

**Report by the Focus Group on:**

**Industrial clusters**

**CLUSTER ANALYSIS & CLUSTER-BASED POLICY  
IN OECD-COUNTRIES**

**VARIOUS APPROACHES, EARLY RESULTS &  
POLICY IMPLICATIONS**

**Draft synthesis report on phase 1 <sup>1</sup>  
OECD-Focus Group on industrial clusters**

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<sup>1</sup> This draft was prepared by Theo Roelandt and Pim den Hertog using the contributions of the focus group members. A full list of the participants of the focus group and the papers prepared for the focus group meetings has published in the Annex of this report. Any comments are welcome.

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## Executive summary

1. *Clusters* can be characterised as being networks of production 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.
2. *Successful and innovative firms are seldom alone.* Innovation and economic growth is often situated within a unique combination of firms tied together by knowledge and production flows. There is a clear trend indicating the *growth of industrial networks*. In the literature Dunning's concept of "*alliance capitalism*" is used to indicate a new stage in the development of modern economic systems: the co-existence of competition, sharpened by globalisation and liberalisation, with an increasing number of network relations and strategic alliances.
3. Networking and clustering has become more important in recent years due to the *changing nature of competition in market-based innovation systems*. For their success in the innovation process, companies are becoming more dependent upon complementary knowledge and know-how in companies other than their own (*interdependency hypothesis*). The synergy stemming from the combination of complementary and dissimilar activities, and the necessity to cope with the dependency upon the environment, are the driving forces behind the development of such co-operative relationships, which increase the innovativeness and competitiveness of all participating parties.
4. *The main principle incentives for alliance and cluster formation* have been to lower transaction costs, to develop new skills, to overcome (or create) entry barriers in markets and to speed up the learning processes. There has been a shift by firms towards disinternalizing activities along and between value chains and towards specialisation on those activities that require resources and capabilities in which firms already have or can easily acquire competitive advantage (*concentrate on critical competency response*). Successful clusters have embedded in the relative competitive advantages and disadvantages of a national system of innovation and should be large enough to capture economies of scale, scope and interdependencies.
5. The rule is that *innovative interactions cross sectoral borders*. Due to this traditional industrial analysis can be criticised for its limited scope. By specifying strict boundaries for industries, the traditional sectoral approach fails to take into account the importance of interconnections and knowledge flows within a network of production. The growth potential can not be analysed by studying separate branches; practically none single sector or firm would succeed without sufficient supporting structures. The cluster approach offers an *alternative* to the traditional *sectoral*

*approach* and is more in line with the changing nature of rivalry in market-based innovation systems as well as with recent insights from modern innovation theory (table 2.2).

6. The *analysis of linkages and interdependence* between actors in a value chain or innovation system can be carried out *at different levels of analysis* (micro, meso and macro; table 2.3 and figures 2.5, 2.6, 2.9, 2.10) and with *different techniques* (i/o-analysis, innovation interactions matrices, graph theory, correspondence analysis, monographic case studies: table 2.4), depending on the needs and questions to be answered. Most countries' cluster analyses concentrate on networks of strongly interdependent firms or industry groups, sometimes focusing on trade linkages, sometimes on innovation linkages, sometimes on knowledge flow linkages and sometimes on a common knowledge base or common factor conditions (table 2.6).
7. Countries' cluster studies have revealed very useful information about the actors involved in clusters, value chain relations of firms, innovation interaction linkages, critical success factors of cluster emergence, mismatches in the institutional setting of clusters innovation systems, systemic imperfections of cluster-based innovation systems and policy options to stimulate the process of upgrading and innovation. In countries that have implemented a comprehensive cluster-based policy, the outcomes of cluster studies have been the corner stone of policy making in this area. Cluster studies not only provide an analytic tool to analyse systems of innovation at the reduced scale level, but in practice can also be used as a working method for policy making and as a development tool for strategic business development.
8. Cluster studies have revealed a need to *redefine the role of the government* as a facilitator of networking, as a catalyst of dynamic comparative advantage and as an institution builder, creating an efficient incentive structure to remove systemic and market inefficiencies in (national) systems of innovation. In most participating countries cluster-based policy initiatives have originated from a trend towards designing governance forms and incentive structures to reduce systemic and market imperfections within their systems of innovation (table 3.2).
9. The *changing role of the state in industrial policy making* coincides with a shift from direct intervention to indirect inducement. In most countries this changed perspective resulted in creating supporting structures, like initiating broker and network agencies and schemes and providing platforms for constructive dialogue and knowledge exchange. Most countries use the cluster approach to organise a *market-led economic development strategy* by initiating dialogue between the various actors in their relevant systems of innovation and fostering knowledge exchange and knowledge transfer.
10. The most common *features of cluster-based policy* are (Table 3.1):
  - (i) a vigorous competition and regulatory reform policy (almost all countries).

- (ii) providing strategic information by technology foresight studies (e.g. Sweden, The Netherlands), cluster studies (e.g. Finland, Denmark, Sweden, The Netherlands, UK, USA, Austria, Italy), special research groups (e.g. Denmark, the Austrian TIP-research programme) or special websites (e.g. like STRATEGIS in Canada).
- (iii) broker and network agencies and schemes (e.g. The Danish network programme, The Dutch Innovation Centres).
- (iv) cluster development programmes (e.g. cluster programmes in Finland and The Netherlands, regional development agencies in UK, USA and Germany and the Flemish R&D-support to clusters).
- (v) initiating joint industry-research centres of excellence (e.g. Belgium, Denmark, Finland, Spain, Sweden, Switzerland and The Netherlands).
- (vi) public procurement policy (e.g. Austria, Denmark and The Netherlands), (vii) institutional renewal in industrial policy making (e.g. Finland and Canada).
- providing platforms for constructive dialogue (e.g. the US focus groups, the Danish reference groups, the Swedish industrial system approach, the UK regional development agencies and the Dutch broker policy, the Finnish National Industrial Strategy).

11. The review of cluster-based policy experiences in the participating countries has identified *pitfalls* which can be used as starting points and *leading policy principles* when designing a comprehensive cluster-based policy:

- (i) the creation of clusters should not be a government-driven effort but should be the result of market-induced and market-led initiatives.
- (ii) government policy should not have a strong orientation towards directly subsidising industries and firms or to limiting the rivalry in the market.
- (iii) government policy should shift from direct intervention to indirect inducement.
- (iv) government should not try to take the direct lead or ownership in cluster initiatives, but basically should work as a *catalyst and broker* that brings actors together and supplies supporting structures and incentives to facilitate the clustering and innovation process.
- (v) cluster policy should not ignore small and emerging clusters; nor should it focus only on ‘classic’ and existing clusters.
- (vi) while cluster policy needs cluster analysis and cluster studies, the government should not focus on analysis alone without action. An effective cluster policy means interaction between researchers, captains of industry, policy-makers and scientists and creating a forum for constructive dialogue.
- (vii) clusters should not be created from “scratch” of declining markets and industries.

# 1. BACKGROUND, COMMON STARTING POINTS AND RESEARCH QUESTIONS

## 1.1 Background

1 This report contributes to the second phase of *the OECD National Systems of Innovation (NSI) Project*. The first phase of the NSI-project particularly looked into measuring and assessing the “knowledge distribution power” of systems of innovation at the national level. Various national case studies were published comparing countries’ NSI, using common indicators on knowledge flows and interactions between actors in the NSI. Early findings were published in an OECD-report on an empirical comparison of national innovation systems (OECD, DSTI/STP/TIP[97]13). In the second phase of the OECD-NSI project various focus groups were formed to conduct in-depth studies of particular aspects of the innovation systems, i.e.:

- (i) institutional linkages,
- (ii) human resource flows,
- (iii) innovative firm behaviour,
- (iv) the innovation systems of developing and “catching up” countries, and
- (v) industrial clusters.

This report summarises the results of the first stage of the work of the OECD focus group on “cluster analysis and cluster-based policy” (CACP).

2 The 1992 OECD TEP-report as well as the experiences during the first phase of the OECD-NSI project clearly showed that our understanding of the functioning of systems of innovation may further improve when analysis takes place at lower levels of aggregation: the (international) networks of production and innovation within a country’s economic structure of production (like the Agro-food cluster, the ICT-cluster, the construction cluster, the services cluster, the metal-electronic cluster and so on). The first stage of the OECD focus group on cluster analysis and cluster policy focuses on reviewing the various approaches on cluster analysis as well as cluster-based policy making in the *participating countries* (Austria, Australia, Belgium, Canada, Denmark, Finland, Germany, Italy, Mexico, The Netherlands, Norway, Spain, Sweden, Switzerland, United Kingdom and the United States of America). This report describes the main findings of the first stage of the CACP focus group work. It reviews:

- (i) the various countries’ *approaches* on cluster analysis, cluster methodologies and cluster concepts,
- (ii) the way cluster studies have been used in *cluster-based policy making* in the various countries,
- (iii) the *rationales* for cluster-based policy and the need for renewal of industrial and technology policy compared to the traditional sectoral approach and
- (iv) similarities and differences in *cluster-based policy instruments* and an assessment of *best practice experiences*.

- 3 Since December 1997 the *second stage* of the research effort of the CACP-focus-group has started. It encompasses:
- (i) assessing the possibilities of developing *a common methodology* to identify clusters and its innovation styles in the participating countries, using a combination of input/output analysis and innovation survey data,
  - (ii) conducting international comparable pilot case studies in the automotive cluster, the ICT-cluster and the Agro-food cluster.
  - (iii) assessing in more detail policy implications and policy instruments and developing a cluster *policy toolbox*.
- The early results of the second stage of this programme will be discussed in the 2nd workshop in Vienna May 4-5 1997 (a joint OECD, Austrian Ministry of Industry and Trade and Dutch Ministry of Economic Affairs workshop). The draft report on the cluster policy tool box will be published Summer 1998 by Technopolis. It is expected that the full draft report on the second stage will be finished at the end of 1998 (October/November)

#### ***Starting points***

4. The first OECD-workshop of the CACP-focus group was held October 10th & 11th 1997 in Amsterdam. The participating countries presented papers reviewing the cluster approach used in their country, paying attention to methodological issues (cluster concept, cluster methodology), empirical results, as well as cluster-based policy making (rationales, policy principles, government roles and policy instruments). This report synthesises and reviews the main findings of this first stage of the CACP focus group research effort.
5. Most of participating countries use some variant of -what we would like to call- the “*interdependency hypothesis*”, stating that the probability of innovations tend to cluster in networks with a high level of forward and backward economic and technological linkages (a dense texture) (for a further explanation, see chapter 2 of this report). The empirical work done in this field seems to support this central hypothesis, like for instance in the work of Chris DeBresson (1996). Most countries’ contributions focus on mutual interdependency and interaction when analysing innovation and have in common their focus on networks of strongly interdependent firms and linkages between business and the knowledge infrastructure (universities, research institutes). This interdependency is in some cases based on trade linkages, sometimes on innovation linkages, sometimes on knowledge flow linkages and sometimes based on a common knowledge base or common factor conditions. This “*interdependency hypothesis*” is the core thesis of the focus group work and has theoretically embedded in the two most essential lessons that can be derived from the literature on innovation systems (Morgan, 1997): (i) interaction and knowledge exchange between different agents in the innovation and value chain, particularly between users and producers and between business and the wider research community play an important role for successfully innovating, and (ii) innovation processes are institutionally shaped and embedded in networks of production and innovation.

6. The following common *starting points* for the focus group work were formulated during the December 11th 1997 (see chapter 2 for further explanation):
- Firms rarely innovate in isolation but in networks of production (OECD, DSTI/STP/TIP[97]13). Most innovative activities involves multiple actors and stems from combining complementary and specialised competencies and knowledge of various actors.
  - The synergy that arises from the combination of complementary knowledge of dissimilar firms and knowledge organisations and the need for firms to cope with the increasing dependency upon their environment are the driving force for the emergence of innovative collaborative agreements and cluster formation;
  - The common theoretical starting point lies within the interactionistic innovation theory and the innovation system approach, stating that innovation basically is an interactive learning process and demands knowledge exchange, interaction and co-operation between various actors in a network of production or value chain;
  - Important innovations stems from “new” combinations of complementary and dissimilar knowledge and competencies.
  - Different types of networks and markets ask for different innovation styles.
  - Cluster initiatives originate from a trend toward governance forms based on networks and partnerships. It coincides with a trend in policy making from direct intervention towards creating mechanisms and incentives of indirect facilitating the networking process. The role of the government needs to be redefined as a facilitator of networking and as a catalyst, broker and institution builder. (Morgan, 1996; Roelandt et al., 1997, Lagendijk & Charles, 1997).
7. Following this line of reasoning the following *working definition* of clusters is used: Clusters can be characterised as being networks of production 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. This implies that innovation is not so much an activity of a single firm; for successfully innovating corporations have become more dependent upon knowledge and know-how in organisations other than their own. In this way the cluster approach is used as a reduced scale model of the NSI-approach. The cluster concept focuses on the linkages and interdependence between actors in the network of production when producing products and services and creating innovations. Compared to the traditional sectoral approach, which focuses on strategic groups of similar firms with similar network positions, the cluster concept offers a new way of looking at the economy and is more in line with the modern and interactionistic innovation theory, with change market developments and with the changing character of market-based capitalism form being hierarchical to alliance in character (Dunning, 1997; Roelandt et al, 1997).

### *1.3. Research Questions*

8. The main goal of the CACP focus group research effort is to gain a better understanding of successful innovative behaviour in various clusters. The following *research questions* will be answered:

- Which clusters can be identified economy-wide?
- How do clusters innovate? What innovation styles are most successful in which cluster?
- How do the same clusters in various countries differ in their economic and innovation performance (“benchmarking”) and what explains the difference in performance?
- What can we learn from that for policy making?
- Which policy instruments have been used in the various countries and what is the role of cluster analysis?
- What are the key instruments and the pitfalls of cluster-based policy making?

This report provides early answers on these questions summarising the findings of stage 1 of the research programme.

## 2. ANALYSING CLUSTER-BASED INNOVATION SYSTEMS

### 2.1 Clusters and the changing nature of market-based innovation systems

1. The *growing attention for cluster analysis* over the past decade reflects the changes in economic theory (interactionistic innovation theory [See the Kline & Rosenberg (1986) model and OECD (1992).], endogenous growth theory [Van Sinderen and Roelandt, 1998], national systems of innovation [Edquist (1997)], as well as the changed nature of rivalry in the market-based economic systems.
2. Up to the mid-1980s economic theory assumed that economic behaviour barely influenced technological renewal (Van Sinderen and Roelandt, 1998). Technology and innovation was treated like ‘*mana from heaven*’ and the linear innovation theory, assuming that innovation was science driven, was unable to provide a sound description or explanation of the actual innovation processes in the market. *Traditionally* innovation was seen as a process of discovery in which new knowledge is transformed into new products via a set of fixed sequences or phases (Smith, 1994). This model has been criticised both in terms of the description of the innovation process as well as the overemphasis placed on R&D.
3. In *modern innovation theory* the strategic behaviour and alliances of firms, as well as the interaction between firms, research institutes, universities and other institutions, are at the heart of the analysis of innovation processes. In the concept of national systems of innovation, as introduced by Freeman (1987) in the mid-1980s and further developed by Lundvall (1992), innovation is considered to be an interactive process. Innovation is seen as a social process that evolves most successfully in a network in which intensive interaction exists between the suppliers and buyers of goods, services, knowledge and technology, including public knowledge infrastructure organisations, such as universities and public knowledge producing agents. Recent research suggests that much upgrading of productive capacity and most innovation is most effectively achieved through networks of interactions between firms, often linked into clusters of activity (Marceau, 1997). To adopt new knowledge often involves close interaction with users and this needs close interaction with suppliers of raw materials and components in networks of production and networks of innovation.
4. The literature on innovation systems has underpinned two essential *dimensions of innovations* (Morgan (1997); Lagendijk & Charles, 1997):
  - (i) The interaction between different agents in the innovation chain, particularly between users and producers of intermediate goods and between business and the wider research community is very important for successfully innovating
  - (ii) Innovation processes are institutionally embedded in the institutional setting of networks of production (clusters).

5. According to modern innovation theory nowadays firms almost never innovate in isolation. Empirical research on CIS-data suggests empirical support for this (Figure 2.1, also see: OECD, DSTI/STP/TIP[97]13). Close interaction and knowledge exchange with customers, suppliers and knowledge producing agents is likely to improve firms' innovativeness (Edquist, 1997). Christian DeBresson (1996) developed - what we would like to call - the "*interdependency hypothesis of innovation*", stating that innovations tend to cluster in economic networks with a high level of forward and backward economic and technological linkages. The economic conditions, like the density of the network of suppliers and users, act as constraints and incentives that make innovative activity more likely in one area than in another. Accordingly competition is not made by single firms, but by networks of dissimilar firms (DeBresson and Amesse, 1991). In this view the probability of innovation strongly depends on the number and variety of supplier and user linkages between firms and industries and between business and knowledge institutes. According to DeBresson (1996) a producer has more incentives to innovate when it serves a variety of user industries and when it uses inputs from a variety of supplying industries. The underlying rationale of this hypothesis is that the variety of information and competencies by dense suppliers and users networks will produce more possibilities to recombine factors. As all innovative outputs need "Neue Kombinationen", it follows that innovative outputs would be more likely when the number of user and producer linkages increases. The central thesis is that the level of innovation performance increases more than proportionately with the number of economic linkages (Figure 2.2). DeBresson (1996) and his associates found significant empirical support for this in such diverse countries as Italy, France and China.
  
6. The Australian case can illustrate the meaning of the interdependency hypothesis and the *importance of dense inter-industry linkages* in the economic structure for innovativeness. The results of input/output analysis for Australia has illustrated that the industrial structure in Australia is extremely patchy, which means that it shows a low level of inter-industry linkages (Marceau, 1997:20). This means that many firms are unable to find partners they need to develop innovative products and processes. As a consequence there is a scarcity of networks of production and innovation (clusters) and networking is not the rule in Australia. Another important reason for not developing clusters is the concentration of economic activity in the hands of only a few players. Industrial activity essentially takes place in vertically integrated large business (most of them being overseas multinationals) and as a consequence innovation takes place in hierarchies rather than in flexible networks or clusters. Marceau pointed out that this can explain the low levels of R&D in Australia as multinationals conduct their R&D "at home". This creates a situation where production and knowledge flows links are not embedded in education, training and research institutions, creating gaps in the innovation networks on which innovative firms depend (Marceau, 1997). This implies that the economic structure is not well embedded in the national knowledge base of the national innovation system.

7. *Why has networking become more important in recent years?* As a result of the increasing liberalisation of world trade and the opening up of sheltered markets, the element of competition becomes more international and more intense (Bergerijk and Mensing, 1997). A firm's competitiveness is becoming more dependent upon the ability to apply new knowledge and technology in products and production processes. Companies must adapt to rapidly changing market conditions or take the lead by innovating their products and production processes in a world where technological developments are taking place at an ever-increasing speed; the same time, the rate of specialisation (through division of labour) is also on the increase (Yoshitomo, 1997). It is becoming increasingly difficult for individual companies to produce all the relevant knowledge themselves and for them to translate new knowledge into innovative products or production processes. To reduce risks and shorten the time to market, companies have to specialise. Consequently, for their success in the innovation process, companies are becoming more dependent upon complementary knowledge and know-how in companies other than their own. Innovation is not so much the activity of a single company (like the 'heroic Schumpeterian entrepreneur'); it requires an active search process to tap new sources of knowledge and technology and to apply them to products and production processes. The synergy stemming from the combination of complementary and dissimilar activities, and the necessity to cope with the dependency upon the environment, are the driving forces behind the development of such co-operative relationships, which increase the innovativeness and competitiveness of all participating parties (Oerlemans, 1997; Porter, 1997).
8. These developments impose great demands on a company's ability *to organise its production process in a flexible way* (Vickery and Wurzburg, 1996). Companies are developing strategies to cope with the increasing dependency upon their environment by a more flexible organisation and the integration of various links in the production chain through entering strategic alliances, joint ventures and consortia. The Technical and Computer Graphics (TCG) in Australia (Marceau, 1997:13-14) and the "Twentse Modulen Group" (TMG) in the Netherlands (Boekholt, 1997) can illustrate the flexibility provided by cluster networks. "In the TCG case one company in the group receives an order. The contracting firm takes charge of the order as a whole. It does not, however, conduct all the work but subcontracts it out to different specialised firms in the group. In this way, one may do the software engineering, one the manufacture of terminals, subcontracting the manufacture of the components to companies outside the group. Another company takes care of any telecommunications elements of the order. The customer only deals with one firm in turn contracts. These groups operate with a minimal of rules and a maximum of flexibility. As a result of its collaborative arrangements, the TCG group is a successful new product developer in the high tech area, linking clients, partner firms and TCG."(Marceau, 1997)
9. The process of division of labour between dissimilar and complementary firms is based on the strategic choice firms have to make between internalising technical knowledge or sharing information with external actors (Richardson, 1972). In this choice a decisive role is played by the *transaction costs* of internal and external

organisation and the costs of acquiring knowledge and technology (Pfeffer, 1972; Williamson, 1975; Pfeffer and Salancik, 1978; Roelandt et al, 1997; Soulié, 1980). Advantages of internalisation include the reduction of uncertainty and dependency upon external players. If a specific activity does not fit well into a firm's own technological basis, high costs will arise from the need to build up the necessary knowledge. New technologies require the adaptation of existing routines, the re-education of personnel, the establishment of cumulative learning processes and economies of scale; a process which specialised suppliers have already gone through. The difference between the transaction costs of internal and external organisation will settle the choice whether or not to internalise. To organise new combinations of complementary competencies in a flexible way there is a range of intermediate technological strategies available, such as strategic alliances, joint ventures, consortia or even informal network relations. Companies tend to concentrate upon a few core activities; activities which do not fit well into their own comparative advantages and technological competencies are outsourced to specialised suppliers (Dunning, 1997; see Van den Hove & Roelandt, 1998 for empirical support). By concentrating upon a few core activities, employees learn specific knowledge, skills and competencies. This makes them more suitable for these main activities and less suitable for all kinds of complementary functions in the production process that are too far removed from their core knowledge base. Thus production and innovation is not the individual activity of one company, but requires the combined action of several companies, each of which is specialised in specific combinations of skills, technology and competencies.

10. *Successful and innovative firms are seldom alone.* Innovation and economic growth is often situated within a unique combination of firms tied together by knowledge and production flows (Rouvinen & Ylä-Anttila, 1997:20). The typical features of clusters are:

- numerous interconnections between firms,
- the existence of technological spill overs and externalities,
- interaction and interplay among participants.

The main idea is that a cluster is better equipped to succeed in the market than an isolated company.

11. According to several researchers, over the past decade the *principle incentive for alliance formation* have been to lower transaction costs, develop new skills and overcome (or create!) entry barriers in markets. (Dunning, 1997:74). Hagendoorn (1993) pointed out that, according to the research undertaken by MERIT, the main goals of most strategic alliances has been to gain access to new and complementary knowledge and to speed up the learning processes. There has been a shift by firms towards disinternalizing activities along and between value chains and towards specialisation on those activities that require resources and capabilities in which firms already have or can easily acquire competitive advantage. Dunning calls this the *concentrate on critical competency response* (Dunning, 1997:75)

12. This disinternalisation is often replaced by controlled *inter-firm co-operative arrangements*. Such agreements are particularly noticeable between firms and their subcontractors (Hagendoorn, 1993). One evident effect is the change in subcontractor relationships (Boekholt, 1997; Roelandt et al, 1997): contractors require higher quality, more flexibility and more complex products from their suppliers. Co-operation with other firms and forming a network can offer:
- more channels for learning and creating expertise,
  - economies of scale,
  - economies of scope (combined expertise can open new market niches for high value added products), and
  - more flexibility and shared risk.
13. There is a clear trend indicating the growth of industrial networks (Dunning, 1997: 79). And this growing significance of inter-firm partnering and of networking is demanding a re-examination of traditional approaches. In the literature the concept of “*alliance capitalism*” (Dunning, 1997; Meeuwssen and Dumont, 1997) is used to indicate this new stage in the development of modern economic systems: the co-existence of competition, sharpened by globalisation and liberalisation, with an increasing number of network relations and strategic alliances. According to Dunning (1997: 112) market-based capitalism is moving from being hierarchical to alliance in character. As a consequence, organisations are becoming more interdependent of each other and there is a growing complementary and specialisation between them.
14. The main *principle incentives for cluster formation and for creating cross-border strategic alliances* are (Dunning, 1997; Boekholt, 1997; Porter, 1997; Hagendoorn, 1993):
- (i) to gain access to new and complementary technology,
  - (ii) to capture economics of synergy or economies of interdependent activities,
  - (iii) to spread risks,
  - (iv) to promote joint R&D efforts with suppliers and users,
  - (v) as a defensive strategy to reduce competition,
  - (iv) to obtain reciprocal benefits from the combined use of complementary assets and knowledge,
  - (v) to speed up the learning process,
  - (vi) to lower transaction costs, and
  - (vii) to overcome (or to create) entry barriers in markets.
15. Reve and Mathiesen (1994: 119-125) summarised the main *critical success factors of cluster emergence*, based on the large number of cluster studies conducted in Finland (Table 2.1). Successful clusters have embedded in the relative competitive advantaged and disadvantages of a national system of innovation and should be large enough to capture economies of scale and scope. Cluster studies in Finland also have shown that demanding customers are the key source of initiating innovation and developing competitive advantage. Advanced suppliers and competitive subcontractors can be the

major source of innovations and allow firms to concentrate on their core competencies. There is no saturation level to clusters' innovativeness; developing economic strengths demand for continuous knowledge development and flexible organisation. Existing strengths will be lost if upgrading strategies stop.

16. According to Peneder and Warta (1997) the cluster hypothesis suggests, that dense economic structures (i.e. the agglomeration of economic activity) may cause improved technological or economic performance of the units engaged (Hutschenreiter, 1994). In a way this cluster hypothesis goes back to Alfred Marshall's work (1890) on explaining the development of industrial complexes by existence of *positive externalities* within agglomerations of interrelated firms and industries. These externalities may come from three sources: 1. pooled labour force for specialised skills, 2. specialised inputs and services from supporting industries, 3. knowledge spill overs between firms. It brings in the idea of inter-relatedness as a source of specialisation in industrial production. Basically the interdependency hypothesis points at the existence of dynamic complementarity within a system of innovation. Innovation in one part of the system exerts impulses for innovation and growth in other parts. Basically, the Austrian, Danish, Dutch, Swedish, American and Finish approach in cluster analysis and cluster-based policy were basically driven by this "dependency hypothesis" (to be discussed later in this chapter).
17. Figure 2.3, adopted from DeBresson & Hu (1997), illustrates that *innovative interactions cross sectoral borders*. In his pioneer work DeBresson (1996) estimates "innovation interactions matrices", indicating the number of direct inter-sectoral interactions when innovating. The figure represents the innovative interactions between industries in the Lombardy region, next to the exchange of goods and services. In some cases innovative interactions exist between two industries with low levels of exchange of goods, like for instance the linkages between Food and Machinery, between Machinery and Textiles and between Machinery and Vehicles. The chemicals industry innovates with the transport-equipment and Machinery industries; the wood and rubber industry innovates with the transport-equipment industry. In all these cases, innovative interactions occur locally without very strong trade linkages. The figure also illustrates a central clique of innovative activity within Lombardy, consisting of chemicals, wood & rubber and machinery. It reveals the presence of a clique of innovative interactions and productive interdependency by chemicals, wood/rubber and machinery. "The industries of this innovative clique also individually interact innovatively as suppliers with the transport-equipment, textiles, paper, energy and food industries." (DeBresson & Hu, 1997: 30).
18. The changed character of market-based innovation systems challenges the *traditional line of reasoning* in economic research primarily analysing horizontal relations between competing firms with similar activities and focusing on price competition, entry barriers and the individual firm or sectors (Roelandt et al, 1997). There is no actual trade off between competition (policy) and co-operation (policy). The question is not whether to compete or to cooperate, but - following Enright's analysis (1995),

rather on what dimensions to compete and on what dimensions to cooperate. A firm's competitiveness depends very much upon the ability to participate in strategic networks. Inter-firm co-operation and competition coincide. For policy makers this implies that a cluster-based policy should always include a vigorous competition policy.

19. The cluster approach offers an *alternative* to the traditional *sectoral approach*; it offers another way of looking at the economy and another way of looking at innovations. To say it simple, the *sectoral approach* focuses on *horizontal relations and competitive interdependence* (relations between direct competitors with similar activities and operating in the same product markets) and the cluster approach in addition focuses at the importance of vertical relationships between dissimilar firms and *symbiotic interdependence based on synergism*. (Pfeffer and Salancik, 1978). Indeed, innovations are strongly stimulated by the *horizontal struggle* between competitors operating on the same product markets, but *vertical relations* between suppliers, main producers and users are also very important for creating innovations. Traditional industrial analysis can be criticised for its limited scope (Rouvinen & Ylä-Anttila, 1997: 20). By specifying strict boundaries for industries (mostly based on some statistical convention), research fails to take into account the importance of interconnections and knowledge flows within a network of production. The growth potential can not be analysed by studying separate branches as was illustrated in Figure 2.3; practically none single sector or firm would succeed without sufficient supporting structures.
20. Table 2.2, adopted with changes from Porter's work (1997), summarises the main *differences between the traditional sectoral approach and the cluster-based approach* which is more in line with recent insights from innovation theory as well as with the changing character of rivalry in the market. The concept of networking and clusters implies redefining the role of governments in industrial policy making (Morgan, 1996): the main task of the policy maker is to facilitate the networking process and to create an institutional setting which provides incentives for market-induced cluster formation (policy implications will be further discussed in section 3).

## 2.2 Cluster studies and methodologies

21. As indicated in the previous section interaction between the various agents in networks of production and innovation as well as interdependency of complementary competencies and knowledge play an important role in defining a cluster (Dreijer, 1997). *Clusters can be characterised* as being networks of production 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 concept focuses on the linkages and interdependence between actors in the network of production when producing products and services and creating innovations.

### ***Methodological issues: the scope of cluster analysis***

22. The *analysis of linkages and interdependence* between actors in a value chain or innovation system can be carried out *at different levels of analysis* (Table 2.3) and with *different techniques*, depending on the needs and questions to be answered. Table 2.4 summarises the various cluster methodologies adopted in the participating countries.
23. Some studies focus on the *firm level* and analyse the competitiveness of a *network of suppliers around a core enterprise*. This kind of analysis is used to make a strategic analysis of the firm and to identify missing links or strategic partners when innovation projects encompass the whole chain of production. In this case, cluster analysis is directly linked to action and strategic business development. Other contributions concentrate at the *meso-level*, mostly conducting some kind of SWOT- or benchmark analysis at the level interrelated branches in a value chain. In a way, most of the Porter studies carried out in different countries (Finland, Sweden, USA, Denmark, the Netherlands) use this level of analysis. And finally some countries' contributions focus on linkages within and between *industry groups* (mega-clusters, like for instance Finland and The Netherlands), mapping specialisation patterns of a country or region economy-wide.
24. Next to the level of analysis cluster methodologies differ in the various use of techniques. In the participating countries four categories of *research techniques* have been used:
- *input-output analysis* focusing on trade linkages between industry groups in the value chains of the economy (like the American, Dutch and Norwegian contribution),
  - *graph analysis* founded in the graph theory and identifying cliques and other types of network linkages between firms or industry groups (Belgium, DeBresson & Hu, 1997),
  - the third category is *correspondence analysis* (like for instance factor analysis, principal components analysis, multi-dimensional scaling and canonical correlation). Basically, all these techniques aim at identifying groups or categories of firms or industries with *similar innovation styles* (like the German and Swiss contribution).
  - And finally, the qualitative case study approach like the Porter studies conducted in the various countries (for example in Finland, Sweden, Denmark, Italy and the Netherlands).
25. Most countries use a combination of different techniques at different levels of aggregation (Table 2.4). Basically most countries combine various techniques to overcome the limitations and methodological problems of using one single technique. The various techniques complement each other: different methodologies answer different questions and provide different sorts of information. Most of the countries'

contributions have in common that they are *on networks of strongly interdependent firms or industry groups*,

- in some cases based on *trade linkages* (Haukness, 1998; Roelandt et al, 1997; Bergman & Feser, 1997),
- sometimes on *innovation linkages* (DeBresson & Hu, 1997),
- sometimes on *knowledge flows linkages* (Viori, 1995; Poti, 1997; Roelandt et al., 1997; Van den Hove and Roelandt, 1997), and
- sometimes based on a *common knowledge base or common factor conditions* (Dreijer et al, 1997).

Nevertheless, the common starting point of all these approaches is the assumption that firms need a network of suppliers, customers and knowledge producing agents to innovate successfully.

26. A clear distinction should be made between approaches focusing on linkages between (dissimilar) actors in networks or value chains and the traditional statistical cluster techniques detecting objects with similar characteristics (cluster analysis in the traditional statistical sense) (Meeuwssen & Dumont, 1997). The latter category of techniques can be used to identify *different styles of innovations* and *different styles of division of labour* when innovating. Some countries, like Switzerland and Germany, focus on this element, assessing categories of firms having the same type of innovation styles, knowledge sources and knowledge transfer mechanisms and identifying success factors for innovation. (Vock, 1997; Arvanitis and Hollenstein, 1997; Spielkamp and Vopel, 1997) Although this latter approach fundamentally differs from the value chain approach, both methodologies can be combined. The first group of techniques can be used to identifying network linkages of production or innovation (using input output tables or innovation interaction matrices) and the latter group of techniques can be used to identify innovation styles within and between the clusters as defined in this study.

27. Next to statistical analysis, many case studies have been conducted in the participating countries (United States, Finland, Sweden, Denmark, Italy, The Netherlands), mostly using Porter's diamond and his network approach as a framework for analysing the competitiveness of the local production structure. In most countries these *monographic cluster case studies* have been complemented with statistical analysis. Case study material can provide more in-depth information and can be used to interpret the structures resulting from statistical analysis. Table 2.5 summarises the major advantages and disadvantages of monographic case studies (Roelandt et al, 1997).

#### ***Drawbacks and advantages of cluster analysis***

28. *At the international level* the comparison of national cluster studies suffer from a lot of methodological bottlenecks and complications. The second phase of the focus group project will produce some pilot studies to assess the possibilities to overcome these methodological bottlenecks. Due to these methodological complications most

countries cluster studies (quantitative as well as qualitative) are hard to compare internationally. The countries experiences with cluster analysis revealed the following methodological bottle-necks:

29. The use of official and existing national and international *data sources* for cluster analysis is limited by conventions on official classification systems of economic activities and industries. Most of these sources have not been designed to cover flow relations between different industries (Pender & Warta, 1997) and to measure the dynamic interactions and linkages between industries and firms. Some countries (especially Denmark, Canada and Finland) decided to improve the statistical information on clusters by establishing statistical groups and research teams to produce data in line with the needs of cluster analysis and cluster-based policy (Dreijer et al, 1997; Sulzenko, 1997). Some countries would like to follow these line of improving statistics for cluster analysis (Belgium, Sweden, The Netherlands).
30. Using *input-output tables* for identifying clusters or technology flows has considerable methodological limitations (also, see: Dreijer et al, 1997). For identifying networks of production the level of aggregation of the i/o-tables is very decisive and cluster analysis needs data at very low levels of aggregation (at least a 3 or 4 digit industry code level). Some countries (like Canada, Denmark, US and the Netherlands) have very detailed and useful input-output tables (and make- and use-tables at product level); other countries only have tables available at a relatively high level of aggregation (2 digit) (like Spain and Germany) and another group of countries have severe data shortages in this field (like for instance Belgium, Switzerland, Sweden, Austria). The official OECD I/O-database, containing i/o-tables for OECD-countries, has a much too aggregated level for conducting international comparable cluster analysis. Countries that do have access to very detailed input-output tables experienced that they can produce stable and useful results when identifying networks of production and innovation. Countries with severe data problems are looking for possibilities to improve their i/o-data sources (like for instance Belgium, Germany, Sweden).
31. The use of *innovation interaction matrixes*, describing the flows of innovations from suppliers to users, is promising but limited to the flows of the major innovations of using and supplying industries. The main advantage of using these tables is their focus on actual innovation interdependency and actual interaction between industry groups when innovating. These tables also suffer from the relatively high level of aggregation. In the future the availability of this kind of data might be improved if questions about the main users and producers of innovations would be added to the questionnaire of the Community Innovation Survey (CIS) of Eurostat.
32. Next to statistical analysis most countries combine their statistical cluster analysis with qualitative and *monographic cluster case studies* (partly to meet the limitations of statistical analysis and available data sources). One of the major disadvantages of case studies is that the approach is intrinsically qualitative. A quantitative approach is

needed to really map production relations, innovative networks and clusters of economic activity. Combining the more qualitative cluster studies with, input-output analysis, can reinforce each other considerably. The dynamics in the clusters identified statistically can only be interpreted sensibly if it is combined with more qualitative insights gained by performing monographic case studies. The major advantages and disadvantages of monographic case studies are given in Table 2.5

33. A final complication of internationally comparing the same clusters in different countries comes from the *changing specialisation patterns world-wide*. The OECD study on comparing national systems of innovations (OECD, 1997) clearly indicated a trend towards growing specialisation between OECD-countries, also between the same industry groups and the same clusters of different countries. This implies that the growing importance of networking between dissimilar and complementary firms with different specialisation patterns we discussed earlier has an important international dimension. As a consequence, the innovation systems and specialisation patterns of the same clusters (operating in value chains producing products and services for the same end product markets) within different countries can differ a lot in institutional setting and innovation performance, which makes identifying “best practices” or “optimal incentive structures in innovation systems” hard to assess. International comparative research in this field can reveal the critical factors of these diverging strategies.

34. *At the national level cluster studies have revealed* -among others -useful information about the actors involved in clusters, value chain relations of firms, innovation interaction linkages, critical factors and mismatches in the institutional setting of clusters’ innovation systems, systemic imperfections of cluster-based innovation systems, common framework conditions, policy options to stimulate the process of upgrading and innovation and critical success factors of cluster emergence. In countries that have implemented a comprehensive cluster-based policy, the outcomes of cluster studies have been the corner stone of policy making in this. Cluster studies not only provide an analytic tool to analyse systems of innovation at the reduced scale level of networks, but in practice can also be used as a working method for policy making in this area and as an economic development tool for strategic business development. (see Chapter 3 for further explanation of the policy use of cluster studies).

35. Reviewing the various countries’ cluster analyses also reveals the *benefits of using cluster analysis* (Dreijer et al, 1997; Roelandt et al, 1997; Porter, 1997; Rouvinen and Ylä-Antilla, 1997; DeBresson, 1996; DeBresson & Hu, 1997):

- It offers a new way of thinking about the economy and organising economic development efforts and it is a useful alternative for the limitations of the traditional sectoral analysis,
- Cluster analysis has better aligned with the changed nature of competition and market-based innovation systems and the main sources of competitive advantage. Cluster analysis capture important linkages in terms of technology, skills, information,

marketing and customer needs that cut across firms and industries, Such linkages and interdependencies are fundamental to competition and, especially, to the direction and pace of innovation.

- Cluster studies have improved the understanding of innovation systems at a reduced scale level, including systemic imperfections and policy options. Cluster studies have revealed information about value chain relations of firms, innovation interaction linkages, critical factors and mismatches in the institutional setting of clusters' innovation systems, systemic imperfections of cluster-based innovation systems, common framework conditions, policy options to stimulate the process of upgrading and innovation and critical success factors of cluster emergence.
- Cluster studies have been the corner stone of industrial policy making in a lot of countries. Cluster studies not only provide an analytic tool to analyse systems of innovation, but can also be used as a working method for policy making in this area and as an economic development tool for strategic business development, in industrialised countries as well as in developing countries (see the UNIDO cluster approach).
- Cluster analysis provides options for recasting the role of the private sector, government, trade associations and educational and research institutions and brings together business development opportunities of firms of all sizes and across traditional industry lines.
- Cluster analysis provides a starting point for creating a forum for constructive business-government dialogue. Not only common problems have been identified, but basically cluster analyses identify common development opportunities and highlights attractive public and private investment opportunities.

### 2.3 *Some countries' experiences in cluster analysis*

36. Table 2.6 summarises the various *clusters identified in the participating countries*. Due to the lack of a common OECD cluster-analysis methodology up to now, the table should be interpreted with care when comparing countries' cluster maps internationally (see above). The second phase of the OECD focus group work is concentrating on assessing possibilities for a common methodology and some pilot studies adopting a common methodology are under construction.

#### ***Denmark***<sup>2</sup>

37. Cluster studies have been the corner stone in Danish industrial policy making since the early 1980s (Dreijer et al, 1997). In Denmark cluster studies started in the early 1980s with industrial complex studies assessing the strengths and weaknesses of the Danish economic structure. The general idea was that linkages between users and suppliers of products and technology are crucial for innovation and the use and diffusion of new technology. The notion of industrial complexes goes back to Marshall's analysis of industrial districts in 1890. In the Danish case the concept of

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<sup>2</sup> Draws heavily on Dreijer et al, 1997.

industrial complexes was theoretically founded in Dahmén's (1988) "development blocks" concept and was defined as groups of industries linked to each other through important transactions of goods and services, according to supply and demand linkages in the structure of production. The industrial complex studies (for Agro-food, textile, environment and office machinery) focused on the development and diffusion of new technology, particularly on the use of micro electronics (Table 2.7)

38. The industrial complex analysis basically focused on producer-user interdependence in terms of trade and technology flows. Recently in Danish cluster analysis there is a clear shift towards analysing clusters in terms of production and innovation linkages as well as comparable "framework conditions", the so-called "resource areas". Resource areas can be characterised as a group of firms in various sectors which are strongly interdependent when innovating and which have common needs in terms of factor conditions.
39. The industrial complex studies of Danish clusters can be seen as the "forerunners" of the Resource Areas introduced in 1993 and have been a reference point when developing the resource areas. The most important source are the Danish Porter studies and the dialogue between representatives of firms, organisations, public institutions and ministries, using various cluster studies as an input. The qualitative Porter studies focused on the value chain relations of the firms, the institutional setting, the firm's surroundings and the firm itself. The Danish Porter exercise resulted in identifying five highly competitive clusters in the Danish economy (Agro-food, shipping, technical, pharmaceutical/biotech and medical technology, mink). The present (politically) identified resource areas result from an intensive dialogue between the government, firms and other relevant organisations, using cluster studies as their main input. The dialogue is an ongoing process which makes the content of the resource areas flexible to changed market conditions. A statistical group was established to produce statistics for the eight areas (Food, consumer goods and leisure, construction, communication, transport, health and general supplier business). A resource area is a broad range of products and services and is made up of industry groups/sectors that are mutually dependent, have the same needs in terms of factor conditions. The resource areas covers the entire Danish economy and are organised around a common knowledge base and the interdependence and need for common policy conditions. The selected areas are to some extent based on cluster studies but at the end the composition of the areas is a result of an interactive consultation and decision making process.

### ***Finland***<sup>3</sup>

40. Vuori (1995) identified four main clusters in the Finnish economy: the forestry, telecommunications, base metals and the energy cluster. Each cluster consists of core industries, which are the most central ones for the cluster, and related and supporting

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<sup>3</sup> Draws heavily on Rouvinen and Ylä-Antilla, 1997.

industries, which are technologically important for the cluster. The various industries in the clusters are connected technologically as well on the base of trade linkages.

41. Finland is one of the countries which conducted extended and comprehensive cluster studies to analyse the strength and weaknesses of the economic structure and identifying opportunities to shift the economic structure towards more knowledge intensive economic activities (Rouvinen, 1996). The cluster approach has been adopted arguing that the traditional industrial analysis had a too limited scope. It was argued that the traditional industrial analyses, by specifying too strict boundaries for industries and markets; simply fail to take into account the importance of interconnections and dependency across industry groups and knowledge flows that are typical for networks of production and innovation. In Finland a variant of Porter's model has been used (see Figure 2.4). The outcomes of the Finnish cluster studies have been used for industrial policy making purposes.

42. Figure 2.5 maps the existing cluster in Finland:

- Forestry cluster: strong competitive position and steadily growing.
- Base metal cluster: semi strong and steadily growing.
- Telecommunication cluster (potential and rapidly growing).
- Well-being cluster (potential, good but volatile growth prospects).
- Environmental cluster: potential, good growth perspectives.
- Transport cluster (potential, two-sided development: some companies are quite competitive, others are fading away).
- Chemical cluster: most important supplier of intermediary inputs for other industries especially forest and construction
- Construction cluster (defensive)
- Foodstuff cluster (defensive)

43. The telecommunications cluster (Figure 2.6), well-being and environmental clusters are on the fast growing markets and has potential for further expansion. It is believed that telecommunications cluster will become one of the cornerstones of the Finnish economy in the future and as a consequence public investment in the telecommunications industry have been remarkable. TEKES, a state-owned fund for technological development, has focused on telecommunications technology in the recent years and universities and other public organisations have directed resources to this cluster as well. Around the telecommunication equipment industry, there has developed a group of subcontractors providing the industry with advanced speciality inputs.

### *Sweden*<sup>4</sup>

46. Sweden has a long standing tradition in cluster studies, analysing the dynamic interdependencies between firms and knowledge institutions (Stenberg and Strandell,

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<sup>4</sup> Draws heavily on Stenberg and Strandell, 1997.

1997). As a consequence in the last decades research and technology policy in Sweden basically has focused on stimulating the formation of competitive network relations within the economic structure. Erik Dahmen is the most influential scholar of industrial dynamics in Sweden and introduced the concept of “development blocks” in the 1950s. In the late 1980s the concept of technological systems was introduced to make the policy implications of Dahmen’s development block approach more explicit by emphasising on the aspect of inter-organisation relations when developing technological competencies. Technological systems are defined as network of agents, interacting in a specific technology area under a particular infrastructure to generate, diffuse and utilise technology. In Sweden the cluster concept was introduced in connection with the number of studies performed in the late 1980s and early 1990s according to Porter’s model. Sweden was one the countries participating in the international comparative study directed by Michael Porter in his *Competitive Advantage of Nations*.

#### ***Belgium (Flanders)*** <sup>5</sup>

47. In Belgium (Flanders) the attention for cluster analysis and cluster-based policy is growing and of recent date. Recently VTO published some studies on Flemish innovation systems and cluster-based innovation systems. In Belgium the adopted cluster approach refers to various agents, institutions and elements of the Flemish innovation system. Some of the cluster studies and cluster platforms explicitly aim at stimulating cross-sectoral technology diffusion and adoption, while others aim at supporting supplier-user networks or to create centres of excellence in newly emerging technologies. The Flemish cluster approach stresses the complementarities between sectors and focus on cross-sectoral specialisation patterns.

#### ***United States of America*** <sup>6</sup>

48. In the U.S.A the cluster approach has been used as an economic development tool at the regional level (Held, 1996). In the U.S.A cluster-based policy refers to actively organising dialogue and interaction between firms across sectors, the local knowledge infrastructure and regional development agencies in “focus groups”. Policy making is an highly interactive process and the focus is on analysing strength and weaknesses of the local economic structure and knowledge infrastructure and identifying business development opportunities (In chapter 3 we will elaborate the policy issue and come back to the American experience). Cluster studies have been used in the development of regional development strategies that attempt to foster and leverage inter-industry synergies and are used as input in the consultation process at the regional level. Cluster analysis focuses on knowledge and value chain linkages in the local economic structure using input-output analysis as well as insight business information.

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<sup>5</sup> Draws heavily on Debackere, 1997.

<sup>6</sup> Draws on Held (1996), Bergman & Feser (1997), Sweeney and Feser (1997), Feser and Bergman (1997), Porter (1997).

49. Figure 2.7 presents the cluster map for the U.S.A and is adopted from Porter (1997). Feser and Bergman (1997), identified a set of twenty-three US manufacturing clusters analysing national inter-industry linkages from national input-output tables.<sup>7</sup> These clusters consists of heavy manufacturing (e.g. metal working, vehicle manufacturing, chemicals and rubber, non-ferrous metals), light manufacturing (e.g. electronics and computers, knitted goods, fabricated textiles, wood products, leather goods, printing and publishing), five separate food-related clusters and several clusters closely related to other major clusters. The results highlight that most clusters are composed of a variety of 2-digit level SIC industries and crosses traditional sectoral *borders*. Besides clusters sometimes include multiple final market product chains, whereas smaller clusters (like tobacco, dairy products and meat products generally encompass only a single major final market product chain.

### ***United Kingdom***<sup>8</sup>

50. The cluster approach in the U.K. has much in common with the U.S.-approach. In the U.K. at the regional level clusters have been initiated by the establishment of a kind of forums: regular meetings of the firms and organisations related to a particular industry in the value chain (see further in chapter 3). In the U.K. the cluster approach is used as an economic development tool bringing together actors and organisations and fostering interaction and knowledge transfer. According to Lagendijk and Charles (1997) clusters can increase the “absorptive capacity” of the regional economy by linking together regional actors which facilitate strategic investment and developing business opportunities in the regional economy. In the UK cluster analysis is directly linked to action for developing regional economies. As a consequence cluster analysis concentrates on cluster based studies focusing on identifying actors and development opportunities for the region which can be used by regional development agencies (like for instance in the Scottish Enterprise cluster approach in Figure 2.8).

### ***The Netherlands***<sup>9</sup>

51. A whole range of empirical cluster analyses of the Dutch industrial structure has been conducted since the mid-1980s. Although there are various methods of identifying clusters, two main types are practised in the Netherlands, i.e. monographic case studies (mainly based on Porter’s diamond) and input-output analysis aiming to identify inter-linkages and knowledge flows between industry groups. In the Netherlands the cluster concept based on complementarity and interdependence in production relations, has become quite pervasive over the last decade, and cluster analyses have gained in popularity. In the Netherlands - as in various other countries - this process was especially fuelled by the publication in 1990 of Porter’s *Competitive Advantage of Nations*.

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<sup>7</sup> This section draws heavily on Feser and Bergman (1997)

<sup>8</sup> Draws heavily on Lagendijk and Charles (1997).

<sup>9</sup> Draws heavily on Roelandt, Den Hertog, Van Sinderen and Vollaard (1997).

52. In 1990 a cluster review study was published, adopting Porter's model to the situation in the Netherlands. This work yielded several new insights into the strength of the Dutch economy in a number of relatively small industry groups where technological upgrading and the quality of the network of supplying and supporting industries play an important role (cut flowers, yacht building, cocoa, construction). It also revealed the depth and breadth of network formation in Dutch agriculture and industry. This first Porter study for the Netherlands initiated many research projects (about 60) in which traditional sectoral studies were gradually replaced by cluster studies focusing on competitive strengths.
53. Over the years the character of these cluster studies has undergone an enormous change. At first the studies could be labelled as analytical devices to gain a better insight into the competitive strengths of individual clusters. Gradually, the analyses served (at the meso level) as a starting point for more strategic advice on:
- how to make individual clusters more competitive;
  - identifying important knowledge issues;
  - designing upgrading strategies, and
  - how to turn negative competitive dynamics into strategic co-operation and differentiation-based competition .
54. Subsequently the cluster studies increasingly served as an input to both macro and micro-level issues. At the macro level, for instance, it was used as an input in discussions on industrial and innovation policy-making and on how to improve the (mis)match between the public research institutions and higher education institutions and industry. At micro-level, cluster studies provided a basis for initiating and supporting innovative micro-level cluster projects aiming to increase co-operation between major companies, their (main) suppliers, (semi-) public knowledge institutes, as well as various other bridging institution (e.g. engineering companies, innovation centres and so on).
55. The input-output analyses from the Netherlands identified twelve conglomerates of inter-linked industry groups (mega clusters) in the Dutch production structure (Figure 2.9). This study revealed that the classification of economic activities into clusters differs clearly from traditional sector classifications. The identified clusters cross the borders of traditional sectors. There is no longer a clear distinction between primary, secondary and tertiary industries, but rather a mixture of industry groups in each cluster (see Roelandt et al for further details).
56. The importance of the cluster commercial services for the Dutch economy is shown by its relatively high contribution to the national product (nearly 30 per cent). From the viewpoint of employment, the two services cluster are of great importance as well: about 50 per cent of the total working population is employed in these two clusters. A recent development in the economy of the Netherlands, the rapid rise of media-related activities, was deduced from the results. A media cluster has been identified, and

interdependence is growing between the media cluster and the communication industries in the ports, transport and communication cluster. The manufacturing clusters and the chemical industries cluster are strongly dependent upon the activities of specialised suppliers abroad. These two latter clusters mainly produce for foreign markets together with the transport, port and communication cluster and the cluster Agro-food. The clusters around health and non-commercial services focus relatively strongly on consumer markets. Although to a lesser extent this also applies to the media cluster.

57. In a sense, the Dutch cluster map has a more or less paradoxical character. On the one hand a cluster is a closely knit framework of trade linkages among industry groups around a core economic activity (e.g. the erection of buildings, the production of machinery, chemicals, multi-media products, etc.). The industry groups within a cluster have specialised around the primary production processes and the core knowledge base within the cluster. On the other hand there is a clear division of labour between clusters. Those activities that do not fit in the knowledge base of a cluster and which are too far removed from the core competencies and activities within a cluster are outsourced to external and specialised suppliers in other clusters. Recently Van den Hoven and Roelandt empirically showed that the division of labour within a cluster stems from specialisation around a common core technology within the value chain. Inter-cluster linkages occur when the demanded technology and competencies are far removed from the core activities of the outsourcing cluster.
58. Table 2.8 summarises the different innovation styles, innovation needs and specialisation patterns of the various clusters. Every cluster has its own need for innovations. In the Construction cluster there is a strong need for product differentiation, which can only be fulfilled by entering into relationships with suppliers outside the cluster. In the Agro-food cluster there is a strong need for product innovation, but this will be addressed primarily by the interaction between the existing collective infrastructure and specialised suppliers from the manufacturing and commercial services clusters. Within the cluster of chemical industries there is a need for upgrading the domestic suppliers. Innovation in the commercial services cluster is mainly realised in co-operation with the manufacturing industries and primary producers in other clusters. Innovation in the media cluster requires the establishment of relations with the development of information and communication technology within the port, transport and communication cluster and the manufacturing industries.
59. To conclude, there is clearly a wide variety of clusters and each cluster plays its own role in the economy-wide innovation process. Specialisation around core activities and outsourcing of economic activities that are distanced from the own knowledge base coincide. In general terms we can distinguish three types of clusters:
- Clusters which are knowledge-intensive and specialised suppliers for innovations in other clusters, like *services*, *the metal-electro-cluster* and the cluster of *chemical industries*. These clusters supply knowledge-intensive services, machinery and

equipment, education and materials which are necessary for nearly every primary production process. The production of these inputs does not fit well into the technology basis of the users, and is therefore sub-contracted to the specialised suppliers in the services, metal-electro and chemical cluster.

- Absorptive clusters with a relatively low R&D effort which are dependent on their suppliers for innovations, like *construction* and *media*.
- Clusters which are relatively autonomous and autarkic concerning their innovation activities, like *Agro-food*, *energy*, and *port, transport and communication*.

#### ***Canada - PM***

#### ***Other countries (Mexico, Spain, Italy) - PM***

### ***2.4 Summary and conclusions***

60. In *modern innovation theory* the strategic behaviour and alliances of firms, as well as the interaction between firms, research institutes, universities and other institutions, are at the heart of the analysis of innovation processes. Recent research suggests that much upgrading of productive capacity and most innovation is most effectively achieved through networks of interactions between firms, often linked into clusters of activity. To adopt new knowledge often involves close interaction with users and this needs close interaction with suppliers of raw materials and components in networks of production and networks of innovation. The literature on innovation systems has underpinned two essential dimensions of innovations: (i) The interaction between different agents in the innovation chain, particularly between users and producers of intermediate goods and between business and the wider research community is very important for successfully innovating, (ii) Innovation processes are institutionally embedded in the institutional setting of networks of production (clusters).

61. Networking has become more important in recent years due to the *changing nature of competition in market-based innovation systems*. As a result of the increasing liberalisation of world trade and the opening up of sheltered markets, the element of competition becomes more international and more intense. A firm's competitiveness is becoming more dependent upon the ability to apply new knowledge and technology in products and production processes. Companies must adapt to rapidly changing market conditions or take the lead by innovating their products and production processes in a world where technological developments are taking place at an ever-increasing speed; the same time, the rate of specialisation (through division of labour) is also on the increase. It is becoming increasingly difficult for individual companies to produce all the relevant knowledge themselves and for them to translate new knowledge into innovative products or production processes. To reduce risks and shorten the time to market, companies have to specialise. Consequently, for their success in the innovation process, companies are becoming more dependent upon complementary knowledge and know-how in companies other than their own

(*dependency hypothesis*). Innovation is not so much the activity of a single company; it requires an active search process to tap new sources of knowledge and technology and to apply them to products and production processes. The synergy stemming from the combination of complementary and dissimilar activities, and the necessity to cope with the dependency upon the environment, are the driving forces behind the development of such co-operative relationships, which increase the innovativeness and competitiveness of all participating parties. These developments impose great demands on a company's ability *to organise its production process in a flexible way*. Companies are developing strategies to cope with the increasing dependency upon their environment by a more flexible organisation and the integration of various links in the production chain through entering strategic alliances, joint ventures and consortia.

62. The process of division of labour between dissimilar and complementary firms is based on the strategic choice firms have to make between internalising technical knowledge or sharing information with external actors. In this choice a decisive role is played by the *transaction costs* of internal and external organisation and the costs of acquiring knowledge and technology. According to several researchers, over the past decade the *principle incentives for alliance formation* have been to lower transaction costs, develop new skills and overcome (or create) entry barriers in markets. The main goals of most strategic alliances has been to gain access to new and complementary knowledge and to speed up the learning processes. There has been a shift by firms towards disinternalizing activities along and between value chains and towards specialisation on those activities that require resources and capabilities in which firms already have or can easily acquire competitive advantage (*concentrate on critical competency response*).
63. *Successful and innovative firms are seldom alone*. Innovation and economic growth is often situated within a unique combination of firms tied together by knowledge and production flows. There is a clear trend indicating the *growth of industrial networks*. And this growing significance of inter-firm partnering and of networking is demanding a re-examination of traditional approaches. In the literature the concept of "*alliance capitalism*" (Dunning, 1997) is used to indicate this new stage in the development of modern economic systems: the co-existence of competition, sharpened by globalisation and liberalisation, with an increasing number of network relations and strategic alliances.
64. The main *principle incentives for cluster formation* and for creating cross-border strategic alliances are: (i) to gain access to new and complementary technology, (ii) to capture economics of synergy or economies of interdependent activities, (iii) to spread risks, (iv) to promote joint R&D efforts with suppliers and users, (v) as a defensive strategy to reduce competition, (vi) to obtain reciprocal benefits from the combined use of complementary assets and knowledge, (vii) to speed up the learning process, (viii) to lower transaction costs, and (ix) to overcome (or to create) entry barriers in markets.

65. Successful clusters have *embedded in the relative competitive advantages and disadvantages of a national system of innovation* and should be large enough to capture economies of scale and scope. Cluster studies have shown that demanding customers are the key source of initiating innovation and developing competitive advantage. Advanced suppliers and competitive subcontractors can be the major source of innovations and allow firms to concentrate on their core competencies. There is no saturation level to clusters' innovativeness; developing economic strengths demand for continuous knowledge development and flexible organisation. Existing strengths will be lost if upgrading strategies stop.
66. The rule is that *innovative interactions cross sectoral borders*. Due to this traditional industrial analysis can be criticised for its limited scope. By specifying strict boundaries for industries (mostly based on some statistical convention), the traditional sectoral approach fails to take into account the importance of interconnections and knowledge flows within a network of production. The growth potential can not be analysed by studying separate branches; practically none single sector or firm would succeed without sufficient supporting structures. The cluster approach offers an *alternative to the traditional sectoral approach*. The *sectoral* approach focuses on *horizontal relations and competitive interdependency* (relations between direct competitors with similar activities and operating in the same product markets) and the cluster approach in addition focuses at the importance of vertical relationships between dissimilar firms and *symbiotic interdependence based on synergism*. The cluster-based approach is more in line with the changing nature of rivalry in market-based innovation systems as well as with recent insights from modern innovation theory. The concept of clusters implies *redefining the role of governments in industrial policy making*: the main task of the policy maker is to facilitate the networking process and to create an institutional setting which provides incentives for market-induced cluster formation
67. Interaction between the various agents in networks of production and innovation as well as interdependency of complementary competencies and knowledge play an important role in *defining a cluster*. Clusters can be characterised as being networks of production 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.
68. The *analysis of linkages and interdependence* between actors in a value chain or innovation system can be carried out *at different levels of analysis* (micro, meso and macro) and with *different techniques* (i/o-analysis, innovation interactions matrices, graph theory, correspondence analysis, monographic case studies), depending on the needs and questions to be answered. All techniques have specific drawbacks and advantages. Most countries combine various techniques to overcome the limitations of one separate technique. Most countries' cluster analysis concentrate on networks of

strongly interdependent firms or industry groups, sometimes focusing on trade linkages, sometimes on innovation linkages, sometimes on knowledge flow linkages and sometimes on a common knowledge base or common factor conditions.

69. This study has revealed that *at the international level* the comparison of national cluster studies suffer from a lot of methodological bottlenecks and complications. Due to these methodological complications most countries' cluster studies (quantitative as well as qualitative) are hard to compare internationally. The second phase of the focus group work will produce pilot studies to assess the possibilities to overcome these methodological bottlenecks.

70. *At the national level cluster studies have revealed* very useful information about the actors involved in clusters, value chain relations of firms, innovation interaction linkages, critical factors and mismatches in the institutional setting of clusters' innovation systems, systemic imperfections of cluster-based innovation systems, common framework conditions, policy options to stimulate the process of upgrading and innovation and critical success factors of cluster emergence. In countries that have implemented a comprehensive cluster-based policy, the outcomes of cluster studies have been the corner stone of policy making in this area. Cluster studies not only provide an analytic tool to analyse systems of innovation at the reduced scale level, but in practice can also be used as a working method for policy making and as an economic development tool for strategic business development.

71. Reviewing the various countries' cluster analyses has revealed the *benefits of using cluster analysis*: (i) It offers a new way of thinking about the economy and organising economic development efforts and it is a useful alternative to overcome the limitations of the traditional sectoral analysis, (ii) Cluster analysis has better aligned with the changed nature of competition and market-based innovation systems and the main sources of competitive advantage. Cluster analysis capture important linkages in terms of technology, skills, information, marketing and customer needs that cut across firms and industries, Such linkages and interdependencies are fundamental to competition and, especially, to the direction and pace of innovation. (iii) Cluster studies have improved the understanding of innovation systems at a reduced scale level, including systemic imperfections and policy options. Cluster studies reveal information about value chain relations of firms, innovation interaction linkages, critical factors and mismatches in the institutional setting of clusters' innovation systems, systemic imperfections of cluster-based innovation systems, common framework conditions, policy options to stimulate the process of upgrading and innovation and critical success factors of cluster emergence. (iv) Cluster studies have been the corner stone of industrial policy making in a lot of countries. Cluster studies not only provide an analytic tool to analyse systems of innovation, but can also be used as a working method for policy making in this area and as an economic development tool for strategic business development, in industrialised countries as well as in developing countries. (v) Cluster analysis provides options for recasting the role of the private sector, government, trade associations and educational and research

institutions and brings together business development opportunities of firms of all sizes and across traditional industry lines. (vi) Cluster analysis provides a starting point for creating a forum for constructive business-government dialogue. Basically cluster analyses can identify common development opportunities and highlights attractive public and private investment opportunities for the future.

### 3. Cluster-based policy making in OECD-countries

#### 3.1 *The changing nature of cluster-based industrial policy making: assessing cluster-based policy principles.*

##### Policy responses to systemic imperfections

1. The emergence of clusters is mostly a market-induced and market-led process without much governmental interference. *Why should governments have a role in strengthening or facilitating the emergence of innovations and strategic cluster formation?* One could argue that establishing alliances and combining various skills in production chains simply should take place in the market. Following this classical line of reasoning the primary task of government should be to facilitate the dynamic functioning of markets and make sure that co-operation does not lead to collusive behaviour which restricts competition. This classical line of reasoning can be criticised for its limited scope and has not aligned with the changing character of market-based innovation systems, the growing understanding of the functioning of market-based innovation systems and insights derived from modern innovation theory (see chapter 2).
2. Indeed, the literature on networking, clustering and innovation systems clearly has portrayed an image of clustering as a *bottom-up and basically market-induced and market-led process*. Nevertheless, it has also revealed the need to redefine the role of the government as a facilitator of networking, as a catalyst of dynamic comparative advantage and as an institution builder (Morgan, 1996), creating an efficient incentive structure to remove systemic and market inefficiencies in (national) systems of innovation. Most countries' industrial policy making actually focus on removing systemic and market failures and on improving the efficient functioning of their systems of innovation (see Tables 3.1 and 3.2 for a review). These *policy responses to systemic imperfections* encompass:
  - (i) establishing a stable and predictable economic and political climate,
  - (ii) creating favourable framework conditions for the efficient and dynamic functioning of free markets and removing market failures,
  - (iii) stimulating (the lack of) interactions and knowledge exchange between the various actors in systems of innovation,
  - (iv) removing informational failures by providing strategic information,
  - (v) removing institutional mismatches and organisational failures within systems of innovation, like for instance mismatches between the (public) knowledge infrastructure and the private needs in the market or a missing demanding customer in the value chain.
  - (vi) removing government failures and government regulations that hinders the process of clustering and innovation.

In most participating countries (for instance Denmark, Finland, UK, USA and The Netherlands) cluster-based policy initiatives have originated from a trend towards designing governance forms and incentive structures to reduce systemic and market imperfections within their systems of innovation.

3. The *changing role of the state in industrial policy making* coincides with a shift from direct intervention to indirect inducement (Morgan, 1996). From that perspective the state should not try to take the lead or ownership in cluster initiatives, but primarily should work as a *catalyst and broker* that brings actors together and supplies supporting structures and incentives to facilitate the clustering and innovation process. In most countries this changed perspective resulted in creating supporting structures, like initiating broker and network agencies and schemes and providing platforms for constructive dialogue and knowledge exchange. In most countries subsidies and compensatory policy are no longer the tools for modern industrial policy making (Rouvinen et al, 1997). Subsidies, designed to directly support industries, distort competition and there is clear a risk of protecting established but non competitive industries and postponing the upgrading and restructuring process towards a knowledge-based economy. Next, informational complexities and the speed of market developments make it impossible for government planning agencies to successfully and directly create clusters. Due to market dynamism, governments are shooting on moving targets and there is a clear risk of missing the target and having a lot of “backfire” at the same time.
4. The *systemic and market facilitating role of government* is still a matter of debate. According to Dunning (1997) a free and efficient functioning market needs a strong government. Governments can act as a creator and overseer of economic organisation as opposed to a participator of the system. Governments should work as institution builders creating appropriate incentive structures, as facilitators of efficient markets and as catalysts of dynamic comparative advantage. The setting up of a market-based system is not costly. However, if markets do fail, it can not necessarily be presumed that government intervention will improve the situation, as the costs of such intervention might be greater than the benefits (Dunning, 1997: 365).

#### **Pitfalls in cluster-based policy making**

5. Our review of cluster-based industrial policy making experiences in OECD-countries clearly has pointed at some *pitfalls* in cluster-based industrial policy making. These pitfalls indicate starting points and leading policy principles when designing a comprehensive cluster-based policy (Held, 1996; Porter, 1997; Roelandt et al, 1997, Rouvinen et al, 1997, Dunning, 1997):
  - (i) The creation of clusters should not be a government-driven effort but should be the result of market-induced and market-led initiatives.
  - (ii) Government policy should not have a strong orientation towards directly subsidising industries and firms or to limiting the rivalry in the market.
  - (iii) Government policy should shift from direct intervention to indirect inducement. Public market interference only can be justified if there is a clear market or systemic

failure. And if there are clear market and systemic imperfections, it can not necessary be concluded that government intervention will improve the situation.

- (iv) Government should not try to take the direct lead or ownership in cluster initiatives, but basically should work as a *catalyst and broker* that brings actors together and supplies supporting structures and incentives to facilitate the clustering and innovation process.
- (v) Cluster policy should not ignore small and emerging clusters; nor should it focus only on 'classic' and existing clusters.
- (vi) While cluster policy needs cluster analysis and cluster studies, the government should not focus on analysis alone without action. An effective cluster policy means interaction between researchers, captains of industry, policy-makers and scientists and creating a forum for constructive dialogue. Cluster analysis provides a tool to analyse systems of innovation, to assess systemic imperfections and in this way provides a working method for constructive dialogue on strengths and weaknesses, competitive advantages and disadvantages, strategic business development and policy options.
- (vii) Clusters should not be created from "scratch" of declining markets and industries. Sometimes the notion of clusters is appropriated by (industrial) policy makers and used as an excuse to continue more or less traditional ways of defensive industrial policy making

#### **Rationales and government roles**

6. The literature indicates the following *rationales for government action* to reduce systemic and market imperfections (Boekholt, 1997; Porter, 1997; Roelandt et al, 1997; Rouvinen et al, 1997, Duning, 1997):
  - The competitiveness of a country's networks of production strongly depends upon the synergies that arise from the interaction between actors involved in the innovation process. A first rationale for economic policy are market and systemic imperfections which hinder the realisation of these synergies: informational and organisational failures and externalities. These market imperfections can, for instance, be the result of a lack of strategic information (on market developments as well as on public needs), bottlenecks in organising dialogue and co-operation between the various actors or environmental and knowledge externalities.
  - An efficient functioning market system can be seen as a public good and needs an overseer and external party who can facilitate the smooth functioning of markets without becoming a participant.
  - The social rate of return on investments in technology and knowledge is a second often used argument why governments have a role to play. This is the case when the social benefits clearly outrun the private returns on investments in technology and knowledge; for instance in the fields of energy, the environment, the infrastructure and the electronic highway. Research has shown that in most OECD-countries the social return on investments in R&D and human capital largely exceeds the private returns (Mohnen, 1996).
  - Another rationale for government action in this field is increasing the rate of return on investments in public R&D by matching private needs with public funded research. By improving the co-operation between firms on the one hand and the public knowledge

infrastructure (universities, research institutes) on the other, more firms can profit from public R&D efforts and the diffusion of knowledge can increase, especially towards SMEs.

- In most countries SMEs have not yet taken into account the benefits of increasing external linkages and sharing knowledge. Many SMEs are unaware of the opportunities that co-operation with other firms and knowledge institutes might offer.
7. According to several policy researchers over the past decade the *most appropriate government roles in cluster-based industrial policy making* are (Boekholt, 1997; Heath, 1998; Porter, 1997; Rouvinen et al, 1997, Ormala, 1997; Roelandt et al, 1997; Lagendijk & Charles, 1997; Held, 1996; Heath, 1998):
- establishing a stable and predictable economic and political climate.
  - creating favourable framework conditions for a smooth and dynamic functioning of markets (infrastructure, competition policy and regulatory reform, providing strategic information),
  - creating a context that encourages innovation and upgrading by organising a challenging economic vision for the nation or region,
  - raising awareness of the benefits of knowledge exchange and networking,
  - providing support and appropriate incentive schemes for collaboration and initiating network brokers and intermediaries that bring together actors,
  - acting as a facilitator and moderator of networking and knowledge exchange,
  - acting as a demanding and launching customer when addressing needs,
  - facilitating an arena for informal and formal exchange of knowledge,
  - setting up competitive programs and projects for collaborative research and development,
  - providing strategic information (technology foresight studies, strategic cluster studies).
  - government should ensure that (public) institutions (especially schools, universities, research institutes) cultivate industry ties,
  - governments can assure that rules and regulations maximise the flexible adaptation to changed market conditions and stimulate innovation and upgrading processes.

### **3.2. Clusters as market-led development strategy**

8. One common lesson from our cluster-based policy review is that the cluster approach can not only be used as an analytic device but at the same time provides a *working method* when policy making is coming in. Most countries use the cluster approach to organise a market-led economic development strategy by initiating dialogue between the various actors in their relevant systems of innovation.
9. For most countries or regions, the most important national asset is having (or creating) an *institutional setting* that is able to develop its economic strengths and competitive advantages into strategic business opportunities and to capture new forms of knowledge and apply them within the context of the local production system

(Lagendijk and Charles, 1997). Some scholars have argued that the large part of the knowledge underpinning region's economic success was obtained from elsewhere, and the success was based on the organisational capability to adapt knowledge to a new commercial environment (Dupuy & Gilly, 1994). The crucial dimension is the way firms and knowledge institutions are embedded in wider networks of economic and knowledge exchange and communication. The success of the upgrading scenario of a nation or region depends on the absorptive potential for knowledge transfer (Lagendijk and Charles, 1997).

10. The cluster approach provided a way to increase the absorptive capacity of the economy as well as a tool to the development of strategic alliances between business and knowledge organisations (Lagendijk & Charles, 1997). In much of the participating countries (USA, UK, Finland, Denmark, Sweden, The Netherlands) cluster-based policy is seen as a *market-led business development strategy* bringing together actors and organisations and fostering knowledge exchange and knowledge transfer. In this way facilitating clustering and networking is a type of *institutional (and systemic) renewal and rebuilding* of existing networks and systems of production and innovation: new platforms of constructive dialogue as a starting point to upraise new institutional structures. According to Lagendijk and Charles (1997), the main goal of cluster-based policy is to facilitate the networking process, depicting local strengths and weaknesses and creating collective action and challenging economic vision for business development.
11. In some countries *at the regional level development agencies* play a crucial role in the clustering process and in developing local business opportunities. Cluster strategies have been adopted for instance within several German Länder (Northrein-Westphalen and Baden-Württemberg), many states in the U.S. and many regions in Europe (Basque Country, Catalonia, Northern Ireland, Styria-Austria). In Emilia-Romagna a general shift can be observed from a policy largely organised along sectoral lines to a more horizontal, inter-sectoral focus (Lagendijk & Charles). Good examples of creating platforms as a regional development tool are among others: the Welsh Supplier Association, the Welsh Technology Clubs (where firms, academics and funding bodies are meeting), the Welsh Medical Technology Forum and the Belgium Plato initiative bringing together SMEs from different sectors with large international companies, managed by the Regional Development Agency in Kempen-Belgium (Boekholt, 1997). A recent evaluation of the Belgium Plato initiative conducted in 1995 revealed that SMEs participating the programme were performing better (growth in turnover and employment) than those who have not participated.
12. The case of Swiss Jura arc illustrates the *importance of networks in the process of restructuring regional economies* as a consequence of changed market conditions (in this case the emergence of new technology) (Vock, 1997). In Jura there was a gradual transformation of the industrial district from watchmaking into a local economy concentrating on microtechnologies. The change in technology contributed to the emergence of a new local system of production and innovation. The conventional

production system of this district based on precision engineering and watchmaking was hit by a major economic crisis in the mid 1970s. Technological changes (modern microtechnologies) and changed market conditions (new competitors in Asian meeting the demand for cheap products) put the industrial district of Jura under heavy strains. The establishment of new networks and competence centres between firms and research and training institutions seemed to be vital in the restructuring process.

### 3.3. Countries' strategies in cluster-based policy <sup>10</sup>

13. In general in a lot of countries the clustering process have been initiated by the establishment of forums, platforms and regular meetings of firms and organisations related to a particular network of production the value chain. Strategic information (technology foresight studies and strategic cluster studies) is often used as an input to the process of dialogue. The way this is actually organised differs between countries, depending on national traditions and culture in policy making, the way dialogue between industry, research and governments have institutionalised in a country, the scale and cope of the country and a country's level of government interference and the specific composition of economic activities and relevant technologies in a country's economy.
14. One fundamental difference in the policy approaches between the participating countries refers to the distinction between a *bottom up approach* on the one hand and a more or less *top down approach* on the other (Boekholt, 1997). The first approach basically focuses on fostering dynamic market functioning and removing market imperfections and the starting point lies in market-induced initiatives with the government acting as a facilitator and moderator without setting national priorities (like for instance in the USA and The Netherlands). In the latter approach government (in dialogue with industry and research agencies) sets national priorities, formulates a challenging view for the future and - before starting the process of dialogue - decides on the actors to be involved in the dialogue process (like for instance in some of the Nordic countries). After having set national priorities and having initiated the dialogue groups the clustering process further is a market-led process without much government interference.
15. Creating incentives for innovative behaviour in the market also requires *innovations in policy-making and institutional renewal of government agencies* (Ormala, 1997; Sulzenco, 1997; Roelandt et al, 1997). There is a strong need growing for 'horizontal policy', integrating the various aspects of functionally-organised policy instruments (e.g. education policy, science policy, trade policy, competition policy, technology policy, public works, fiscal policy and so on, see figure 3.1). According to Ormala (1997) governments are not necessarily organised to manage innovation policy in the best possible way. Ministries usually have sectoral and functional responsibilities.

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<sup>10</sup> This review will be complemented later by a more comprehensive overview of cluster-based policies in OECD-countries, to be published in the Summer 1998 by Technopolis (Boekholt & Thuriaux)

Innovation policy demands for horizontal policies, which requires a co-ordinated contribution from a number of different sectors. Governments have a key role to play not only in managing knowledge in their ministries and agencies but also in improving the acquisition and application of knowledge on an economy-wide base. One way could be to encourage the mobility of personnel between public sector and business (Ormala, 1997: 5).

16. Table 3.1 summarises the various approaches and cluster-based policy initiatives in the participating countries. The most common *features of cluster-based policy* are:

- (i) a vigorous competition and regulatory reform policy (almost all countries),
- (ii) providing strategic information by technology foresight studies (e.g. Sweden, The Netherlands), cluster studies (e.g. Finland, Denmark, Sweden, The Netherlands, U.K., USA, Austria, Italy), special research groups (e.g. Denmark, the Austrian TIP-research programme), or special websites (e.g. like STRATEGIS in Canada),
- (iii) broker and network agencies and schemes (e.g. The Danish network programme, The Dutch Innovation Centres),
- (iv) cluster development programmes (e.g. cluster programmes in Finland and The Netherlands, regional development agencies in UK, USA and Germany and the Flemish R&D-support to clusters)
- (v) initiating joint industry-research centres of excellence (e.g. Belgium, Denmark, Finland, Spain, Sweden, Switzerland and The Netherlands)
- (vi) public procurement policy (e.g. Austria, Denmark and The Netherlands),
- (vii) institutional renewal in industrial policy making (e.g. Finland and Canada)
- (viii) providing platforms for constructive dialogue (e.g. the US focus groups, the Danish reference groups, the Swedish industrial system approach, the U.K. regional development agencies and the Dutch broker policy)

17. A good example of governments providing business with *strategic information* is the Austrian TIP-Research Programme (Peneder & Warta, 1997). TIP forms a network of researchers, scientists, entrepreneurs, managers and public policy decision makers in Austria and abroad and it produces a continuous flow of information on the competitiveness of Austrian economy. TIP bases its consultancy work on analyses of the national system of innovation at the macro, meso and micro level with a special view to technological development.

#### ***US focus groups***

18. In the U.S. the cluster approach has been used as *an economic development tool at the regional level* (Held, 1996). In this case cluster-based policy refers to actively organising dialogue and interaction between firms across sectors, the local knowledge infrastructure and regional development agencies in “focus groups”. Policy making is a highly interactive process and the focus is on analysing strength and weaknesses of the local economic structure and knowledge infrastructure and identifying business development opportunities. Cluster studies are used as an input in the focus group meetings. Cluster analysis focuses on knowledge and value chain linkages in the local

economic structure using input-output analysis (Feser and Bergman, 1996) as well as insight business information.

19. In New York State, during the intensive dialogue between business, knowledge infrastructure and government in the focus groups five strategic clusters have been identified: information technology, bio-medical technology, distribution, business services and tourism. The consultation process produced a development agreement in the information technology cluster and a report on the opportunities to develop new business in the distribution cluster. The experienced advantages of strategic networking in the focus groups are:

- i. improving inter-firm communication and knowledge exchange,
- ii. promoting strategic alliances between supplier and user industries, and
- iii. identifying missing links in the local cluster structure as well as opportunities to attract new firms to fill in the gap.

In New York, Held (1996: 252) “found that carefully constructed focus groups are an extremely useful way to identify policy and program needs that component industries within the clusters share, thereby suggesting efficient uses of limited economic development resources” (...) Focus groups also served to build support within the private sector for post-research activities”.

#### ***Danish reference groups in resource areas***

20. In Denmark dialogue between firms, organisations and related ministries is organised by constituting reference groups in each of the resource areas (see chapter 2 for the meaning of resource areas) (Dreijer et al, 1997; Danish Ministry of Industry and Trade, 1997). In these dialogue groups critical policy conditions are identified. In February 1997 66 new policy initiatives were implemented. This process of consultation resulted among others in the constitution of new cross sectoral research centres (centres of excellence) in the fields of medical technology, ICT and bio technology. Next, in some areas (tourism and consumer goods) development centres were initiated and in the transport area new educational programmes have been implemented.

#### ***Swedish industrial system programme***

21. Recently Sweden launched the “industrial systems” programme, aiming at stimulating strategic dialogue between industries and other relevant actors on the country’s strategic economic development issues for the near future and on demands for public policy (Stenberg & Strandell, 1997). This new policy instrument, inspired by the Danish “resource areas working method”, emphasises the interconnection between manufacturing industries and the growth of business services. An industrial system encompasses different industrial branches as well as the business services. The industrial systems project includes the development of methods identifying existing and emerging clusters as well as methods to determine appropriate framework conditions for individual clusters. An other recently launched cluster based initiative in Sweden are technology foresight studies, among other identifying actual and potential innovative clusters

### ***UK regional development agencies***

22. In the UK cluster initiatives have emerged both as part of the desire to improve the benefits from foreign investments by supporting supply chains and other forms of inter-firm relationships, and to support networking among local firms, especially SMEs (Legendijk & Charles). Regional Development Agencies (like the Welsh Development Agency and Scottish Enterprise) play an important role in this process. There is a great variation in the initiatives taken. The regional development agencies have built up a strong expertise in:

- (i) detecting business development opportunities and attracting foreign investments,
- (ii) supply chain development,
- (iii) technology development and commercialisation, and
- (iv) promoting inter-firm co-operation.

### ***Flemish R&D support to clusters***

23. In Belgium-Flanders R&D-support to clusters is restricted to those clusters that match the criteria of the government: (i) the cluster should improve the Flemish international competitiveness, (ii) the cluster should be a new emerging co-operating network, (iii) the cluster should encompass at least two phases of the value chain, (iv) the cluster should have a positive impact on the employment growth in the region. Next, the formation of clusters should be creating synergies for all participants. Basically the Belgium government has provided direct support to firms in the field of scientific research, strategic investments, education and stimulating export performance.

### ***Dutch broker policy***

24. Recently the Dutch cluster-based policy basically has focused on three features (Roelandt et al, 1997):

- (i) creating favourable framework conditions to facilitate a smooth and dynamic functioning of markets,
- (ii) broker policies, establishing a meeting ground for dialogue between firms and research institutes to identify and develop new business opportunities (platforms, cluster programmes and the Innovation Centres),
- (iii) government acting as a demanding customer when addressing needs.

25. In the Netherlands government plays a facilitating role in organising the dialogue about future technological and market developments and provide strategic information. This requires an intensive exchange of information between policy-makers, market actors and knowledge-producing agents. Concrete examples in the Netherlands are: technology forecasts studies mapping future trends in technology and conducting benchmark studies on clusters. Such initiatives are usually joint projects between the public and private sector. In the Netherlands, sometimes market parties express the wish to cooperate, yet they need an external party to support the process of co-operation. For example, in the area of the development of Chipcards and more recently the Electronic Superhighway, the government brought the major players

together in a platform. Since 1994 a total of 24 cluster projects in several industries have emerged.

- In the Netherlands recently some initiatives have been started to initiate and actively organise innovative cluster formation of market parties charged with the provision of public needs. The idea was that in industry, especially in those sectors in which large projects are undertaken (e.g. chemical industry, offshore industry, energy industry) lessons are learned concerning design competition, more integrated project responsibility (turnkey contracting), the sharing of risks and benefits, functional specifications and so on. Next the Dutch government examined the possibilities to start procurement procedures -within the framework of EU regulations on public procurement- for a number of large projects that are clearly aimed at bringing about innovations in this field. These include road construction, construction of new hospitals, houses and homes for the elderly, and road pricing.

#### ***Finnish National Industrial Strategy***

26. In the 1990s in Finland there has been a gradual shift in orientation of R&D policies towards innovation policy using competition policy and framework policies (regulatory reform) as its main principles (Ormala, 1997). The main features of Finnish new industrial and technology policy are:

- allocate financing of research to end-users on the basis of competition,
- launch research programs in strategic fields and strengthen the centre of excellence in the universities
- initiating clusters programmes in telecommunication, foodstuff, transport, environment, forest and welfare clusters. The main aim of these programmes is to create new co-operation between scientific and technological organisations, industry and government organisations.

27. In Finland the cluster approach was introduced as a new policy instrument during the late 1980s and early 1990s. Bad economic performance and the lack of innovative and successful firms and the need to renew and upgrade the existing economic structure asked for redefining the role of industrial policy and study the determinants of Finnish competitiveness. The Finnish industrial structure was somewhat one-sided and was concentrated in the forest and metal industries. During the 1970s and 1980s a structural change towards more knowledge-based industries took place, but in 1990 the country was struck by a severe structural crisis: from 1990 to 1994 the industrial employment decreased by one-fourth. The decades of a rather planned economy created much inflexibility and a whole jungle of regulations. One of the goals of redesigning industrial policy was to replace the old regime.

28. In Finland there has been a substantial increase in government research financing since 1996 and the Finnish National Science and Technology Policy Council is playing an important role in allocating these funds to national priority fields. A part of these funds have been used to initiate cluster programmes. The results of cluster studies (see chapter 2) have been used to set national priorities, but these national

priorities were finally chosen on the base of expert opinions in working groups formed to specify in more detail for which purposes the funding is channelled. TEKES, a state owned fund for technology development, also takes initiatives to promote dialogue between industry and research institutions.

#### **Canada (PM)**

#### **Other countries (Spain, Italy, Mexico) PM**

### **3.4 Summary and conclusion**

29. Table 3.2 summarises the countries' *cluster-based policy responses to systemic and market imperfections*.
30. Following the classical line of reasoning the primary task of government should be to facilitate the dynamic functioning of markets and make sure that co-operation does not lead to collusive behaviour which restricts competition. This classical line of reasoning can be criticised for its limited scope and has not aligned with the changing character of market-based innovation systems, the growing understanding of the functioning of market-based innovation systems and insights derived from modern innovation theory. Indeed clustering and networking basically is a *bottom-up and basically market-induced and market-led process*. Nevertheless, cluster studies has also revealed the need to *redefine the role of the government* as a facilitator of networking, as a catalyst of dynamic comparative advantage and as an institution builder, creating an efficient incentive structure to remove systemic and market inefficiencies in (national) systems of innovation.
31. Most countries' industrial policy making actually focus on *removing systemic and market failures and on improving the efficient functioning of their systems of innovation*. In most participating countries cluster-based policy initiatives have originated from a trend towards designing governance forms and incentive structures to reduce systemic and market imperfections within their systems of innovation. These *policy responses to systemic imperfections* encompass: (i) establishing a stable and predictable economic and political climate, (ii) creating favourable framework conditions for the efficient and dynamic functioning of free markets and removing market failures, (iii) stimulating (the lack of) interactions and knowledge exchange between the various actors in systems of innovation, (iv) removing informational failures by providing strategic information, (v) removing institutional mismatches and organisational failures within systems of innovation, like for instance mismatches between the (public) knowledge infrastructure and the private needs in the market or a missing demanding customer in the value chain. (vi) removing government failures and government regulations that hinders the process of clustering and innovation.
32. This *changing role of the state in industrial policy making* coincides with a shift from direct intervention to indirect inducement. Governments primarily should work as a

*catalyst and broker* that brings actors together and supplies supporting structures and incentives to facilitate the clustering and innovation process. In most countries this changed perspective resulted in creating supporting structures, like initiating broker and network agencies and schemes and providing platforms for constructive dialogue and knowledge exchange.

33. The review of cluster-based policy experiences in the participating countries has identified *pitfalls* which can be used as starting points and *leading policy principles* when designing a comprehensive cluster-based policy: (i) the creation of clusters should not be a government-driven effort but should be the result of market-induced and market-led initiatives. (ii) government policy should not have a strong orientation towards directly subsidising industries and firms or to limiting the rivalry in the market. (iii) government policy should shift from direct intervention to indirect inducement. (iv) government should not try to take the direct lead or ownership in cluster initiatives, but basically should work as a *catalyst and broker* that brings actors together and supplies supporting structures and incentives to facilitate the clustering and innovation process. (v) cluster policy should not ignore small and emerging clusters; nor should it focus only on 'classic' and existing clusters. (vi) while cluster policy needs cluster analysis and cluster studies, the government should not focus on analysis alone without action. An effective cluster policy means interaction between researchers, captains of industry, policy-makers and scientists and creating a forum for constructive dialogue. (vii) clusters should not be created from "scratch" of declining markets and industries. Sometimes the notion of clusters is appropriated by (industrial) policy makers and used as an excuse to continue more or less traditional ways of defensive industrial policy making
34. The most appropriate *government roles* in cluster-based industrial policy making are: (i) establishing a stable and predictable economic and political climate. (ii) creating favourable framework conditions for a smooth and dynamic functioning of markets (infrastructure, competition policy and regulatory reform, providing strategic information), (iii) creating a context that encourages innovation and upgrading by organising a challenging economic vision for the nation or region, (iv) raising awareness of the benefits of knowledge exchange and networking, (v) providing support and appropriate incentive schemes for collaboration and initiating network brokers and intermediaries that bring together actors, (vi) acting as a facilitator and moderator of networking and knowledge exchange, (vii) acting as a demanding and launching customer when addressing needs, (viii) facilitating an arena for informal and formal exchange of knowledge, (ix) setting up competitive programs and projects for collaborative research and development, (x) providing strategic information (technology foresight studies, strategic cluster studies). (xi) government should ensure that (public) institutions (especially schools, universities, research institutes) cultivate industry ties, (xii) governments can assure that rules and regulations maximise the flexible adaptation to changed market conditions and stimulate innovation and upgrading processes.

35. One common lesson from our cluster-based policy review is that the cluster approach can not only be used as an analytic device but at the same time provides a working method when policy making is coming in. Most countries use the cluster approach to organise a *market-led economic development strategy* by initiating dialogue between the various actors in their relevant systems of innovation. In much of the participating countries (USA, UK, Finland, Denmark, Sweden, The Netherlands) cluster-based policy is seen as a market-led business development strategy bringing together actors and organisations and fostering knowledge exchange and knowledge transfer.
36. The most common *features of cluster-based policy* are: (i) a vigorous competition and regulatory reform policy (almost all countries), (ii) providing strategic information by technology foresight studies (e.g. Sweden, The Netherlands), cluster studies (e.g. Finland, Denmark, Sweden, The Netherlands, U.K., USA, Austria, Italy), special research groups (e.g. Denmark, the Austrian TIP-research programme), or special websites (e.g. like STRATEGIS in Canada), (iii) broker and network agencies and schemes (e.g. The Danish network programme, The Dutch Innovation Centres), (iv) cluster development programmes (e.g. cluster programmes in Finland and The Netherlands, regional development agencies in UK, USA and Germany and the Flemish R&D-support to clusters), (v) initiating joint industry-research centres of excellence (e.g. Belgium, Denmark, Finland, Spain, Sweden, Switzerland and The Netherlands), (vi) public procurement policy (e.g. Austria, Denmark and The Netherlands), (vii) institutional renewal in industrial policy making (e.g. Finland and Canada) (viii) providing platforms for constructive dialogue (e.g. the US focus groups, the Danish reference groups, the Swedish industrial system approach, the U.K. regional development agencies and the Dutch broker policy, the Finnish National Industrial Strategy)

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## **ANNEX CONTAINING TABLES AND FIGURES**

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*Note prepared for the OECD-Secretariat and the OECD TIP-group  
Presented at the 2nd OECD-workshop on cluster analysis and cluster-based policy  
Vienna, May 4th & 5th*

The Hague/Utrecht, May 1998

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**Table 2.1 - The preconditions of a cluster's emergence:  
nine critical success factors in the Finnish case**

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- **Time.** Often, successful clusters date back to relative advantages or disadvantages which were present centuries ago. In any case, it takes time to develop industrial base, customer relations, and brand names.
- **Critical mass.** An industry has to be fairly big before economies of scale and scope can be fully utilised.
- **Entrepreneurs and dedicated people.** Most dynamic clusters contain stories of entrepreneurs who significantly influenced the industry.
- **Demanding international customers.** Cluster studies show that demanding customers are the key source of competitive advantage.
- **Rivalry and co-operation.** Rival companies are the main feature of a cluster. Lucrative companies, however, often co-operate even with their main competitors when necessary and mutually beneficial.
- **Advanced suppliers.** Competitive subcontractors can be a major source of innovations and allow firms to concentrate on their core competencies.
- **Flexible organisation and management.** Organisational flexibility is needed especially during periods of excessive turmoil.
- **Continuous knowledge development.** There is no saturation level to cluster innovativeness. Existing competitive strength will be lost if the upgrading process stops.
- **National pride.** Industries that are nationally appreciated attract the best talent in the country.

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Source: Reve and Mathiesen 1994, pp. 119-125

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<b>Table 2.2 - Traditional sectoral approach versus Cluster-based approach</b>	
<i>Sectoral approach</i>	<i>Cluster-based approach</i>
<ul style="list-style-type: none"> <li>• Groups with similar network positions.</li> </ul>	<ul style="list-style-type: none"> <li>• Strategic groups with mostly complementary and dissimilar network positions.</li> </ul>
<ul style="list-style-type: none"> <li>• Focus on end product industries.</li> </ul>	<ul style="list-style-type: none"> <li>• Include customers, suppliers, service providers and specialised institutions.</li> </ul>
<ul style="list-style-type: none"> <li>• Focus on direct and indirect competitors.</li> </ul>	<ul style="list-style-type: none"> <li>• Incorporate the array of interrelated industries sharing common technology, skills, information, inputs, customers and channels.</li> </ul>
<ul style="list-style-type: none"> <li>• Hesitancy to co-operate with rivals.</li> </ul>	<ul style="list-style-type: none"> <li>• Most participants are not direct competitors but share common needs and constraints.</li> </ul>
<ul style="list-style-type: none"> <li>• Dialogue with government often gravitates towards subsidies, protection and limiting rivalry.</li> </ul>	<ul style="list-style-type: none"> <li>• Wide scope for improvements on areas of common concern that will improve productivity and raise the plane of competition.</li> <li>• A forum for more constructive and efficient business-government dialogue</li> </ul>
<ul style="list-style-type: none"> <li>• Looking for diversity in existing trajectories</li> </ul>	<ul style="list-style-type: none"> <li>• Looking for synergies and new combinations</li> </ul>
<p>Source: Adapted from Porter, 1997.</p>	

**Table 2.3 - Cluster analysis at different levels of analysis**

<i>Level of analysis</i>	<i>Cluster concept</i>	<i>Focus of analysis</i>
national level (macro)	industry groups linkages in the economic structure	<ul style="list-style-type: none"><li>• specialisation patterns of a national/regional economy</li><li>• need for innovation and upgrading products and processes in mega-clusters</li></ul>
branch or industry level (meso)	inter- and intra-industry-linkages in the different stages of the production chain of similar end product(s)	<ul style="list-style-type: none"><li>• SWOT- and benchmark-analysis of industries</li><li>• exploring innovation needs</li></ul>
firm level (micro)	specialised suppliers around one or a few core enterprises (inter-firm linkages)	<ul style="list-style-type: none"><li>• strategic business development</li><li>• chain analysis and chain management</li><li>• development of collaborative innovation projects</li></ul>

Source: Roelandt et al, 1997.

**Table 2.4 - Cluster methodologies adopted in participating countries**

country	Level of analysis			Cluster technique				Cluster concept
	micro	meso	macro	I/O	Graph	Cores	Case	
AUS		x	x	x			x	networks of production, networks of innovation, networks of interaction
AUT		x	x				x	patent data & trade performance
BEL	x				x			sciento-metrics
CAN		x	x	x			x	networks or chains of production, innovation and co-operation
DK	x	x		x	x		x	systems of innovation
FNL	x	x					x	resource areas
GER	x	x		x		x		clusters as unique combinations of firms tied together by knowledge
IT		x		x				similar firms and innovation styles
MEX		x	x				x	inter-industry knowledge flows
NL		x	x	x			x	systems of innovation
SP		x		x			x	value chains and networks of production
SWE		x					x	systems of innovation
SWI	x	x				x	x	systems of interdependent firms in different industries
UK	x	x					x	patent data
USA		x		x			x	networks of innovation
								regional systems of innovation
								chains and networks of production

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**Table 2.5 - Advantages and drawbacks of monographic case studies**

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<i>Advantages</i>	<i>Drawbacks</i>
<ul style="list-style-type: none"><li>• Increased knowledge about the ‘real economy’</li><li>• Contribution to the recognition that strong innovative networks cut through different industries</li><li>• Stimulated the debate about the strengths and weaknesses of the Dutch economy</li><li>• Focused on the importance of knowledge (pooling) and upgrading for all industries</li><li>• Showed variety in geographic scope of clusters</li><li>• Highlighted the role of institutions in supporting and facilitating innovation</li><li>• Paved the way for more cluster specific policy-making</li></ul>	<ul style="list-style-type: none"><li>• Strength in exports is the main indicator for identifying the most competitive clusters</li><li>• Usability of cluster chart therefore limited</li><li>• Porters diamond basically a heuristic device</li><li>• Porter analysis is a (quick and dirty?) tool to map competitiveness and system dynamics at meso level. Combination with other tools and methods is needed to use it both at the macro and micro-level for formulating strategies</li><li>• Basically qualitative</li><li>• Results are hard to compare between clusters</li></ul>

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**Table 2.6 - Clusters identified in the various countries**

<i>Country</i>	<i>Con- struc- tion</i>	<i>Chemi- cals</i>	<i>Com. Service s</i>	<i>Non- com. Service s</i>	<i>Energy</i>	<i>Health</i>	<i>Agro- food</i>	<i>Media</i>	<i>Manu. Paper</i>	<i>Manu. Metal- electro</i>	<i>Manu. Other</i>	<i>Port, transp., commu- nic.</i>	<i>Bio- medica l</i>	<i>ICT</i>	<i>Wood &amp; paper</i>	<i>Biotec hnolog y</i>	<i>Materi als</i>	<i>Consu- mer goods &amp; leisure</i>	<i>Genera l supplie r busines s</i>
Australia			X				X			X		X	X	X					
Austria	X	X						X		X	X	X		X	X				
Belgium					X									X		X	X		
Canada																			
Denmark	X				X	X	X					X		X				X	X
Finland	X	X			X	X	X			X		X		X	X				
Germany																			
Italy																			
Mexico																			
Netherlands.	X	X	X	X	X	X	X	X	X	X	X	X							
Spain														X					
Sweden	X				X		X			X				X	X		X		
Switzerl. I																			
Switzerl. II																			
UK																			
USA	X	X			X		X	X		X	X			X	X	X			

Country	Enviro nmenta l	Machi- nery	Transp ort (vehi- cles)	Aero space	Other	Remarks
Australia					X	
Austria						
Belgium						
Canada						No clusters were specified for the Canadian case.
Denmark						
Finland	X					
Germany						
Italy						In the Italian contribution which focuses on technology flows no clusters were specified.
Mexico						
Netherlands.						
Spain						
Sweden		X	X			
Switzerl. I						
Switzerl. II						
UK						
USA			X	X		

**Table 2.7 - Danish industrial complex studies in the mid 1980s:  
the example of the Agro-Food and Textile Complex**

<i>industrial complex</i>	<i>main issue</i>	<i>policy recommendations</i>
Agro-Food	<ul style="list-style-type: none"> <li>• strong linkages between food processing and machinery</li> <li>• vulnerable specialisation in standardised products</li> <li>• demanding users play an important role for developing new technology</li> </ul>	<ul style="list-style-type: none"> <li>• new technology is no solution without organisational changes</li> <li>• need for “complex policy” directed to improving vertical relations</li> </ul>
Textile	<ul style="list-style-type: none"> <li>• tendency towards standardisation</li> </ul>	<ul style="list-style-type: none"> <li>• innovation needed through interaction between agents in the complex</li> </ul>

Sources: Lundvall et al (1984); Pasinetti (1981), adopted from: Dreijer et al (1997).

**Table 2.8 - Clusters' innovation style, technology fields and their role economy-wide**

<b>Cluster</b>	<b>Innovation style and technology field</b>
Construction	Acquisition of technology primarily via specialised suppliers; technology follower; high absorptive capacity; strong emphasis on process innovation; need for product innovation and differentiation. Main technology field: construction technology and civil engineering.
Chemical industries	High extent of technology development; engine for innovation in other clusters; high extent of process R&D; need for upgrading. Main technology fields: high and low molecular materials technology and process technology.
Commercial services	Innovation strongly dependent upon specialised suppliers in the manufacturing industry in particular; large extent of process innovation; engine for innovations in other clusters; interactive relationship with innovation processes in other clusters; need for knowledge intensive innovations. Main technology fields: Information technology and electrotechnical technology.
Non-comm. services	Acquisition of technology via specialised suppliers; engine behind upgrading of knowledge base via public knowledge infrastructure; need for a greater spin-off to commercial production clusters. Main technology field: fundamental and basic research.
Energy	Relatively low-tech. Main technology fields: energy technology and mineralogy.
Health	Large extent of product and process innovation; innovations strongly focused upon own cluster (autarkic). Main technology fields: medical research and pharmacy and basic research.
Agro-food	Autarkic in technological terms; acquisition of technology via independent collective infrastructure in combination with specialised suppliers in generic clusters; potential innovations especially in overlapping areas with other clusters; need for product innovation. Main technology field: food and process technology.
Media	Technology follower with a high absorptive capacity; for innovation dependent upon specialised suppliers; strong pattern of product innovation. Growing link with communication industries. Main technology field: information technology.
Manufacturing metal-electro	High extent of technological development; engine behind many innovation processes in other clusters; high extent of process innovation; product innovations especially in overlapping areas with other clusters. Main technology fields: electrotechnical research, manufacturing technology, transport technology and information technology.
Port, transport & communication	Process innovation primarily via specialised suppliers; need for higher creation of added value, and application of information and communication technology. Main technology fields: logistics, information technology and defence technology.

Source: Roelandt et al, 1997.

**Table 3.2 - Countries' strategies in cluster-based policy**

<b>Country</b>	<b>Approach</b>	<b>Cluster analysis</b>	<b>Policy initiatives/Policy principles</b>
Austria	systems of interdependent economic entities	<ul style="list-style-type: none"> <li>• improving I/O-tables</li> <li>• traditional statistical cluster analysis screening for patterns of innovative activities</li> <li>• case studies</li> </ul>	<ul style="list-style-type: none"> <li>• cluster policy in design (?):</li> <li>• framework conditions (regulatory reform, human capital development)</li> <li>• providing platforms for co-operation and experimentation</li> <li>• raising public awareness of technologies</li> <li>• demand pull by public procurement</li> </ul>
Australia	networks of economic activity	<ul style="list-style-type: none"> <li>• case studies of industrial districts (geographical propinquity) and resource based clusters</li> <li>• i/o-analysis on inter-industry linkages</li> </ul>	<ul style="list-style-type: none"> <li>• no comprehensive cluster-based policy</li> <li>• networking schemes encouraging the emergence of inter-firm networks</li> </ul>
Belgium (Flanders)	Networks or chains of production, innovation and co-operation	<ul style="list-style-type: none"> <li>• Graph analysis and case study work</li> <li>• improving i/o statistics</li> <li>• technology flows</li> <li>• technology clubs (similar collaboration patterns)</li> </ul>	<ul style="list-style-type: none"> <li>• cluster-based policy under construction</li> <li>• market induced cluster initiatives</li> <li>• government facilitating co-operation</li> <li>• subsidies and firms' co-financing in cluster programmes (in metal processing industry, plastics, space industry, SMEs, furniture)</li> <li>• stimulating cross-sectoral technology diffusion</li> <li>• supporting supplier-producer networks</li> <li>• centres of excellence around newly emerging technologies</li> </ul>
Denmark	Resource areas	<ul style="list-style-type: none"> <li>• industrial districts / development blocks</li> <li>• Porter-like cluster studies</li> <li>• improving statistics</li> <li>• cluster analysis as an input to the process of dialogue</li> </ul>	<ul style="list-style-type: none"> <li>• dialogue in reference groups</li> <li>• centres of excellence in specific areas</li> <li>• new educational programmes in specific areas</li> <li>• development centres in specific areas</li> <li>• top down approach (selected priority fields)</li> <li>• institutional reform in policy making (co-ordination between ministries)</li> </ul>
Finland	Clusters as a unique combination of firms tied together by knowledge	<ul style="list-style-type: none"> <li>• Porter-based cluster studies</li> </ul>	<ul style="list-style-type: none"> <li>• clusters as an economic development tool</li> <li>• identifying sources of competitive advantages in</li> </ul>

**Table 3.2 - Countries' strategies in cluster-based policy**

<b>Country</b>	<b>Approach</b>	<b>Cluster analysis</b>	<b>Policy initiatives/Policy principles</b>
	and production flows		Finnish economy <ul style="list-style-type: none"> <li>• competition policy and structural reform</li> <li>• creating advanced factors of production (basically creating favourable framework conditions)</li> <li>• cluster programmes, strategic research, centres of excellence</li> </ul>
Spain	cluster's systems of innovation	<ul style="list-style-type: none"> <li>• clusters as industry of groups with common knowledge base (electronics and telecommunication) - highly qualitative methodology</li> </ul>	<ul style="list-style-type: none"> <li>• No explicit cluster-based policy.</li> <li>• promote diffusion and co-operation between actors in NIS when providing public R&amp;D-support</li> </ul>
The Netherlands	Value Chain Approach	<ul style="list-style-type: none"> <li>• Porter-like cluster studies</li> <li>• Cluster benchmark studies</li> <li>• Input-output analysis</li> </ul>	<ul style="list-style-type: none"> <li>• dialogue in specific platforms</li> <li>• brokerage and network policy</li> <li>• public consultancy</li> <li>• providing strategic information (a/o. technology foresight studies)</li> <li>• renewal in procurement policy</li> <li>• deregulation and competition policy</li> </ul>
United Kingdom	Regional systems of innovation	<ul style="list-style-type: none"> <li>• cluster case studies focus on identifying actors and development opportunities for the region</li> </ul>	<ul style="list-style-type: none"> <li>• Clusters as a regional development tool</li> <li>• government as catalyst and broker</li> <li>• regional cluster programmes</li> </ul>
United States	Clusters (chains of production) as a regional development tool.	<ul style="list-style-type: none"> <li>• cluster analysis focusing on the strengths and weaknesses of the local economic structure and identifying business opportunities.</li> <li>• cluster analysis used as an input to the consultation process.</li> <li>• input/output analysis combined with insight information from business</li> </ul>	<ul style="list-style-type: none"> <li>• dialogue in regional focus groups</li> <li>• regional development plans</li> </ul>
Spain	inter-sectoral linkages and dependency	<ul style="list-style-type: none"> <li>• technology and innovation flow analysis</li> </ul>	<ul style="list-style-type: none"> <li>• Framework policy</li> <li>• Stimulating R&amp;D-co-operation and R&amp;D-networks</li> <li>• Research Centres (mixed private and public)</li> </ul>

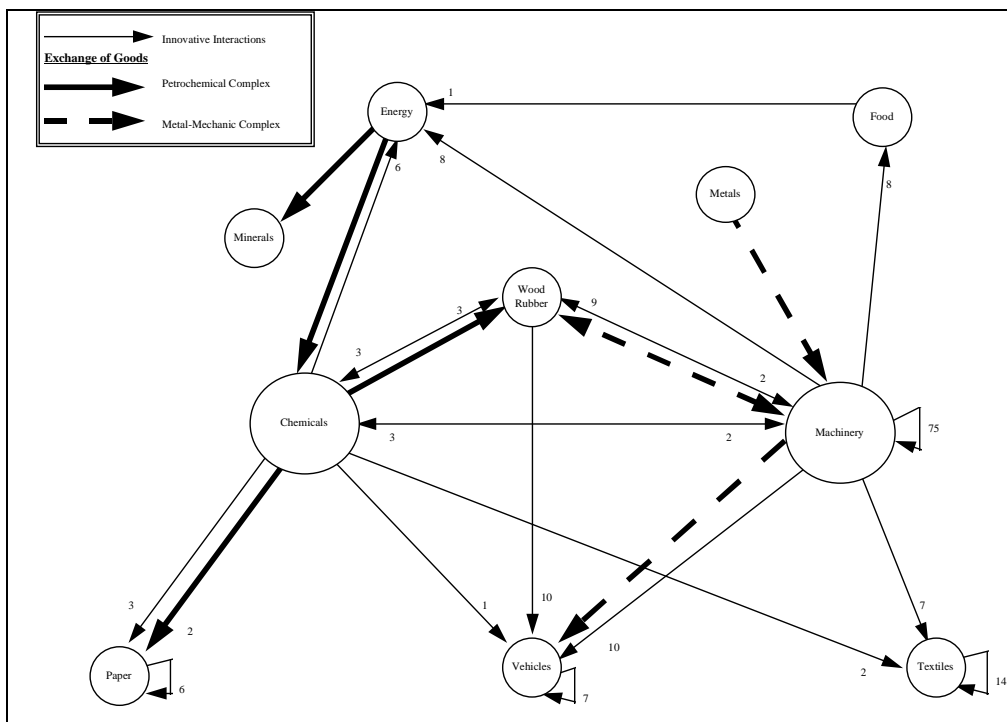
**Table 3.2 - Countries' strategies in cluster-based policy**

<b>Country</b>	<b>Approach</b>	<b>Cluster analysis</b>	<b>Policy initiatives/Policy principles</b> participation) and Science Parks.
Sweden	Interdependencies between firms in different sectors	<ul style="list-style-type: none"> <li>• Development blocks (in the 1950s)</li> <li>• Technological systems (late 1980s)</li> <li>• Network approach (since 1970s)</li> <li>• Porter studies (since mid 1980s)</li> </ul>	<ul style="list-style-type: none"> <li>• Cluster-based policy under construction</li> <li>• General framework conditions</li> <li>• Technology procurement</li> <li>• stimulating R&amp;D co-operation</li> <li>• research centres</li> <li>• industrial systems project (is being set up) to stimulate strategic dialogue</li> <li>• technology foresight studies identifying actual or potential innovative clusters</li> </ul>
Switzerland	Networks of innovation	<ul style="list-style-type: none"> <li>• case study work on restructuring system of production and innovation (Swiss Jura arc)</li> <li>• analysing technological spill overs and innovation styles</li> </ul>	<ul style="list-style-type: none"> <li>• action programme for diffusion of specific technology (Computer Integrated Manufacturing)</li> <li>• setting up competence centres integrated in regional networks</li> </ul>

<b>Table 3.1 - Systemic and market imperfections and cluster-based policy response</b>		
<i>Systemic and market imperfections</i>	<i>Policy response</i>	<i>Countries' focus in cluster-based policy making</i> <sup>11</sup>
I. inefficient functioning of markets	<ul style="list-style-type: none"> <li>• competition policy and regulatory reform</li> </ul>	<ul style="list-style-type: none"> <li>• most countries</li> </ul>
II. informational failures	<ul style="list-style-type: none"> <li>• technology foresights</li> <li>• strategic market information &amp; strategic cluster studies</li> </ul>	<ul style="list-style-type: none"> <li>• Sweden, The Netherlands, Canada, Denmark, Finland, The Netherlands, USA</li> </ul>
III. limited interaction between actors in innovation systems	<ul style="list-style-type: none"> <li>• broker and networking agencies and schemes</li> <li>• provide platforms for constructive dialogue</li> <li>• facilitating co-operation in networks (cluster development schemes)</li> </ul>	<ul style="list-style-type: none"> <li>• Australia, Denmark, The Netherlands,</li> <li>• Austria, Denmark, Finland, USA, The Netherlands, UK, Sweden, Germany</li> <li>• Belgium, Finland, UK, USA, The Netherlands</li> </ul>
IV. institutional mismatches between (public) knowledge infrastructure and market needs	<ul style="list-style-type: none"> <li>• joint industry-research centres of excellence</li> <li>• facilitating joint industry-research co-operation</li> <li>• human capital development</li> <li>• technology transfer programmes</li> </ul>	<ul style="list-style-type: none"> <li>• Belgium, Denmark, Finland, Spain, Sweden, Switzerland, The Netherlands</li> <li>• Spain, Finland, Sweden,</li> <li>• Denmark, Sweden</li> <li>• Spain, Switzerland</li> </ul>
V. missing demanding customer	<ul style="list-style-type: none"> <li>• public procurement policy</li> </ul>	<ul style="list-style-type: none"> <li>• Austria, The Netherlands, Sweden, Denmark</li> </ul>
VI. government failure	<ul style="list-style-type: none"> <li>• privatisation</li> <li>• get out of subsidy business</li> <li>• horizontal policy making</li> <li>• public consultancy</li> <li>• downsizing government interference</li> </ul>	<ul style="list-style-type: none"> <li>• Most countries</li> <li>• Canada</li> <li>• Denmark, Finland, Canada</li> <li>• Canada, The Netherlands</li> <li>• Canada, USA</li> </ul>

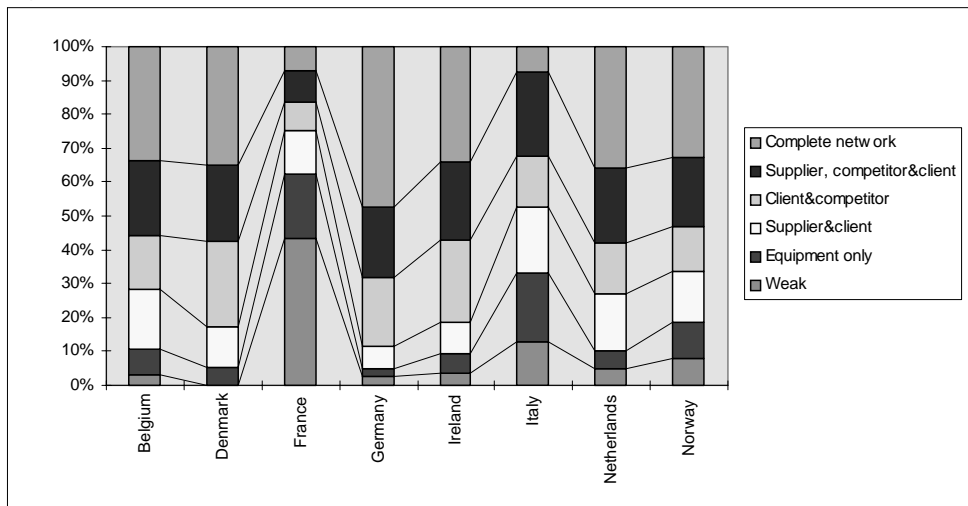
<sup>11</sup> Preliminary review to be discussed during the 2nd workshop in Vienna, May 4th & 5th. Participating countries are asked to check this table for their country. Any comments on this table are welcome. This table intends to indicate the most important characteristics of a country's cluster-based policy. A more comprehensive study to fill in the policy matrix is conducted by Technopolis (P. Boekholt & B. Thuriaux, *Overview of cluster-based policies in International Perspective*), to be published in the Summer of 1998.

**Figure 2.3 - Innovative interactions and exchange of goods within Lombardy**



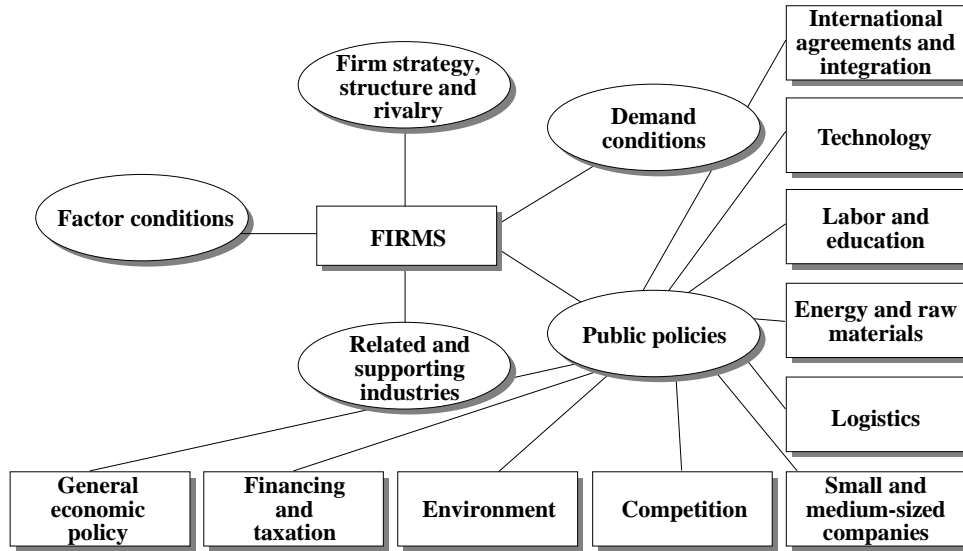
Source: DeBresson & Hu, 1997.

**Figure 2.1 - Networks of innovation in 8 OECD-countries**

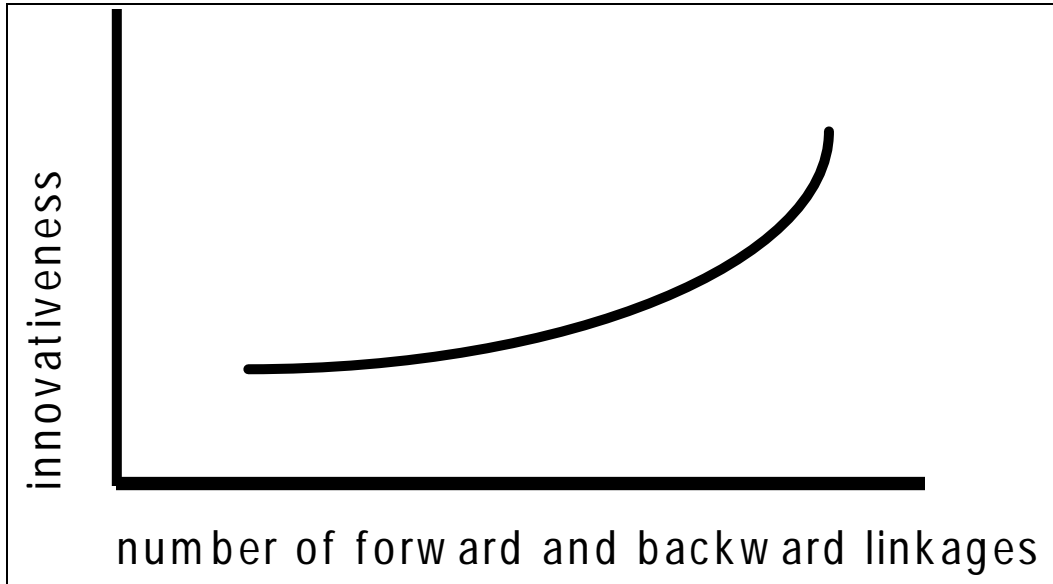


**Source: DeBresson et al, 1997, from CIS data**

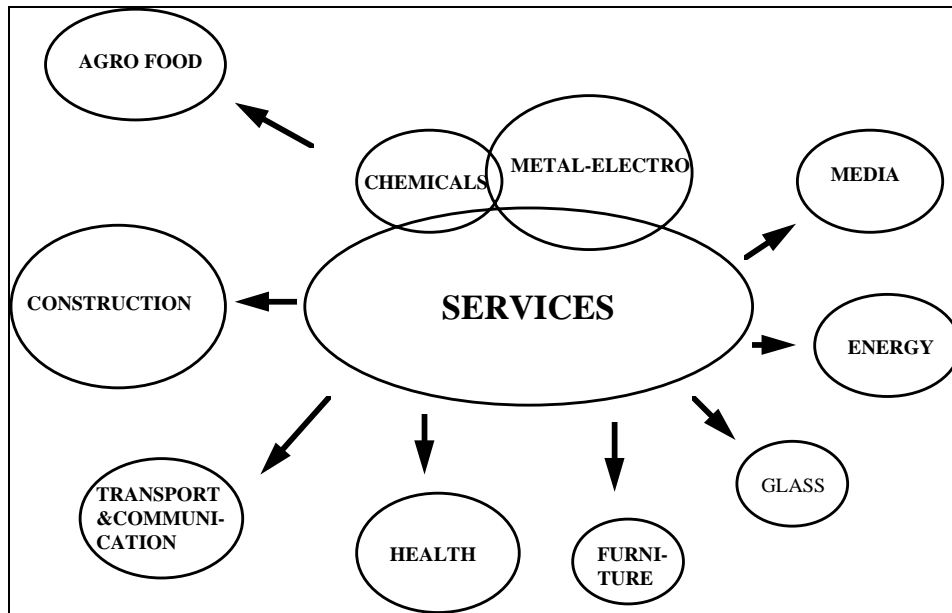
Figure 2.4 - Porter's diamond in cluster case studies: The Finnish example



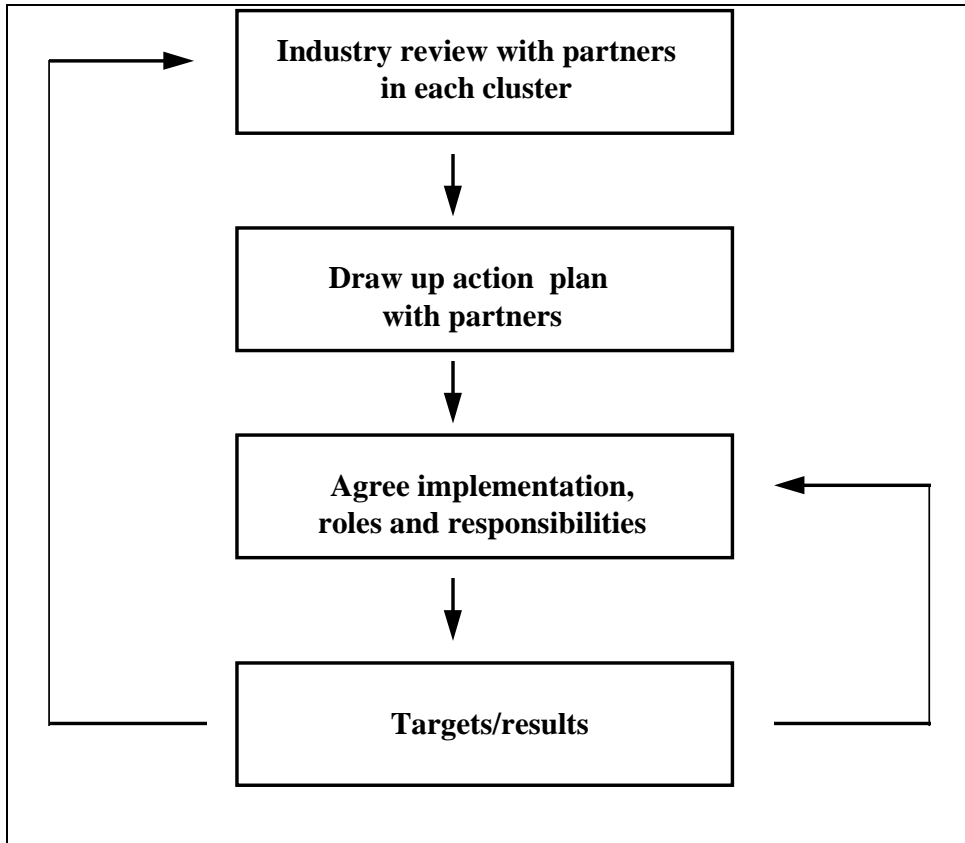
**Figure 2.2 - The vertical interdependency hypothesis**



**Figure 2.9 - Mega clusters in the Dutch economy, 1992**

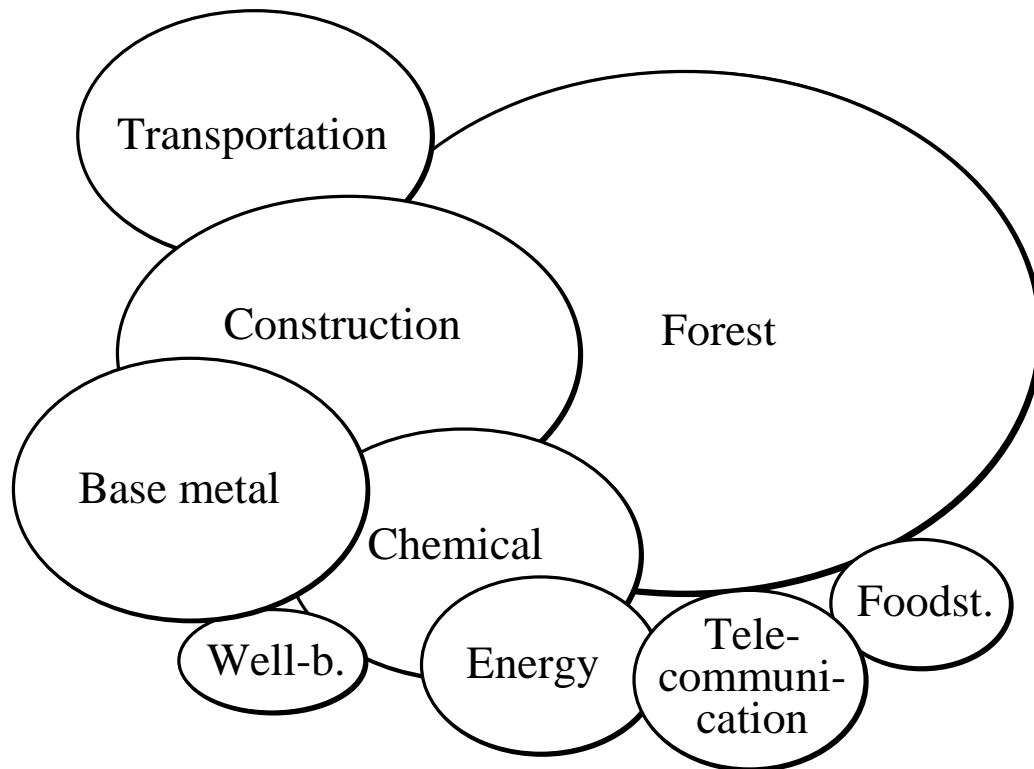


**Figure 2.8 - Scottish Enterprise cluster approach**

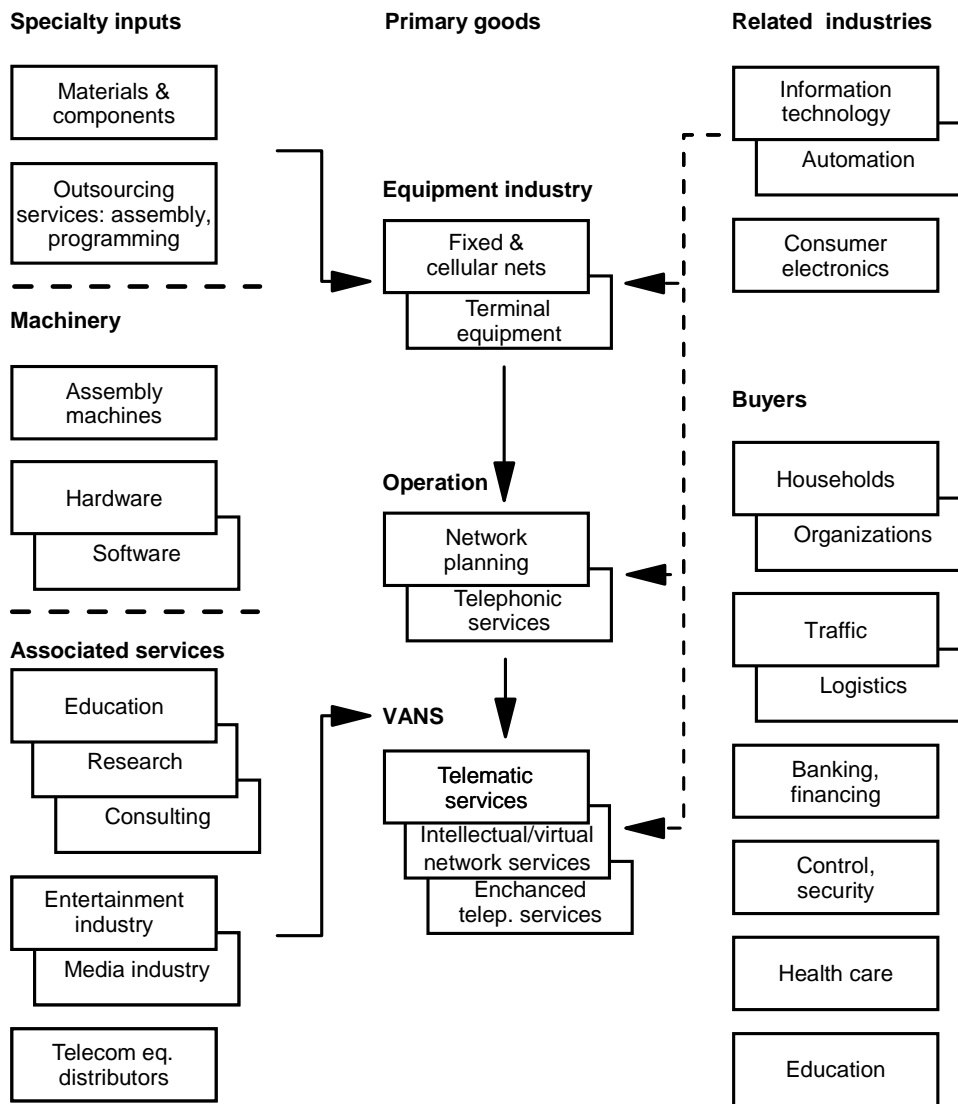


**Source: Legendijk and Charles, 1997.**

**Figure 2.5 - Mega clusters in the Finnish economy**



**Figure 2.6 - The tele-communication cluster in Finland**



**Figure 2.7 - Clusters in the U.S.-economy**

**Figure 2.10 - The Ottawa cluster**

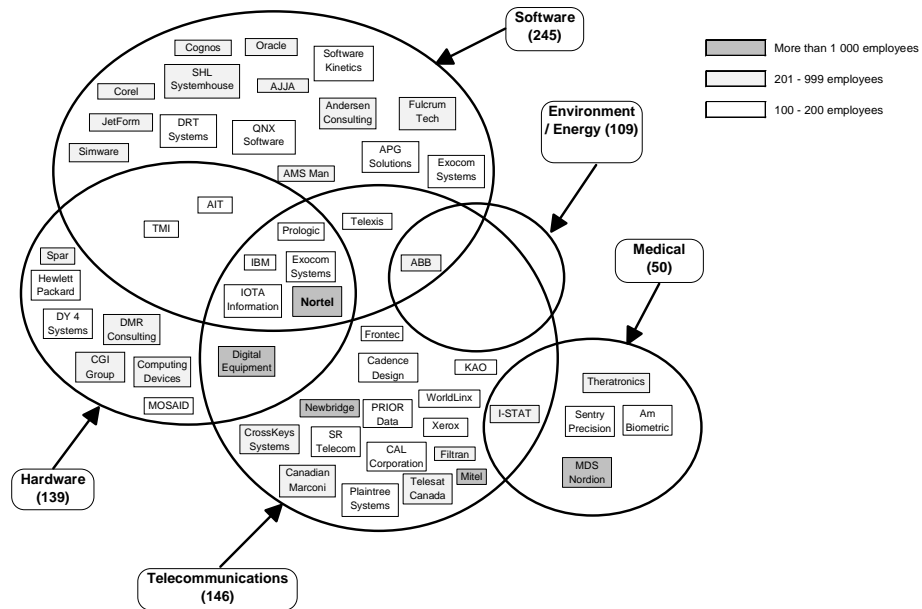


Figure 3.1 - Horizontal cluster-based policy making

