSINESS SERVICES**

4.2 Denmark

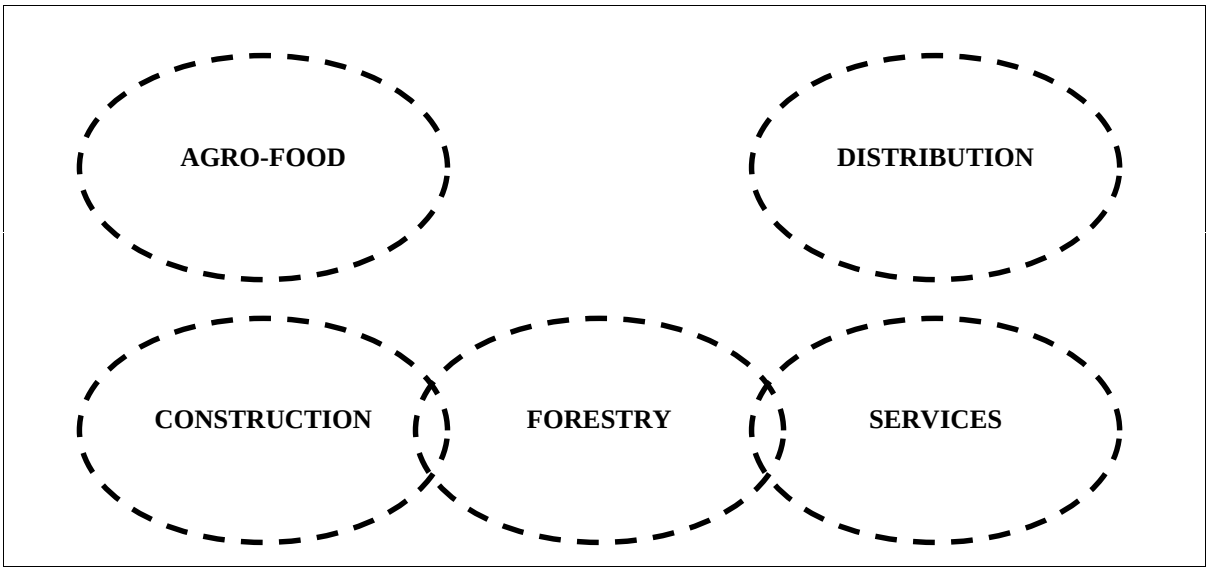
The only truly unique cluster to Denmark is its CRAFTS cluster. This cluster oddly connects textiles to poultry/fur farming to fishing industries in an independent structure. Other countries see occasional links between these industries as well, but they are incorporated in bigger structures such as the AGRO-FOOD or TEXTILES clusters. Apparently, in Denmark these industries and the links between them are (statistically) strong enough to 'survive on their own'.

Exhibit 4.4: the Danish cluster chart



4.3 Finland

Exhibit 4.5: the Finnish cluster chart



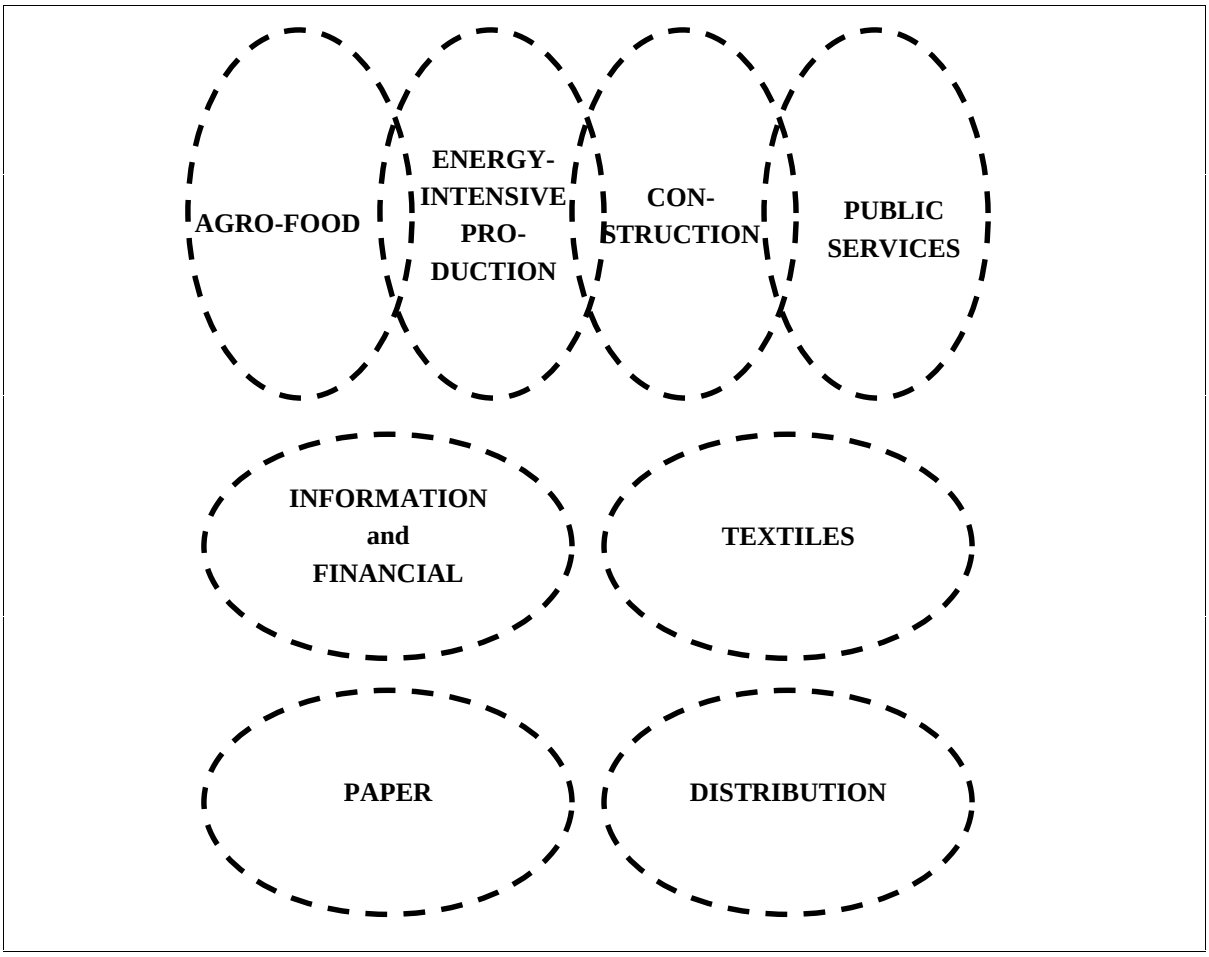
Besides the three clusters AGRO-FOOD, CONSTRUCTION and DISTRIBUTION, Finland features two clusters not seen in any of the other countries: the FORESTRY and SERVICES clusters.

The FORESTRY cluster is a stretched, strongly linked production chain. Forestry in the centre of the chain supplies to the wood industries on one side and the paper industries on the other. The fact that only Finland has a FORESTRY cluster is easy to explain: Finland is the only country of the five where forestry is such an important activity that it is a cluster of its own. Traditionally, forestry plays an important role in the Finnish economy.

The SERVICES cluster is less obvious in contents and focus than the FORESTRY cluster. Incorporating business services, textiles and general/public services this small cluster is rather heterogeneous. The activities in this cluster are elsewhere (parts of) other clusters. Combined in the Finnish services cluster, especially business services and public services are separated in different clusters in the other countries.

4.4 The Netherlands

Exhibit 4.6: the Dutch cluster chart



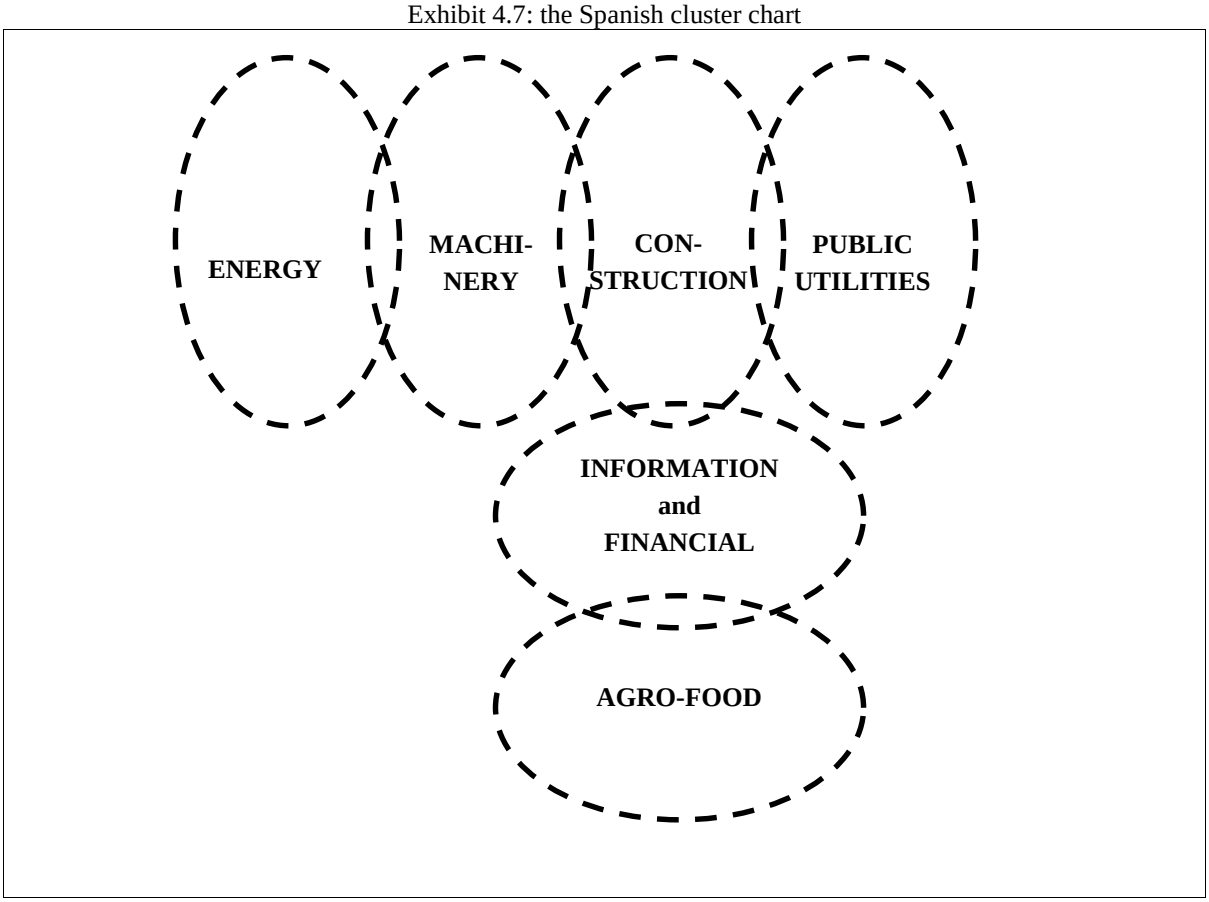
Besides 6 more common clusters, the clusters only identified in the Dutch economy are PAPER and PUBLIC SERVICES.

The PAPER cluster sees the (supplying) paper manufacturing industry as its central hub, with the using industries such as wallpaper, office paper supplies, cardboard and cardboarding as the spokes around paper manufacturing. Unlike in other countries, paper industries in the Netherlands are linked together in a clear-cut, independent cluster structure, instead of being part of other clusters such as FORESTRY, BUSINESS SERVICES or INFORMATION AND FINANCIAL.

The PUBLIC SERVICES cluster includes the likes of health, education, government, public and governmental services and various organizations at all levels. While in other countries this kind of cluster is called PUBLIC UTILITIES instead of PUBLIC SERVICES this is different for the Netherlands. The Dutch public cluster focuses more on 'soft services' like education and health and less on utilities such as communications and transport. Therefore PUBLIC SERVICES instead of PUBLIC UTILITIES…

4.5 Spain

Exhibit 4.7: the Spanish cluster chart



The ‘odd couple’ in the Spanish economy are the two clusters ENERGY and MACHINERY.
The ENERGY cluster, with a strong focus on energy indeed, is actually made up of two separate parts. One part are the oil and transport industries, the other part is purely energy: it includes the coal, cokes, electricity and nuclear power industries. The Spanish ENERGY cluster is the only ENERGY cluster, because analysis shows that only in Spain energy industries have stronger links to the other energy industries than to using industries such as the metals and chemicals industries.
The MACHINERY cluster is quite peculiar. There are actually two parts linked together, the electrical/computer part is a user of the non-standard cycle of iron, metals, metal manufactures and equipment and vehicles/recycling. Only in Spain are all the typical machinery industries actually linked together, instead of being incorporated in other clusters such as CONSTRUCTION AND ENERGY-INTENSIVE PRODUCTION.

4.6 Similar clusters in different countries

AGRO-FOOD: Belgium, Denmark, Finland, the Netherlands and Spain

Despite minor national differences, all countries feature an AGRO-FOOD cluster that looks basically the same: agriculture at the centre of the cluster, with related (food) industries using and selling agricultural products surrounding this centre. The most striking difference between the countries is that Finland is the only country that besides the agriculture and food industries has a small chemicals component incorporated in its cluster as well.

CONSTRUCTION: Belgium, Denmark, Finland, the Netherlands and Spain

The second cluster that all countries have in common is CONSTRUCTION. The cluster looks like a construction industry hub with construction-related spokes in Belgium, Denmark and the Netherlands. In Finland this cluster sees the construction industry incorporated in the cycle central to the cluster, while in Spain this cluster looks more like a technological complex (with a central place for the construction industry). When it comes to the contents of the CONSTRUCTION cluster, all countries are fairly alike covering industries such as materials, machinery and equipment, real estate and government procurement.

ENERGY-INTENSIVE PRODUCTION: Belgium, Denmark and the Netherlands

In all three countries this cluster is a composite of two or three of the same components energy, metals and chemicals. In Belgium these components are energy and metals, in Denmark they are energy and chemicals, while in the Netherlands all three components energy, metals and chemicals are incorporated. When it comes to cluster structure, this cluster isn't really homogeneous across the three countries: no specific 'ENERGY-INTENSIVE PRODUCTION cluster structure' can be identified.

INFORMATION AND FINANCIAL: Denmark, the Netherlands and Spain

This cluster is a quite diverse arrangement in all three countries. Financial services and business services occur in each country. Paper industries are part of the cluster only in Denmark and Spain and not in the Netherlands, since paper is its own cluster in the Netherlands. Both Denmark and the Netherlands feature printing and publishing while Spain doesn't. Finally, the components culture, media and consulting are an important part of the cluster only in the Netherlands.

DISTRIBUTION: Denmark, Finland, the Netherlands

The structure of the DISTRIBUTION cluster is complex and different from each other in all three countries, but there are similarities in the components. General transport is part of the cluster in all three countries. Trade is part of the cluster in Denmark and Finland, while Denmark and the Netherlands both feature transport services as well as water transport. In Finland on the other hand , important parts of the cluster also include civil engineering and communications.

TEXTILES: Belgium and the Netherlands

The TEXTILES clusters need little words, they are simple and are simply very comparable: they include textiles and textile products, especially clothing. The major difference is that the structure resembles a chain in Belgium, while in the Netherlands it is more of a technological complex.

PUBLIC UTILITIES: Denmark and Spain

Both countries have different structures, but both clusters cover health and government services. The tree-like Danish structure also includes communications and household services, while in the Spanish chain/technological complex chemicals and transport are also included.

4.7 Conclusions

Comparing the 'Belgian' results found in this analysis with those of the Belgians themselves learns a very important lesson: that despite the use of a standardised algorithm, cluster analysis remains an arbitrary process. Up to the point where graph analysis is introduced, results are (almost completely) the same. Agreeably, PEETERS and TIRI (1999) argue that the final phase in cluster analysis demands certain experience and creativity of the researcher when balancing clusters and industry groups. They speak of a subjective yet well founded allocation process, using criteria such as functional similarities and reason.

Several reasons for the existence of country-specific clusters can be identified, namely:

Exhibit 4.8: reasons for international differences in clustering

- differences in focus between related clusters;
- differences in the allocation of similar industries over different clusters; and
- differences in national specialisation patterns.

Summarizing these reasons and allocating them to the different clusters yields the following table:

Exhibit 4.9: reasons for country-specific clusters

CLUSTER	COUNTRY	FOCUS	ALLOCATION	SPECIALISATION
Business services	Belgium	**X**	**X**	
Crafts	Denmark		**X**	
Forestry	Finland			**X**
Paper	Netherlands		**X**	**X**
Public services	Netherlands	**X**		
Energy	Spain			**X**
Machinery	Spain		**X**	**X**

Although differences in national specialisation patterns are the most important reason for the existence of different national clusters (as would and could be expected), they are not the sole reason. Differences in the allocation of similar industries over different clusters and differences in focus between related clusters do to a lesser extent also influence differences in national cluster structures.

When it comes to similar clusters in different countries, one striking result directly comes to mind: the more traditional and 'sectoral' clusters are (AGRO-FOOD, CONSTRUCTION, TEXTILES), the more similar they are in structure and contents. The clusters that have a bigger tendency towards re-combination of traditional sectors (ENERGY-INTENSIVE PRODUCTION, INFORMATION AND FINANCIAL, DISTRIBUTION) typically show larger differences in both structure and contents.

5 Analysis of styles of innovation, based on the Community Innovation Survey

This chapter deals with the problem of formalisation of the innovative cluster concept within the National Systems of Innovation approach. The used data, being the 1993 Community Innovation Survey, will be discussed first. After dealing with the data, the how's and why's of the computer algorithm used to analyse them will be introduced.

5.1 The Community Innovation Survey (CIS)

By releasing the 'Oslo Manual' (OECD, 1992), the OECD has provided guidelines on how to collect and interpret innovation surveys. The 'Oslo Manual' initiated the launch of systematic, representative, internationally comparable surveys of innovative activity. In 1993 the OECD and the European Community teamed up by conducting the first Community Innovation Survey. This so-called CIS I deals with innovation in the period 1990-1992 and includes data from the following 13 countries: Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, United Kingdom and Norway. Despite the collective guidelines used in conducting CIS I, it is not completely comparable. For all countries the survey deals includes manufacturing industries. Germany, Greece, Italy, the Netherlands and the United Kingdom included not only manufacturing industries but also the service sectors.
Since the analysis in this thesis includes Belgium, Denmark and the Netherlands, the populations in the three surveys are not compatible and comparable. Therefore in this paper two sets of results for the Netherlands are presented: one set dealing with both the manufacturing industries and the service sectors and one set just covering the manufacturing.

Exhibit 5.1: questions in CIS I

- Structure of the enterprise
- Economic activities
- General information about innovation activities
- Sources of information for innovation
- Objectives for innovation
- Acquisition of technology
- Transfer of technology
- Acquisition/transfer of technology
- Methods used to maintain or increase competitiveness of product or process innovation
- Research and Development activity
- R&D co-operation arrangements with other enterprises or institutions
- Factors hampering innovation
- Costs of innovation
- Breakdown of 1992 total sales
- Breakdown of 1992 export sales
- Breakdown of 1992 innovative sales

The data used in this analysis are micro-data. Basically the term micro-data means firm-level data, and using firm-level data for example enables cross-tabulation of variables. In order to obtain survey data representative for the entire population of firms in the economy, the micro-data are weighed. Weighing the micro-data means multiplying them with a so-called grossing-up factor. This grossing-up factor is determined by dividing the total number of firms in a certain class of industry by the number of firms in that particular class of industry actually responding to the survey.

5.2 The innovation algorithm

Since it uses the same (type of) data, the innovation algorithm used in this analysis almost inevitable draws heavily on two earlier studies on innovative behaviour (DEBRESSON ET AL., 1997; SPIELKAMP & VOPEL, 1997). DeBresson and partners have come up with a taxonomy of networks for innovative activity. They identified the following types of networks in increasing order of strength of network ties:

Exhibit 5.2: types of innovation networks

- Weak Network;
- Equipment Only;
- Supplier & Client;
- Client & Competitor;
- Supplier, Competitor, Client; and
- Complete Network.

Source: DEBRESSON ET AL., 1997

The 'DeBresson taxonomy' is actually the one that is used in this thesis to characterize innovation networks. But the way to determine these types of networks is actually more dependent on the method of Spielkamp and Vopel:

Exhibit 5.3: variables determining structure and performance of innovative clusters

- Innovative Behaviour;
- Knowledge Transfer Channels; and
- Information Sources.

Source: SPIELKAMP & VOPEL, 1997

This thesis uses an algorithm that combines these features. Note that the determinants of the variables 'Innovative Behaviour' and 'Innovation Networks' add up to 100%. Within the variable

'R&D Networks', the three respective determinants add up to 100% as well. Within the other variables, there is overlap between the determinants:

Exhibit 5.4: determinants of styles of innovation

- **Innovative Behaviour**

Non-innovative Firms
('*not developed or introduced technologically changed products or processes*')
Innovative Firms, no R&D
('*developed or introduced technologically changed products or processes; not engaged in R&D*')
Innovative Firms, R&D
('*developed or introduced technologically changed products or processes; engaged in R&D*')

- **Knowledge Acquisition Channels**

Formal Channels
('*right to use others' inventions; results of R&D contracted out; use of consultancy services; acquisition of technology through purchase of another enterprise; purchase of equipment*')
Informal Channels
('*communication with/specialist services from other enterprise; hiring skilled employees*')
International Channels
('*right to use others' inventions; results of R&D contracted out; use of consultancy services; acquisition of technology through purchase of another enterprise; purchase of equipment; communication with/specialist services from other enterprise; hiring skilled employees; acquisition from 'mother'/'daughter'/'sister':* EC/non EC/USA/Japan/other')
National Channels
('*right to use others' inventions; results of R&D contracted out; use of consultancy services; acquisition of technology through purchase of another enterprise; purchase of equipment; communication with/specialist services from other enterprise; hiring skilled employee; acquisition from 'mother'/'daughter'/'sister':* national')
Internal Channels
('*acquisition from 'mother'/'daughter'/'sister'*')

- **Information Sources**

Internal Sources
('*within enterprise; within group of enterprises*')
Direct External Sources
('*competitors in your line of business; consultancy firms; technical institutes*')
Indirect External Sources
('*suppliers of material and components; suppliers of equipment; clients or customers*')
Public Sources
('*universities/higher education; government laboratories*')
General Sources
('*patent disclosures; professional conferences, meetings, professional journals; fairs, exhibitions*')

- **R&D Networks**

Internal/External Network
('*mother/daughter/sister enterprises*
vs.
clients/customers; suppliers; competitors; joint ventures; consultants; government laboratories; research institutes; universities/higher education; industry-operated R&D labs')
Public/Private Network
('*government laboratories; universities/higher education*
vs.
clients/customers; suppliers; mother/daughter/sister enterprises; competitors; joint ventures; consultants; research institutes; industry-operated R&D labs')
National/International Network
('*clients/customers; suppliers; mother/daughter/sister enterprises; competitors; joint ventures; consultants; government laboratories; research institutes; universities/higher education; industry-operated R&D labs:* regional/national vs. EC/non EC/USA/Japan/other')

- **Knowledge Infrastructure**

Public Knowledge
('information sources*: universities/higher education; government laboratories*
R&D network: *government laboratories; universities/higher education*')
Private Knowledge
('information sources*: technical institutes*
R&D network: *research institutes; industry-operated R&D labs*')
Consultants
('information sources*: consultancy firms*
knowledge transfer channels: *consultancy services*
R&D network: *consultants*')

- **Innovation Networks**

Weak Network
Equipment Only
('knowledge transfer channels: *purchase/sales of equipment*')
Supplier & Client
('information sources*: suppliers of material and components; suppliers of equipment; clients or customers*
R&D network: *suppliers; clients/customers*')
Client & Competitor
('information sources*: clients or customers; competitors in your line of business*
R&D network: *clients/customers; competitors*')
Supplier, Competitor, Client
('information sources*: suppliers of material and components; suppliers of equipment; competitors in your line of business; clients or customers*
R&D network: *suppliers; competitors; clients/customers*')
Complete Network
('knowledge transfer channels: *purchase/sales of equipment*
information sources*: suppliers of material and components; suppliers of equipment; competitors in your line of business; clients or customers*
R&D network: *suppliers; competitors; clients/customers*')

As shown, the variables used to determine 'innovation networks' are actually the same variables used to determine the other determinants. This means that in a way 'innovation networks' (DEBRESSON ET AL.) is a composite determinant of 'innovative behaviour' (SPIELKAMP and VOPEL), 'knowledge acquisition channels' (SPIELKAMP and VOPEL), 'information sources' (SPIELKAMP and VOPEL) and 'R&D networks'. By doing this, the algorithm makes maximum use of the data available in CIS I.

This being said, the conclusion is that although the 'innovation networks algorithm' isn't exactly new, it is still a purposeful refinement of existing methodologies.

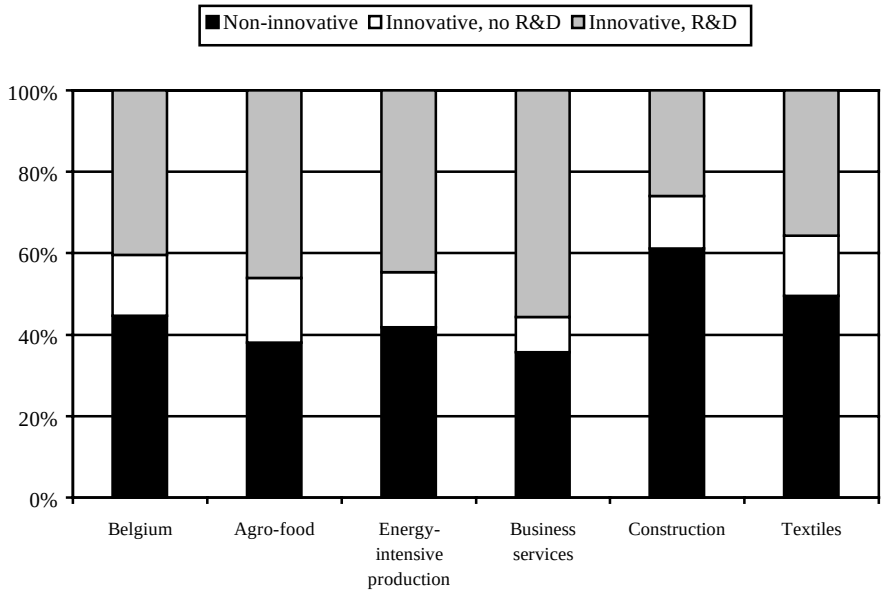
6 Results styles of innovation for 3 OECD-countries: Belgium, Denmark and the Netherlands

In this chapter the most remarkable results for the styles of innovation analysis will be discussed, at first per country and after that per similar cluster for more than one country. Only a brief impression of the results will be given in order to maintain a good overview. For every country the distribution of structural innovation and of innovation networks over the clusters will be highlighted. The complete results and the statistical details of the analysis can be found in Appendix V.

6.1 Belgium

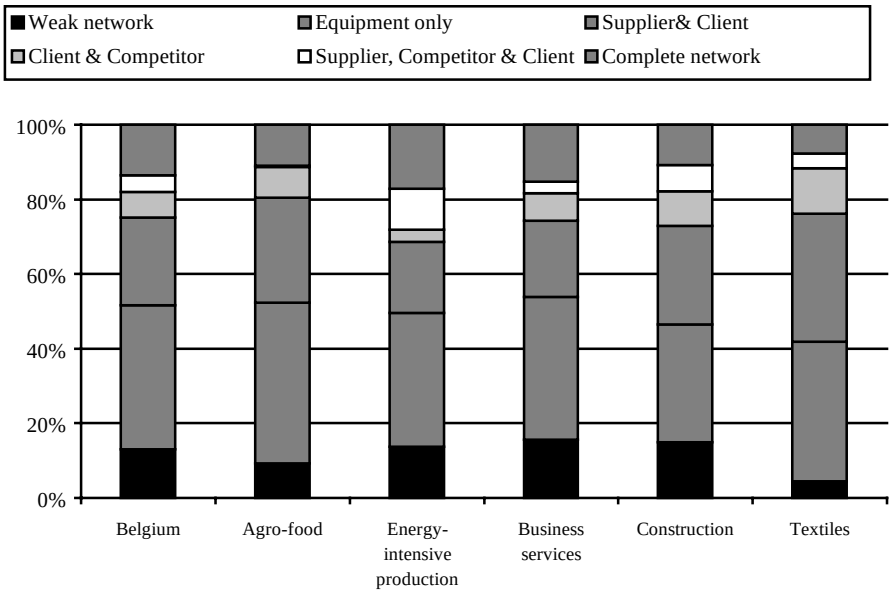
This first exhibit shows the distribution of structural innovation over the Belgian economy and the Belgian clusters.

Exhibit 6.1: distribution of structural innovation in Belgium



Although the distribution of innovation over the clusters looks pretty much equal, there are two clusters that can be regarded as extremes. The percentage of innovative firms that are engaged in R&D is more than twice as high in the BUSINESS SERVICES clusters compared to the CONSTRUCTION cluster. Not surprisingly, the percentage of non-innovative firms in the CONSTRUCTION cluster is in its turn much higher than in the BUSINESS SERVICES cluster.

Exhibit 6.2: distribution of innovation networks in Belgium

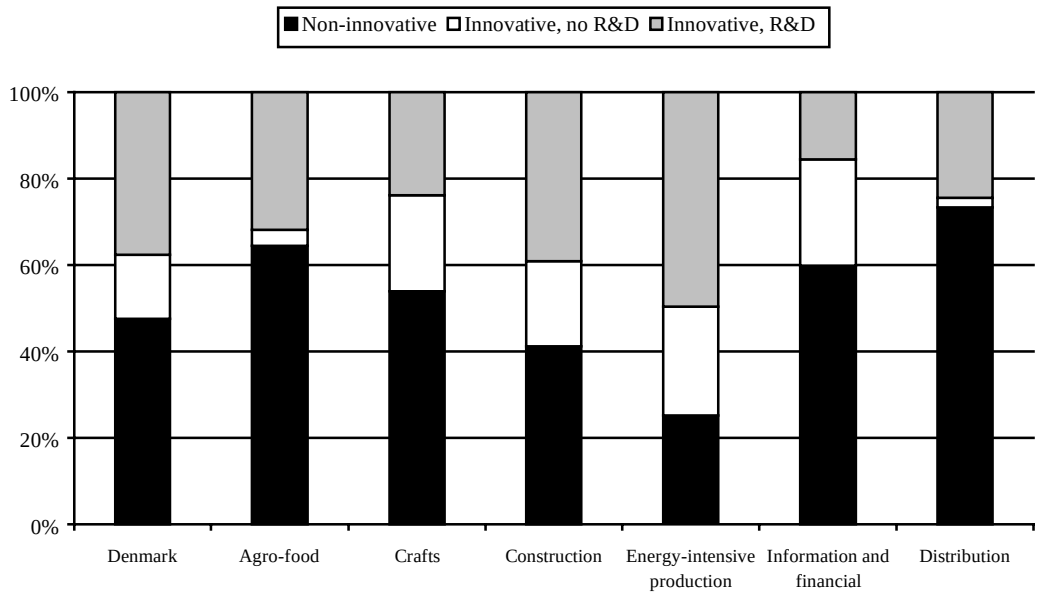


Looking at the distribution of innovation networks, no real extremes can be discovered. Remarkably, the 'innovation gap' between the BUSINESS SERVICES and CONSTRUCTION clusters isn't reflected in their innovation networks.

6.2 Denmark

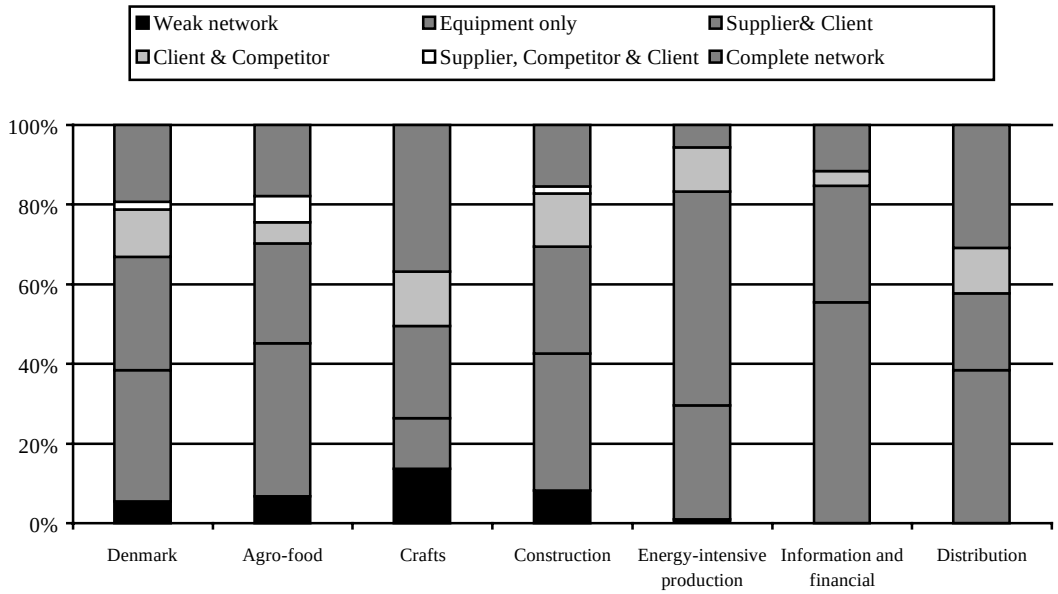
For the Danish case, the distribution of structural innovation over the economy and its clusters is pictured first as well.

Exhibit 6.3: distribution of structural innovation in Denmark



In Denmark, two clusters clearly out-perform the others when it comes to innovation. CONSTRUCTION and ENERGY-INTENSIVE PRODUCTION have both the lowest proportion of non-innovative firms and the highest proportion of firms that are innovative and perform R&D.

Exhibit 6.4: distribution of innovation networks in Denmark

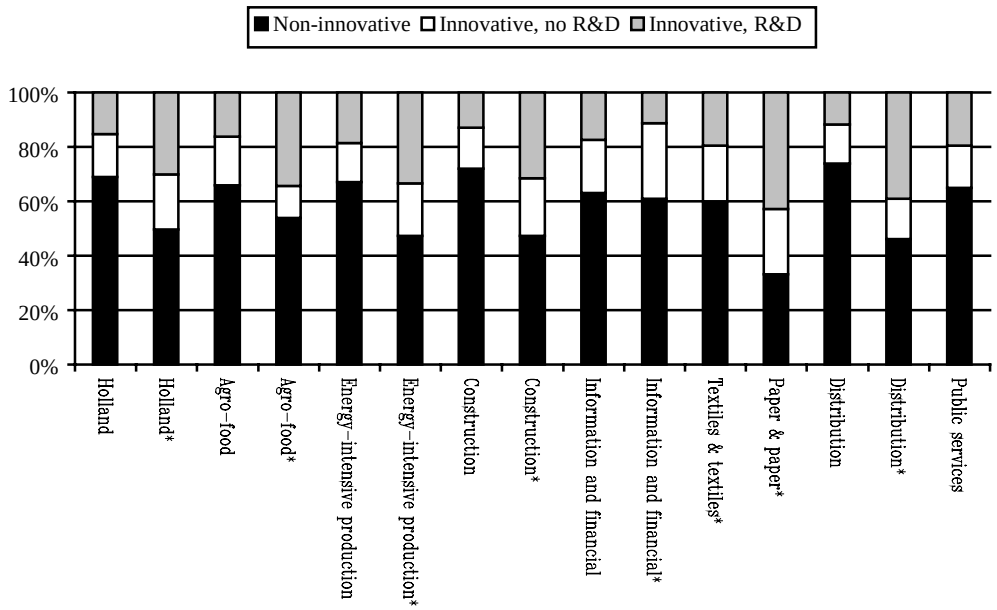


Just as in the Belgian case, the distribution of innovation networks doesn't reflect the distribution of structural innovation. When it comes to networks, the out-performers are the CRAFTS and the DISTRIBUTION clusters. The ENERGY-INTENSIVE PRODUCTION cluster and the INFORMATION AND FINANCIAL cluster come to attention because more than 50% of their firms are dedicated to one single type of network: 'supplier & client' and 'equipment only' respectively.

6.3 The Netherlands

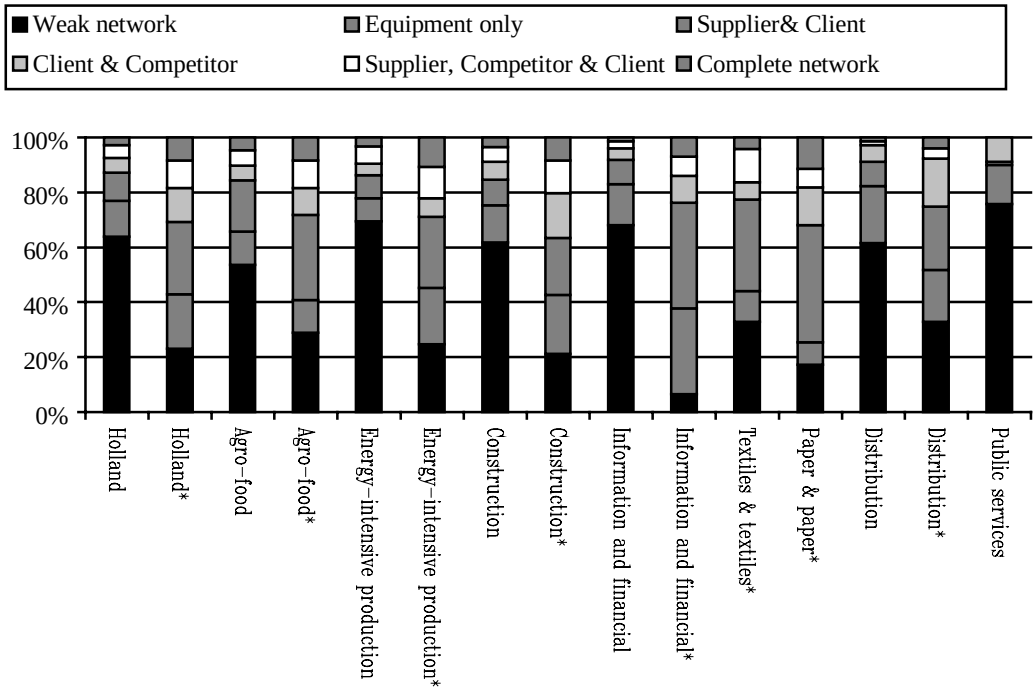
Because the Community Innovation Survey was conducted only for manufacturing industries in most countries, including Belgium and Denmark, and both for manufacturing industries and service sectors for just a few countries, including the Netherlands, an adjustment is necessary in order for the CIS to be completely comparable. Two data sets are analysed for the Netherlands: the complete survey population of manufacturing industries and service sectors (called "Holland") and the reduced population comparable to Belgium and Denmark of just the manufacturing industries (called "Holland*"). Most clusters lose large parts of their population due to the reduction. The TEXTILES and PAPER clusters are the only ones that are not affected by the reduction. The PUBLIC SERVICES cluster, on the other hand, completely disappears when using the comparable data set. Both the complete and comparable versions of the Dutch analysis are presented here.

Exhibit 6.5: distribution of structural innovation in the Netherlands



Analysing the complete population, no large differences between the clusters are found. The differences are larger looking at the reduced population. While the INFORMATION AND FINANCIAL and TEXTILES clusters are under-performing, the champion of structural innovation in the Netherlands is clearly the PAPER cluster.

Exhibit 6.6: distribution of innovation networks in the Netherlands



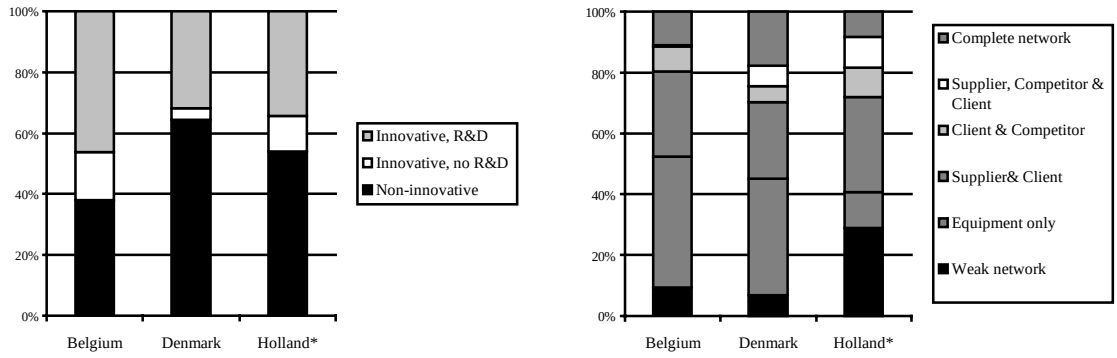
Differences between clusters in the Netherlands are not that spectacular (as in Belgium and Denmark). The AGRO-FOOD cluster is doing slightly better than the rest and the PUBLIC SERVICES

cluster is doing slightly worse using the complete data set. Using the reduced data set PAPER (again) is doing better, while TEXTILES (again) and DISTRIBUTION are under-performing.

6.4 Similar clusters in different countries

In this paragraph the clusters that occur in multiple countries are compared with respect to their innovation networks: AGRO-FOOD, ENERGY-INTENSIVE PRODUCTION, CONSTRUCTION, TEXTILES, INFORMATION AND FINANCIAL and DISTRIBUTION.

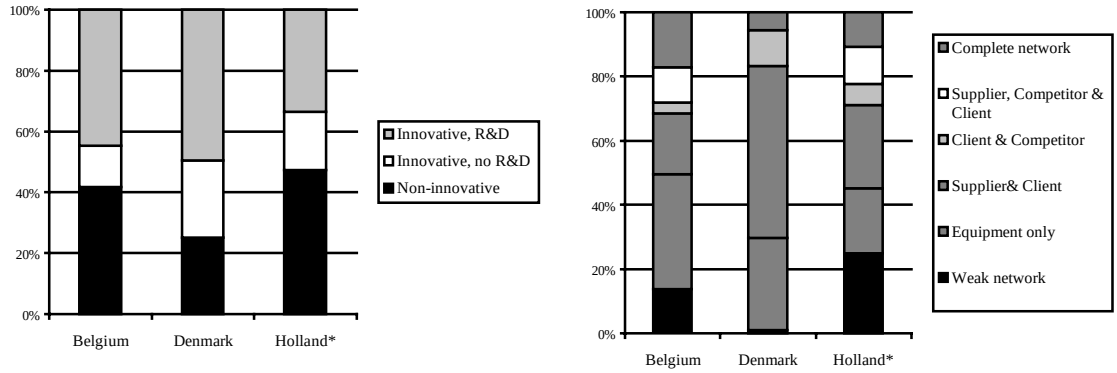
Exhibits 6.7 and 6.8: distribution of structural innovation and distribution of innovation networks over AGRO-FOOD clusters



With respect to innovative performance, Belgium is the absolute leader. The Dutch and Danish AGRO-FOOD clusters rank 2nd and 3rd, respectively. Strange enough, the innovation network density in increasing order ranges from the Netherlands to Belgium to Denmark. So the country with the most innovation-prone AGRO-FOOD cluster qua distribution of innovation networks has the worst innovative performance…

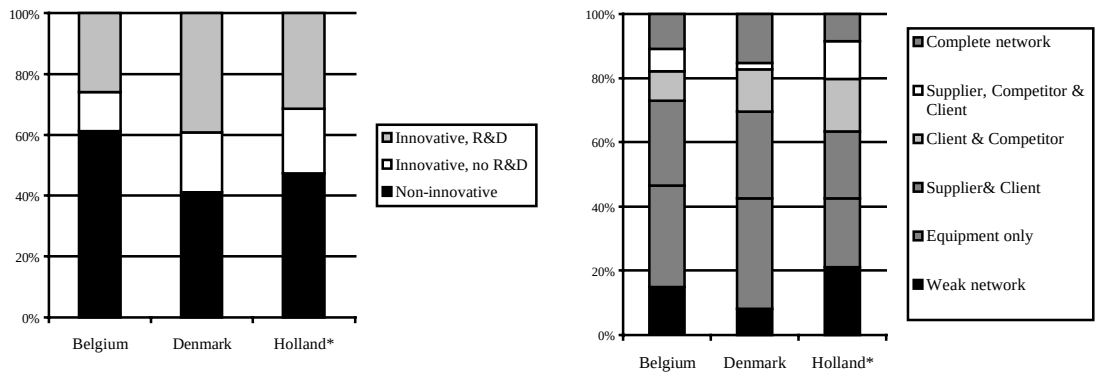
The imposition of survey limitations (the exclusion of the service sectors leading to a focus only on manufacturing industries) matters little in this respect: all three clusters lose their agriculture core (besides the service sectors, agriculture is not included in the survey as well) and their agricultural services and hotels and restaurants parts. Actually, the damage to the number of network relations in the cluster chart seems to be smallest in the Netherlands.

Exhibits 6.9 and 6.10: distribution of structural innovation and distribution of innovation networks over ENERGY-INTENSIVE PRODUCTION clusters



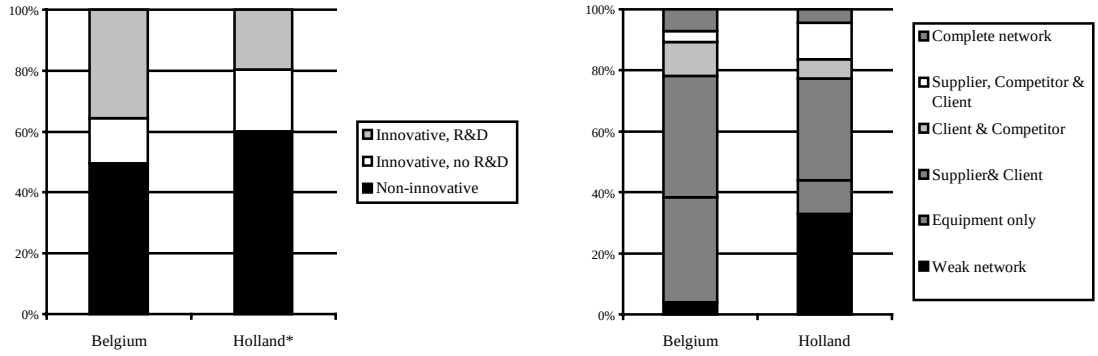
Belgium and the Netherlands are performing pretty alike with their ENERGY-INTENSIVE PRODUCTION clusters (although Belgium's network quality and innovative performance is somewhat higher). Denmark's ENERGY-INTENSIVE PRODUCTION cluster is the stranger of the three. Being the cluster with the best innovative performance and having the lowest proportion of both 'weak' ànd 'complete networks' the Danish cluster dominantly focuses on 'suppliers & clients' when innovating. Some of this can be explained by the CIS limitations: with the energy part gone, the cluster charts change. In the Netherlands, energy is the link between chemicals and metals, so network relations are severely harmed. In Belgium, on the other hand, the cluster isn't structured around energy, so it is left with a still firmly linked metals part. In Denmark, the missing of energy means that the rest of the cluster only consists of chemical industries, classical mutual using and supplying chemical industries to be more specific. The focus of its innovation networks on 'suppliers & clients' could possibly be explained by the remaining of petroleum refining, plastic manufacturing and plastic products manufacturing…

Exhibits 6.11 and 6.12: distribution of structural innovation and distribution of innovation networks over CONSTRUCTION clusters



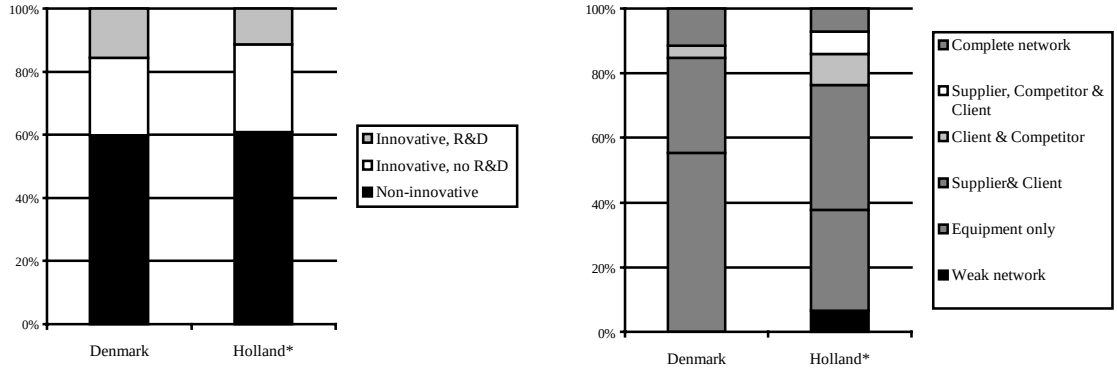
Noticing that (again) network quality in the Netherlands is lowest and in Denmark highest, differences for the CONSTRUCTION cluster are minimal compared to other clusters. Differences in structural innovation are larger: Denmark also is the best performer in this respect, followed closely by the Netherlands and, at a larger distance, Belgium. Accents in network relations are placed differently in each country, but the overall picture looks pretty homogeneous. The consequences of the Survey limitations are pretty homogeneous as well: with their construction hub and their trade/real estate parts missing, all three cluster graphs are deprived of almost all linkages.

Exhibit 6.13 and 6.14: distribution of innovation networks and distribution of innovation networks over TEXTILES clusters



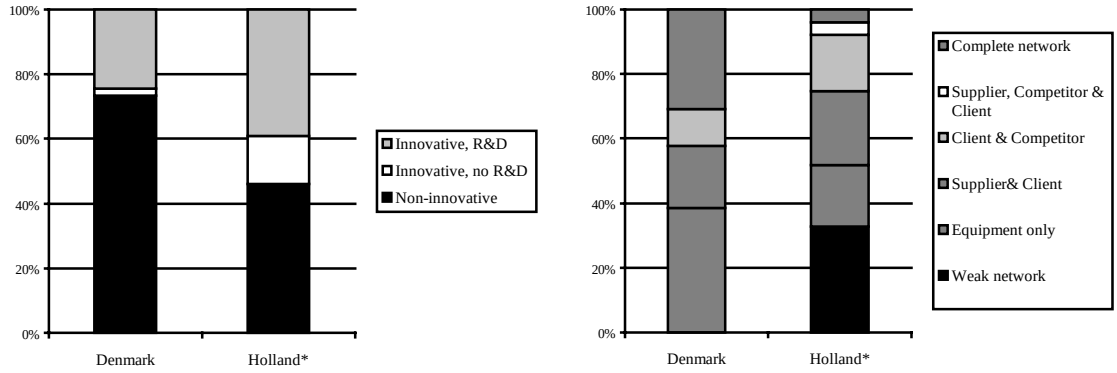
The fact that the Belgian TEXTILES cluster is more structured towards innovation than its Dutch counterpart is mainly due to the difference in 'weak network-equipment only' distribution. Apart from the fact that Belgium totally out-scores the Netherlands in this respect, differences aren't all that large. The fact that both clusters are unaffected by the CIS restrictions means that Belgium simply has a competitive edge over the Netherlands regarding innovation networks. This is neatly reflected in the distribution of structural innovation: Belgium translates its advantage over the Netherlands in innovation networks in a higher innovative performance.

Exhibit 6.15 and 6.16 : distribution of structural innovation and distribution of innovation networks over INFORMATION AND FINANCIAL clusters



Despite the large correspondence, with a slight Danish advantage over the Netherlands, in innovative performance, comparability between Denmark and the Netherlands regarding the innovation networks in their INFORMATION AND FINANCIAL clusters is minimal. Denmark's cluster totally lacks 'weak network' and 'supplier, competitor & client' relationships, while more than half of its network relations are of the 'equipment only' kind. The Dutch cluster has a much more gradual distribution, and can be regarded as more innovation-prone, although this doesn't translate in performance. After imposing the CIS limitations on the clusters, the two clusters are left only with their paper (Denmark) and their publishing/printing (Denmark and the Netherlands) parts. The effect on cluster linkages is far greater in the Netherlands than it is in Denmark, which could mean that in reality the Dutch cluster really overpowers its Danish counterpart when it comes to network quality.

Exhibit 6.17 and 6.18: distribution of structural innovation and distribution of innovation networks over DISTRIBUTION clusters



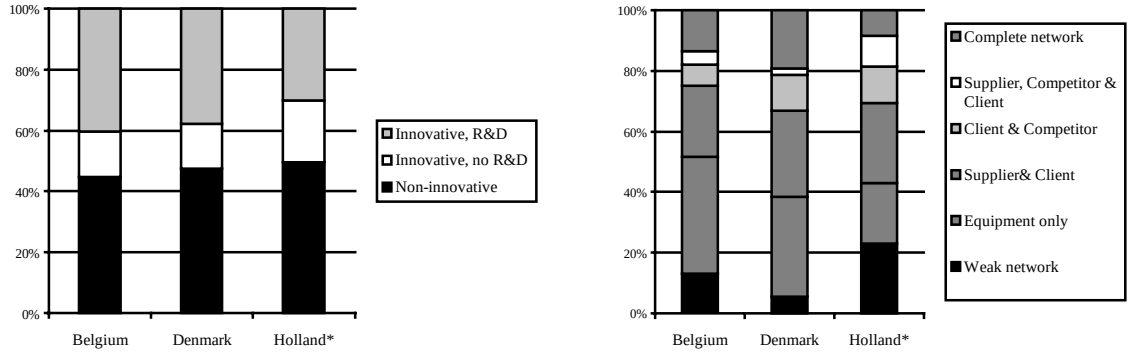
These DISTRIBUTION cluster results are very confusing. Innovative performance in the Netherlands is by far better than in Denmark. But in Denmark the distribution of innovation networks is far less gradual and at the same time also far more innovation-prone than its Dutch twin is. With respect to their cluster graphs and CIS restrictions: the consequences are very large. The Netherlands misses out on its transport industries and is left with some transportation manufacturing, with a low level of linkages. The consequences for Denmark are even more dramatic: only the (now unlinked) shipbuilding industry ('other transport equipment') is left of its cluster structure! This could explain the strange results of this analysis: the available data are simply not sufficient.

6.5 Conclusions

The general conclusion of this chapter is fairly simple: according to CIS I data the presence of dense innovation networks is strongest in Denmark, followed by Belgium and, at a further distance, the Netherlands.

But the most striking result is that there seems to be no significant correlation between the distribution of innovation networks and innovative performance. When it comes to structural innovation Belgium ranks first, followed by Denmark and the Netherlands.

Exhibits 6.19 and 6.20: distribution of structural innovation and distribution of innovation networks over national economies



One of the explanations of this anomaly could be that the variables used in determining the distribution of innovation networks are sensitive to subjectivity. The variables deal with how a firm *perceives* the impact of change in products or processes, or how it *perceives* the importance of some factor on its own behaviour. The possibility that national specifics such as the general feeling about the economy, government promotion of economic co-operation or cultural values influence this perception shouldn't be ruled out.

Another possible explanation of the structure-performance paradox is more fundamental (and pretty scary as well): possibly the structure of innovation networks doesn't even influence innovative performance. It is beyond this thesis to go deeper into this possibility, but who knows somebody else will…

Another conclusion that can be readily drawn is that the CIS I data represent too small a part of the cluster population in order to have a significant value in the analysis of National Systems of Innovation. The limitations of the data have two consequences for the analysis: the clusters as used in the analysis are not adequately representative for the actual cluster population and analysis of the structure of the cluster with respect to innovative performance becomes obsolete.

The problems of the adequate representation of the cluster population and of the cluster structure could be solved easily: by expanding the Community Innovation Survey to the entire economy.

The problem of national differences in perception of importance of variables on innovative behaviour might be harder to solve, but this problem has a smaller influence on analysis in the first place.

7 Concluding remarks

Concluding this thesis, one can say that we are getting there, but that we're not there yet. Let's recall the central question to this thesis:

Is it possible to compare innovative clusters in different countries in cluster structure and innovative behaviour, and if so, can a relationship between the two be established?

Answering this question is easy: YES, there is a way to compare innovative clusters, but NO, drawing 'hard' conclusions from the results is still tricky. There is still a reasonable subjective element in the cluster identification process, while the data (both IO-tables and CIS I) have severe limitations because of insufficient standardisation.

The cluster algorithm is performing well, and the resulting cluster graphs are easily apprehensible, offering a good overview of the cluster structure. The results of the cluster identification show similar clusters in different countries (mostly 'traditional' and quite 'sectoral' clusters, think of the AGRO-FOOD clusters), clusters typical for a countries' traditional specialisation pattern (think of the Finnish FORESTRY cluster) and clusters typical for a countries' set of 'Neue Kombinationen' (think of the INFORMATION AND FINANCIAL clusters).

Using the innovation networks algorithm and linking these networks to the identified clusters poses no problems as well. It is difficult however, to derive any conclusions from this 'innovation link'. Differences in overall national innovative performance and in availability of data prohibit the noticing of any serious correlation between cluster structure and innovative behaviour.

The limited objectivity in cluster identification, as illustrated by the differences in the analysis of Belgian clusters by the Belgian team and by yours truly, will not be easy to lift. As stated earlier, for now the researcher will have to depend on experience and creativity.

The poor standardisation and comparability of data can be solved more easily, but this is beyond the researcher. Input-output tables need to be available at lower, and more comparable, aggregation levels, while innovation surveys need to incorporate the entire population in the economy, and not just the service sectors.

The data limitations and the resulting problem of not being able to uncover the relationship between cluster structure and innovative performance means that (new) policy implications are impossible to get at. Because for now there are no structure-performance distinctions between the several types of clusters, cluster policy measures have to remain general. This is a plea for, for example, the present Dutch cluster policy of creating general favourable framework conditions and of brokering between demand and supply of knowledge.

And that's why I would like to conclude this thesis by saying: we are getting there, but that we're not there yet!

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Appendix Ia: Cluster-algorithm (downstream)

I/O cluster-analysis
DOWNSTREAM
A.H.Verbeek, Ministerie van Economische Zaken, 8 June 1999
GAUSS for Windows NT/95, version 3.2.35

MAIN PROGRAM

```
new ;
cls ;
format /rz ;

@ The first downstream threshold value k1 is entered by the user @
correct_number = 0 ;
do until correct_number == 1 ;
        "What first downstream threshold value do you want to use? " ;
        "(Enter a number between 0 and 1 and hit <Enter>): " ; threshold_value_k = con(1,1) ;
        if threshold_value_k >= 0 and threshold_value_k <= 1 ;
                format 4,3 ;
                "The first downstream threshold value k1 =  " threshold_value_k ;
                "Hit <Enter> to continue " ; wait ;
                correct_number = 1 ;
        else ;
                "Please enter a number between 0 and 1! " ; wait ;
                cls ;
        endif ;
endo ;
cls ;

@ The second downstream threshold value k2 is entered by the user @
correct_number = 0 ;
do until correct_number == 1 ;
        "What second downstream threshold value do you want to use? " ;
        "(Enter a number between 0 and 1 and hit <Enter>): " ; threshold_value_k2 = con(1,1) ;
        if threshold_value_k2 >= 0 and threshold_value_k2 <= 1 ;
                format 4,3 ;
                "The second downstream threshold value k2 =  " threshold_value_k2 ;
                "Hit <Enter> to continue " ; wait ;
                correct_number = 1 ;
        else ;
                "Please enter a number between 0 and 1! " ; wait ;
                cls ;
        endif ;
endo ;
cls ;
```

STEP 1: THE I/O-TABLE IS LOADED

```
@ The matrix is loaded (at this point the matrix does not yet have the right dimensions!) @
"The matrix will be loaded (make sure you enter the right matrix!). " ;
"Hit <Enter> to start loading the matrix. " ; wait ;

@ PLEASE ENTER THE FILE THAT CONTAINS THE MATRIX HERE @
load _new_matrix[]= c:\hessel\cluster\countries\holland\iotables\ioafm93l.txt ;
"The matrix is loaded successfully! (However, not yet in the right format) " ;
"Hit <Enter> to continue " ; wait ;
cls ;

@ The number of rows (equalling the number of columns) of the matrix is entered by the user @
correct_number = 0 ;
do until correct_number == 1 ;
        "How many rows (= number of columns) does the matrix contain? " ;
        "(Enter a number between 1 and 500.): " ; number_rows = con(1,1) ;
        if number_rows >= 1 and number_rows <= 500 ;
                format /rz /ld 3,0 ;
```

```
                    "The matrix which is loaded has dimensions " ; number_rows "by" number_rows ;
                    "Hit <Enter> to continue " ; wait ;
                    correct_number = 1 ;
          else ;
                    "Please enter a number between 1 and 500! " ;
                    "Hit <Enter> to continue " ; wait ;
                    cls ;
          endif ;
          cls ;
endo ;

number_cols = number_rows ;
number_sectors = number_cols ;

@ The matrix is reshaped in order to get a 'number_rows x number_cols' matrix @
_new_matrix = reshape(_new_matrix,number_rows,number_cols) ;

@ The diagonal of the matrix is set equal to zero @
_new_matrix = diagrv(_new_matrix,zeros(rows(_new_matrix),1));
```

STEP 2: THE CLUSTER MATRIX IS CALCULATED, USING ITERATIONS

```
@ We use a dummy that determines how many iterations are done; as long as this dummy equals one a @
@ new iteration is being performed; if this dummy becomes zero, the last iteration has been performed @
continuation_dummy = 1 ;
iteration_number = 1 ;
do while continuation_dummy == 1 ;
"\lThe iteration number = " iteration_number ; wait ;

@ The number of rows and the number of columns of the new matrix are determined @
number_rows = rows(_new_matrix) ;
number_cols = number_rows ;
```

STEP 2a: THE FIRST OUTPUT MATRIX IS CALCULATED

```
@ The vector with the maxima of each row of the matrix is computed @
vector_maximum_cols =  maxc(_new_matrix') ;

@ The vector with the sum of each row of the matrix is calculated @
vector_rowsum = sumc(_new_matrix') ;

@ We must account for the possibility that the sum of the row elements equals zero (which would lead to @
@ a division-by-zero problem in the next steps); because the maximum value of a zero row vector is equal @
@ to zero we set the sum of the row elements equal to the arbitrary number 1; this can be done because @
@ in the rest of the program we will only need the ratio of the maximum value and the sum, which in this @
@ special case will be equal to zero @
for i (1,number_rows,1) ;
          if vector_rowsum[i,1] == 0 ;
                    vector_rowsum[i,1] = 1 ;
          endif ;
endfor ;

@ The vector with the row-maxima is divided by the vector with the sum of the rows of the matrix @
vector_maximum_divided_by_sum = vector_maximum_cols./vector_rowsum ;

@ The interval in which the value of vector of maxima divided by the sum must be is set using the first @
@ downstream threshold value k1 @
interval = threshold_value_k|1 ;

@ The row element numbers of the vector for which the maximum divided by the sum is valid in the @
@ interval are calculated @
vector_elements_within_interval = indexcat(vector_maximum_divided_by_sum,interval) ;
if sumc(indexcat(vector_maximum_divided_by_sum,threshold_value_k|threshold_value_k)) > 0 ;
          vector_elements_within_interval = sortc(indexcat(vector_maximum_divided_by_sum,interval)|
          indexcat(vector_maximum_divided_by_sum,threshold_value_k,threshold_value_k)) ;
endif ;

@ If there are no rows left for which the maximum element divided by the sum of the elements is within @
@ the interval, the cluster matrix has been found; the dummy is set equal to zero @
if counts(vector_maximum_divided_by_sum - threshold_value_k,0) == number_rows ;
          continuation_dummy = 0 ;
```

```
else ;

@ The column element numbers of the maximum values of the rows of the matrix are calculated @
matrix_elements_maximum_cols = zeros(number_rows,number_cols) ;
for k (1,rows(vector_elements_within_interval),1) ;
        i = vector_elements_within_interval[k,1] ;
        column_numbers = indexcat(_new_matrix[i,.]',vector_maximum_cols[i,1]) ;
        column_numbers1 = column_numbers[.,1]' ;
        if cols(column_numbers1) == number_cols ;
                matrix_elements_maximum_cols[i,.] = column_numbers1 ;
        else ;
                matrix_elements_maximum_cols[i,1:cols(column_numbers1)] = column_numbers1 ;
        endif ;
endfor ;

@ The vector with the sum of the column element numbers of the new matrix is calculated @
vector_colsum = sumc(_new_matrix) ;

@ Again, we must account for the possibility of division by zero in the next steps @
for i (1,number_rows,1) ;
        if vector_colsum[i,1] == 0 ;
                vector_colsum[i,1] = 1 ;
        endif ;
endfor ;

@ The matrix which contains the elements of the ratio of the maximum values and the sum of the column @
@ elements is calculated @
matrix_maxima_divided_by_colsum = zeros(number_rows,number_rows) ;
for row (1,number_rows,1) ;
        column = 1 ;
        do while matrix_elements_maximum_cols[row,column] /= 0 ;
                matrix_maxima_divided_by_colsum[row,column]=
                _new_matrix[row,matrix_elements_maximum_cols[row,column]] ./
                 vector_colsum[matrix_elements_maximum_cols[row,column],1] ;
                column = column + 1 ;
        endo ;
endfor ;

@ The interval in which the values of the matrix of the ratio of the maxima and the sum of the column @
@ elements must be is set using the second downstream threshold value k2 @
        interval = threshold_value_k2|1 ;
        format /rz /ld 4,3 ;

@ The matrix element numbers for which the maximum divided by the sum of the column elements @
@ are valid in the interval are calculated @
matrix_elements_within_interval = zeros(number_rows,number_rows) ;
for column (1,number_rows,1) ;
        vector_elements = indexcat(matrix_maxima_divided_by_colsum[.,column],interval) ;
if sumc(indexcat(matrix_maxima_divided_by_colsum[.,column],threshold_value_k2|threshold_value_k2)) > 0 ;
        vector_elements = sortc(indexcat(matrix_maxima_divided_by_colsum[.,column],interval)|
        indexcat(matrix_maxima_divided_by_colsum[.,column],threshold_value_k2,threshold_value_k2)) ;
endif ;
if counts(matrix_maxima_divided_by_colsum[.,column] - threshold_value_k2,0) /= number_rows ;
        matrix_elements_within_interval[1:rows(vector_elements),column] = vector_elements ;
endif ;
endfor ;
format /rz /ld 1,0 ;

matrix_elements = zeros(number_rows,number_rows) ;
i = 1 ;
do while matrix_elements_within_interval[1,i] /= 0 ;
        j = 1 ;
do while matrix_elements_within_interval[j,i] /= 0 ;
        if i == 1 ;
                matrix_elements[matrix_elements_within_interval[j,i],i] =
                matrix_elements_maximum_cols[matrix_elements_within_interval[j,i],i] ;
        else ;
                for k (1,i - 1,1) ;
                if matrix_elements[matrix_elements_within_interval[j,i],k] == 0 ;
                        matrix_elements[matrix_elements_within_interval[j,i],k] =
                        matrix_elements_maximum_cols[matrix_elements_within_interval[j,i],i] ;
                else ;
                        matrix_elements[matrix_elements_within_interval[j,i],i] =
                        matrix_elements_maximum_cols[matrix_elements_within_interval[j,i],i] ;
                endif ;
                endfor ;
```

```
            endif ;
            j = j + 1 ;
endo ;
i = i + 1 ;
endo ;

@ The first output matrix is calculated; the first column contains the row number, the last column      @
@ contains the ratio of the maximum and the sum of the row elements; the other columns contain the @
@ column number(s) of the maximum as well as the maxima (in case of more highest values) and @
@ zeros (just to fill up the matrix @
output_matrix_1 = seqa(1,1,number_rows)~matrix_elements~vector_maximum_divided_by_sum ;
format /rz /ld 5,4 ;

@ The first output matrix is saved to disk as down1.fmt @
output file = c:\hessel\down1 ;
save c:\hessel\down1 = output_matrix_1 ;
```

STEP 2b: THE SECOND OUTPUT MATRIX IS CALCULATED

```
@ The matrix which keeps track of the major supplies is calculated using ones and zeros; for each @
@ row the column elements which contain the maximum value and for each column the row elements @
@ for which the column value is equal to the maximum value of this row,are given the value 1; thus a @
@ symmetric matrix is calculated @
output_matrix_2 = zeros(number_rows,number_cols) ;
i = 1 ;
do while i < number_rows + 1 ;
            j = 1 ;
            do until matrix_elements[i,j] == 0 ;
                        output_matrix_2[i,matrix_elements[i,j]] = 1 ;
                        output_matrix_2[matrix_elements[i,j],i] = 1 ;
                        format /rz ;
                        i matrix_elements[i,j] ;
                        j = j +1 ;
            endo ;
            i = i + 1 ;
endo ;

@ The second output matrix is saved to disk @
output file = c:\hessel\down2 ;
save c:\hessel\down2 = output_matrix_2 ;
```

STEP 2c: THE THIRD OUTPUT MATRIX IS CALCULATED

```
@ The collection of sectors which form a cluster is initialized using zeros @
_set_numbers = zeros(number_rows,1) ;
_set_matrix = _set_numbers ;

cluster_number = 1 ;
do while sumc(_set_numbers[.,1]) /= number_cols ;
   if cluster_number == 1 ;

@ The first cluster is defined by the sectors which are associated with the first sector; the @
@ variable new_number is set equal to the row which belongs to this sector @
      sector_numbers = 1 ;
   else ;

@ The residual sector numbers (sectors which have not yet been considered) are determined @
      residual_sectors = indexcat(_set_numbers,0) ;
      sector_numbers = residual_sectors[1,1] ;
   endif ;

@ The (iterative!) procedure Recursiv is used to compute the new cluster @
Recursiv(sector_numbers) ;

@ The matrix_set_matrix which keeps track of the clusters is calculated; each column of the matrix @
@ (except the first column) is associated with a cluster; the sector which belongs to the cluster @
@ in a certain column has a value one in this column @
sum_old_set_numbers = sumc(_set_matrix[.,1:cluster_number]') ;

@ The new cluster is added to _set_matrix @
```

```
_set_matrix = _set_matrix~(_set_numbers - sum_old_set_numbers) ;
cluster_number = cluster_number + 1 ;
endo ;

@ The first column of _set_matrix contains zeros and is deleted from the matrix @
_set_matrix = _set_matrix[.,2:cluster_number] ;

@ The third output matrix is constructed; the matrix consists of columns with the element numbers @
@ of the sectors which belong to the cluster in the associated column filled up with zeros; the element @
@ numbers are sorted in descending order; note that after the first iteration the sectors are 'hidden' within @
@ the clusters; that is the reason why a special matrix is introduced to keep track of all the sectors @
output_matrix_3 = diagrv(eye(number_rows),seqa(1,1,number_rows))*_set_matrix ;
matrix_2 = zeros(number_rows,1) ;
for i (1,cols(output_matrix_3),1) ;
        matrix_2 = matrix_2~(rev(sortc(output_matrix_3[.,i],1))) ;
endfor ;
output_matrix_3 = matrix_2[.,2:cols(matrix_2)] ;

@ Now the matrix which keeps of the sectors is calculated using the information of the third @
@ output matrix @
if iteration_number == 1 ;

@ In the first iteration the third output matrix is saved for use in the second iteration @
output_matrix_3_old = output_matrix_3 ;
else ;

@ Now the sectors which formed the clusters in the former iteration are assigned to the new clusters @
output_matrix_3_new = zeros(number_sectors,cols(output_matrix_3)) ;
for column (1,cols(output_matrix_3),1) ;
        count = rows(output_matrix_3) - counts(output_matrix_3[.,column],0) ;
        sector_vector = 0 ;
        for row (1,count,1) ;
                sector_vector = sector_vector|output_matrix_3_old[.,output_matrix_3[row,column]] ;
                        sector_vector = rev(sortc(sector_vector[1:rows(sector_vector),1],1)) ;
                        sector_vector = sector_vector[1:number_sectors,.] ;
        endfor ;
        output_matrix_3_new[.,column] = sector_vector ;
endfor ;

@ The new third output matrix becomes the old third output matrix in the next iteration @
output_matrix_3_old = output_matrix_3_new ;
endif ;
format /rz ;
for i (1,cols(output_matrix_3_old),1) ;
        "\lCluster number = " i ; wait ;
        for j (1,rows(output_matrix_3_old),1) ;
                if output_matrix_3_old[j,i] /= 0 ;
                        output_matrix_3_old[j,i] ; wait ;
                endif ;
        endfor ;
endfor ;

@ The third output matrix is saved to disk @
output file = c:\hessel\down3 ;
save c:\hessel\down3 = output_matrix_3 ;
```

STEP 2d: THE FOURTH OUTPUT MATRIX IS CALCULATED

```
@ The original matrix is reduced by aggregation of the rows and columns for each cluster @
@ using  _set_matrix; the result is a new matrix where the number of rows (and columns) equals @
@ the number of clusters found in the iteration before @
   _new_matrix = _set_matrix*_new_matrix*_set_matrix ;

@ The diagonal of the new matrix is set equal to zero @
_new_matrix = diagrv(_new_matrix,zeros(rows(_new_matrix),1)) ;
endif ;
        if (rows(_new_matrix) == 1) and (cols(_new_matrix) == 1) ;
                continuation_dummy = 0 ;
        else ;
                iteration_number = iteration_number + 1 ;
        endif ;
endo ;
```

```
output_matrix_4 = _new_matrix ;
"\lThe fourth output matrix = " ; output_matrix_4 ; wait ;

@ The fourth output matrix is saved to disk @
output file = c:\hessel\down4 ;
save c:\hessel\down4 = output_matrix_4 ;
```

PROCEDURE RECURSIV

```
proc(0) = Recursiv(sector_numbers) ;
   local i,potential_sector_numbers,number_sector_numbers ;
   number_sector_numbers = rows(sector_numbers) ;
   i = 1 ;

@ For each new sector number there's a check-up whether it is already in a cluster; the variable @
@ _set_numbers keeps track of the sectors that are already in a cluster @
do while i /= number_sector_numbers + 1 ;

@ If the sector is not already in a cluster, the sector is checked on associated sectors @
            if _set_numbers[sector_numbers[i,1],1] == 0 ;
             _set_numbers[sector_numbers[i,1],1] = 1 ;

@ The sectors associated with the new sector number are calculated @
            potential_sector_numbers = indexcat(output_matrix_2[sector_numbers[i,1],.]',1) ;
          Recursiv(potential_sector_numbers) ;
                    else ;
            endif ;
            i = i + 1 ;
endo ;
endp ;
```

Appendix Ib: Cluster-algorithm (upstream)

I/O cluster-analysis
UPSTREAM
A.H.Verbeek, Ministerie van Economische Zaken, 8 June 1999
GAUSS for Windows NT/95, version 3.2.35

MAIN PROGRAM

```
new ;
cls ;
format /rz ;

@ The first upstream threshold value l1 is entered by the user @
correct_number = 0 ;
do until correct_number == 1 ;
        "What first downstream threshold value do you want to use? " ;
        "(Enter a number between 0 and 1 and hit <Enter>): " ; threshold_value_l = con(1,1) ;
        if threshold_value_l >= 0 and threshold_value_l <= 1 ;
                format 4,3 ;
                "The first downstream threshold value l1 =  " threshold_value_l ;
                "Hit <Enter> to continue " ; wait ;
                correct_number = 1 ;
        else ;
                "Please enter a number between 0 and 1! " ; wait ;
                cls ;
        endif ;
endo ;
cls ;

@ The second downstream threshold value l2 is entered by the user @
correct_number = 0 ;
do until correct_number == 1 ;
        "What second downstream threshold value do you want to use? " ;
        "(Enter a number between 0 and 1 and hit <Enter>): " ; threshold_value_l2 = con(1,1) ;
        if threshold_value_l2 >= 0 and threshold_value_l2 <= 1 ;
                format 4,3 ;
                "The second downstream threshold value l2 =  " threshold_value_l2 ;
                "Hit <Enter> to continue " ; wait ;
                correct_number = 1 ;
        else ;
                "Please enter a number between 0 and 1! " ; wait ;
                cls ;
        endif ;
endo ;
cls ;
```

STEP 1: THE I/O-TABLE IS LOADED

```
@ The matrix is loaded (at this point the matrix does not yet have the right dimensions!) @
"The matrix will be loaded (make sure you enter the right matrix!). " ;
"Hit <Enter> to start loading the matrix. " ; wait ;

@ PLEASE ENTER THE FILE THAT CONTAINS THE MATRIX HERE @
load _new_matrix[]= c:\hessel\cluster\countries\holland\iotables\ioafm93l.txt ;
"The matrix is loaded successfully! (However, not yet in the right format) " ;
"Hit <Enter> to continue " ; wait ;
cls ;

@ The number of rows (equalling the number of columns) of the matrix is entered by the user @
correct_number = 0 ;
do until correct_number == 1 ;
        "How many rows (= number of columns) does the matrix contain? " ;
        "(Enter a number between 1 and 500.): " ; number_rows = con(1,1) ;
        if number_rows >= 1 and number_rows <= 500 ;
                format /rz /ld 3,0 ;
```

```
                    "The matrix which is loaded has dimensions " ; number_rows "by" number_rows ;
                    "Hit <Enter> to continue " ; wait ;
                    correct_number = 1 ;
          else ;
                    "Please enter a number between 1 and 500! " ;
                    "Hit <Enter> to continue " ; wait ;
                    cls ;
          endif ;
          cls ;
endo ;

number_cols = number_rows ;
number_sectors = number_cols ;

@ The matrix is reshaped in order to get a 'number_rows x number_cols' matrix @
_new_matrix = reshape(_new_matrix,number_rows,number_cols) ;

@ The diagonal of the matrix is set equal to zero @
_new_matrix = diagrv(_new_matrix,zeros(rows(_new_matrix),1));

@ THE MATRIX IS TRANSPOSED WHICH IS THE ONLY DIFFERENCE @
@ WITH THE DOWNSTREAM PROGRAM @
_new_matrix =_new_matrix' ;
```

STEP 2: THE CLUSTER MATRIX IS CALCULATED, USING ITERATIONS

```
@ We use a dummy that determines how many iterations are done; as long as this dummy equals one a @
@ new iteration is being performed; if this dummy becomes zero, the last iteration has been performed @
continuation_dummy = 1 ;
iteration_number = 1 ;
do while continuation_dummy == 1 ;
"\lThe iteration number = " iteration_number ; wait ;

@ The number of rows and the number of columns of the new matrix are determined @
number_rows = rows(_new_matrix) ;
number_cols = number_rows ;
```

STEP 2a: THE FIRST OUTPUT MATRIX IS CALCULATED

```
@ The vector with the maxima of each row of the matrix is computed @
vector_maximum_cols =  maxc(_new_matrix') ;

@ The vector with the sum of each row of the matrix is calculated @
vector_rowsum = sumc(_new_matrix') ;

@ We must account for the possibility that the sum of the row elements equals zero (which would lead to @
@ a division-by-zero problem in the next steps); because the maximum value of a zero row vector is equal @
@ to zero we set the sum of the row elements equal to the arbitrary number 1; this can be done because @
@ in the rest of the program we will only need the ratio of the maximum value and the sum, which in this @
@ special case will be equal to zero @
for i (1,number_rows,1) ;
          if vector_rowsum[i,1] == 0 ;
                    vector_rowsum[i,1] = 1 ;
          endif ;
endfor ;

@ The vector with the row-maxima is divided by the vector with the sum of the rows of the matrix @
vector_maximum_divided_by_sum = vector_maximum_cols./vector_rowsum ;

@ The interval in which the value of vector of maxima divided by the sum must be is set using the first @
@ downstream threshold value l1 @
interval = threshold_value_l|1 ;

@ The row element numbers of the vector for which the maximum divided by the sum is valid in the @
@ interval are calculated @
vector_elements_within_interval = indexcat(vector_maximum_divided_by_sum,interval) ;
if sumc(indexcat(vector_maximum_divided_by_sum,threshold_value_l|threshold_value_l)) > 0 ;
          vector_elements_within_interval = sortc(indexcat(vector_maximum_divided_by_sum,interval)|
          indexcat(vector_maximum_divided_by_sum,threshold_value_l,threshold_value_l)) ;
endif ;
```

```
@ If there are no rows left for which the maximum element divided by the sum of the elements is within @
@ the interval, the cluster matrix has been found; the dummy is set equal to zero @
if counts(vector_maximum_divided_by_sum - threshold_value_l,0) == number_rows ;
        continuation_dummy = 0 ;
else ;

@ The column element numbers of the maximum values of the rows of the matrix are calculated @
matrix_elements_maximum_cols = zeros(number_rows,number_cols) ;
for l (1,rows(vector_elements_within_interval),1) ;
        i = vector_elements_within_interval[l,1] ;
        column_numbers = indexcat(_new_matrix[i,.]',vector_maximum_cols[i,1]) ;
        column_numbers1 = column_numbers[.,1]' ;
        if cols(column_numbers1) == number_cols ;
                matrix_elements_maximum_cols[i,.] = column_numbers1 ;
        else ;
                matrix_elements_maximum_cols[i,1:cols(column_numbers1)] = column_numbers1 ;
        endif ;
endfor ;

@ The vector with the sum of the column element numbers of the new matrix is calculated @
vector_colsum = sumc(_new_matrix) ;

@ Again, we must account for the possibility of division by zero in the next steps @
for i (1,number_rows,1) ;
        if vector_colsum[i,1] == 0 ;
                vector_colsum[i,1] = 1 ;
        endif ;
endfor ;

@ The matrix which contains the elements of the ratio of the maximum values and the sum of the column @
@ elements is calculated @
matrix_maxima_divided_by_colsum = zeros(number_rows,number_rows) ;
for row (1,number_rows,1) ;
        column = 1 ;
        do while matrix_elements_maximum_cols[row,column] /= 0 ;
                matrix_maxima_divided_by_colsum[row,column]=
                _new_matrix[row,matrix_elements_maximum_cols[row,column]] ./
                 vector_colsum[matrix_elements_maximum_cols[row,column],1] ;
                column = column + 1 ;
        endo ;
endfor ;

@ The interval in which the values of the matrix of the ratio of the maxima and the sum of the column @
@ elements must be is set using the second downstream threshold value l2 @
        interval = threshold_value_l2|1 ;
        format /rz /ld 4,3 ;

@ The matrix element numbers for which the maximum divided by the sum of the column elements @
@ are valid in the interval are calculated @
matrix_elements_within_interval = zeros(number_rows,number_rows) ;
for column (1,number_rows,1) ;
        vector_elements = indexcat(matrix_maxima_divided_by_colsum[.,column],interval) ;
if sumc(indexcat(matrix_maxima_divided_by_colsum[.,column],threshold_value_l2|threshold_value_l2))>0;
        vector_elements = sortc(indexcat(matrix_maxima_divided_by_colsum[.,column],interval)|
        indexcat(matrix_maxima_divided_by_colsum[.,column],threshold_value_l2,threshold_value_l2)) ;
endif ;
if counts(matrix_maxima_divided_by_colsum[.,column] - threshold_value_l2,0) /= number_rows ;
        matrix_elements_within_interval[1:rows(vector_elements),column] = vector_elements ;
endif ;
endfor ;
format /rz /ld 1,0 ;

matrix_elements = zeros(number_rows,number_rows) ;
i = 1 ;
do while matrix_elements_within_interval[1,i] /= 0 ;
        j = 1 ;
do while matrix_elements_within_interval[j,i] /= 0 ;
        if i == 1 ;
                matrix_elements[matrix_elements_within_interval[j,i],i] =
                matrix_elements_maximum_cols[matrix_elements_within_interval[j,i],i] ;
        else ;
                for l (1,i - 1,1) ;
                if matrix_elements[matrix_elements_within_interval[j,i],l] == 0 ;
                        matrix_elements[matrix_elements_within_interval[j,i],l] =
                        matrix_elements_maximum_cols[matrix_elements_within_interval[j,i],i] ;
                else ;
```

```
                                matrix_elements[matrix_elements_within_interval[j,i],i] =
                                matrix_elements_maximum_cols[matrix_elements_within_interval[j,i],i] ;
                        endif ;
                        endfor ;
                endif ;
                j = j + 1 ;
endo ;
i = i + 1 ;
endo ;

@ The first output matrix is calculated; the first column contains the row number, the last column      @
@ contains the ratio of the maximum and the sum of the row elements; the other columns contain the @
@ column number(s) of the maximum as well as the maxima (in case of more highest values) and @
@ zeros (just to fill up the matrix @
output_matrix_1 = seqa(1,1,number_rows)~matrix_elements~vector_maximum_divided_by_sum ;
format /rz /ld 5,4 ;

@ The first output matrix is saved to disk as down1.fmt @
output file = c:\hessel\down1 ;
save c:\hessel\down1 = output_matrix_1 ;
```

STEP 2b: THE SECOND OUTPUT MATRIX IS CALCULATED

```
@ The matrix which keeps track of the major supplies is calculated using ones and zeros; for each @
@ row the column elements which contain the maximum value and for each column the row elements @
@ for which the column value is equal to the maximum value of this row,are given the value 1; thus a @
@ symmetric matrix is calculated @
output_matrix_2 = zeros(number_rows,number_cols) ;
i = 1 ;
do while i < number_rows + 1 ;
        j = 1 ;
        do until matrix_elements[i,j] == 0 ;
                output_matrix_2[i,matrix_elements[i,j]] = 1 ;
                output_matrix_2[matrix_elements[i,j],i] = 1 ;
                format /rz ;
                i matrix_elements[i,j] ;
                j = j +1 ;
        endo ;
        i = i + 1 ;
endo ;

@ The second output matrix is saved to disk @
output file = c:\hessel\down2 ;
save c:\hessel\down2 = output_matrix_2 ;
```

STEP 2c: THE THIRD OUTPUT MATRIX IS CALCULATED

```
@ The collection of sectors which form a cluster is initialized using zeros @
_set_numbers = zeros(number_rows,1) ;
_set_matrix = _set_numbers ;

cluster_number = 1 ;
do while sumc(_set_numbers[.,1]) /= number_cols ;
   if cluster_number == 1 ;

@ The first cluster is defined by the sectors which are associated with the first sector; the @
@ variable new_number is set equal to the row which belongs to this sector @
      sector_numbers = 1 ;
   else ;

@ The residual sector numbers (sectors which have not yet been considered) are determined @
      residual_sectors = indexcat(_set_numbers,0) ;
      sector_numbers = residual_sectors[1,1] ;
   endif ;

@ The (iterative!) procedure Recursiv is used to compute the new cluster @
Recursiv(sector_numbers) ;

@ The matrix_set_matrix which keeps track of the clusters is calculated; each column of the matrix @
@ (except the first column) is associated with a cluster; the sector which belongs to the cluster @
```

```
@ in a certain column has a value one in this column @
sum_old_set_numbers = sumc(_set_matrix[.,1:cluster_number]') ;

@ The new cluster is added to _set_matrix @
_set_matrix = _set_matrix~(_set_numbers - sum_old_set_numbers) ;
cluster_number = cluster_number + 1 ;
endo ;

@ The first column of _set_matrix contains zeros and is deleted from the matrix @
_set_matrix = _set_matrix[.,2:cluster_number] ;

@ The third output matrix is constructed; the matrix consists of columns with the element numbers @
@ of the sectors which belong to the cluster in the associated column filled up with zeros; the element @
@ numbers are sorted in descending order; note that after the first iteration the sectors are 'hidden' within @
@ the clusters; that is the reason why a special matrix is introduced to keep track of all the sectors @
output_matrix_3 = diagrv(eye(number_rows),seqa(1,1,number_rows))*_set_matrix ;
matrix_2 = zeros(number_rows,1) ;
for i (1,cols(output_matrix_3),1) ;
        matrix_2 = matrix_2~(rev(sortc(output_matrix_3[.,i],1))) ;
endfor ;
output_matrix_3 = matrix_2[.,2:cols(matrix_2)] ;

@ Now the matrix which keeps of the sectors is calculated using the information of the third @
@ output matrix @
if iteration_number == 1 ;

@ In the first iteration the third output matrix is saved for use in the second iteration @
output_matrix_3_old = output_matrix_3 ;
else ;

@ Now the sectors which formed the clusters in the former iteration are assigned to the new clusters @
output_matrix_3_new = zeros(number_sectors,cols(output_matrix_3)) ;
for column (1,cols(output_matrix_3),1) ;
        count = rows(output_matrix_3) - counts(output_matrix_3[.,column],0) ;
        sector_vector = 0 ;
        for row (1,count,1) ;
                sector_vector = sector_vector|output_matrix_3_old[.,output_matrix_3[row,column]] ;
                        sector_vector = rev(sortc(sector_vector[1:rows(sector_vector),1],1)) ;
                        sector_vector = sector_vector[1:number_sectors,.] ;
        endfor ;
        output_matrix_3_new[.,column] = sector_vector ;
endfor ;

@ The new third output matrix becomes the old third output matrix in the next iteration @
output_matrix_3_old = output_matrix_3_new ;
endif ;
format /rz ;
for i (1,cols(output_matrix_3_old),1) ;
        "\lCluster number = " i ; wait ;
        for j (1,rows(output_matrix_3_old),1) ;
                if output_matrix_3_old[j,i] /= 0 ;
                        output_matrix_3_old[j,i] ; wait ;
                endif ;
        endfor ;
endfor ;

@ The third output matrix is saved to disk @
output file = c:\hessel\down3 ;
save c:\hessel\down3 = output_matrix_3 ;
```

STEP 2d: THE FOURTH OUTPUT MATRIX IS CALCULATED

```
@ The original matrix is reduced by aggregation of the rows and columns for each cluster @
@ using  _set_matrix; the result is a new matrix where the number of rows (and columns) equals @
@ the number of clusters found in the iteration before @
   _new_matrix = _set_matrix'*_new_matrix*_set_matrix ;

@ The diagonal of the new matrix is set equal to zero @
_new_matrix = diagrv(_new_matrix,zeros(rows(_new_matrix),1)) ;
endif ;
        if (rows(_new_matrix) == 1) and (cols(_new_matrix) == 1) ;
                continuation_dummy = 0 ;
        else ;
```

```
                    iteration_number = iteration_number + 1 ;
            endif ;
endo ;

output_matrix_4 = _new_matrix ;
"\lThe fourth output matrix = " ; output_matrix_4 ; wait ;

@ The fourth output matrix is saved to disk @
output file = c:\hessel\down4 ;
save c:\hessel\down4 = output_matrix_4 ;
```

PROCEDURE RECURSIV

```
proc(0) = Recursiv(sector_numbers) ;
   local i,potential_sector_numbers,number_sector_numbers ;
   number_sector_numbers = rows(sector_numbers) ;
   i = 1 ;

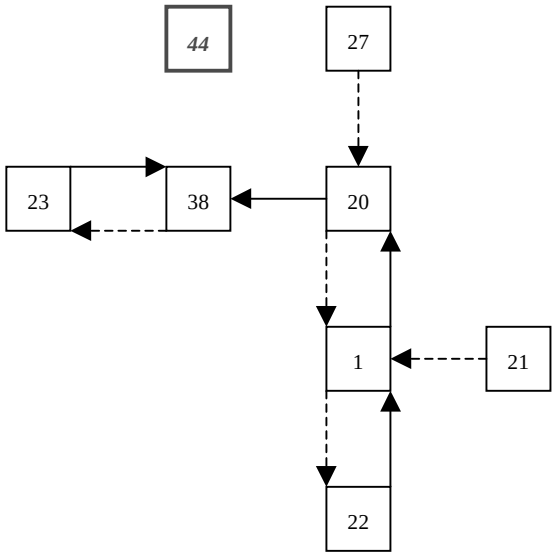
@ For each new sector number there's a check-up whether it is already in a cluster; the variable @
@ _set_numbers keeps track of the sectors that are already in a cluster @
do while i /= number_sector_numbers + 1 ;

@ If the sector is not already in a cluster, the sector is checked on associated sectors @
            if _set_numbers[sector_numbers[i,1],1] == 0 ;
             _set_numbers[sector_numbers[i,1],1] = 1 ;

@ The sectors associated with the new sector number are calculated @
            potential_sector_numbers = indexcat(output_matrix_2[sector_numbers[i,1],.]',1) ;
          Recursiv(potential_sector_numbers) ;
                    else ;
            endif ;
            i = i + 1 ;
endo ;
endp ;
```

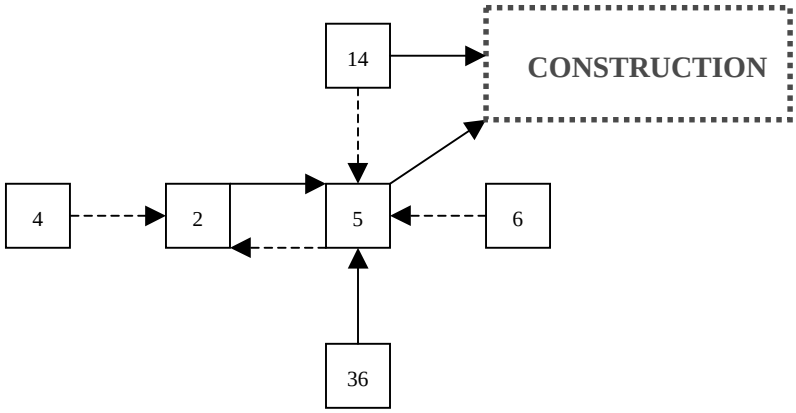
Appendix IIa: Clusters Belgium

AGRO-FOOD	
1	Agriculture
20	Meat
21	Dairies
22	Foodstuff n.e.c.
23	Beverages
27	Leather
38	Horeca
44	Transport related services



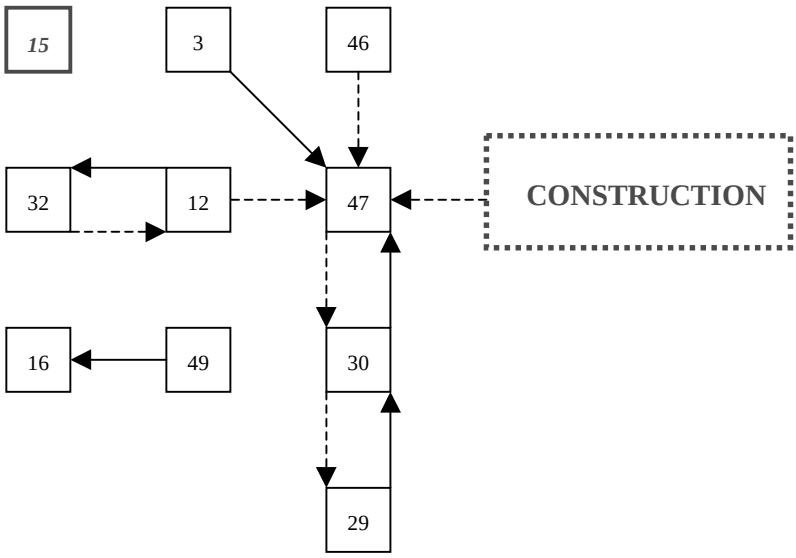
Belgium, 1995
51 industries, 39 allocated
down1: 0.2
down2: 0.05
up1: 0.15
up2: 0.05

ENERGY-INTENSIVE PRODUCTION	
2	Energy n.e.c.
4	Electricity
5	Ferrous metals
6	Non-ferrous metals
14	Metal products
36	Recycling



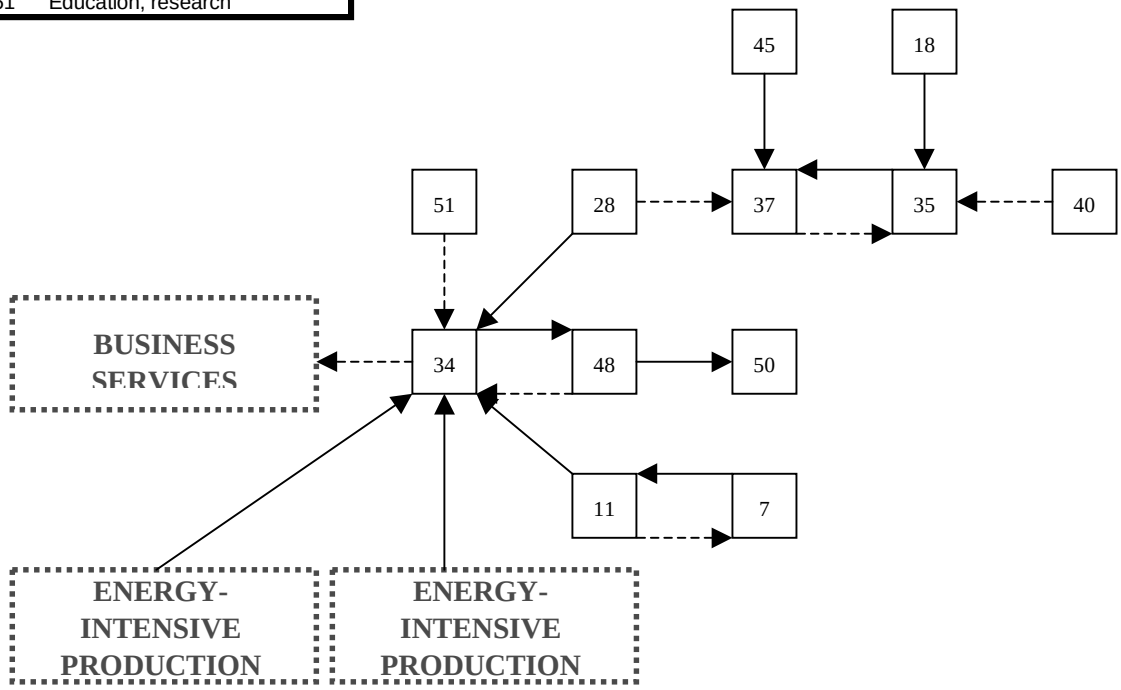
Belgium, 1995
51 industries, 39 allocated
down1: 0.2
down2: 0.05
up1: 0.15
up2: 0.05

BUSINESS SERVICES	
3	Water
12	Chemicals
15	Agricultural, industrial machines
16	Office machines
29	Paper
30	Paper products
32	Plastics
46	Banking, insurance
47	Services n.e.c.
49	Health



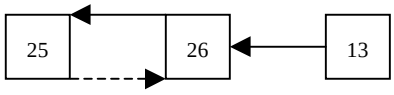
Belgium, 1995
51 industries, 39 allocated
down1: 0.2
down2: 0.05
up1: 0.15
up2: 0.05

CONSTRUCTION	
7	Cement, lime, gypsum
11	Construction materials
18	Automobiles
28	Wood
34	Construction
35	Automobile repairs
37	Trade
40	Road transport
45	Communication
48	Real estate
50	Government
51	Education, research



Belgium, 1995
51 industries, 39 allocated
down1: 0.2
down2: 0.05
up1: 0.15
up2: 0.05

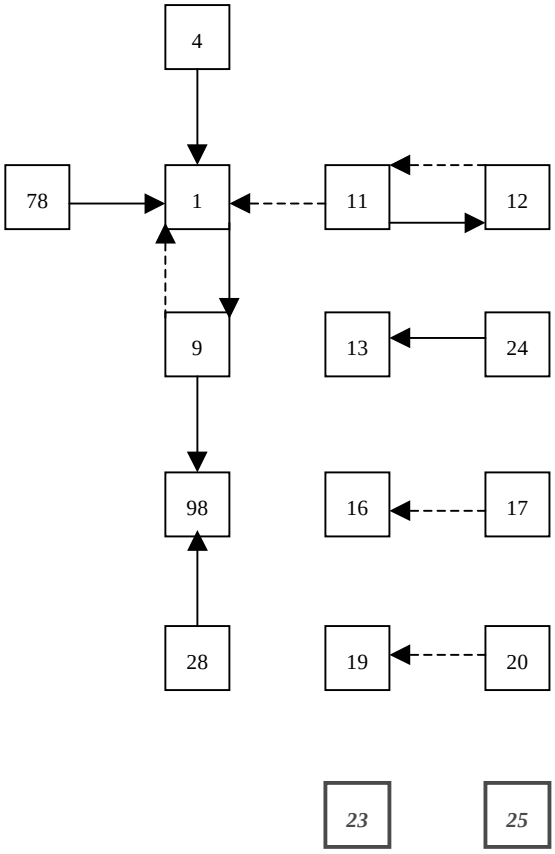
TEXTILES	
13	Synthetic fibres
25	Ready-made clothing
26	Textiles n.e.c.



Belgium, 1995
51 industries, 39 allocated
down1: 0.2
down2: 0.05
up1: 0.15
up2: 0.05

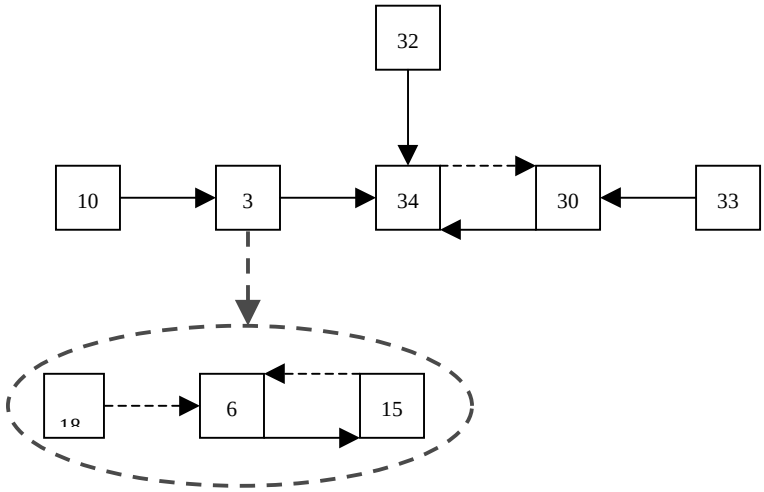
Appendix IIb: Clusters Denmark

AGRO-FOOD	
1	Agriculture
4	Agricultural services
9	Slaughtering etc. of pigs and cattle
11	Dairies
12	Processed cheese, condensed milk
13	Ice cream manufacturing
16	Oil mills
17	Margarine manufacturing
19	Grain mill products
20	Bread factories
23	Sugar factories and refineries
24	Chocolate and sugar confectionery
25	Manufacturing of prepared animal feeds
28	Breweries
78	Repair of machinery
98	Restaurants and hotels



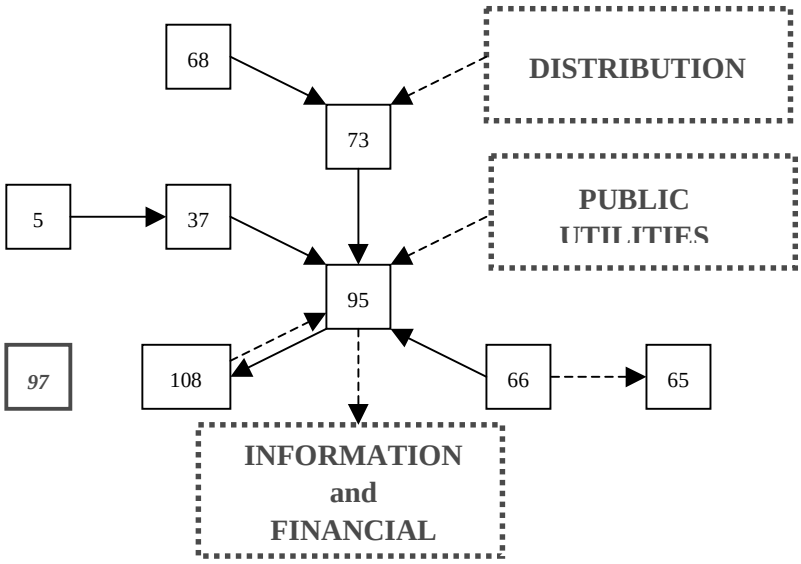
Denmark, 1992
117 industries, 62 allocated
down1: 0.25
down2: 0.05
up1: 0.2
up2: 0.05

CRAFTS	
3	Fur farming etc.
6	Fishing
10	Poultry killing, dressing, packing
15	Processing of fish
18	Fish meal manufacturing
30	Spinning, weaving etc. of textiles
32	Knitting mills
33	Cordage, rope and twine industries
34	Manufacture of wearing apparel



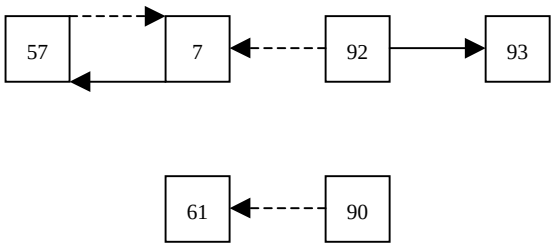
Denmark, 1992
117 industries, 62 allocated
down1: 0.25
down2: 0.05
up1: 0.2
up2: 0.05

CONSTRUCTION	
5	Forestry and logging
37	Manufacture of wood products (excl. furniture)
65	Manufacture of cement, lime and plaster
66	Concrete products and stone cutting
68	Iron and steel works
73	Manufacture of structural metal products
95	Construction
97	Retail trade
108	Real estate



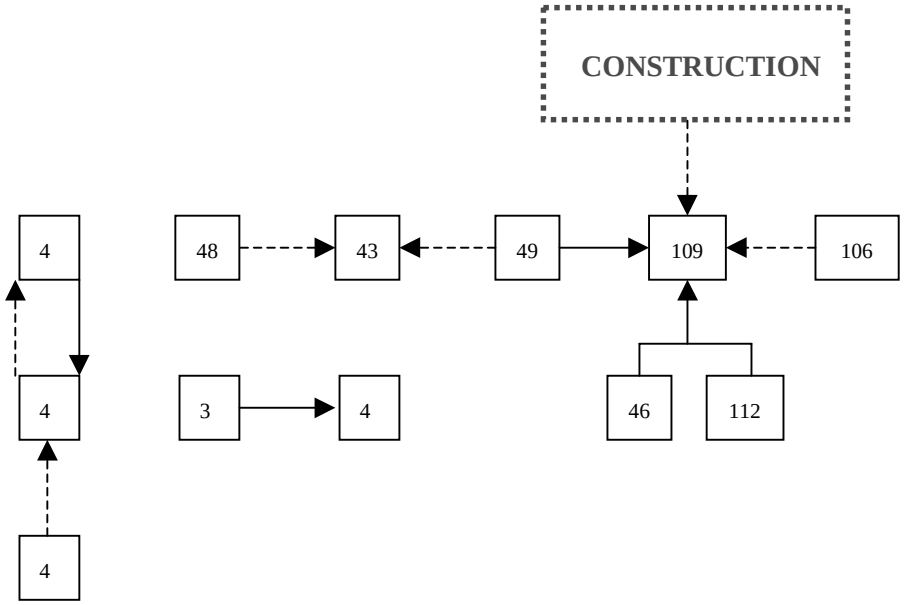
Denmark, 1992
117 industries, 62 allocated
down1: 0.25
down2: 0.05
up1: 0.2
up2: 0.05

ENERGY-INTENSIVE PRODUCTION	
7	Extraction of coal, oil and gas
57	Petroleum refineries
61	Manufacturing of plastic products n.e.c.
90	Manufacturing of toys, sporting goods, etc.
92	Gas manufacture and distribution
93	Steam and hot water supply



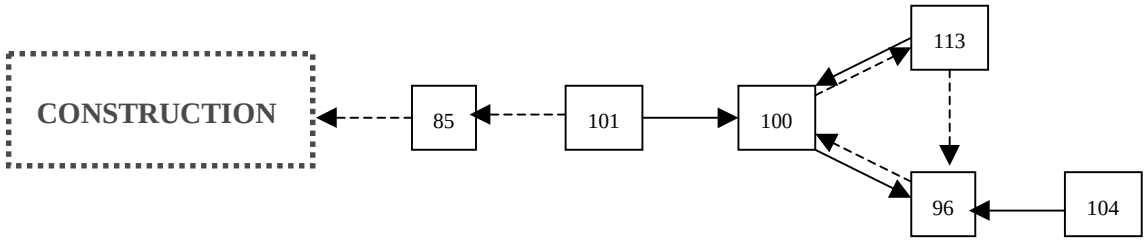
Denmark, 1992
117 industries, 62 allocated
down1: 0.25
down2: 0.05
up1: 0.2
up2: 0.05

INFORMATION and FINANCIAL	
39	Manufacturing of pulp, paper, paperboard
40	Manufacturing of paper containers, wallpaper
42	Book printing
43	Offset printing
45	Bookbinding
46	Newspaper printing and publishing
47	Book and art publishing
48	Magazine publishing
49	Other publishing
106	Financial institutions
109	Business services
112	Recreational and cultural services



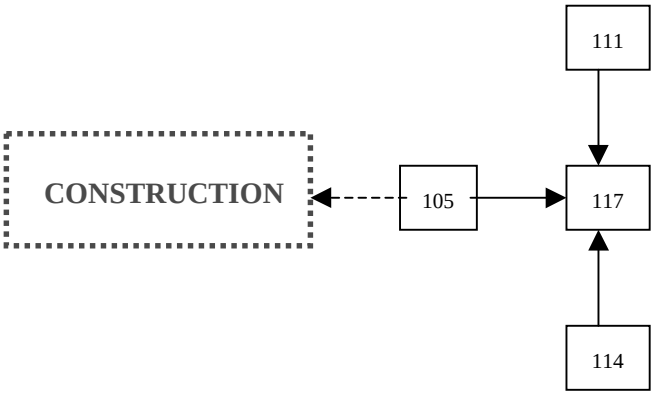
Denmark, 1992
117 industries, 62 allocated
down1: 0.25
down2: 0.05
up1: 0.2
up2: 0.05

DISTRIBUTION	
85	Ship building and repairing
96	Wholesale trade
100	Other land transport
101	Ocean and coastal water transport
104	Services allied to transport, etc.
113	Repair of motor vehicles



Denmark, 1992
117 industries, 62 allocated
down1: 0.25
down2: 0.05
up1: 0.2
up2: 0.05

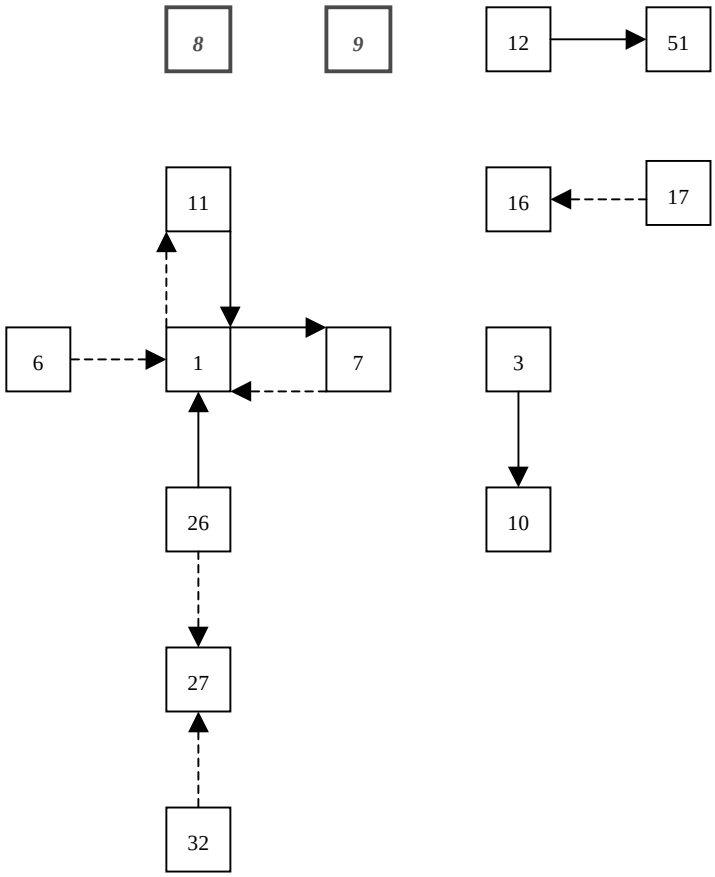
PUBLIC UTILITIES	
105	Communication
111	Health, market services
114	Household services
117	Producers of government services



Denmark, 1992
117 industries, 62 allocated
down1: 0.25
down2: 0.05
up1: 0.2
up2: 0.05

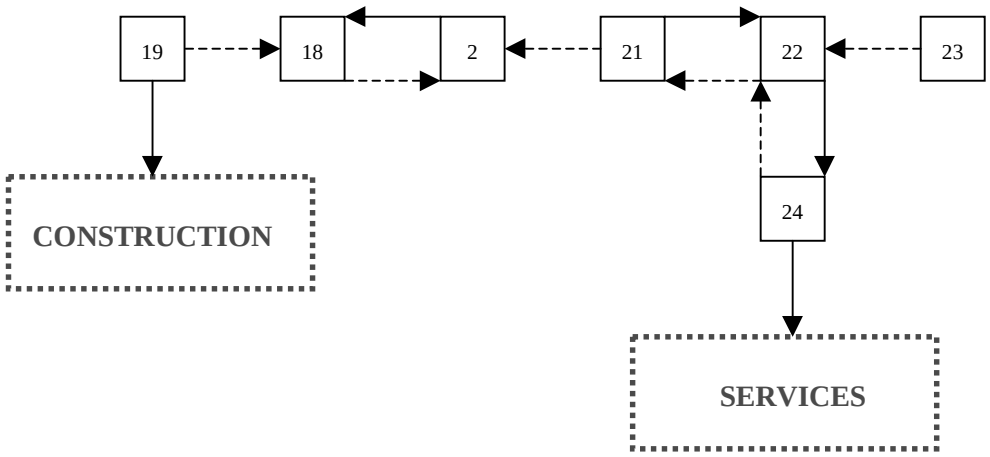
Appendix IIc: Clusters Finland

AGRO-FOOD	
1	Agriculture
3	Fishing and hunting
6	Slaughtering, preparing and preserving meat
7	Manufacture of dairy products
8	Manufacture of grain mill and bakery products
9	Manufacture of sugar, chocolate and sugar confectionery
10	Manufacture of other food products
11	Manufacture of prepared animal feeds
12	Manufacture of beverages
16	Manufacture of leather and products of leather and fur
17	Manufacture of footwear
26	Manufacture of fertilizers and pesticides
27	Manufacture of basic chemicals and man-made fibres
32	Manufacture of plastic products
51	Hotels and restaurants



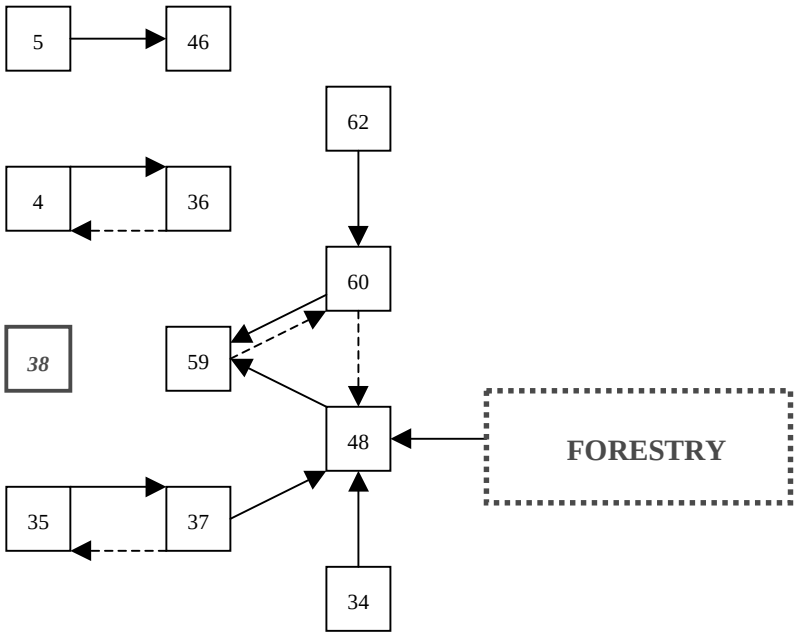
Finland, 1993
64 industries, 48 allocated
down1: 0.3
down2: 0.07
up1: 0.25
up2: 0.07

FORESTRY	
2	Forestry and logging
18	Sawmilling and planing of wood, impregnation of wood
19	Manufacture of other wooden products and structures
21	Manufacture of pulp
22	Manufacture of paper and paperboard
23	Manufacture of articles of paper and paperboard
24	Printing



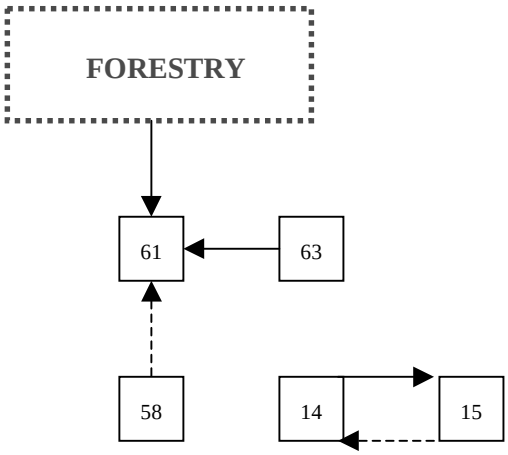
Finland, 1993
64 industries, 48 allocated
down1: 0.3
down2: 0.07
up1: 0.25
up2: 0.07

CONSTRUCTION	
4	Metal ore mining
5	Other mining
34	Manufacture of other earthenware products
35	Manufacture of iron and steel
36	Manufacture of non-ferrous metals
37	Manufacture of fabricated metal products
38	Manufacture of machinery, except electrical
46	Electricity, gas and steam
48	Building of complete constructions or parts thereof
59	Letting of own property
60	Real estate activities
62	Community and social services



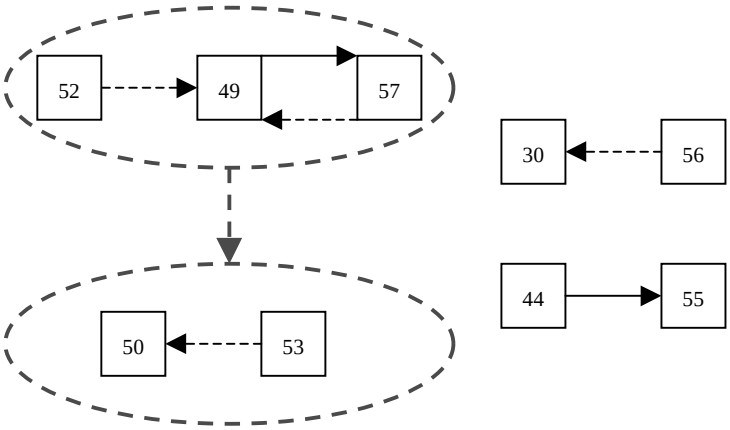
Finland, 1993
64 industries, 48 allocated
down1: 0.3
down2: 0.07
up1: 0.25
up2: 0.07

SERVICES	
14	Manufacture of textiles
15	Manufacture of wearing apparel
58	Financial intermediation
61	Other business activities
63	Recreational and cultural services



Finland, 1993
64 industries, 48 allocated
down1: 0.3
down2: 0.07
up1: 0.25
up2: 0.07

DISTRIBUTION	
30	Manufacture of refined petroleum products and coke
44	Manufacture of other transport equipment
49	Other construction (civil engineering)
50	Wholesale and retail trade
52	Railway transport
53	Other land transport
55	Air transport
56	Supporting and auxiliary transport activities, travel agencies
57	Post and telecommunications

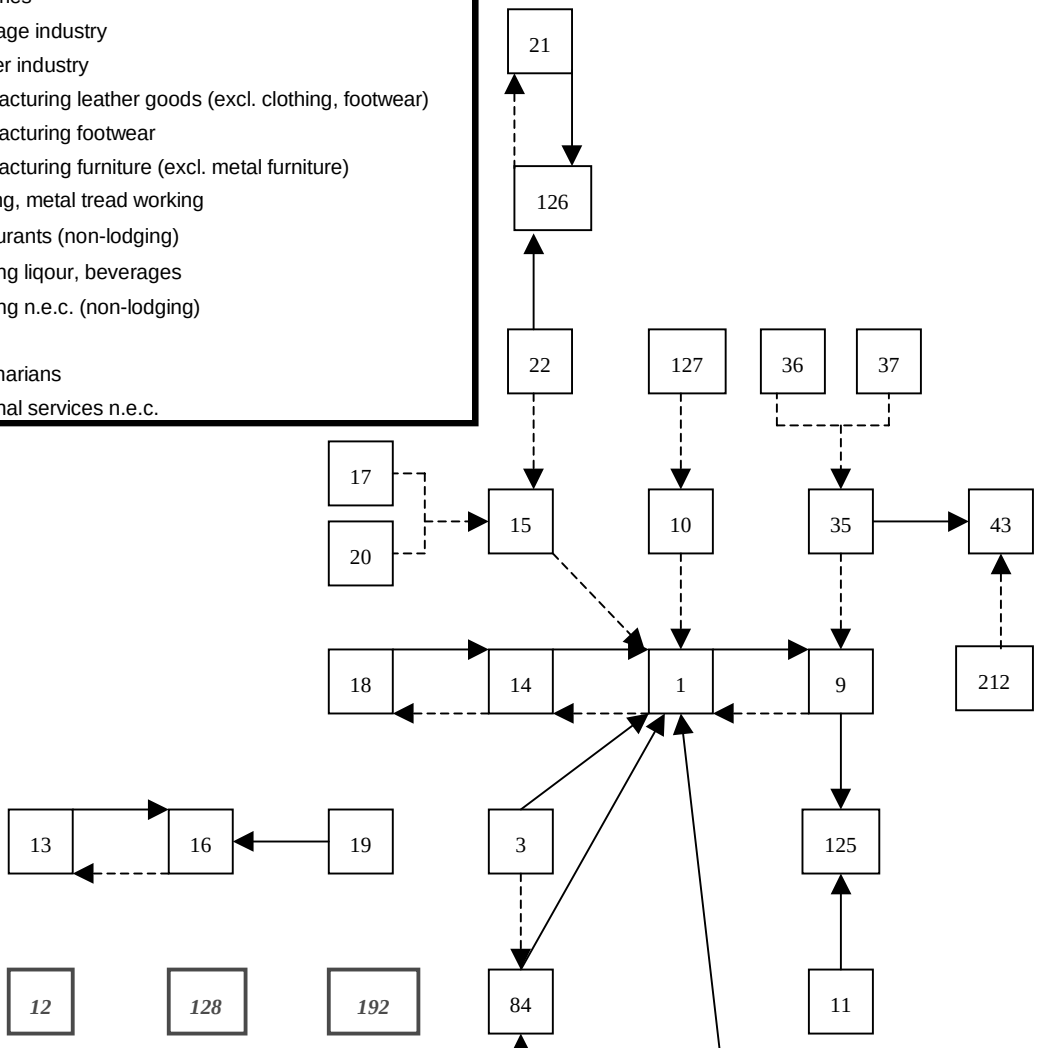


Finland, 1993
64 industries, 48 allocated
down1: 0.3
down2: 0.07
up1: 0.25
up2: 0.07

Appendix IId: Clusters the Netherlands

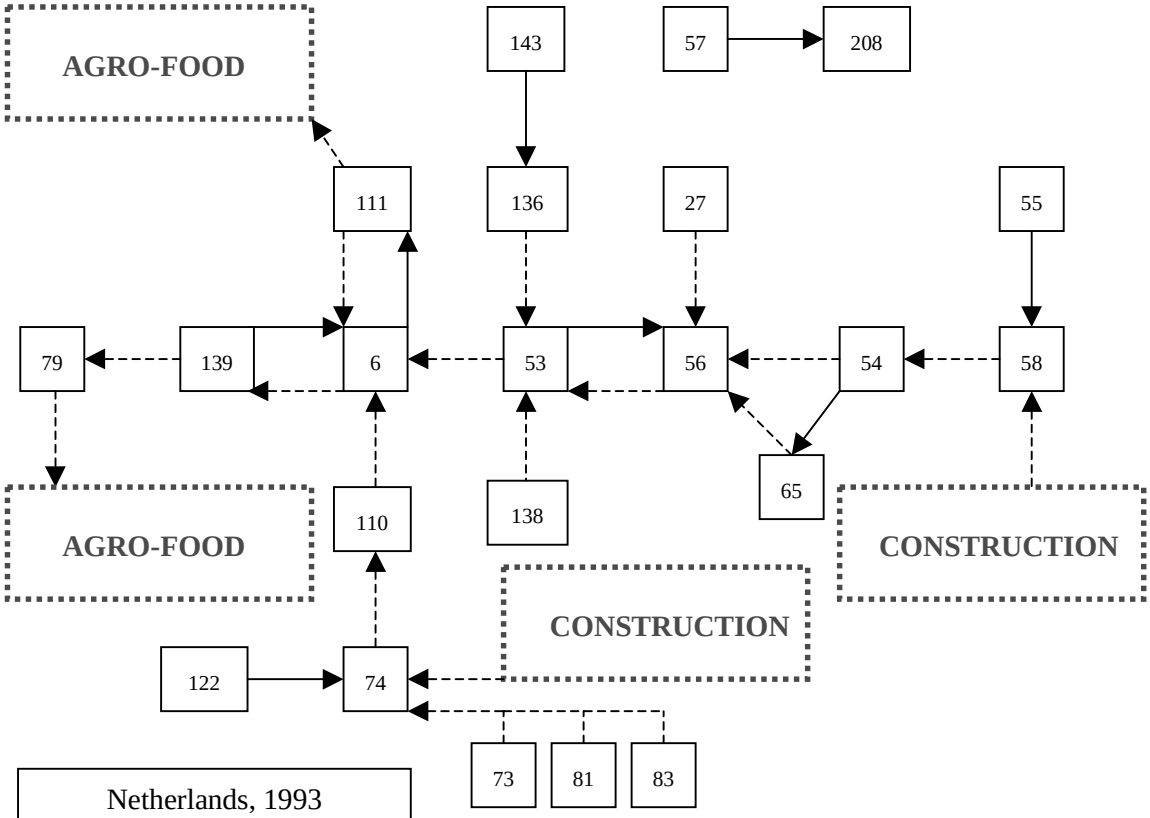
AGRO-FOOD

1	Agriculture
3	Agricultural services
9	Slaughterhouses and meat processing
10	Dairies, dairy products
11	Fish processing
12	Vegetable, fruit processing
13	Grain processing
14	Cattle food industry
15	Sugar industry
16	Bread, cake, other flour processing industries
17	Cacao, chocolate, sugar confectionery
18	Margarine, oil, fat, starch industries
19	Food industries n.e.c.
20	Alcohol, distilling industries
21	Breweries
22	Beverage industry
35	Leather industry
36	Manufacturing leather goods (excl. clothing, footwear)
37	Manufacturing footwear
43	Manufacturing furniture (excl. metal furniture)
84	Welding, metal tread working
125	Restaurants (non-lodging)
126	Catering liqour, beverages
127	Catering n.e.c. (non-lodging)
128	Hotels
192	Veterinarians
212	Personal services n.e.c.



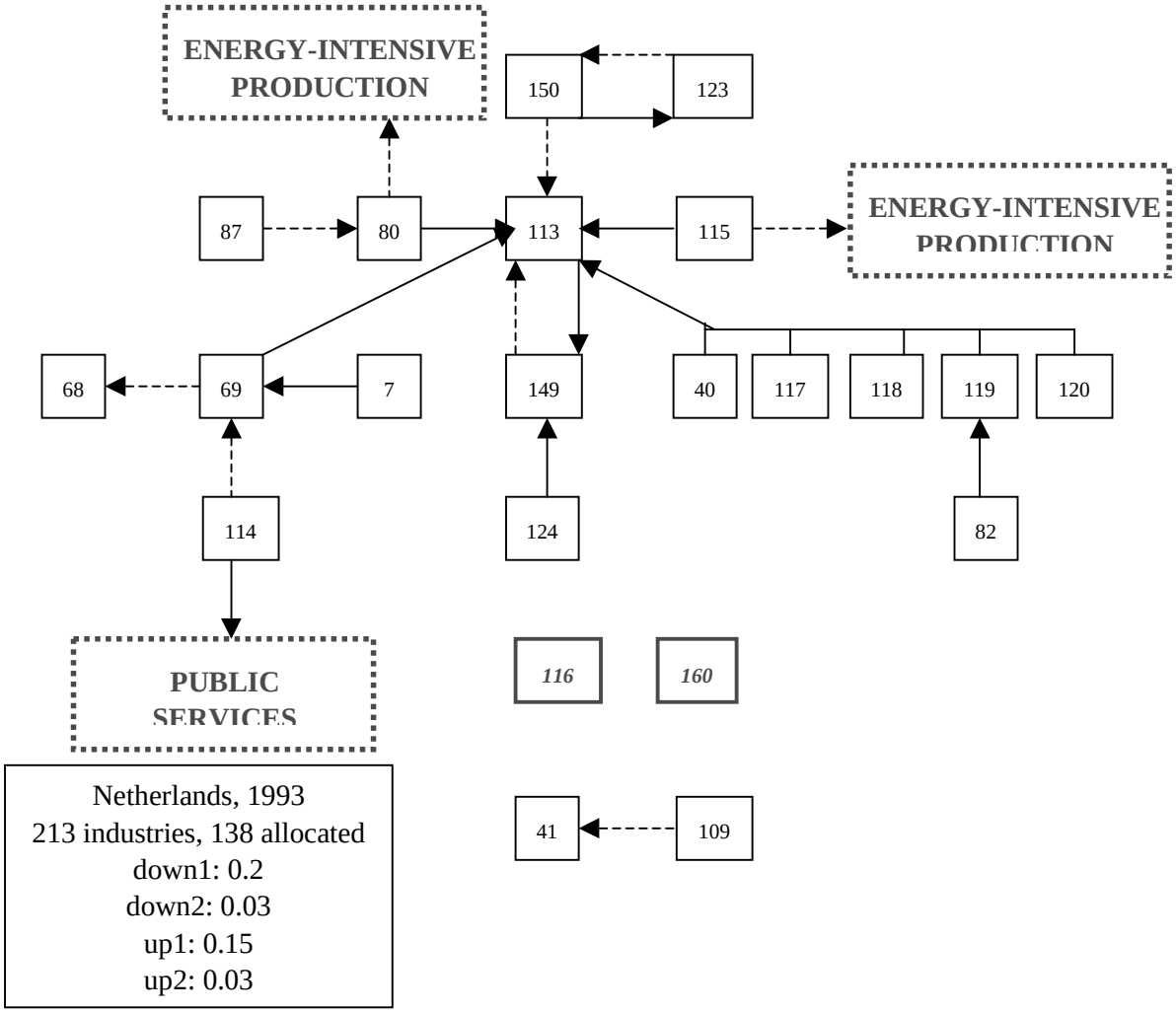
Netherlands, 1993
213 industries, 138 allocated
down1: 0.2
down2: 0.03
up1: 0.15
up2: 0.03

ENERGY-INTENSIVE PRODUCTION	
6	Oil, gas drilling and exploration
27	Manufacturing carpets, doormats, linoleum
53	Oil refineries, oil and coal industries
54	Manufacturing plastics
55	Manufacturing coloring, paint (pigments)
56	Manufacturing fertilizer, industrial gas, chemical ingredients, thread, fibre
57	Manufacturing soap, detergent, perfume, cosmetics
58	Manufacturing paints, varnishes, ink
65	Manufacturing plastic products
73	Wire-drawing, rolling mills
74	Iron, steel works
79	Manufacturing tanks, reservoirs, pipe-lines
81	Manufacturing metal packing
83	Manufacturing metal funiture, metal products n.e.c.
110	Electric light, power
111	Gas manufacture, distribution
122	Wholesale trade scrap metal, junk
136	Air transport, air transport services (airport)
138	Cargo transport (land)
139	Pipe-lines, services road transport
143	Travel agencies
208	Cleaning companies

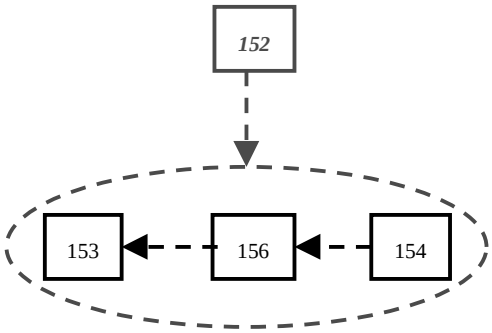


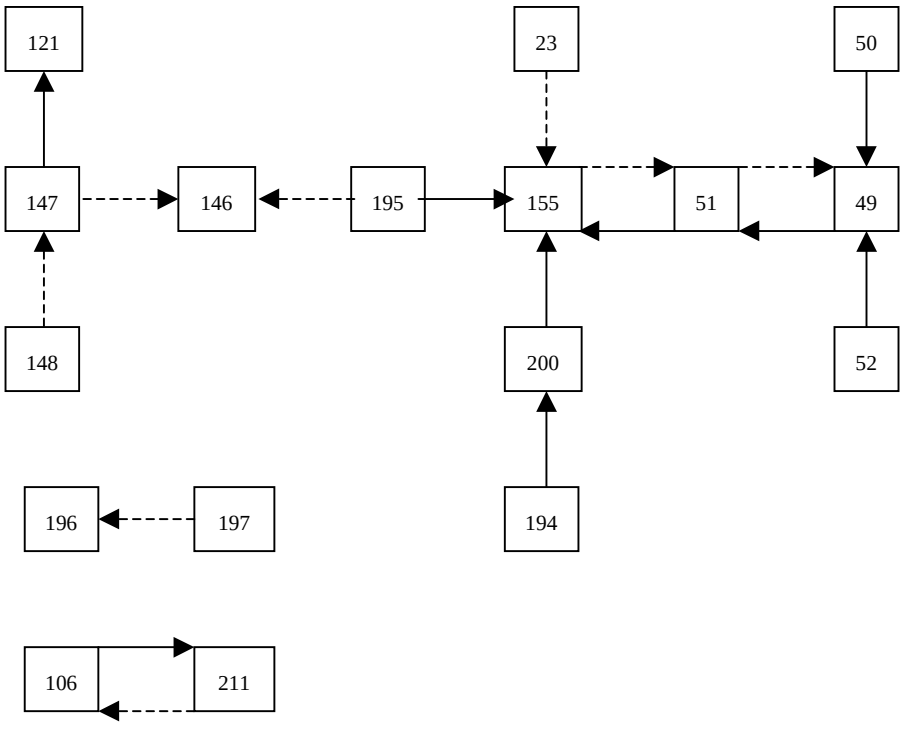
Netherlands, 1993
213 industries, 138 allocated
down1: 0.2
down2: 0.03
up1: 0.15
up2: 0.03

CONSTRUCTION	
7	Sand, gravel mining
40	Manufacturing carpentry, parquet floors, w ooden packing
41	Manufacturing w ooden goods n.e.c.
68	Cement, lime, plaster industries
69	Concrete, cement stone industries
80	Manufacturing metal products n.e.c.
82	Manufacturing heating, cooking equipment (excl. electrical)
87	Manufacturing machinery food, chemical industries
109	Manufacturing n.e.c.
113	Construction
114	Infrastructural construction
115	Painters, glaziers, paper-hangers
116	Plastering
117	Fine construction w ork n.e.c.
118	Plumbing, pipe-fitting, instalment sanitary equipment
119	Instalment central heating, air treating equipment, isolation
120	Electrotechnical instalment (construction)
123	Retail trade
124	Real estate agencies
149	Exploitation, trade houses
150	Exploitation, trade office buildings
160	Bodies of public management, assisting public management



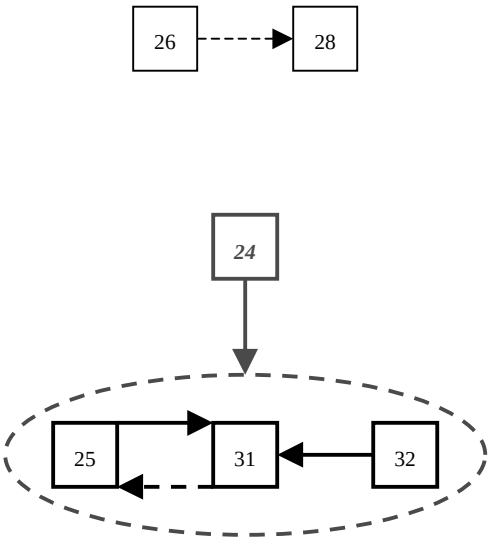
INFORMATION and FINANCIAL	
23	Tobacco industry
49	New spaper printing
50	Graphical reproduction industry
51	Publishing
52	Binding
106	Foto, film laboratories
121	Wholesale trade
146	Railw ay transport, communications, road transport
147	Banking
148	Insurance
152	Accountants, tax consultants
153	Computer services
154	Engineering, architectural, other technical consultancy
155	Advertising agencies
156	Economical, business consultancy
194	Libraries, museums, cultural heritage
195	Radio, television
196	Cinematic organisations
197	Cinemas
200	Artistic organizations, artists
211	Photographers





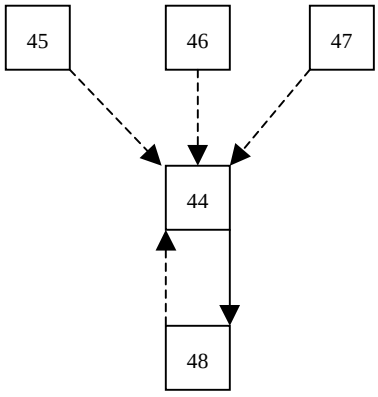
Netherlands, 1993
213 industries, 138 allocated
down1: 0.2
down2: 0.03
up1: 0.15

TEXTILES	
24	Wool industry
25	Cotton industry
26	Manufacturing knitting-wear, stockings
28	Textile ennoblement industry
31	Manufacturing ready-made clothing
32	Manufacturing tailor-made clothing



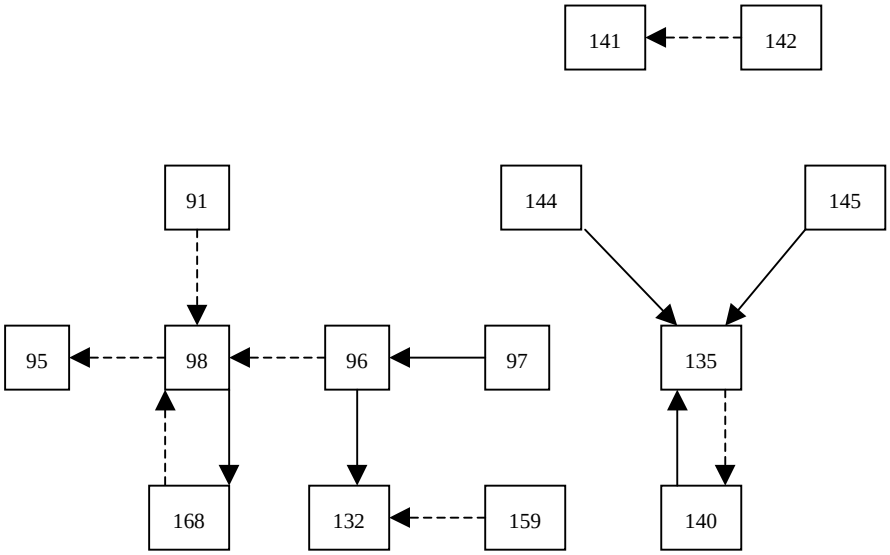
Netherlands, 1993
213 industries, 138 allocated
down1: 0.2
down2: 0.03
up1: 0.15
up2: 0.03

PAPER	
44	Manufacturing paper, paper board
45	Manufacturing wallpaper, paper goods n.e.c.
46	Manufacturing bags, printer paper, office supplies
47	Cardboard industry
48	Cardboarding industry



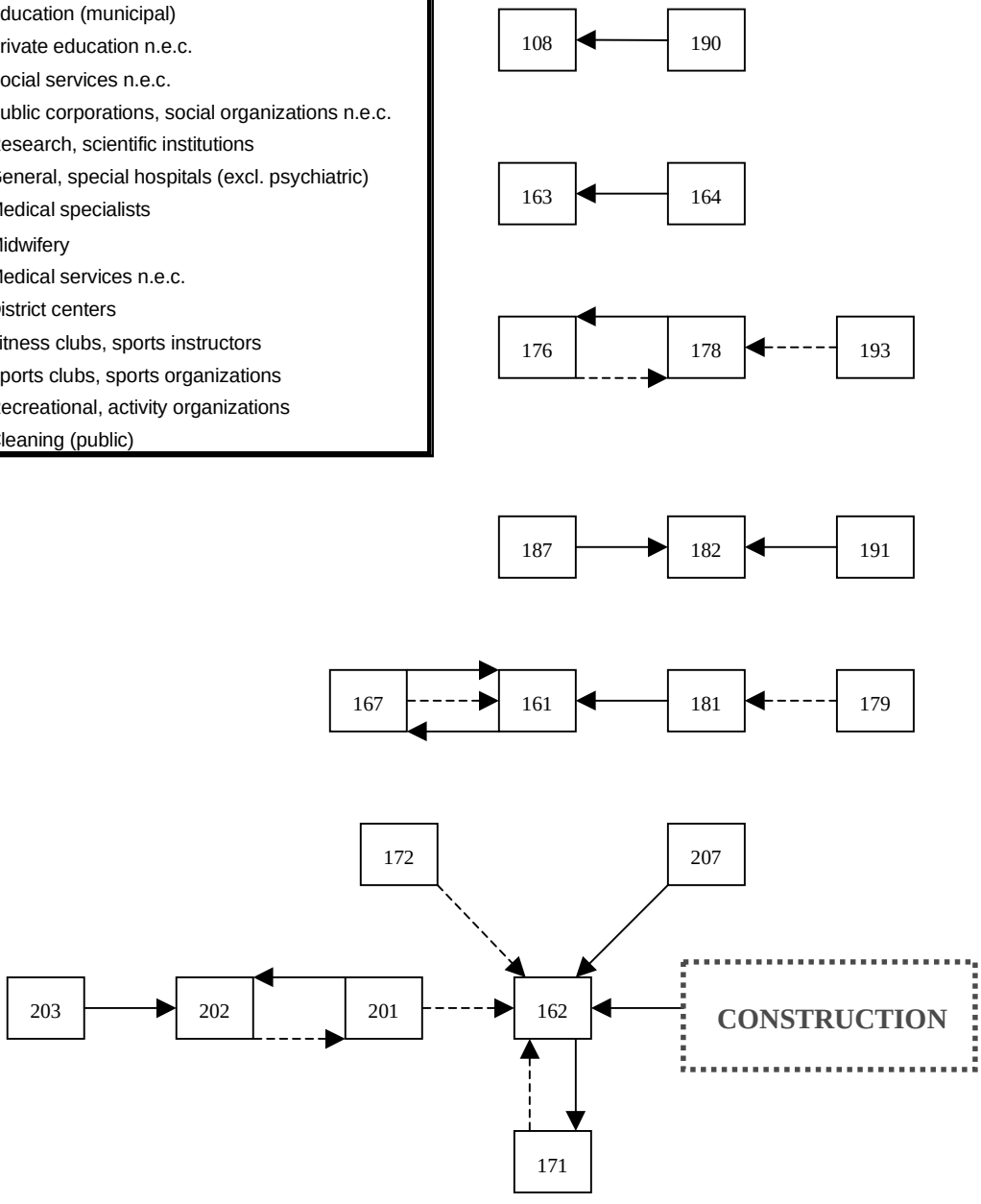
Netherlands, 1993
213 industries, 138 allocated
down1: 0.2
down2: 0.03
up1: 0.15
up2: 0.03

DISTRIBUTION	
91	Manufacturing boiling kettles, power tools
95	Manufacturing electrotechnical equipment n.e.c.
96	Manufacturing automobiles, automobile parts
97	Manufacturing trailers, transporters, coach-works
98	Manufacturing aircraft, ships, transporting devices n.e.c.
132	Repair automobiles
135	Ocean, coastal water transport
140	Services ocean, coastal water transport
141	River transport
142	Services river transport
144	Forwarding agencies, ship-brokers, charters
145	Warehousing
159	Rental machines, other movables
168	Government (military)



Netherlands, 1993
213 industries, 138 allocated
down1: 0.2
down2: 0.03
up1: 0.15
up2: 0.03

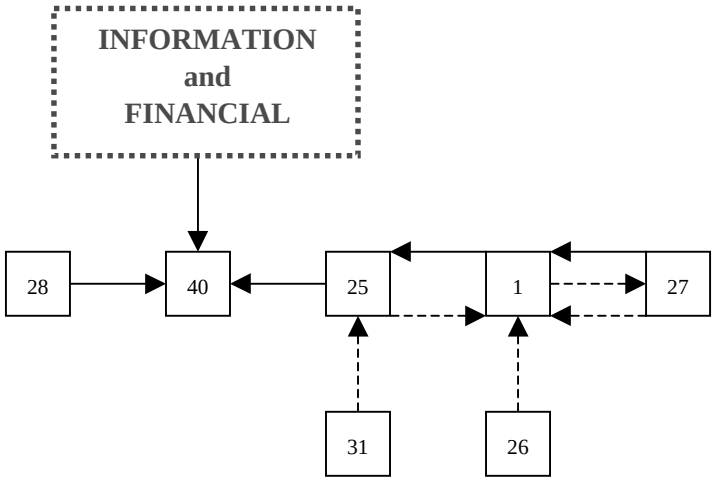
PUBLIC SERVICES	
108	Government provided workshops
161	Government (civil)
162	Municipalities
163	Public arrangements
164	Provinces
167	Social security bodies, sick funds
171	Education (denominational)
172	Education (municipal)
176	Private education n.e.c.
178	Social services n.e.c.
179	Public corporations, social organizations n.e.c.
181	Research, scientific institutions
182	General, special hospitals (excl. psychiatric)
187	Medical specialists
190	Midwifery
191	Medical services n.e.c.
193	District centers
201	Fitness clubs, sports instructors
202	Sports clubs, sports organizations
203	Recreational, activity organizations
207	Cleaning (public)



Netherlands, 1993
213 industries, 138 allocated
down1: 0.2
down2: 0.03
up1: 0.15
up2: 0.03

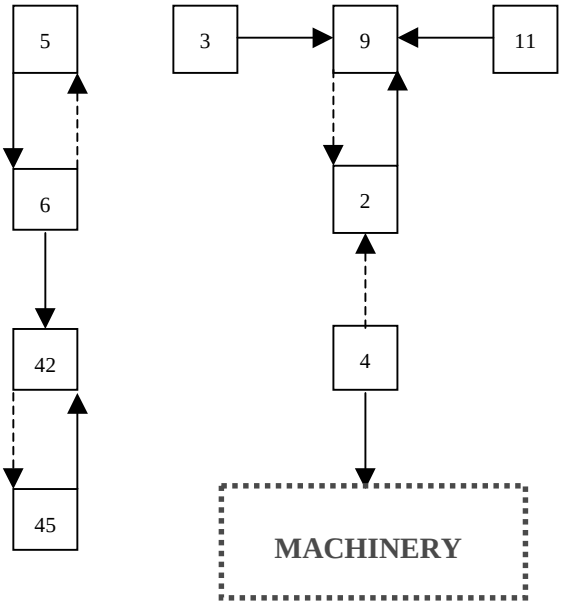
Appendix IIe: Clusters Spain

AGRO-FOOD	
1	Agriculture, fishing
25	Meat, canned food
26	Milk, milk by-products
27	Food n.e.c.
28	Beverages
31	Leather, footwear
40	Restoring, lodging



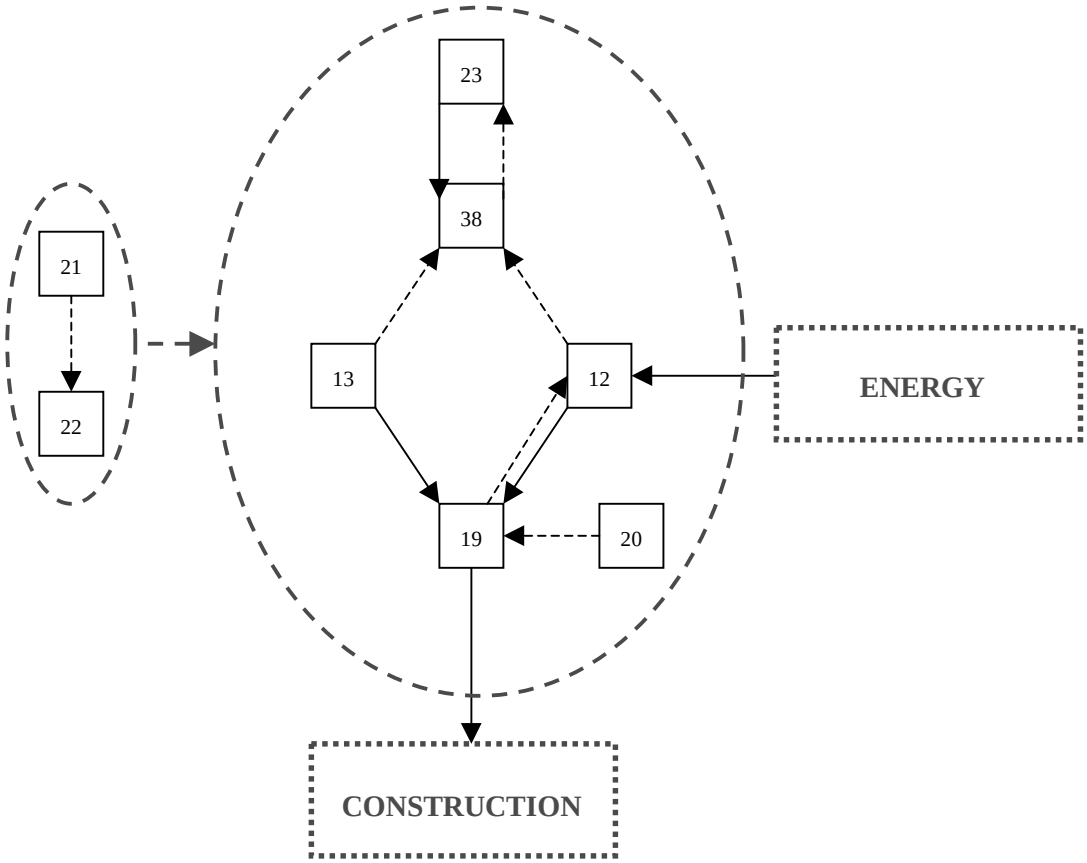
Spain, 1993
57 industries, 41 allocated
down1: 0.25
down2: 0.07
up1: 0.2
up2: 0.07

ENERGY	
2	Coal
3	Brown coal
4	Cokes
5	Crude oil
6	Refined oil
9	Electric power
11	Nuclear fuel
42	Road transportation
45	Additional transportation services



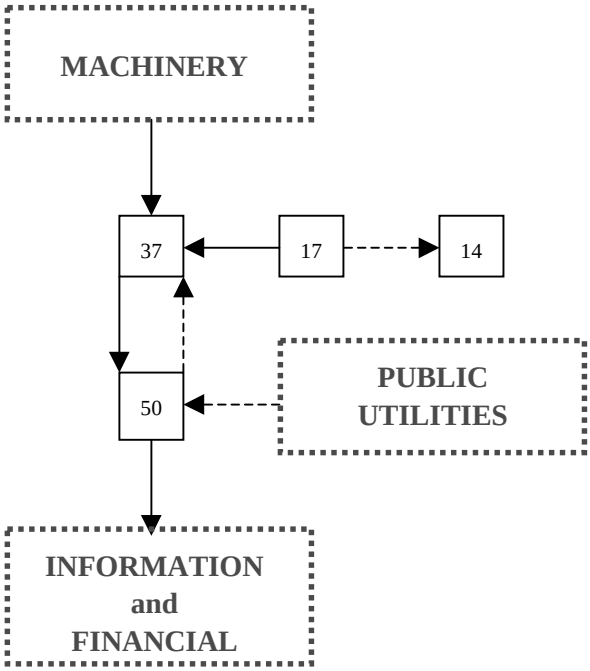
Spain, 1993
57 industries, 41 allocated
down1: 0.25
down2: 0.07
up1: 0.2
up2: 0.07

MACHINERY	
12	Iron, iron manufactures
13	Non-ferrous metals
19	Metal manufactures
20	Agricultural, industrial equipment
21	Office machinery, computers
22	Electrical industry
23	Motor vehicles
38	Recycling



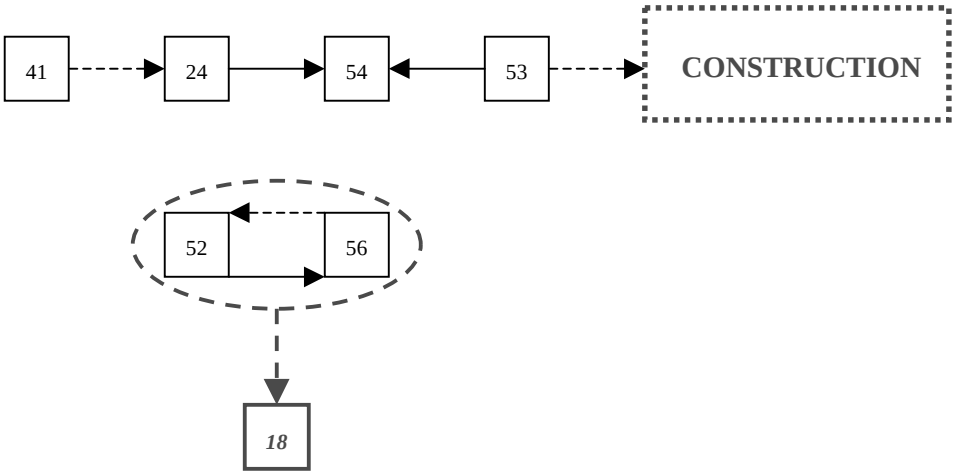
Spain, 1993
57 industries, 41 allocated
down1: 0.25
down2: 0.07
up1: 0.2
up2: 0.07

CONSTRUCTION	
14	Concrete, lime, gypsum
17	Non-metalic minerals n.e.c.
37	Construction
50	Real estate



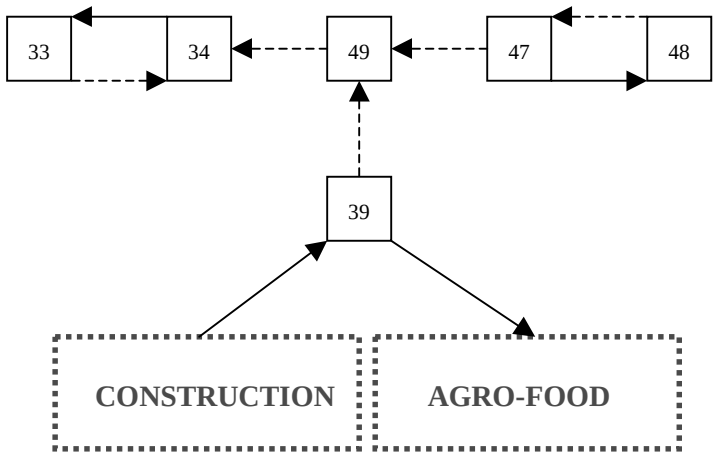
Spain, 1993
57 industries, 41 allocated
down1: 0.25
down2: 0.07
up1: 0.2
up2: 0.07

PUBLIC UTILITIES	
18	Chemicals
24	Transport material n.e.c.
41	Railway transport
52	Health services (market)
53	Health services (non-market)
54	Public services
56	Health services n.e.c.



Spain, 1993
57 industries, 41 allocated
down1: 0.25
down2: 0.07
up1: 0.2
up2: 0.07

INFORMATION and FINANCIAL	
33	Paper, paper pulp
34	Paper manufactures, publications
39	Commerce
47	Insurance
48	Banking
49	Services provided to enterprises



Spain, 1993
57 industries, 41 allocated
down1: 0.25
down2: 0.07
up1: 0.2
up2: 0.07

Appendix IIIa: innovation-algorithm (variables)

i = 2 digits NACE code

v1 = "Developed or introduced technologically changed products 1990–1992" (*1 = yes, 2 = no*)
v2 = "Developed or introduced technologically changed processes 1990-1992" (*1 = yes, 2 = no*)
v3 = "Intend to innovate in the next three years (1993-1995)" (*1 = yes, 2 = no*)

v4 = "Importance of information sources"
(*1 = insignificant,*
2 = slightly significant,
3 = moderately significant,
4 = very significant,
***5 = crucial*)**
v4_1 = "within enterprise"
v4_2 = "within group of enterprises"
v4_3 = "suppliers of material and components"
v4_4 = "suppliers of equipment"
v4_5 = "clients or customers"
v4_6 = "competitors in your line of business"
v4_7 = "consultancy firms"
v4_8 = "universities/higher education"
v4_9 = "government laboratories"
v4_10 = "technical institutes"
v4_11 = "patent disclosures"
v4_12 = "professional conferences, meetings, professional journals"
v4_13 = "fairs, exhibitions"

v6 = "Use of knowledge acquisition channels" (*0 = no, 1 = yes*)
v6_11 = "right to use others'inventions: national"
v6_12 = "right to use others'inventions: EC"
v6_13 = "right to use others'inventions: non EC"
v6_14 = "right to use others'inventions: USA"
v6_15 = "right to use others'inventions: Japan"
v6_16 = "right to use others'inventions: other"
v6_21 = "results of R&D contracted out: national"
v6_22 = "results of R&D contracted out: EC"
v6_23 = "results of R&D contracted out: non EC"
v6_24 = "results of R&D contracted out: USA"
v6_25 = "results of R&D contracted out: Japan"
v6_26 = "results of R&D contracted out: other"
v6_31 = "use of consultancy services: national"
v6_32 = "use of consultancy services: EC"
v6_33 = "use of consultancy services: non EC"
v6_34 = "use of consultancy services: USA"
v6_35 = "use of consultancy services: Japan"
v6_36 = "use of consultancy services: other"
v6_41 = "acquisition of technology through the purchase of another enterprise: national"
v6_42 = "acquisition of technology through the purchase of another enterprise: EC"
v6_43 = "acquisition of technology through the purchase of another enterprise: non EC"
v6_44 = "acquisition of technology through the purchase of another enterprise: USA"
v6_45 = "acquisition of technology through the purchase of another enterprise: Japan"
v6_46 = "acquisition of technology through the purchase of another enterprise: other"
v6_51 = "purchase of equipment: national"
v6_52 = "purchase of equipment: EC"
v6_53 = "purchase of equipment: non EC"
v6_54 = "purchase of equipment: USA"
v6_55 = "purchase of equipment: Japan"
v6_56 = "purchase of equipment: other"
v6_61 = "communication with/specialist services from other enterprise: national"
v6_62 = "communication with/specialist services from other enterprise: EC"
v6_63 = "communication with/specialist services from other enterprise: non EC"
v6_64 = "communication with/specialist services from other enterprise: USA"
v6_65 = "communication with/specialist services from other enterprise: Japan"
v6_66 = "communication with/specialist services from other enterprise: other"
v6_71 = "hiring skilled employees: national"
v6_72 = "hiring skilled employees: EC"
v6_73 = "hiring skilled employees: non EC"
v6_74 = "hiring skilled employees: USA"
v6_75 = "hiring skilled employees: Japan"
v6_76 = "hiring skilled employees: other"

v7 = "Use of knowledge transfer channels" (*0 = no, 1 = yes*)
v7_31 = "consultancy services for other companies: national"
v7_32 = "consultancy services for other companies: EC"
v7_33 = "consultancy services for other companies: non EC"
v7_34 = "consultancy services for other companies: USA"
v7_35 = "consultancy services for other companies: Japan"
v7_36 = "consultancy services for other companies: other"
v7_51 = "sales of equipment: national"
v7_52 = "sales of equipment: EC"
v7_53 = "sales of equipment: non EC"
v7_54 = "sales of equipment: USA"
v7_55 = "sales of equipment: Japan"
v7_56 = "sales of equipment: other"

v8 = "Use of knowledge acquisition channels" (*0 = no, 1 = yes*)
v8_11 = "acquisition from 'mother'/'daughter'/'sister': national"
v8_12 = "acquisition from 'mother'/'daughter'/'sister': EC"
v8_13 = "acquisition from 'mother'/'daughter'/'sister': non EC"
v8_14 = "acquisition from 'mother'/'daughter'/'sister': USA"
v8_15 = "acquisition from 'mother'/'daughter'/'sister': Japan"
v8_16 = "acquisition from 'mother'/'daughter'/'sister': other"

v10a = "Enterprise engaged in R&D in 1992?" (*1 = yes, 2 = no)*

v11_1 = "Is the enterprise engaged in R&D cooperation?" (*1 = yes, 2 = no*)
(*0 = no, 1 = yes*)
v11_2r = "clients/customers: regional"
v11_21 = "clients/customers: national"
v11_22 = "clients/customers: EC"
v11_23 = "clients/customers: non EC"
v11_24 = "clients/customers: USA"
v11_25 = "clients/customers: Japan"
v11_26 = "clients/customers: other"
v11_3r = "suppliers: regional"
v11_31 = "suppliers: national"
v11_32 = "suppliers: EC"
v11_33 = "suppliers: non EC"
v11_34 = "suppliers: USA"
v11_35 = "suppliers: Japan"
v11_36 = "suppliers: other"
v11_4r = "mother/daughter/sister enterprises: regional"
v11_41 = "mother/daughter/sister enterprises: national"
v11_42 = "mother/daughter/sister enterprises: EC"
v11_43 = "mother/daughter/sister enterprises: non EC"
v11_44 = "mother/daughter/sister enterprises: USA"
v11_45 = "mother/daughter/sister enterprises: Japan"
v11_46 = "mother/daughter/sister enterprises: other"
v11_5r = "competitors: regional"
v11_51 = "competitors: national"
v11_52 = "competitors: EC"
v11_53 = "competitors: non EC"
v11_54 = "competitors: USA"
v11_55 = "competitors: Japan"
v11_56 = "competitors: other"
v11_6r = "joint ventures: regional"
v11_61 = "joint ventures: national"
v11_62 = "joint ventures: EC"
v11_63 = "joint ventures: non EC"
v11_64 = "joint ventures: USA"
v11_65 = "joint ventures: Japan"
v11_66 = "joint ventures: other"
v11_7r = "consultants: regional"
v11_71 = "consultants: national"
v11_72 = "consultants: EC"
v11_73 = "consultants: non EC"
v11_74 = "consultants: USA"
v11_75 = "consultants: Japan"
v11_76 = "consultants: other"
v11_8r = "government laboratories: regional"
v11_81 = "government laboratories: national"
v11_82 = "government laboratories: EC"
v11_83 = "government laboratories: non EC"
v11_84 = "government laboratories: USA"
v11_85 = "government laboratories: Japan"
v11_86 = "government laboratories: other"
v11_9r = "research institutes: regional"

v11_91 = “research institutes: national”
v11_92 = “research institutes: EC”
v11_93 = “research institutes: non EC”
v11_94 = “research institutes: USA”
v11_95 = “research institutes: Japan”
v11_96 = “research institutes: other”
v11_10r = “universities/higher education: regional”
v11_101 = “universities/higher education: national”
v11_102 = “universities/higher education: EC”
v11_103 = “universities/higher education: non EC”
v11_104 = “universities/higher education: USA”
v11_105 = “universities/higher education: Japan”
v11_106 = “universities/higher education: other”
v11_11r = “industry-operated R&D labs: regional”
v11_111 = “industry-operated R&D labs: national”
v11_112 = “industry-operated R&D labs: EC”
v11_113 = “industry-operated R&D labs: non EC”
v11_114 = “industry-operated R&D labs: USA”
v11_115 = “industry-operated R&D labs: Japan”
v11_116 = “industry-operated R&D labs: other”

Appendix IIIb: innovation-algorithm (program)

```
=======================================*program cluster Belgium*=======================================

COMPUTE clus = i .
EXECUTE .

RECODE
clus        (15, 19 = 1)
            (27, 28  = 2)
            (21, 24, 25, 29, 30 = 3)
            (20, 26, 34 = 4)
            (17, 18 = 5)
            (16, 22, 31, 32, 33, 35, 36 = SYSMIS) .
EXECUTE .

FREQUENCIES
  VARIABLES=clus
  /ORDER  ANALYSIS .
=============================================================================================
=======================================*program cluster Denmark*=======================================

COMPUTE clus = i .
EXECUTE .

RECODE
clus        (15 = 1)
            (17, 18, 19  = 2)
            (20, 26, 27, 28 = 3)
            (23, 25 = 4)
            (21, 22 = 5)
            (35 = 6)
            (16, 24, 29, 30, 31, 32, 33, 34, 36 = SYSMIS) .
EXECUTE .

FREQUENCIES
  VARIABLES=clus
  /ORDER  ANALYSIS .
=============================================================================================
=====================================*program cluster Holland*=====================================

COMPUTE clus = i .
EXECUTE .

RECODE
clus        (15, 19, 55, 93 = 1)
            (23, 24, 25, 27, 36, 40, 51, 62 = 2)
            (20, 26, 28, 29, 45, 52, 70 = 3)
            (16, 22, 64, 65, 66, 67, 72, 74 = 4)
            (17, 18 = 5)
            (21 = 6)
            (31, 34, 35, 50, 61, 63, 71 = 7)
            (73, 75, 80, 85, 90, 91, 92 = 8)
            (30, 32, 33, 41, 60, 95 = SYSMIS) .
EXECUTE .

FREQUENCIES
  VARIABLES=clus
  /ORDER  ANALYSIS .

=============================================================================================
=================================*program systems of innovation*=================================

COMPUTE Inno = 99 .
EXECUTE .

DO IF (v1 = 2 and v2 = 2) .
RECODE
            inno (99 = 1) .
END IF .
EXECUTE .

DO IF ((v1 = 1 or v2 = 1) and v10a = 2) .
RECODE
            inno (99 = 2) .
```

```
END IF .
EXECUTE .

DO IF ((v1 = 1 or v2 = 1) and v10a = 1) .
RECODE
        inno (99 = 3) .
END IF.
EXECUTE .

FREQUENCIES
        VARIABLES = inno .
EXECUTE .

CROSSTABS
  /TABLES=clus  BY inno
  /FORMAT= AVALUE TABLES
  /CELLS= COUNT ROW TOTAL .


IF      (v6_11 = 1 or v6_12 = 1 or v6_13 = 1 or v6_14 = 1 or v6_15 = 1 or v6_16 = 1 or
        v6_21 = 1 or v6_22 = 1 or v6_23 = 1 or v6_24 = 1 or v6_25 = 1 or v6_26 = 1 or
        v6_31 = 1 or v6_32 = 1 or v6_33 = 1 or v6_34 = 1 or v6_35 = 1 or v6_36 = 1 or
        v6_41 = 1 or v6_42 = 1 or v6_43 = 1 or v6_44 = 1 or v6_45 = 1 or v6_46 = 1 or
        v6_51 = 1 or v6_52 = 1 or v6_53 = 1 or v6_54 = 1 or v6_55 = 1 or v6_56 = 1)
        know1 = 1 .
IF      (v6_11 = 0 and v6_12 = 0 and v6_13 = 0 and v6_14 = 0 and v6_15 = 0 and v6_16 = 0 and
        v6_21 = 0 and v6_22 = 0 and v6_23 = 0 and v6_24 = 0 and v6_25 = 0 and v6_26 = 0 and
        v6_31 = 0 and v6_32 = 0 and v6_33 = 0 and v6_34 = 0 and v6_35 = 0 and v6_36 = 0 and
        v6_41 = 0 and v6_42 = 0 and v6_43 = 0 and v6_44 = 0 and v6_45 = 0 and v6_46 = 0 and
        v6_51 = 0 and v6_52 = 0 and v6_53 = 0 and v6_54 = 0 and v6_55 = 0 and v6_56 = 0)
        know1 = 0 .
EXECUTE .

IF      (v6_61 =1 or v6_62 = 1 or v6_63 =1 or v6_64 = 1 or v6_65 = 1 or v6_66 =1 or
        v6_71 = 1 or v6_72 = 1 or v6_73 = 1 or v6_74 = 1 or v6_75 = 1 or v6_76 =1)
        know2 = 1 .
IF      (v6_61 =0 and v6_62 = 0 and v6_63 =0 and v6_64 = 0 and v6_65 = 0 and v6_66 =0 and
        v6_71 = 0 and v6_72 = 0 and v6_73 = 0 and v6_74 = 0 and v6_75 = 0 and v6_76 =0)
        know2 = 0 .
EXECUTE .

IF      (v6_12 = 1 or v6_13 = 1 or v6_14 = 1 or v6_15 = 1 or v6_16 = 1 or
        v6_22 = 1 or v6_23 = 1 or v6_24 = 1 or v6_25 = 1 or v6_26 = 1 or
        v6_32 = 1 or v6_33 = 1 or v6_34 = 1 or v6_35 = 1 or v6_36 = 1 or
        v6_42 = 1 or v6_43 = 1 or v6_44 = 1 or v6_45 = 1 or v6_46 = 1 or
        v6_52 = 1 or v6_53 = 1 or v6_54 = 1 or v6_55 = 1 or v6_56 = 1 or
        v6_62 = 1 or v6_63 = 1 or v6_64 = 1 or v6_65 = 1 or v6_66 = 1 or
        v6_72 = 1 or v6_73 = 1 or v6_74 = 1 or v6_75 = 1 or v6_76 = 1 or
        v8_12 = 1 or v8_13 = 1 or v8_14 = 1 or v8_15 = 1 or v8_16 = 1)
        know3 = 1 .
IF      (v6_12 = 0 and v6_13 = 0 and v6_14 = 0 and v6_15 = 0 and v6_16 = 0 and
        v6_22 = 0 and v6_23 = 0 and v6_24 = 0 and v6_25 = 0 and v6_26 = 0 and
        v6_32 = 0 and v6_33 = 0 and v6_34 = 0 and v6_35 = 0 and v6_36 = 0 and
        v6_42 = 0 and v6_43 = 0 and v6_44 = 0 and v6_45 = 0 and v6_46 = 0 and
        v6_52 = 0 and v6_53 = 0 and v6_54 = 0 and v6_55 = 0 and v6_56 = 0 and
        v6_62 = 0 and v6_63 = 0 and v6_64 = 0 and v6_65 = 0 and v6_66 = 0 and
        v6_72 = 0 and v6_73 = 0 and v6_74 = 0 and v6_75 = 0 and v6_76 = 0 and
        v8_12 = 0 and v8_13 = 0 and v8_14 = 0 and v8_15 = 0 and v8_16 = 0)
        know3 = 0 .
EXECUTE .

IF      (v6_11 = 1 or v6_21 = 1 or v6_31 = 1 or v6_41 = 1 or v6_51 = 1 or v6_61 =1 or v6_71 = 1 or
        v8_11 = 1)
        know4 = 1 .
IF      (v6_11 = 0 and v6_21 = 0 and v6_31 = 0 and v6_41 = 0 and v6_51 = 0 and v6_61 = 0 and v6_71 = 0 and
        v8_11 = 0)
        know4 = 0 .
EXECUTE .

IF      (v8_11 = 1 or v8_12 = 1 or v8_13 = 1 or v8_14 = 1 or v8_15 = 1 or v8_16 = 1)
        know5 = 1 .
IF      (v8_11 = 0 and v8_12 = 0 and v8_13 = 0 and v8_14 = 0 and v8_15 = 0 and v8_16 = 0)
        know5 = 0 .
EXECUTE .

DESCRIPTIVES
```

```
  VARIABLES=know1 know2 know3 know4 know5
  /FORMAT = LABELS NOINDEX
  /STATISTICS=MEAN STDDEV MIN MAX
  /SORT = MEAN (A) .
EXECUTE .

CROSSTABS
  /TABLES=clus  BY know1 know2 know3 know4 know5
  /FORMAT= AVALUE TABLES
  /CELLS= COUNT ROW TOTAL .

COMPUTE info1s = v4_1 + v4_2 .
COMPUTE info2s = v4_6 + v4_7 + v4_10 .
COMPUTE info3s = v4_3 + v4_4 + v4_5 .
COMPUTE info4s = v4_8 + v4_9 .
COMPUTE info5s = v4_11 + v4_12 + v4_13 .
EXECUTE .

IF (info1s <= "survey mean info1s") info1 = 0 .
IF (info1s > "survey mean info1s") info1 = 1 .
EXECUTE .

IF (info2s <= "survey mean info2s") info2 = 0 .
IF (info2s > "survey mean info2s") info2 = 1 .
EXECUTE .

IF (info3s <= "survey mean info3s") info3 = 0 .
IF (info3s > "survey mean info3s") info3 = 1 .
EXECUTE .

IF (info4s <= "survey mean info4s") info4 = 0 .
IF (info4s > "survey mean info4s") info4 = 1 .
EXECUTE .

IF (info5s <= "survey mean info5s") info5 = 0 .
IF (info5s > "survey mean info5s") info5 = 1 .
EXECUTE .

"survey mean info1s Belgium" = 5.3975
"survey mean info2s Belgium" = 6.4476
"survey mean info3s Belgium" = 10.1710
"survey mean info4s Belgium" = 3.6869
"survey mean info5s Belgium" = 7.8496
"survey mean info1s Denmark" = 5.7832
"survey mean info2s Denmark" = 7.2952
"survey mean info3s Denmark" = 10.3095
"survey mean info4s Denmark" = 4.0159
"survey mean info5s Denmark" = 7.3938
"survey mean info1s Holland" = 4.9390
"survey mean info2s Holland" = 6.2701
"survey mean info3s Holland" = 10.0671
"survey mean info4s Holland" = 3.8049
"survey mean info5s Holland" = 7.2656

DESCRIPTIVES
  VARIABLES=info1 info2 info3 info4 info5
  /FORMAT = LABELS NOINDEX
  /STATISTICS=MEAN STDDEV MIN MAX
  /SORT = MEAN (A) .
EXECUTE .

CROSSTABS
  /TABLES=clus  BY info1 info2 info3 info4 info5
  /FORMAT= AVALUE TABLES
  /CELLS= COUNT ROW TOTAL .


COMPUTE coin = v11_1 .
EXECUTE .

DO IF (v11_4r = 0 and v11_41 = 0 and v11_42 = 0 and v11_43 = 0 and v11_44 = 0 and v11_45 = 0 and v11_46 = 0) .
RECODE coin (1 = 2) .
END IF .
EXECUTE .

RECODE coin (2 = 0) .
```

```
EXECUTE .

COMPUTE coex = v11_1 .
EXECUTE .

DO IF     (v11_2r = 0 and v11_21 = 0 and v11_22 = 0 and v11_23 = 0 and v11_24 = 0 and v11_25 = 0 and v11_26 = 0 and
          v11_3r = 0 and v11_31 = 0 and v11_32 = 0 and v11_33 = 0 and v11_34 = 0 and v11_35 = 0 and v11_36 = 0 and
          v11_5r = 0 and v11_51 = 0 and v11_52 = 0 and v11_53 = 0 and v11_54 = 0 and v11_55 = 0 and v11_56 = 0 and
          v11_6r = 0 and v11_61 = 0 and v11_62 = 0 and v11_63 = 0 and v11_64 = 0 and v11_65 = 0 and v11_66 = 0 and
          v11_7r = 0 and v11_71 = 0 and v11_72 = 0 and v11_73 = 0 and v11_74 = 0 and v11_75 = 0 and v11_76 = 0 and
          v11_8r = 0 and v11_81 = 0 and v11_82 = 0 and v11_83 = 0 and v11_84 = 0 and v11_85 = 0 and v11_86 = 0 and
          v11_9r = 0 and v11_91 = 0 and v11_92 = 0 and v11_93 = 0 and v11_94 = 0 and v11_95 = 0 and v11_96 = 0 and
          v11_10r = 0 and v11_101 = 0 and v11_102 = 0 and v11_103 = 0 and v11_104 = 0 and v11_105 = 0 and v11_106 = 0 and
          v11_11r = 0 and v11_111 = 0 and v11_112 = 0 and v11_113 = 0 and v11_114 = 0 and v11_115 = 0 and v11_116 = 0) .
RECODE coex (1 = 2) .
END IF .
EXECUTE .

RECODE coex (2 = 0) .
EXECUTE .

COMPUTE coinex = v11_1 .
EXECUTE .

DO IF     (v11_4r = 0 and v11_41 = 0 and v11_42 = 0 and v11_43 = 0 and v11_44 = 0 and v11_45 = 0 and v11_46 = 0)
          or
          (v11_2r = 0 and v11_21 = 0 and v11_22 = 0 and v11_23 = 0 and v11_24 = 0 and v11_25 = 0 and v11_26 = 0 and
          v11_3r = 0 and v11_31 = 0 and v11_32 = 0 and v11_33 = 0 and v11_34 = 0 and v11_35 = 0 and v11_36 = 0 and
          v11_5r = 0 and v11_51 = 0 and v11_52 = 0 and v11_53 = 0 and v11_54 = 0 and v11_55 = 0 and v11_56 = 0 and
          v11_6r = 0 and v11_61 = 0 and v11_62 = 0 and v11_63 = 0 and v11_64 = 0 and v11_65 = 0 and v11_66 = 0 and
          v11_7r = 0 and v11_71 = 0 and v11_72 = 0 and v11_73 = 0 and v11_74 = 0 and v11_75 = 0 and v11_76 = 0 and
          v11_8r = 0 and v11_81 = 0 and v11_82 = 0 and v11_83 = 0 and v11_84 = 0 and v11_85 = 0 and v11_86 = 0 and
          v11_9r = 0 and v11_91 = 0 and v11_92 = 0 and v11_93 = 0 and v11_94 = 0 and v11_95 = 0 and v11_96 = 0 and
          v11_10r = 0 and v11_101 = 0 and v11_102 = 0 and v11_103 = 0 and v11_104 = 0 and v11_105 = 0 and v11_106 = 0 and
          v11_11r = 0 and v11_111 = 0 and v11_112 = 0 and v11_113 = 0 and v11_114 = 0 and v11_115 = 0 and v11_116 = 0) .
RECODE coinex (1 = 2).
END IF .
EXECUTE .

RECODE coinex (2 = 0) .
EXECUTE .

COMPUTE copub = v11_1 .
EXECUTE .

DO IF     (v11_8r = 0 and v11_81 = 0 and v11_82 = 0 and v11_83 = 0 and v11_84 = 0 and v11_85 = 0 and v11_86 = 0 and
          v11_10r = 0 and v11_101 = 0 and v11_102 = 0 and v11_103 = 0 and v11_104 = 0 and v11_105 = 0 and v11_106 = 0) .
RECODE copub (1 = 2) .
END IF .
EXECUTE .

RECODE copub (2 = 0) .
EXECUTE .

COMPUTE copri = v11_1 .
EXECUTE .

DO IF     (v11_2r = 0 and v11_21 = 0 and v11_22 = 0 and v11_23 = 0 and v11_24 = 0 and v11_25 = 0 and v11_26 = 0 and
          v11_3r = 0 and v11_31 = 0 and v11_32 = 0 and v11_33 = 0 and v11_34 = 0 and v11_35 = 0 and v11_36 = 0 and
          v11_4r = 0 and v11_41 = 0 and v11_42 = 0 and v11_43 = 0 and v11_44 = 0 and v11_45 = 0 and v11_46 = 0 and
          v11_5r = 0 and v11_51 = 0 and v11_52 = 0 and v11_53 = 0 and v11_54 = 0 and v11_55 = 0 and v11_56 = 0 and
          v11_6r = 0 and v11_61 = 0 and v11_62 = 0 and v11_63 = 0 and v11_64 = 0 and v11_65 = 0 and v11_66 = 0 and
          v11_7r = 0 and v11_71 = 0 and v11_72 = 0 and v11_73 = 0 and v11_74 = 0 and v11_75 = 0 and v11_76 = 0 and
          v11_9r = 0 and v11_91 = 0 and v11_92 = 0 and v11_93 = 0 and v11_94 = 0 and v11_95 = 0 and v11_96 = 0 and
          v11_11r = 0 and v11_111 = 0 and v11_112 = 0 and v11_113 = 0 and v11_114 = 0 and v11_115 = 0 and v11_116 = 0) .
RECODE copri (1 = 2) .
END IF .
EXECUTE .

RECODE copri (2 = 0) .
EXECUTE .

COMPUTE copupr = v11_1 .
EXECUTE .

DO IF     (v11_8r = 0 and v11_81 = 0 and v11_82 = 0 and v11_83 = 0 and v11_84 = 0 and v11_85 = 0 and v11_86 = 0 and
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        v11_10r = 0 and v11_101 = 0 and v11_102 = 0 and v11_103 = 0 and v11_104 = 0 and v11_105 = 0 and v11_106 = 0)
        or
        (v11_2r = 0 and v11_21 = 0 and v11_22 = 0 and v11_23 = 0 and v11_24 = 0 and v11_25 = 0 and v11_26 = 0 and
        v11_3r = 0 and v11_31 = 0 and v11_32 = 0 and v11_33 = 0 and v11_34 = 0 and v11_35 = 0 and v11_36 = 0 and
        v11_4r = 0 and v11_41 = 0 and v11_42 = 0 and v11_43 = 0 and v11_44 = 0 and v11_45 = 0 and v11_46 = 0 and
        v11_5r = 0 and v11_51 = 0 and v11_52 = 0 and v11_53 = 0 and v11_54 = 0 and v11_55 = 0 and v11_56 = 0 and
        v11_6r = 0 and v11_61 = 0 and v11_62 = 0 and v11_63 = 0 and v11_64 = 0 and v11_65 = 0 and v11_66 = 0 and
        v11_7r = 0 and v11_71 = 0 and v11_72 = 0 and v11_73 = 0 and v11_74 = 0 and v11_75 = 0 and v11_76 = 0 and
        v11_9r = 0 and v11_91 = 0 and v11_92 = 0 and v11_93 = 0 and v11_94 = 0 and v11_95 = 0 and v11_96 = 0 and
        v11_11r = 0 and v11_111 = 0 and v11_112 = 0 and v11_113 = 0 and v11_114 = 0 and v11_115 = 0 and v11_116 = 0) .
RECODE copupr (1 = 2) .
END IF .
EXECUTE .

RECODE copupr (2 = 0) .
EXECUTE .

COMPUTE conat = v11_1 .
EXECUTE .

DO IF   (v11_2r = 0 and v11_3r = 0 and v11_4r = 0 and v11_5r = 0 and v11_6r = 0 and v11_7r = 0 and v11_8r and v11_9r = 0 and
        v11_10r =0 and v11_11r = 0 and v11_21 = 0 and v11_31 = 0 and v11_41 = 0 and v11_51 = 0 and v11_61 = 0 and
        v11_71 = 0 and v11_81 and v11_91 = 0 and v11_101 =0 and v11_111 = 0) .
RECODE conat (1 = 2) .
END IF .
EXECUTE .

RECODE conat (2 = 0) .
EXECUTE .

COMPUTE coint = v11_1 .
EXECUTE .

DO IF   (v11_22 = 0 and v11_23 = 0 and v11_24 = 0 and v11_25 = 0 and v11_26 = 0 and
        v11_32 = 0 and v11_33 = 0 and v11_34 = 0 and v11_35 = 0 and v11_36 = 0 and
        v11_42 = 0 and v11_43 = 0 and v11_44 = 0 and v11_45 = 0 and v11_46 = 0 and
        v11_52 = 0 and v11_53 = 0 and v11_54 = 0 and v11_55 = 0 and v11_56 = 0 and
        v11_62 = 0 and v11_63 = 0 and v11_64 = 0 and v11_65 = 0 and v11_66 = 0 and
        v11_72 = 0 and v11_73 = 0 and v11_74 = 0 and v11_75 = 0 and v11_76 = 0 and
        v11_82 = 0 and v11_83 = 0 and v11_84 = 0 and v11_85 = 0 and v11_86 = 0 and
        v11_92 = 0 and v11_93 = 0 and v11_94 = 0 and v11_95 = 0 and v11_96 = 0 and
        v11_102 = 0 and v11_103 = 0 and v11_104 = 0 and v11_105 = 0 and v11_106 = 0 and
        v11_112 = 0 and v11_113 = 0 and v11_114 = 0 and v11_115 = 0 and v11_116 = 0) .
RECODE coint (1 = 2) .
END IF .
EXECUTE .

RECODE coint (2 = 0) .
EXECUTE .

COMPUTE conain = v11_1 .
EXECUTE .

DO IF   (v11_2r = 0 and v11_3r = 0 and v11_4r = 0 and v11_5r = 0 and v11_6r = 0 and v11_7r = 0 and v11_8r and
        v11_9r = 0 and v11_10r =0 and v11_11r = 0 and v11_21 = 0 and v11_31 = 0 and v11_41 = 0 and v11_51 = 0 and
        v11_61 = 0 and v11_71 = 0 and v11_81 and v11_91 = 0 and v11_101 =0 and v11_111 = 0)
        or
        (v11_22 = 0 and v11_23 = 0 and v11_24 = 0 and v11_25 = 0 and v11_26 = 0 and
        v11_32 = 0 and v11_33 = 0 and v11_34 = 0 and v11_35 = 0 and v11_36 = 0 and
        v11_42 = 0 and v11_43 = 0 and v11_44 = 0 and v11_45 = 0 and v11_46 = 0 and
        v11_52 = 0 and v11_53 = 0 and v11_54 = 0 and v11_55 = 0 and v11_56 = 0 and
        v11_62 = 0 and v11_63 = 0 and v11_64 = 0 and v11_65 = 0 and v11_66 = 0 and
        v11_72 = 0 and v11_73 = 0 and v11_74 = 0 and v11_75 = 0 and v11_76 = 0 and
        v11_82 = 0 and v11_83 = 0 and v11_84 = 0 and v11_85 = 0 and v11_86 = 0 and
        v11_92 = 0 and v11_93 = 0 and v11_94 = 0 and v11_95 = 0 and v11_96 = 0 and
        v11_102 = 0 and v11_103 = 0 and v11_104 = 0 and v11_105 = 0 and v11_106 = 0 and
        v11_112 = 0 and v11_113 = 0 and v11_114 = 0 and v11_115 = 0 and v11_116 = 0) .
RECODE conain (1 = 2) .
END IF .
EXECUTE .

RECODE conain (2 = 0) .
EXECUTE .

COMPUTE coreg = v11_1 .
EXECUTE .
```

```
DO IF      (v11_2r = 0 and v11_3r = 0 and v11_4r = 0 and v11_5r = 0 and v11_6r = 0 and v11_7r = 0 and v11_8r and v11_9r = 0 and
           v11_10r =0 and v11_11r = 0) .
RECODE coreg (1 = 2) .
END IF .
EXECUTE .

RECODE coreg (2 = 0) .
EXECUTE .

DESCRIPTIVES
  VARIABLES=coin coex coinex
  /FORMAT = LABELS NOINDEX
  /STATISTICS=MEAN STDDEV MIN MAX
  /SORT = MEAN (A) .
EXECUTE .

DESCRIPTIVES
  VARIABLES=copub copri copupr
  /FORMAT = LABELS NOINDEX
  /STATISTICS=MEAN STDDEV MIN MAX
  /SORT = MEAN (A) .
EXECUTE .

DESCRIPTIVES
  VARIABLES=coreg conat coint conain
  /FORMAT = LABELS NOINDEX
  /STATISTICS=MEAN STDDEV MIN MAX
  /SORT = MEAN (A) .
EXECUTE .

COMPUTE coinexcu = v11_1 .
EXECUTE .

RECODE
coinexcu (2 = 1) .
EXECUTE .

DO IF (coinex = 1) .
RECODE
coinexcu (1 = 4) .
END IF .
EXECUTE .

DO IF (coinex = 0 and coin = 1) .
RECODE
coinexcu (1 = 3) .
END IF .
EXECUTE .

DO IF (coinex = 0 and coex = 1) .
RECODE
coinexcu (1 = 2) .
END IF .
EXECUTE .

COMPUTE copuprcu = v11_1 .
EXECUTE .

RECODE
copuprcu (2 = 1) .
EXECUTE .

DO IF (copupr = 1) .
RECODE
copuprcu (1 = 4) .
END IF .
EXECUTE .

DO IF (copupr = 0 and copub = 1) .
RECODE
copuprcu (1 = 3) .
END IF .
EXECUTE .

DO IF (copupr = 0 and copri = 1) .
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RECODE
copuprcu (1 = 2) .
END IF .
EXECUTE .

COMPUTE conaincu = v11_1 .
EXECUTE .

RECODE
conaincu (2 = 1) .
EXECUTE .

DO IF (conain = 1) .
RECODE
conaincu (1 = 4) .
END IF .
EXECUTE .

DO IF (conain = 0 and conat = 1) .
RECODE
conaincu (1 = 3) .
END IF .
EXECUTE .

DO IF (conain = 0 and coint = 1) .
RECODE
conaincu (1 = 2) .
END IF .
EXECUTE .

FREQUENCIES
VARIABLES=coinexcu copuprcu conaincu.
EXECUTE.

CROSSTABS
  /TABLES=clus  BY coinexcu copuprcu conaincu
  /FORMAT= AVALUE TABLES
  /CELLS= COUNT ROW TOTAL .


COMPUTE public = 0 .
EXECUTE .

DO IF (v1 = 2 and v2 = 2 and v3 = 2) .
RECODE
public (0 = SYSMIS) .
END IF .
EXECUTE .

DO IF      (v4_8 >= 4 or v4_9 >= 4
           or
           v11_8r = 1 or v11_81 = 1 or v11_82 = 1 or v11_83 = 1 or v11_84 = 1 or v11_85 = 1 or v11_86 = 1
           or
           v11_10r = 1 or v11_101 = 1 or v11_102 = 1 or v11_103 = 1 or v11_104 = 1 or v11_105 = 1 or v11_106 = 1) .
RECODE
public (0 = 1) .
END IF .
EXECUTE .

COMPUTE private = 0 .
EXECUTE .

DO IF (v1 = 2 and v2 = 2 and v3 = 2) .
RECODE
private (0 = SYSMIS) .
END IF .
EXECUTE .

DO IF      (v4_10 >= 4
           or
           v11_9r = 1 or v11_91 = 1 or v11_92 = 1 or v11_93 = 1 or v11_94 = 1 or v11_95 = 1 or v11_96 = 1
           or
           v11_11r = 1 or v11_111 = 1 or v11_112 = 1 or v11_113 = 1 or v11_114 = 1 or v11_115 = 1 or v11_116 = 1) .
RECODE
private (0 = 1) .
END IF .
```

```
EXECUTE .

COMPUTE consult = 0 .
EXECUTE .

DO IF (v1 = 2 and v2 = 2 and v3 = 2) .
RECODE
consult (0 = SYSMIS) .
END IF .
EXECUTE .

DO IF      (v4_7 >= 4
           or
           v6_31 = 1 or v6_32 = 1 or v6_33 = 1 or v6_34 = 1 or v6_35 = 1 or v6_36 = 1
           or
           v7_31 = 1 or v7_32 = 1 or v7_33 = 1 or v7_34 = 1 or v7_35 = 1 or v7_36 = 1
           or
           v11_7r = 1 or v11_71 = 1 or v11_72 = 1 or v11_73 = 1 or v11_74 = 1 or v11_75 = 1 or v11_76 = 1 ) .
RECODE
consult (0 = 1) .
END IF .
EXECUTE .

COMPUTE oecd7 = 0 .
EXECUTE .

DO IF (v1 = 2 and v2 = 2 and v3 = 2) .
RECODE
oecd7 (0 = SYSMIS) .
END IF .
EXECUTE .

DO IF      (public = 1 or private = 1 or consult = 1) .
RECODE
oecd7 (0 = 1) .
END IF .
EXECUTE .

DESCRIPTIVES
  VARIABLES=private public consult oecd7
  /FORMAT=LABELS NOINDEX
  /STATISTICS=MEAN STDDEV MIN MAX
  /SORT=MEAN (A) .
EXECUTE.

CROSSTABS
  /TABLES=clus  BY oecd7
  /FORMAT= AVALUE TABLES
  /CELLS= COUNT ROW TOTAL .

COMPUTE oecd1 = 1 .
EXECUTE .

DO IF (v1 = 2 and v2 = 2 and v3 = 2) .
RECODE
oecd1 (1 = SYSMIS) .
END IF .
EXECUTE .

COMPUTE oecd2 = 0 .
EXECUTE .

DO IF (v1 = 2 and v2 = 2 and v3 = 2) .
RECODE
oecd2 (0 = SYSMIS) .
END IF .
EXECUTE .

DO IF      (v6_51 = 1 or v6_52 = 1 or v6_53 = 1 or v6_54 = 1 or v6_55 = 1 or v6_56 = 1
           or
           v7_51 = 1 or v7_52 = 1 or v7_53 = 1 or v7_54 = 1 or v7_55 = 1 or v7_56 = 1) .
RECODE
oecd2 (0 = 1) .
END IF .
EXECUTE .
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```
COMPUTE oecd3 = 0 .
EXECUTE .

DO IF (v1 = 2 and v2 = 2 and v3 = 2) .
RECODE
oecd3 (0 = SYSMIS) .
END IF .
EXECUTE .

DO IF      (v4_3 >= 4 or v4_4 >= 4
           or
           v11_3r = 1 or v11_31 = 1 or v11_32 = 1 or v11_33 = 1 or v11_34 = 1 or v11_35 = 1 or v11_36 = 1)
           and
           (v4_5 >= 4
           or
           v11_2r = 1 or v11_21 = 1 or v11_22 = 1 or v11_23 = 1 or v11_24 = 1 or v11_25 = 1 or v11_26 = 1) .
RECODE
oecd3 (0 = 1) .
END IF .
EXECUTE .

COMPUTE oecd4 = 0 .
EXECUTE .

DO IF (v1 = 2 and v2 = 2 and v3 = 2) .
RECODE
oecd4 (0 = SYSMIS) .
END IF .
EXECUTE .

DO IF      (v4_5 >= 4
           or
           v11_2r = 1 or v11_21 = 1 or v11_22 = 1 or v11_23 = 1 or v11_24 = 1 or v11_25 = 1 or v11_26 = 1)
           and
           (v4_6 >= 4
           or
           v11_5r = 1 or v11_51 = 1 or v11_52 = 1 or v11_53 = 1 or v11_54 = 1 or v11_55 = 1 or v11_56 = 1) .
RECODE
oecd4 (0 = 1) .
END IF .
EXECUTE .

COMPUTE oecd5 = 0 .
EXECUTE .

DO IF (v1 = 2 and v2 = 2 and v3 = 2) .
RECODE
oecd5 (0 = SYSMIS) .
END IF .
EXECUTE .

DO IF      (v4_3 >= 4 or v4_4 >= 4
           or
           v11_3r = 1 or v11_31 = 1 or v11_32 = 1 or v11_33 = 1 or v11_34 = 1 or v11_35 = 1 or v11_36 = 1)
           and
           (v4_6 >= 4
           or
           v11_5r = 1 or v11_51 = 1 or v11_52 = 1 or v11_53 = 1 or v11_54 = 1 or v11_55 = 1 or v11_56 = 1)
           and
           (v4_5 >= 4
           or
           v11_2r = 1 or v11_21 = 1 or v11_22 = 1 or v11_23 = 1 or v11_24 = 1 or v11_25 = 1 or v11_26 = 1) .
RECODE
oecd5 (0 = 1) .
END IF .
EXECUTE .

COMPUTE oecd6 = 0 .
EXECUTE .

DO IF (v1 = 2 and v2 = 2 and v3 = 2) .
RECODE
oecd6 (0 = SYSMIS) .
END IF .
EXECUTE .
```

```
DO IF      (v6_51 = 1 or v6_52 = 1 or v6_53 = 1 or v6_54 = 1 or v6_55 = 1 or v6_56 = 1
            or
            v7_51 = 1 or v7_52 = 1 or v7_53 = 1 or v7_54 = 1 or v7_55 = 1 or v7_56 = 1)
            and
            (v4_3 >= 4 or v4_4 >= 4
            or
            v11_3r = 1 or v11_31 = 1 or v11_32 = 1 or v11_33 = 1 or v11_34 = 1 or v11_35 = 1 or v11_36 = 1)
            and
            (v4_6 >= 4
            or
            v11_5r = 1 or v11_51 = 1 or v11_52 = 1 or v11_53 = 1 or v11_54 = 1 or v11_55 = 1 or v11_56 = 1)
            and
            (v4_5 >= 4
            or
            v11_2r = 1 or v11_21 = 1 or v11_22 = 1 or v11_23 = 1 or v11_24 = 1 or v11_25 = 1 or v11_26 = 1) .
RECODE
oecd6 (0 = 1) .
END IF .
EXECUTE .

DESCRIPTIVES
  VARIABLES=oecd1 oecd2 oecd3 oecd4 oecd5 oecd6
  /FORMAT=LABELS NOINDEX
  /STATISTICS=MEAN STDDEV MIN MAX
  /SORT=MEAN (A) .
EXECUTE .

COMPUTE oecdcum = 1 .
EXECUTE .

DO IF (v1 = 2 and v2 = 2 and v3 = 2) .
RECODE
oecdcum (1 = SYSMIS) .
END IF .
EXECUTE .

DO IF (oecd6 = 1) .
RECODE
oecdcum (1 = 6) .
END IF .
EXECUTE .

DO IF (oecd6 = 0 and oecd5 = 1) .
RECODE
oecdcum (1 = 5) .
END IF .
EXECUTE .

DO IF (oecd6 = 0 and oecd5 = 0 and oecd4 = 1) .
RECODE
oecdcum (1 = 4) .
END IF .
EXECUTE .

DO IF (oecd6 = 0 and oecd5 = 0 and oecd4 = 0 and oecd3 = 1) .
RECODE
oecdcum (1 = 3 ) .
END IF .
EXECUTE .

DO IF (oecd6 = 0 and oecd5 = 0 and oecd4 = 0 and oecd3 = 0 and oecd2 = 1) .
RECODE
oecdcum (1 = 2) .
END IF .
EXECUTE .

FREQUENCIES
VARIABLES=oecdcum .
EXECUTE .

CROSSTABS
  /TABLES=clus  BY oecdcum
  /FORMAT= AVALUE TABLES
  /CELLS= COUNT ROW TOTAL .
==============================================================================================
```

Appendix IV: Styles of innovation Belgium, Denmark and the Netherlands

Distribution of firms over clusters

Belgium	Frequency	Percentage
AGRO-FOOD	1472	21,5%
ENERGY-INTENSIVE PRODUCTION	1431	20,9%
BUSINESS SERVICES	1626	23,8%
CONSTRUCTION	922	13,5%
TEXTILES	1394	20,4%
Total	6845	100%
Missing	1810	

Denmark	Frequency	Percentage
AGRO-FOOD	382	20,3%
CRAFTS	206	11,0%
CONSTRUCTION	662	35,2%
ENERGY-INTENSIVE PRODUCTION	143	7,6%
INFORMATION and FINANCIAL	392	20,9%
DISTRIBUTION	94	5,0%
Total	1879	100%
Missing	1407	

the Netherlands	Frequency	Percentage
AGRO-FOOD	2738	6,3%
ENERGY-INTENSIVE PRODUCTION	9051	20,9%
CONSTRUCTION	17831	41,2%
INFORMATION and FINANCIAL	7185	16,6%
TEXTILES	521	1,2%
PAPER	183	0,4%
DISTRIBUTION	4364	10,1%
PUBLIC SERVICES	1375	3,2%
Total	43248	100%
Missing	2538	

the Netherlands*	Frequency	Percentage
AGRO-FOOD	1131	12,1%
ENERGY-INTENSIVE PRODUCTION	1660	17,8%
CONSTRUCTION	3762	40,3%
INFORMATION and FINANCIAL	1358	14,6%
TEXTILES	521	5,6%
PAPER	183	2,0%
DISTRIBUTION	716	7,7%
Total	9331	100%
Missing	467	

Distribution of structural innovation over clusters

Belgium	Non-innovative firms	Innovative firms, no R&D	Innovative firms, R&D	Obs.
ECONOMY	44,7%	15,0%	40,4%	8655
AGRO-FOOD	38,0%	15,9%	46,1%	1472
ENERGY-INTENSIVE PRODUCTION	41,8%	13,5%	44,7%	1430
BUSINESS SERVICES	35,7%	8,6%	55,7%	1626
CONSTRUCTION	61,1%	12,9%	26,0%	922
TEXTILES	49,6%	14,8%	35,7%	1394

Denmark	Non-innovative firms	Innovative firms, no R&D	Innovative firms, R&D	Obs.
ECONOMY	47,4%	14,8%	37,8%	3286
AGRO-FOOD	64,4%	3,7%	31,9%	382
CRAFTS	53,9%	22,3%	23,8%	206
CONSTRUCTION	41,2%	19,6%	39,1%	662
ENERGY-INTENSIVE PRODUCTION	25,2%	25,2%	49,7%	143
INFORMATION and FINANCIAL	59,9%	24,5%	15,6%	392
DISTRIBUTION	73,4%	2,1%	24,5%	94

the Netherlands	Non-innovative firms	Innovative firms, no R&D	Innovative firms, R&D	Obs.
ECONOMY	69,0%	15,7%	15,3%	45786
AGRO-FOOD	65,9%	17,9%	16,2%	2738
ENERGY-INTENSIVE PRODUCTION	67,2%	14,2%	18,7%	9050
CONSTRUCTION	72,1%	15,0%	12,9%	17832
INFORMATION and FINANCIAL	63,1%	19,6%	17,3%	7185
TEXTILES	60,1%	20,3%	19,6%	521
PAPER	33,2%	23,9%	42,9%	184
DISTRIBUTION	74,0%	14,2%	11,8%	4363
PUBLIC SERVICES	65,0%	15,5%	19,5%	1374

the Netherlands*	Non-innovative firms	Innovative firms, no R&D	Innovative firms, R&D	Obs.
ECONOMY	49,6%	20,2%	30,2%	9798
AGRO-FOOD	54,0%	11,6%	34,4%	1131
ENERGY-INTENSIVE PRODUCTION	47,3%	19,3%	33,5%	1661
CONSTRUCTION	47,2%	21,3%	31,5%	3762
INFORMATION and FINANCIAL	60,9%	27,8%	11,3%	1357
TEXTILES	60,1%	20,3%	19,6%	521
PAPER	33,2%	23,9%	42,9%	184
DISTRIBUTION	46,1%	14,8%	39,1%	716

Distribution of knowledge acquisition channels over clusters

Belgium	Formal channels*	Informal channels**	International channels	National channels	Internal channels	Obs.
ECONOMY	86,1%	67,6%	74,0%	76,4%	25,3%	4790
AGRO-FOOD	83,3%	73,2%	62,7%	84,5%	19,1%	912
ENERGY-INTENSIVE PRODUCTION	83,9%	69,7%	82,5%	79,0%	24,8%	832
BUSINESS SERVICES	89,2%	66,7%	86,6%	65,7%	40,8%	1047
CONSTRUCTION	92,8%	59,9%	86,1%	74,9%	16,4%	359
TEXTILES	85,1%	54,6%	70,7%	74,3%	24,1%	703

Denmark	Formal channels*	Informal channels**	International channels	National channels	Internal channels	Obs.
ECONOMY	95,8%	56,1%	75,3%	78,8%	47,2%	1729
AGRO-FOOD	100,0%	61,8%	83,8%	80,9%	71,3%	136
CRAFTS	86,2%	63,2%	86,2%	80,0%	57,9%	94
CONSTRUCTION	97,9%	48,5%	66,3%	86,2%	55,3%	389
ENERGY-INTENSIVE PRODUCTION	91,6%	64,8%	72,9%	84,1%	20,6%	107
INFORMATION and FINANCIAL	100,0%	51,0%	82,8%	47,8%	47,1%	157
DISTRIBUTION	88,0%	64,0%	92,0%	100,0%	68,0%	25

the Netherlands	Formal channels*	Informal channels**	International channels	National channels	Internal channels	Obs.
ECONOMY	46,9%	33,0%	26,0%	51,0%	17,9%	14190
AGRO-FOOD	58,9%	39,1%	30,5%	64,3%	31,0%	935
ENERGY-INTENSIVE PRODUCTION	44,4%	30,5%	35,8%	45,7%	18,9%	2970
CONSTRUCTION	46,7%	31,7%	23,7%	52,7%	15,7%	4980
INFORMATION and FINANCIAL	40,9%	30,3%	17,6%	46,3%	15,6%	2648
TEXTILES	87,5%	45,9%	71,6%	74,9%	31,7%	208
PAPER	82,0%	50,0%	68,9%	79,7%	64,8%	122
DISTRIBUTION	49,3%	38,6%	22,2%	49,8%	10,9%	1135
PUBLIC SERVICES	42,7%	38,7%	14,5%	46,7%	12,7%	482

the Netherlands*	Formal channels*	Informal channels**	International channels	National channels	Internal channels	Obs.
ECONOMY	83,2%	51,4%	50,9%	86,3%	34,1%	4939
AGRO-FOOD	78,8%	60,8%	47,7%	88,8%	44,4%	520
ENERGY-INTENSIVE PRODUCTION	77,1%	52,7%	65,6%	85,1%	32,0%	876
CONSTRUCTION	85,4%	45,9%	52,3%	84,3%	35,1%	1987
INFORMATION and FINANCIAL	88,1%	55,1%	23,8%	96,0%	24,3%	530
TEXTILES	87,5%	45,9%	71,6%	74,9%	31,7%	208
PAPER	82,0%	50,0%	68,9%	79,7%	64,8%	122
DISTRIBUTION	85,5%	60,6%	45,6%	89,6%	23,6%	386

* Right of use others' inventions, R&D contracted out, consultants, purchase of other enterprise
** Purchase of equipment, communication with other enterprises, hiring skilled employees

Distribution of information sources over clusters

Belgium	Internal sources	Direct external sources *	Indirect external sources **	Public sources ***	General sources ****	Obs.
ECONOMY	30,9%	45,5%	43,5%	52,7%	57,7%	4790
AGRO-FOOD	15,3%	44,6%	45,6%	45,5%	45,4%	912
ENERGY-INTENSIVE PRODUCTION	43,5%	60,4%	47,7%	66,0%	55,6%	832
BUSINESS SERVICES	38,0%	42,4%	39,1%	53,0%	64,0%	1047
CONSTRUCTION	27,9%	37,0%	39,6%	55,0%	60,2%	359
TEXTILES	28,6%	40,4%	44,2%	40,7%	54,8%	703

Denmark	Internal sources	Direct external sources *	Indirect external sources **	Public sources ***	General sources ****	Obs.
ECONOMY	50,0%	47,7%	49,7%	31,2%	50,9%	1729
AGRO-FOOD	73,5%	58,8%	33,8%	31,6%	61,8%	136
CRAFTS	46,3%	43,2%	54,7%	33,7%	37,9%	94
CONSTRUCTION	54,1%	40,5%	34,9%	24,9%	39,8%	389
ENERGY-INTENSIVE PRODUCTION	53,3%	67,3%	75,0%	39,3%	62,6%	107
INFORMATION and FINANCIAL	61,1%	36,3%	60,5%	11,5%	54,8%	157
DISTRIBUTION	73,1%	64,0%	20,0%	38,5%	50,0%	25

the Netherlands	Internal sources	Direct external sources *	Indirect external sources **	Public sources ***	General sources ****	Obs.
ECONOMY	60,4%	44,2%	49,4%	52,9%	47,7%	4913
AGRO-FOOD	62,3%	56,7%	52,7%	59,4%	49,2%	520
ENERGY-INTENSIVE PRODUCTION	63,3%	44,7%	48,6%	56,8%	54,4%	875
CONSTRUCTION	61,0%	45,3%	45,6%	56,2%	47,3%	1987
INFORMATION and FINANCIAL	53,6%	24,3%	61,45	26,6%	38,3%	530
TEXTILES	45,7%	42,0%	51,9%	50,2%	38,6%	208
PAPER	58,2%	47,5%	58,2%	57,7%	46,7%	122
DISTRIBUTION	53,6%	43,05	49,2%	51,0%	33,2%	386

* Competitors, consultants, technical institutes
** Suppliers, clients, customers
*** Universities/higher education, government laboratories
**** Patent disclosures, conferences/meetings/journals, fairs/exhibitions

Distribution of R&D networks over clusters

Belgium	No internal/ external network	Only external network	Only internal network	Internal/ external network	Obs.
ECONOMY	71,9%	19,8%	0,9%	7,5%	4790
AGRO-FOOD	71,4%	22,9%	1,0%	4,7%	913
ENERGY-INTENSIVE PRODUCTION	67,6%	20,4%	2,5%	9,5%	833
BUSINESS SERVICES	59,7%	28,2%	1,1%	11,0%	1046
CONSTRUCTION	79,4%	14,2%		6,4%	359
TEXTILES	82,7%	9,8%		7,5%	704

Belgium	No public/ private network	Only private network	Only public network	Public/ private network	Obs.
ECONOMY	71,9%	13,0%	3,8%	11,4%	4790
AGRO-FOOD	71,4%	14,1%	8,5%	5,9%	913
ENERGY-INTENSIVE PRODUCTION	67,6%	22,9%		9,5%	833
BUSINESS SERVICES	59,7%	16,8%	4,7%	18,8%	1046
CONSTRUCTION	79,4%	10,6%		10,0%	359
TEXTILES	82,8%	6,4%	0,9%	10,0%	704

Belgium	No national/ international network	Only international network	Only national network	National/ international network	Obs.
ECONOMY	71,1%		9,7%	19,2%	4790
AGRO-FOOD	71,0%		20,8%	8,2%	913
ENERGY-INTENSIVE PRODUCTION	67,7%		4,1%	28,2%	833
BUSINESS SERVICES	58,0%		8,9%	33,1%	1046
CONSTRUCTION	79,4%		8,9%	11,7%	359
TEXTILES	82,7%		4,4%	12,9%	704

Denmark	No internal/ external network	Only external network	Only internal network	Internal/ external network	Obs.
ECONOMY	54,5%	27,9%	3,5%	14,1%	1729
AGRO-FOOD	31,6%	27,2%	14,0%	27,2%	136
CRAFTS	67,4%	24,2%		8,4%	95
CONSTRUCTION	62,2%	22,6%	4,6%	10,5%	389
ENERGY-INTENSIVE PRODUCTION	57,0%	18,7%	14,0%	10,3%	107
INFORMATION and FINANCIAL	78,5%	17,1%	1,3%	3,2%	158
DISTRIBUTION	44,0%	20,0%		36,0%	25

Denmark	No public/ private network	Only private network	Only public network	Public/ private network	Obs.
ECONOMY	54,5%	28,2%	0,9%	16,4%	1729
AGRO-FOOD	31,9%	50,4%		17,8%	136
CRAFTS	67,4%	27,4%		5,3%	95
CONSTRUCTION	62,2%	29,0%	0,5%	8,2%	389
ENERGY-INTENSIVE PRODUCTION	57,0%	39,3%		3,7%	107
INFORMATION and FINANCIAL	79,0%	21,0%			158
DISTRIBUTION	44,0%	36,0%		20,0%	25

Denmark	No national/ international network	Only international network	Only national network	National/ international network	Obs.
ECONOMY	54,4%		0,1%	45,5%	1729
AGRO-FOOD	31,6%			68,4%	136
CRAFTS	68,1%			31,9%	95
CONSTRUCTION	61,7%		0,5%	37,8%	389
ENERGY-INTENSIVE PRODUCTION	57,0%			43,0%	107
INFORMATION and FINANCIAL	79,0%			21,0%	158
DISTRIBUTION	44,0%			56,0%	25

the Netherlands	No internal/ external network	Only external network	Only internal network	Internal/ external network	Obs.
ECONOMY	77,5%	16,5%		6,1%	14190
AGRO-FOOD	79,4%	12,2%		8,4%	936
ENERGY-INTENSIVE PRODUCTION	74,0%	14,5%		11,4%	2970
CONSTRUCTION	79,9%	16,4%		3,7%	4979
INFORMATION and FINANCIAL	77,3%	19,4%		3,3%	2648
TEXTILES	86,1%	9,1%		4,8%	208
PAPER	63,1%	20,5%		16,4%	122
DISTRIBUTION	79,0%	16,5%		4,5%	1136
PUBLIC SERVICES	73,9%	21,0%		5,2%	482

the Netherlands	No public/ private network	Only private network	Only public network	Public/ private network	Obs.
ECONOMY	77,5%	12,3%		10,2%	14190
AGRO-FOOD	79,5%	10,8%		9,7%	936
ENERGY-INTENSIVE PRODUCTION	74,0%	12,8%		13,2%	2970
CONSTRUCTION	79,9%	10,3%		9,8%	4979
INFORMATION and FINANCIAL	77,3%	16,0%		6,7%	2648
TEXTILES	86,1%	7,2%		6,7%	208
PAPER	63,1%	27,0%		9,8%	122
DISTRIBUTION	79,1%	14,9%		6,0%	1136
PUBLIC SERVICES	74,0%	10,4%		15,6%	482

the Netherlands	No national/ international network	Only international network	Only national network	National/ international network	Obs.
ECONOMY	77,5%			22,5%	14190
AGRO-FOOD	79,4%			20,6%	936
ENERGY-INTENSIVE PRODUCTION	74,0%			26,0%	2970
CONSTRUCTION	79,9%			20,1%	4979
INFORMATION and FINANCIAL	77,3%			22,7%	2648
TEXTILES	86,5%			13,5%	208
PAPER	63,1%			36,9%	122
DISTRIBUTION	79,1%			20,9%	1136
PUBLIC SERVICES	73,9%			26,1%	482

the Netherlands*	No internal/ external network	Only external network	Only internal network	Internal/ external network	Obs.
ECONOMY	74,5%	17,0%		8,5%	4939
AGRO-FOOD	66,7%	20,6%		12,7%	520
ENERGY-INTENSIVE PRODUCTION	73,0%	13,5%		13,5%	875
CONSTRUCTION	77,4%	15,9%		6,7%	1987
INFORMATION and FINANCIAL	86,2%	10,2%		3,6%	530
TEXTILES	86,1%	9,1%		4,8%	208
PAPER	63,1%	20,5%		16,4%	122
DISTRIBUTION	69,7%	23,6%		6,7%	386

the Netherlands*	No public/ private network	Only private network	Only public network	Public/ private network	Obs.
ECONOMY	74,5%	12,9%		12,6%	4939
AGRO-FOOD	66,6%	18,0%		15,4%	520
ENERGY-INTENSIVE PRODUCTION	73,0%	14,2%		12,8%	875
CONSTRUCTION	77,4%	10,9%		11,7%	1987
INFORMATION and FINANCIAL	86,1%	7,9%		6,0%	530
TEXTILES	86,1%	7,2%		6,7%	208
PAPER	63,1%	27,0%		9,8%	122
DISTRIBUTION	69,7%	17,9%		12,4%	386

the Netherlands*	No national/ international network	Only international network	Only national network	National/ international network	Obs.
ECONOMY	74,5%			25,5%	4939
AGRO-FOOD	66,7%			33,3%	520
ENERGY-INTENSIVE PRODUCTION	73,0%			27,0%	875
CONSTRUCTION	77,4%			22,6%	1987
INFORMATION and FINANCIAL	86,1%			13,9%	530
TEXTILES	86,5%			13,5%	208
PAPER	63,1%			36,9%	122
DISTRIBUTION	69,7%			30,3%	386

Distribution of knowledge infrastructure over clusters

Belgium	Knowledge infrastructure*	Obs.
ECONOMY	67,7%	4944
AGRO-FOOD	61,7%	930
ENERGY-INTENSIVE PRODUCTION	59,3%	872
BUSINESS SERVICES	75,9%	1083
CONSTRUCTION	73,8%	359
TEXTILES	67,3%	704

Denmark	Knowledge infrastructure*	Obs.
ECONOMY	69,1%	1737
AGRO-FOOD	59,6%	136
CRAFTS	63,2%	95
CONSTRUCTION	56,3%	389
ENERGY-INTENSIVE PRODUCTION	62,4%	109
INFORMATION and FINANCIAL	59,2%	157
DISTRIBUTION	100,0%	25

the Netherlands	Knowledge infrastructure*	Obs.
ECONOMY	36,9%	14474
AGRO-FOOD	41,1%	935
ENERGY-INTENSIVE PRODUCTION	31,6%	3070
CONSTRUCTION	40,7%	5076
INFORMATION and FINANCIAL	30,6%	2713
TEXTILES	52,4%	208
PAPER	79,5%	122
DISTRIBUTION	41,65	1158
PUBLIC SERVICES	33,8%	482

the Netherlands*	Knowledge infrastructure*	Obs.
ECONOMY	64,3%	4974
AGRO-FOOD	63,7%	520
ENERGY-INTENSIVE PRODUCTION	61,4%	875
CONSTRUCTION	65,5%	2009
INFORMATION and FINANCIAL	56,7%	534
TEXTILES	52,4%	208
PAPER	79,5%	122
DISTRIBUTION	81,8%	396

* Public research, private research or consultants

Distribution of innovation networks over clusters

Belgium	Weak network	Equipment only	Supplier & Client	Client & Competitor	Supplier, Competitor & Client	Complete network	Obs.
ECONOMY	13,0%	38,7%	23,5%	6,8%	4,5%	13,5%	4944
AGRO-FOOD	9,3%	43,1%	28,0%	8,2%	0,4%	11,0%	931
ENERGY-INTENSIVE PRODUCTION	13,7%	35,9%	18,9%	3,3%	10,9%	17,2%	871
BUSINESS SERVICES	15,6%	38,3%	20,4%	7,4%	3,0%	15,3%	1083
CONSTRUCTION	15,0%	31,5%	26,5%	9,2%	7,0%	10,9%	359
TEXTILES	4,4%	37,4%	34,4%	12,2%	3,8%	7,8%	704

Denmark	Weak network	Equipment only	Supplier & Client	Client & Competitor	Supplier, Competitor & Client	Complete network	Obs.
ECONOMY	5,5%	32,95	28,4%	11,9%	2,0%	19,2%	1737
AGRO-FOOD	6,7%	38,5%	25,2%	5,2%	6,7%	17,8%	135
CRAFTS	13,7%	12,6%	23,2%	13,7%		36,8%	95
CONSTRUCTION	8,2%	34,4%	26,9%	13,3%	1,8%	15,4%	390
ENERGY-INTENSIVE PRODUCTION	0,9%	28,7%	53,7%	11,1%		5,6%	108
INFORMATION and FINANCIAL		55,4%	29,3%	3,8%		11,5%	157
DISTRIBUTION		38,5%	19,2%	11,5%		30,8%	26

the Netherlands	Weak network	Equipment only	Supplier & Client	Client & Competitor	Supplier, Competitor & Client	Complete network	Obs.
ECONOMY	63,7%	13,1%	10,2%	5,4%	4,6%	2,9%	14474
AGRO-FOOD	53,6%	12,3%	18,5%	5,5%	5,6%	4,6%	935
ENERGY-INTENSIVE PRODUCTION	69,6%	8,3%	8,4%	4,3%	6,3%	3,2%	3069
CONSTRUCTION	61,9%	13,5%	9,3%	6,5%	5,5%	3,4%	5076
INFORMATION and FINANCIAL	68,2%	14,8%	9,0%	4,2%	2,4%	1,5%	2713
TEXTILES	32,9%	11,1%	33,3%	6,3%	12,1%	4,3%	207
PAPER	17,2%	8,2%	42,6%	13,9%	6,6%	11,5%	122
DISTRIBUTION	61,6%	20,7%	9,0%	6,0%	1,4%	1,4%	1157
PUBLIC SERVICES	75,7%	14,3%	1,0%	8,9%			481

the Netherlands*	Weak network	Equipment only	Supplier & Client	Client & Competitor	Supplier, Competitor & Client	Complete network	Obs.
ECONOMY	23,0%	20,0%	26,4%	12,2%	10,1%	8,4%	4974
AGRO-FOOD	29,0%	11,7%	31,2%	9,8%	10,0%	8,3%	520
ENERGY-INTENSIVE PRODUCTION	24,8%	20,4%	25,9%	6,6%	11,4%	10,8%	875
CONSTRUCTION	21,1%	21,5%	20,9%	16,3%	11,7%	8,5%	2009
INFORMATION and FINANCIAL	6,6%	31,1%	38,6%	9,7%	6,9%	7,1%	534
TEXTILES	32,9%	11,1%	33,3%	6,3%	12,1%	4,3%	208
PAPER	17,2%	8,2%	42,6%	13,9%	6,6%	11,5%	122
DISTRIBUTION	32,8%	18,9%	23,0%	17,4%	3,8%	4,0%	396

Appendix V: Linking clusters to the CIS-I NACE-codes

NACE		Belgium		Denmark		the Netherlands	
1	Agriculture, hunting and related service activities		AGRO-FOOD		AGRO-FOOD		AGRO-FOOD
2	Forestry, logging and related service activities	*1*	*Agriculture, hunting and related service activities*	*1*	*Agriculture, hunting and related service activities*	*1*	*Agriculture, hunting and related service activities*
5	Fishing, operation of fish hatcheries and fish farms	*5*	*Fishing, operation of fish hatcheries and fish farms*	15	Manufacture of food products and beverages	*5*	*Fishing, operation of fish hatcheries and fish farms*
10	Mining of coal and lignite	15	Manufacture of food products and beverages	*55*	*Hotels and restaurants*	15	Manufacture of food products and beverages
11	Extraction of crude petroleum and natural gas	19	Tanning and dressing of leather; manufacture of leather products		CRAFTS	19	Tanning and dressing of leather; manufacture of leather products
12	Mining of uranium and thorium ores	*55*	*Hotels and restaurants*	*5*	*Fishing, operation of fish hatcheries and fish farms*	***55***	***Hotels and restaurants***
13	Mining of metal ores	*63*	*Supporting and auxiliary transport activities; activities of travel agencies*	17	Manufacture of textiles	***93***	***Other service activities***
14	Other mining and quarrying		ENERGY-INTENSIVE PRODUCTION	18	Manufacture of wearing apparel, dressing and dying of fur		ENERGY-INTENSIVE PRODUCTION
15	Manufacture of food products and beverages	27	Manufacture of basic metals	19	Tanning and dressing of leather; manufacture of leather products	*11*	*Extraction of crude petroleum and natural gas*
16	Manufacture of tobacco products	28	Manufacture of fabricated metal products, except machinery and equipment n.e.c.		CONSTRUCTION	23	Manufacture of coke, refined petroleum products and nuclear fuel
17	Manufacture of textiles	*37*	*Recycling*	*2*	*Forestry, logging and related service activities*	24	Manufacture of chemicals and chemical products
18	Manufacture of wearing apparel, dressing and dying of fur	*40*	*Electricity, gas, steam and hot water supply*	*14*	*Other mining and quarrying*	25	Manufacture of rubber and plastic products
19	Tanning and dressing of leather; manufacture of leather products		BUSINESS SERVICES	20	Manufacture of wood and products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	27	Manufacture of basic metals
20	Manufacture of wood and products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	21	Manufacture of pulp, paper and paper products	26	Manufacture of other non-metallic mineral products	36	Manufacture of furniture; manufacturing n.e.c.
21	Manufacture of pulp, paper and paper products	24	Manufacture of chemicals and chemical products	27	Manufacture of basic metals	***40***	***Electricity, gas, steam and hot water supply***
22	Publishing, printing and reproduction of recorded media	25	Manufacture of rubber and plastic products	28	Manufacture of fabricated metal products, except machinery and equipment n.e.c.	***51***	***Wholesale trade and commission trade, except of motor vehicles and motor cycles***
23	Manufacture of coke, refined petroleum products and nuclear fuel	29	Manufacture of machinery and equipment n.e.c.	*45*	*Construction*	***62***	***Air transport***
24	Manufacture of chemicals and chemical products	30	Manufacture of office machinery and computers	*52*	*Retail trade, except of motor vehicles and motor cycles; repair of personal and household goods*		CONSTRUCTION
25	Manufacture of rubber and plastic products	*41*	*Collection, purification and distribution of water*	*70*	*Real estate activities*	*14*	*Other mining and quarrying*
26	Manufacture of other non-metallic mineral products	*65*	*Financial intermediation, except insurance and pension funding*		ENERGY-INTENSIVE PRODUCTION	20	Manufacture of wood and products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials

27	Manufacture of basic metals	*66*	*Insurance and pension funding, except compulsory social security*	*10*	*Mining of coal and lignite*	26	Manufacture of other non-metallic mineral products
28	Manufacture of fabricated metal products, except machinery and equipment n.e.c.	*67*	*Activities auxiliary to financial intermediation*	*11*	*Extraction of crude petroleum and natural gas*	28	Manufacture of fabricated metal products, except machinery and equipment n.e.c.
29	Manufacture of machinery and equipment n.e.c.	*72*	*Computer and related activities*	23	Manufacture of coke, refined petroleum products and nuclear fuel	29	Manufacture of machinery and equipment n.e.c.
30	Manufacture of office machinery and computers	*74*	*Other business activities*	25	Manufacture of rubber and plastic products	*37*	*Recycling*
31	Manufacture of electrical machinery and apparatus n.e.c.	*85*	*Health and social work*	*40*	*Electricity, gas, steam and hot water supply*	***45***	***Construction***
32	Manufacture of radio, television and communication equipment and apparatus	CONSTRUCTION		INFORMATION and FINANCIAL		***52***	***Retail trade, except of motor vehicles and motor cycles; repair of personal and household goods***
33	Manufacture of medical, precision and optical instruments, watches and clocks	*14*	*Other mining and quarrying*	21	Manufacture of pulp, paper and paper products	***70***	***Real estate activities***
34	Manufacture of motor vehicles, trailers and semi-trailers	20	Manufacture of wood and products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	22	Publishing, printing and reproduction of recorded media	INFORMATION and FINANCIAL	
35	Manufacture of other transport equipment	26	Manufacture of other non-metallic mineral products	*65*	*Financial intermediation, except insurance and pension funding*	16	Manufacture of tobacco products
36	Manufacture of furniture; manufacturing n.e.c.	34	Manufacture of motor vehicles, trailers and semi-trailers	*66*	*Insurance and pension funding, except compulsory social security*	22	Publishing, printing and reproduction of recorded media
37	Recycling	*45*	*Construction*	*67*	*Activities auxiliary to financial intermediation*	***64***	***Post and telecommunications***
40	Electricity, gas, steam and hot water supply	*50*	*Sale, maintenance and repair of motor vehicles and motorcycles, retail sale of automotive fuel*	*72*	*Computer and related activities*	***65***	***Financial intermediation, except insurance and pension funding***
41	Collection, purification and distribution of water	*51*	*Wholesale trade and commission trade, except of motor vehicles and motor cycles*	*74*	*Other business activities*	***66***	***Insurance and pension funding, except compulsory social security***
45	Construction	*52*	*Retail trade, except of motor vehicles and motor cycles; repair of personal and household goods*	*92*	*Recreational, cultural and sporting activities*	***67***	***Activities auxiliary to financial intermediation***
50	Sale, maintenance and repair of motor vehicles and motorcycles, retail sale of automotive fuel	*60*	*Land transport; transport and pipelines*	DISTRIBUTION		***72***	***Computer and related activities***
51	Wholesale trade and commission trade, except of motor vehicles and motor cycles	*64*	*Post and telecommunications*	35	Manufacture of other transport equipment	***74***	***Other business activities***
52	Retail trade, except of motor vehicles and motor cycles; repair of personal and household goods	*70*	*Real estate activities*	*50*	*Sale, maintenance and repair of motor vehicles and motorcycles, retail sale of automotive fuel*	TEXTILES	
55	Hotels and restaurants	*73*	*Research and development*	*51*	*Wholesale trade and commission trade, except of motor vehicles and motor cycles*	17	Manufacture of textiles
60	Land transport; transport and pipelines	*75*	*Public administration and defence, compulsory social security*	*60*	*Land transport; transport and pipelines*	18	Manufacture of wearing apparel, dressing and dying of fur
61	Water transport	*80*	*Education*	*61*	*Water transport*	PAPER	

62	Air transport
63	Supporting and auxiliary transport activities; activities of travel agencies
64	Post and telecommunications
65	Financial intermediation, except insurance and pension funding
66	Insurance and pension funding, except compulsory social security
67	Activities auxiliary to financial intermediation
70	Real estate activities
71	Renting of machinery and equipment without operator and of personal and household goods
72	Computer and related activities
73	Research and development
74	Other business activities
75	Public administration and defence, compulsory social security
80	Education
85	Health and social work
90	Sewage and refuse disposal, sanitation and similar activities
91	Activities of membership organizations n.e.c.
92	Recreational, cultural and sporting activities
93	Other service activities
95	Private households with employed persons
99	Extra-territorial organizations and bodies

TEXTILES	
17	Manufacture of textiles
18	Manufacture of wearing apparel, dressing and dying of fur

63	*Supporting and auxiliary transport activities; activities of travel agencies*

PUBLIC UTILITIES	
64	*Post and telecommunications*
75	*Public administration and defence, compulsory social security*
85	*Health and social work*
95	*Private households with employed persons*

21	Manufacture of pulp, paper and paper products

DISTRIBUTION	
31	Manufacture of electrical machinery and apparatus n.e.c.
34	Manufacture of motor vehicles, trailers and semi-trailers
35	Manufacture of other transport equipment
50	***Sale, maintenance and repair of motor vehicles and motorcycles, retail sale of automotive fuel***
61	***Water transport***
63	***Supporting and auxiliary transport activities; activities of travel agencies***
71	***Renting of machinery and equipment without operator and of personal and household goods***

PUBLIC SERVICES	
73	***Research and development***
75	***Public administration and defence, compulsory social security***
80	***Education***
85	***Health and social work***
90	***Sewage and refuse disposal, sanitation and similar activities***
91	***Activities of membership organizations n.e.c.***
92	***Recreational, cultural and sporting activities***

Industries and clusters printed in italics are not available in the Community Innovation Survey.
Dutch industries and clusters printed in bold italics are not included in the "Holland*" data set.