Strategic Study

Industry clusters and SMEs

A state-of-the-art study

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Zoetermeer, December 1998

ISBN: 90-371-0723-0
Price: NLG 35.-
Order number: B9806

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This study is funded by the Ministry of Economic Affairs.

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1 Introduction

1.1 Industry clusters and SMEs: a new perspective

Nowadays, concepts such as co-operatives, business networks, strategic alliances and industry clusters have gained much popularity in business, government and the academic world. These concepts have in common that they refer to strategic co-operation between organisations. In general, strategic co-operation is viewed as an organisational survival strategy in today's intensely competitive business environment. Some authors suggest that co-operation strategies are part of a new industrial order ('alliance capitalism'), in which competitiveness depends on the continuous collaboration of organisations with external sources of knowledge (Best, 1990: Kenworthy, 1995: Enright, 1995; Dunning, 1997).

The idea of interorganisational co-operation is not new. For example, in the medieval period members of guilds used to collaborate with each other. What is new, however, is the aim of the modern co-operative efforts and the environment in which firms have to operate. Through co-operation members of guilds tried to reduce uncertainty in an unstable and sometimes even hostile political environment and to co-operate in the field of production, standards and quality regulations for the craft. Although modern co-operative efforts often also aim to reduce uncertainty they have a different reason. These efforts are responses to the increasing complexity of the market and the dynamic business environment in which firms have to operate and the resulting uncertainty about their future market position. Co-operation enables modern firms to innovate, to get access to information and technology, to realise economies of scale, to increase their market power and/or to enter new geographical areas all with the basic motive to reduce uncertainty about their market position and maintain or enhance their competitiveness.

It is not only the uncertainty of the increasingly dynamic international business environment which has resulted in the emergence of modern industry clusters. Modern co-operative efforts are often technology-based, aiming at collaborative research and development (R&D) in order to realise product and/or process innovations or to shorten the time to market period. As a result these co-operatives involve a complex interplay of different parties (firms such as suppliers and customers, universities, research institutes, consultants)

which provide each other with complementary knowledge. This complexity of co-operative efforts together with the growing uncertainty of firms about their future market position has led to the emergence of co-operatives, which can be typified as modern industry clusters.

When discussing industry clusters, many authors analyse the nature and the effects of a cluster irrespective of the characteristics of its participants. Literature often pays no explicit attention to the influence firm size has on the position and role of the firms within an industry cluster. Several authors, however, argue that the difference between large firms and small and medium sized firms (SMEs) can be of importance and should be taken into account when analysing phenomena such as industry clusters (Nooteboom, 1993; Rothwell, 1995; Oerlemans, 1996; Klein Woolthuis, 1996). In order to reduce uncertainty and maintain their competitiveness SMEs may be willing to develop new products, but do not have the economies of scale and scope in the R&D-function which large firms often do have. Large firms, in contrast, may not possess the specialised knowledge of SMEs. Through co-operation a trade-off can be realised between a large and a small firm in such a case. In order to attain economies of scale or scope SMEs do not necessarly have to co-operate with large firms. It is also possible that only small firms are involved in co-operatives to attain these economies or only large firms are participating in a cluster in order to develop a certain specialisation.

Since motives for clustering may differ along with firm size, it can be argued that the role and position in industry clusters as well as the characteristics of industry clusters may differ along with firm size. In this study the aspect of firm size will therefore be integrated in the analysis of industry clusters. In order to do so and also for the assessment of the role and position of SMEs in industry clusters in future research, a broad definition of a modern industry cluster will be applied. As will be further discussed in chapter 6, limiting the definition to technology-based co-operative efforts inhibits the risk of limiting our analysis. In the study, however, it will become clear to the reader that modern industry clusters are often associated, in international literature, with innovative activities within industrial sectors. As we will see in chapter 5, empirical evidence also suggests that the main motives for SMEs to participate in a modern industry cluster are technology-based. Since this is the case, we will analyse and deepen our understanding of industry clusters by focusing on technology-driven co-operative activities, which primarily take place within industrial sectors. However, in the synthesis of the study

results we will come to our own working definition of modern industry clusters. This broad definition will form the basis for further research on the role and position of SMEs in these clusters.

1.2 Aim of the study

The first aim of this study is to synthesise different contributions from literature in order to come to a working definition of industry clusters. The second aim is to study the aspect of firm size in industry clusters and to develop a preliminary theoretical framework which will form the basis of future research to assess the role and position of SMEs in industry clusters

To realise these aims, the first step is to study the market trends which have resulted in a new economic structure in which innovation and industry clustering play an important role. Next, we will focus on different ways of cluster thinking. Researchers and governments may look at industry clusters as being industrial districts, systems of innovation or as crucial networks in a nation's value system (Porter). Although these ways of thinking have received individual attention over time, they still coexist as different approaches each of them focusing on one or more specific cluster dimensions. In fact, the coexistence of these cluster approaches present a general picture of industry clusters and show that they can have a multi-dimensional character. The resulting multi-dimensional approach, including a vertical, horizontal, geographical and/or an institutional dimension, will not only be applied to come to a definition of industry clusters but also as an instrument to study industry clusters and to assess the role and position of SMEs in these clusters.

To deepen our further understanding of clustering we next connect industry clusters with theoretical concepts such as market failures, transaction costs and relationships. After this broad theoretical framework we turn to the literature that can be used to examine the aspect of firm size (large firms versus SMEs) in industry clusters. Finally, various contributions from literature on industry clusters and SMEs will be brought together in a theoretical framework which can be applied for future research to assess the role and position of these firms in industry clusters.

1.3 Outline of the study

After this introductory chapter the study is divided in four chapters. Chapter 2 deals with market trends favouring the emergence of industry clusters. In chapter 3 and 4, in respective order, ways of

cluster thinking and economic theories with respect to clustering are discussed. Chapter 5 is devoted to the question what role the aspect of firm size plays in industry clusters. In chapter 6 a synthesis of the previous chapters is made and a preliminary theoretical framework is developed for further research on the role and position of SMEs in industry clusters.

2 The emergence of industry clusters

The growing attention for industry clusters in the 1990s is connected with a business environment which has become increasingly uncertain and complex. The uncertainty and complexity are caused by various market trends, which will be discussed in this chapter[1]. It will become clear that these trends have led to the paradoxical situation that competition and co-operation between market parties go together. At the same time the market trends have changed the structure of the economy from one consisting of various industries towards one composed of industry clusters.

This chapter is organised as follows. In section 2.1 we successively describe the market trends favouring industry clustering. Section 2.2 explains how these trends have resulted in a new competitive structure and in a balance between competition and co-operation. The shift from industries to industry clusters in the economy is examined in section 2.4. Finally, in section 2.5 the chapter ends with a conclusion.

2.1 Market trends favouring industry clustering

The emergence of industry clusters can be related to trends that came about in the world market, in particular globalisation, technological developments, changing market demand and trends in the regulatory environment (cf. Peters and Lever, 1996). As a result of these trends the rivalry in the market has not only intensified, but also changed in character.

Globalisation

The term ‘globalisation’ refers to the phenomenon that currently the number of economic relations in the world economy is increasing. Due to the liberalisation of world trade, European unification, the opening of the Central and Eastern European economies, increasing foreign direct investments and the migration of labour, more and more connections between parties emerge in the market place. The phenomenon of globalisation results in a functional integration of spatially dispersed activities with no company or country being able to operate in a totally independent manner (Petrella, 1995). This new

1 We would like to thank Koos van Dijken for his contribution to the study and especially to the contents of this chapter.

global context forces companies to change their competition strategies in the market.

Technological developments

For ten years now one has been able to observe the trend that the pace of technological development is accelerating. In particular, developments in information and communication technology have led to a reduction in the cost of transporting people, goods, services and information (Dicken, 1992). Although these 'space shrinking technologies' lead to cost reductions, simultaneously the necessity for R&D to develop new technologies is becoming more expensive. This is caused by the fact that nowadays most innovations are realised by combining several complex technologies ('cross roads technologies'). Examples of such technologies are optomechatronics and biochemistry (Technology Radar, 1998).

Changing market demand

Another important market development is the change of preferences on the demand side of the economy. Both consumers and contractors have stricter requirements regarding the quality of the products and services they buy (Commandeur, 1994). This 'customisation' means that products and services have to be tailored to the individual customer requirements. Demand for new products and product varieties is increasing at the cost of a relatively stable demand for mass products. To satisfy this demand for a greater variety of products, firms apply batch type machines that can produce without the loss of too much efficiency in their production process (Thurik, 1993).

Product life cycles and time to market shorten

Due to this intensifying international competition the product life cycle shortens more and more, meaning that the life curve of a product from the moment it is introduced until the moment it is taken off the market is becoming shorter (Commandeur, 1994). The shortening of the product life cycle continuously increases the need for new products and, as a consequence, for new product development. Not only the intensity, but also the character of competition has changed (Roelandt et al., 1997). Some time ago many companies could suffice by competing as to price, but nowadays their competitiveness is becoming more dependent upon the ability to develop innovations, i.e. new products, services and production processes and upon the time to market or speed to introduce new products or product varieties. At the same time, the rate of specialisation between companies is increasing. In order to avoid too many risks and to reduce their time to market, many firms are forced to specialise around their core

competencies. This specialisation can be evident from the sale or outsourcing of business activities and from the splitting up of company parts into independent business units.

Specialisation and more focus on core competences

The simultaneous need for new product development, a shorter time to market period and specialisation poses problems for firms. These developments require several different technologies, innovative speed and also financial resources. Firms are often not capable of meeting all these requirements. They are able to specialise in a certain area and direct their own resources towards these so-called core competences, but for all necessary complementary competences they increasingly depend on other firms and institutions. The ways in which firms gain access to complementary competences vary from the establishment of mergers and acquisitions (concentration) to more flexible technological co-operatives such as joint ventures and outsourcing. The benefits of such co-operation for the participants are clear: it allows them to gain new skills and technologies, realise efficiency improvements, share costs and risks and penetrate new markets (Veugelers, 1998). The focus on core competences can be seen throughout the entire value chain. The market trends described have also forced supplying industries to specialise and increase their product and service quality. The higher quality of its suppliers makes it easier for a demanding firm to focus on its own core competences and, at the same time, forms a sound basis for co-operation (van Dijken et al, 1995).

2.2 Balancing competition and co-operation

The market developments described create the paradoxical situation that firms co-operate in order to remain competitive. However, success stories of industry clusters, in which competition and inter-firm co-operation coexist with an innovating economy, show that firms are able to resolve the paradox. To note a famous example, firms producing ceramic tiles in the region of Emilia-Romagna co-operate in the field of purchasing and research on materials, while competing aggressively with each other in the market place at the same time. Therefore, firms should not ask themselves whether to compete or to co-operate, but rather on what dimensions to compete and on what dimensions to co-operate (Enright, 1997). This question involves a trade-off between access to more resources versus the potential for loss of proprietary information to competitors. In short, firms should try to balance competition and co-operation (Kenworthy, 1995).

Shift from the managed economy to the entrepreneurial economy

The idea that competition and co-operation should go hand in hand can be related to the more general context sketched by Audretsch and Thurik (1997). They argue that currently a fundamental shift is taking place in OECD-countries from the 'managed economy' to the 'entrepreneurial economy'. One of the changes in this fundamental shift involves is the emergence of the view that competition and co-operation are not substitutes, but rather complements. According to the authors the end of the managed economy and the emergence of the entrepreneurial economy is a consequence of two important forces of globalisation. First, low-cost but highly skilled competition from Central and Eastern Europe as well as from Asia has threatened the managed economies of Western Europe and North America. Second, the revolution in telecommunications and microprocessors has lowered the cost of shifting standardised economic activity out of these high-cost economies into lower-cost locations elsewhere in the world.

Monopolisation versus co-operation

The managed economy, which flourished for most of the 20th century, was characterised by stability, continuity, scale and homogeneity (Chandler, 1990). The comparative advantage of this economy was primarily based on the availability of traditional production factors (land, labour and capital). In contrast, turbulence, flexibility, diversity and heterogeneity are central concepts in the entrepreneurial economy, in which the comparative advantage is derived from innovative activities. To conduct these activities a new production factor is necessary, namely new, innovative knowledge. In the managed economy knowledge was typically associated with power. For instance, the practice within large organisations such as IBM and Philips seemed to be 'knowledge is power'. Monopolisation rather than co-operation in the field of knowledge was considered to be beneficial for the economy. In the entrepreneurial economy, however, co-operation between individuals in networks, such as in California's Silicon Valley, is considered as a useful means to transmit new knowledge across agents, firms and even industries (Saxenian, 1990). The individuals in such networks are stimulated to interact co-operatively in order to create new knowledge that otherwise would remain undiscovered. At the same time, firms compete with each other for new knowledge, which is embodied in these individuals. In this context Audretsch and Thurik (1997) argue: 'Thus, there is a high degree of competition for new ideas among the very firms that are co-operating to create those ideas'.

Balancing competition and co-operation determines a firm's competitive advantage

In the entrepreneurial economy competitiveness depends on knowledge and on the ability of firms to participate in networks to make use of this knowledge. In this economy knowledge-based competition and co-operation are regarded as the only way for firms to respond to the intensifying competition from low-wage countries and to survive in the international market place. An increase in such competition may actually induce an increase in co-operation between firms searching for new knowledge. In this view, the key success factor for a firm's competitive advantage is the degree to which the firm is able to balance competition and co-operation in the field of innovative activities.

Strategic importance enhances the complexity of co-operation agreements

In order to survive, companies have to specialise and focus on their core competences and have to co-operate in order to gain access to complementary competences. Therefore, more and more companies are aware of the fact that technological co-operation activities are of strategic importance for them in order to survive. As a consequence, co-operation agreements are set up for a longer term and are increasingly formalised in an independent legal structure. Furthermore, the co-operative structures are becoming more complex. Strategic co-operative activities are not limited anymore to two companies in the same branch of industry (sector) setting up a joint venture. Instead, the agreements are frequently characterised by both vertical and horizontal relationships, within or beyond the same value chain and within or beyond the traditional borders of sectors. Due to the growing complexity of these co-operatives the number of their participants is also growing.

2.3 From industries towards industry clusters

The preceding sections of this chapter suggest that clustering of market parties is a relatively new phenomenon. However, looking at the historical development of the European economy, one can see that this is not the case. Generally speaking, one can notice a trend throughout the last five centuries going from a cluster economy towards an economy of mass-production and back to a cluster economy. From the Middle Ages on until the end of the 19th century, the European economic system was characterised by local economic activities on a small scale.

Local co-operation in the craft sector in the Middle Ages

In the medieval period firms were mainly operating in the craft sector and often collaborated with other firms in corporate groups such as guilds. The members of the guilds co-operated with each other in the field of production activities, standards and quality regulations for the sector. Like modern co-operatives, guilds can be seen as centres of industrial production in which the risks for its members were reduced (Ogilvie and Cerman, 1996).

Regional concentrated networks in the 19th century

Historical examples of industry clustering in the 19th century can be found in Great-Britain as well as in the Netherlands. The British cotton industry derived much of its competitiveness from regionally concentrated networks in which producers co-operated with suppliers of machines and transportation facilities (Lazonick, 1992). In addition, the success of the steel industry in Great-Britain can be ascribed to the interfirm co-operation in the domain of R&D ('collective invention') (Allen, 1983). The 19th century Dutch economy also provides us with examples of local clustering of industries (Bos, 1982). In various parts of the Netherlands regional networks of firms were co-operating in the development and production of for example sheets (Leiden), textiles (Twente, Tilburg) or shoes (Langstraat) and cacao butter (Zaanstad).

The rise of the managed economy

In the beginning of the 20th century this period was followed by what can be called the 'managed economy' discussed in the previous section. In this 'big is beautiful'-period mass production was the central issue (Taylorism). Companies were looking for economies of scale and were competing on prices. In this period co-operative activities were not regarded as useful, because they would involve a reduction of a firm's competitiveness.

Clustering in the entrepreneurial economy

In modern times, however, the idea of clustering as a competition strategy has returned, although the background is somewhat different from the previous type. It is not so much the proximity of suppliers near a firm, but rather the changed economic structure that calls for the cluster approach instead of the traditional sectoral approach. First, technological co-operation in industry clusters often crosses sectoral borders, because innovations often are realised by combining different technologies (Technology Radar, 1997). Second, the modern economy is characterised by vanishing borders between

manufacturing and services as well as between private and public organisations. As large companies are increasingly concentrating on their basic competences, former company functions such as services (e.g. automation support) are sourced out to other organisations (Illeris, 1996). Therefore, Porter (1997) argues that the cluster approach offers an alternative for the traditional industry approach. According to him there are several points at which clusters differ from industries (sectors). These points are listed below in table 2.1.

Table 2.1 Industries / Sectors versus Industry clusters

Industries / Sectors	Industry clusters
• Focus on one or a few end product industries	• Include customers, suppliers, service providers, and specialised institutions
• Participants are direct or indirect competitors	• Incorporate the array of interrelated industries sharing technology, skills, information, inputs, customers, and channels
⇓	⇓
• Hesitancy to co-operate with rivals	• Most participants are not direct competitors but share common needs and constraints
• Dialogue with government often gravitates towards subsidy, protection, and limiting rivalry	• Wide scope for improvements on areas of common concern that will improve productivity and raise the plane of competition
• Lower return on investments	• Leverages public and private investments
• Risk of dulling local competition	• A forum for more constructive and efficient business-government dialogue

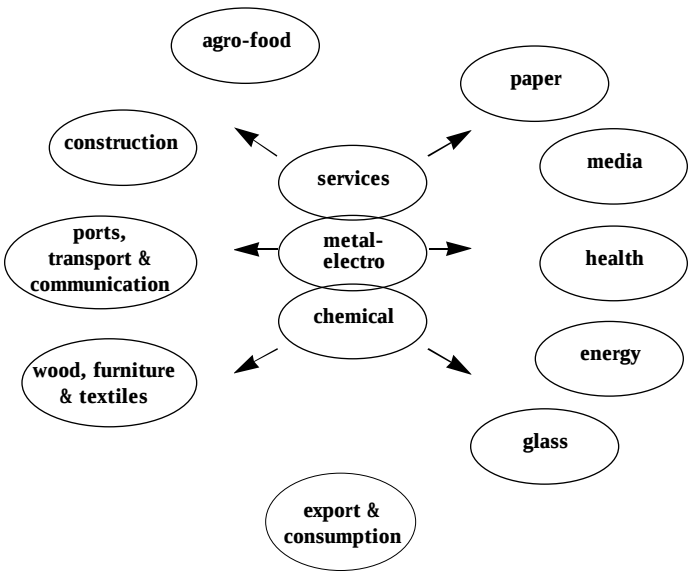
Source: Porter (1997).

Dutch national clusters

As a result of the focus of companies on core competences and, at the same time, the trend towards outsourcing of non core competences, problems arise in output measuring. Because some industrial companies still conduct service activities, while others have sourced them out, difficulties arise in the registration of personnel. In the first case, personnel is categorised as belonging to the manufacturing industry and in the second case as service industry personnel. One way to prevent such measurement problems, is to look at the economy in terms of clusters. Roelandt et al. (1997) have identified the existing clusters in the Dutch economy with the help of an 'input-output analysis'. By using this aggregation method linkages between

main suppliers of goods/services and main users can be analysed at the level of industry groups. The authors identified the following large conglomerates of interlinked industry groups at national level, also called megaclusters: construction; chemical industries; commercial services; non-commercial services; energy; health; agro-food; media; paper; metal-electro; wood, furniture & textiles, and port, transport & communication. Figure 2.1 shows that the identified clusters in the Dutch economy cross the borders of traditional industries. Therefore, it seems better to speak of a mixture of industry groups in a cluster than to make a distinction between primary, secondary and tertiary industries. To note an example, the health cluster does not only include health and veterinary services ((academic) hospitals, psychiatric institutions and other medical services, dentists and veterinary surgeons), but also firms producing phamaceutical products and sterile dressings (Roelandt et al., 1997). Thus, clusters are complex entities composed of linkages between suppliers, customers and/or knowledge institutes co-operating in order to create innovative value added.

Figure 2.1 Clusters in the Dutch economy at the national level



Source: Roelandt et al. (1997).

2.4 Conclusion

This chapter has revealed that developments in the world market have not only intensified competition, but also changed its character. The competitiveness of firms is becoming increasingly dependent on their ability to innovate and co-operate with other parties in industry clusters. As a result, firms have to find a balance between competition on the one hand and co-operation on the other hand. As industry clusters emerge more and more in the market it seems more realistic to use the cluster approach than the traditional industry approach when looking at the structure of modern economies.

The focus on core competences and the strategic importance of co-operation both have an impact on the role and position of SMEs in the value chain. As a matter of fact, firm size may even have lost its importance as a success factor. Some market trends which have enhanced the strategic importance of co-operation may actually favour smallness. In chapter 5, some of the advantages of SMEs in co-operation agreements will be discussed.

However, in order to understand the role and position of SMEs in industry clusters, it is first necessary to get to know industry clusters. In order to analyse and investigate industry clusters, policy makers and researchers apply several ways of cluster thinking. These approaches have received individual attention over time, but do coexist in modern cluster policy as well as in industrial cluster theory.

3 An overview of cluster thinking

As a result of the market trends described in the preceding chapter industry clusters have emerged in the market. Not only firms and policy makers, but also researchers are increasingly interested in industry clusters. In consequence cluster studies have been or are being carried out in many OECD-countries. These studies are often based on one of the following cluster approaches (OECD, 1998):
– industrial districts;
– systems of innovation;
– Porter's clusters.

We will discuss these approaches successively in the following three sections (3.1, 3.2 and 3.3). In section 3.4 the various cluster dimensions on which the approaches focus are presented and illustrated with some examples of existing clusters in the Netherlands. The chapter ends with a conclusion in section 3.5.

3.1 Industrial districts

Marshall: firms benefit from geographical concentration

In the first place industry clusters can be understood as 'industrial districts'. The notion of industrial districts goes back to Marshall (1947) who presented an economic analysis of the location of industries. The author explains the development of geographically concentrated clusters, which he calls 'industrial districts', by three factors: specialised labour, specialised intermediate inputs and knowledge spillovers. First, firms are attracted to a particular location by a labour market with highly skilled workers. These workers do not only possess specialised technical skills, but also knowledge about people and their work in the industrial district. Second, location near a pool of specialised intermediate inputs provides advantages to a firm. In this way the firm can obtain specialised equipment, tools, technologies and services from supporting industries. Third, firms can absorb knowledge spillovers in an industrial district, because it is easier to realise information exchange within the same location than over great distances. The various benefits of localisation are external to the particular firms ('external economies'), but internal to the industrial district as a whole. Marshall argues that the achievement of these benefits depends on the existence of close social relationships between firms creating an 'industrial atmosphere' within the district (see also Becattini, 1990). It is clear that such an atmos-

phere favours the learning and innovation process of the firms in the region:

'Good work is rightly appreciated, inventions and improvements in machinery, in processes and the general organisation of the business have their merits promptly discussed: if one man starts a new idea, it is taken up by others and combined with suggestions of their own; and thus becomes the source of further new ideas' (Marshall, 1947: 225).

The revival of Marshallian industrial districts

Marshall left most of his ideas regarding industrial districts undeveloped. However, his analysis played an important role in explaining the economic success of clusters of small firms in the North of Italy during the last 15 to 20 years (Cooke and Morgan, 1994). In the region of Emilia-Romagna, for example, clusters producing machine tools, tiles, knitting and footwear can be found. Although around three-quarters of the manufacturing workers are employed in firms with 100 employees, the region has developed from one of the poorest in Italy to one of the richest in Europe. The success of the clusters in northern Italy attracted the interest of policy makers and researchers. Clusters of small firms were identified and studied in other countries also. Examples of such 'Marshallian industrial districts' are Baden-Württemberg (Southern Germany), Jutland (Denmark) and Silicon Valley (California). In the analysis of such industrial districts, however, the researchers place more emphasis on the role of institutions than Marshall did. In addition to inter-firm linkages linkages with institutions, such as trade associations and government agencies, are also seen as important factors explaining the success of industrial districts.

The contribution of Piore and Sabel (1984) stimulated further research on industrial districts. In their book 'The Second Industrial Divide' Piore and Sabel identify fundamental shifts in the social organisation of production and exchange in industrial economies. The authors argue that since the 1970s the system of mass production has been in a crisis. A clear indication of the possible end of this period of 'Fordism' is, according to them, the emergence of networks of small firms. The firms in a network can acquire competitive advantage by using their flexibility to specialise in niche markets. By co-operating with other firms in product design or manufacturing they can benefit from cost advantages ('collaboration economies'). These networks lead to the clustering of actors in the same region,

because co-operation is facilitated by face-to-face interactions and local social relationships.

One of the authors who was inspired by the concept of 'industrial districts' is Krugman (1991). In his work, Marshall's (1947) ideas are formalised and brought up to date. In his work Marshall's (1947) ideas are formalised and Krugman stresses the importance of large-scale firms with increasing returns to scale for the emergence of a cluster at a particular location. These firms will attract supplier firms in order to lower transportation costs and they will stimulate the development of a local pool of skilled labour around these firms. Through the exchange of specialised inputs, services and labour the firms within the cluster continuously learn from each other. In this way they can profit from 'agglomeration economies'. The author thus views geographical clustering of production as a means for firms to create sustainable competitive advantage, even in a world economy that is becoming more and more closely integrated.

Peneder and Warta (1997) interpret the analysis of Marshall in another way. They highlight the aspect of 'interrelatedness' in industrial districts. This hypothesis of interrelatedness focuses on the existence of dynamic complements between firms in a cluster which influence the specialisation pattern in production. Innovation in one part of the industrial district results in positive effects for innovation in other parts of the district. Therefore, the authors expect a cluster of firms to perform better as one whole than the sum of its individual firms. Industrial districts show a mix of competition and co-operation

Other authors (Best, 1990; You and Wilkinson, 1994) see the key to understanding the success of industrial districts in the particular mix of competition and co-operation among its firms. The firms in an industrial district are specialised, but linked with each other through co-operation in the field of product design or manufacturing. At the same time the firms have to compete in the product market with other firms supplying similar products and services in the district. The co-operative aspects of the inter-firm relationships help the firms to overcome their disadvantage of small size, while the competitive aspects provide them the flexibility that large, integrated firms often do not possess. A balance between competition and co-operation thus seems crucial for the functioning of industrial districts.

Based on the various contributions in literature on industrial districts, Rabellotti (1998) concludes that industrial districts (clusters) can be identified by four stylised facts:

- a group of geographically concentrated and specialised small and medium-sized enterprises;
- a common behavioural code because the actors are linked by the same cultural and social background;
- a set of linkages between enterprises based on the exchange of goods, services, labour and information;
- a network of public and private local institutions which support the actors in the cluster.

In sum, by considering clusters as industrial districts one recognises the fact that many clusters are closely embedded in their regional environment. Austria is a country in which this approach is applied to analyse clusters in the economy (Peneder and Warta, 1997).

3.2 Systems of innovation

Until the 1960s economists viewed innovative activities as technologically driven. Innovation was assumed to be a linear process passing from scientific discovery, applied research, development and production, ultimately leading to a new product or process on the market. During the late 1960s this 'technology push'-model was replaced by the 'market pull'-model of innovation (Rothwell, 1994). In this model innovation was seen as driven by the needs of customers on the market, resulting in well focused R&D and in a new product or process to meet customer requirements.

Various institutions are involved in the innovation process

In modern literature on innovation systems these linear models are considered as far too simplistic. Authors as Freeman (1987) and Lundvall (1992) suggest that instead the innovation process is characterised by complicated feedback mechanisms and interactive relations regarding research, development, production and marketing. It is argued that innovation is a cumulative, interactive and learning process and that firms are almost never able to innovate in isolation. Also various other organisations are involved in the development and diffusion of innovations. These organisations can be other firms (suppliers, customers, competitors) but also universities, research institutes, private consultants, government agencies, etc. Together, these market and non-market institutions constitute what has been called a 'system of innovation' (Edquist, 1997). A system of innovation can be defined as a '... set of distinct institutions which jointly

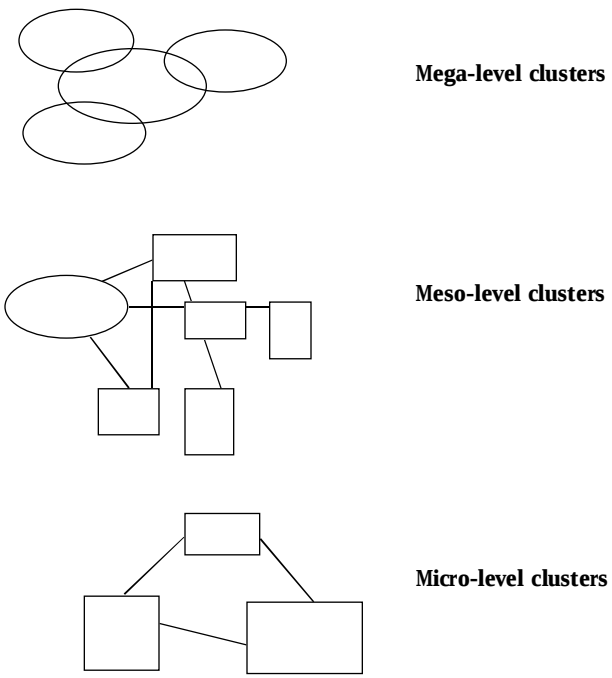
and individually contribute to the development and diffusion of new technologies and which provide the framework within which governments form and implement policies to influence the innovation process' (Metcalfe, 1995). In this view, the interplay of the innovative activities of firms and the functioning of institutions are seen as crucial for the rate and direction of technological change in a system. The approach of systems of innovation has recently received considerable attention from policy makers and researchers. Although the approach is considered to be a useful tool for a better understanding of innovation processes, it is still associated with conceptual problems (Edquist, 1997). Depending on the focus of analysis, authors define systems of innovation in geographical terms, using different levels of aggregation, or in technological terms. Often innovation systems are studied from a national perspective (see for example Nelson, 1993). But innovation systems may also be regional or local within a country or even include a part of the world, such as the innovation system of an integrated Europe (see Caracostas and Soete, 1997). Within any of these geographically determined systems one can distinguish one or more technological systems of innovation. Carlsson and Stankiewicz (1995) describe a technological system as '... a network of agents interacting in a specific economic/industrial area under a particular institutional infrastructure or set of infrastructures and involved in the generation, diffusion and utilisation of technology.' In analysing industry clusters both the geographical and the technological approach of systems of innovation are used.

Industry clusters appear at different levels of aggregation

Within the OECD National Systems of Innovation (NSI)-project industry clusters are studied by using a reduced scale model of the NSI-approach (OECD, 1998). The starting point of this cluster approach is that innovation is not so much an activity of a single firm, but rather a learning process that requires interaction, knowledge exchange and co-operation between various organisations in a network of production. This is supported by literature on innovation systems that argues that innovations have two essential dimensions (Morgan, 1997). First, the interaction between different actors in the innovation process is very important for innovating successfully. This applies in particular to the interaction between users and producers of intermediate goods (e.g. raw materials and components) and between the business and research community. Second, the innovation process is institutionally embedded in production networks (clusters). In this view clusters can be analysed by identifying the linkages and the interdependence between actors in an institutional setting of networks of production.

By following the perspective of clusters as a reduced scale model of the NSI-approach, one can distinguish three different kinds of clusters in an economy: macro clusters, meso clusters and micro clusters (Cimoli, 1997; Roelandt et al., 1997; OECD, 1998). In figure 3.1 these cluster types are presented. First, there are macro clusters referring to the national level. These clusters are composed of linkages within and between industry groups which indicate specialisation patterns in the economic structure of a country. Examples of these 'mega clusters' in the Netherlands are the metal-electro cluster, the cluster of chemical industries or the cluster of services. Second, clusters can be sectoral or regional concentrated. Such clusters can be found at the meso level of the economy and are made up by linkages within and between industries or regions. As an example of a meso cluster one can think of the network of firms and the knowledge infrastructure of the Dutch flower cluster. Finally, micro clusters at firm level are of importance in the economy. In this case specialised suppliers are linked to one or a few core firms (e.g. the Océ-cluster in the southern part of the Netherlands).

Figure 3.1 Clusters at different levels of aggregation



Source: Roelandt and Den Hertog (1997).

Innovating firms and other institutions must have economic competence

Besides the NSI-approach the technological systems approach can be used to analyse industry clusters. Technological systems are defined by technology rather than by geographical boundaries. Further, these systems differ from national systems of innovation in the degree of emphasis laid on the diffusion and utilisation of a new technology distinct from its generation. Carllson and Stankiewicz (1995) criticise the assumption of authors in the NSI-tradition that just because an innovation exists, it is also known and used effectively by the actors in the innovation system. They argue, however, that a new technology does not offer practical business opportunities for firms, unless it is converted into economic activity. Therefore, the actors in a given system must possess a certain economic competence (absorptive capacity) which is defined by the authors as '... the ability to identify, expand and exploit business opportunities'. Carllson and Stankiewicz (1995) suggest that it may not be sufficient to have only a few competent actors in the innovation system. A variety of actors is needed, each with specific economic competence. To increase their competence they must act together in clusters which are considered as means to reduce the risk involved in innovative activities. In clusters information on innovations can be provided in time and corrective action can be taken whenever necessary. By clustering with other organisations firms can increase the connectivity of the system, thus helping both themselves and other actors. In addition, the authors see bridging institutions as important actors in establishing links between otherwise disconnected actors in the system, particularly between universities and private firms. Finally, it is argued that firms have to broaden their technology base. Such technology diversification may have two advantages: (1) it is less likely that firms will be surprised when new technologies appear and (2) it is easier for firms to take advantage of unexpected results of their R&D-activities (serendipity). So, by clustering with other organisations, by strengthening bridging institutions and by broadening their technology base, firms can contribute to a stronger technological system.

In short, the systems of innovation approach stresses the importance of linkages between firms and other institutions in the innovation process. If the resulting innovations are diffused and utilised well, the innovation system as a whole can perform successfully.

3.3 Porter's industry clusters

Nations derive their competitive advantage from clusters of industries

Another cluster approach is that of Porter (1990) who wrote the important book 'The Competitive Advantage of Nations'. This author is interested in the question why only certain countries generate many firms which become successful international competitors in one or more industries. In his analysis Porter focuses on the individual firm and its position in the structure of a particular cluster of firms in the same industry. He suggests that domestic competition continuously creates pressure on firms to innovate. In his view, firms and their relations of competition and co-operation with other organisations are the key to the competitive advantage of these firms, but also to that of the whole nation. Porter argues, then, that these innovative firms derive this competitive advantage from their place within a group of four sets of factors (determinants), which he calls the 'diamond'. These factors are:

(1) **factor conditions.** This determinant refers to a nation's position with regard to factors of production. Competitive advantage is not so much created by basic factors (cheap unskilled labour, natural resources etc.), but rather by advanced factors, which have to be constantly upgraded (e.g. highly skilled labour, a modern infrastructure).

(2) **demand conditions**. The nature of domestic market demand for a product or a service influences the success of a firm in international markets. This depends on the relative size and growth of the home-market, the quality of demand and the presence of mechanisms transmitting domestic preferences to foreign markets.

(3) **related and supporting industries.** These play an important role in the ability of firms to compete internationally. The existence of industries that provide firms with inputs for the innovation process stimulates competition and co-operation. Often the exchange of these inputs is facilitated by geographical proximity.

(4) **firm strategy, structure and rivalry**. Differences in national economic structure, organisational culture, institutions (e.g. the capital market) and history contribute to national competitive success. These conditions determine how firms are created, organ-

ised and managed, as well as how intense the domestic rivalry is.

The determinants of the diamond reinforce each other and together create the national environment in which firms operate. If this context is dynamic and challenging, nations ultimately succeed in one or more industries because firms are stimulated to upgrade their advantages over time. Porter also mentions two additional factors playing a role in national competitive advantage:

(5) **chance events.** Chance factors can cause shifts in a nation's competitive position and include elements such as major technological changes, shifts in exchange rates or input prices and important political developments.

(6) **the government.** Governments play an important role in influencing the dynamics between the four determinants of the diamond through regulations related to business, policies towards the physical and educational infrastructure etc.

If all the factors of the diamond are functioning well, the result is a cluster of successful firms, both between and within given industries. Porter (1990) defines such a cluster as '... a group of rival firms, suppliers and customers, specialised research centres and skilled labor pools that are able to draw on common skills, ideas and innovations generated by the cluster as a whole, which would not be present if the firm operated in isolation.'

Horizontal and vertical relations of firms within a value system

Porter's view on clusters is inspired by his earlier publication 'Competitive Advantage' (Porter, 1985), in which he uses the concept of 'value' to analyse the competitive position of a firm. Porter argues that a firm can be seen as a value chain, i.e. the collection of activities that are performed to design, produce, market, deliver and support a product that creates value for the buyers. Each of these activities can contribute to lower costs for the firm and create a basis for product differentiation. The firm's value chain is embedded in a larger stream of activities that is called the value system. The value system includes suppliers, delivering products and services to the firm, and various channels. On its way to the buyer the product passes through value chains of these channels which perform additional activities for the firm, such as distribution activities. Thus, creating and sustaining competitive advantage does not only depend upon

the firm's value chain, but also upon the question how the firm fits in the overall value system. As a result, clusters of competitive industries emerge, providing primary goods (end products), machinery for production, specialised inputs and associated services. According to Porter, these clusters of related and supporting industries are crucial for competitive success.

An important element of Porter's value chain approach to clusters is its emphasis on the end use of products. Consequently, Porter distinguishes sixteen possible clusters in terms of the final products that result from them:

- **upstream clusters:** materials/metals, semi-conductors/computers, forest products and petroleum/chemicals;

- **supportive clusters:** transportation, energy, office, telecommunications, defence and other multiple business services;

- **downstream clusters:** food/beverages, housing/household, leisure, health care, textile/clothing and personal affairs.

Porter considers the performance of products made in a cluster on the world market as a main indicator for its competitiveness. By including only the more competitive half of all clusters in a country, one can draft a 'cluster chart' which can be used for a comparison of the relative specialisation patterns between countries. Following this method for the Dutch economy, the strongest clusters appear to be food/beverages, petroleum/chemicals, transportation and materials/metals (Jacobs and De Man, 1996). In chapter 2 we already saw Porter arguing that the cluster approach is another way of looking at the economy. The traditional sectoral approach deals with horizontal relations and competitive interdependence: relations between direct competitors in the same product market. The cluster approach focuses on horizontal relations too, but in addition on vertical relations and synergetic interdependence between suppliers, main producers and users (see also OECD, 1998).

The value chain approach of clustering

Porter's ideas on clusters have had considerable influence on researchers and policy makers over the years. In various countries (the United States, the Netherlands, Italy, Denmark, Sweden, Finland) the diamond and the value chain-analysis have been used as a framework to analyse the competitiveness of (parts of) the

national economy. For example, in the Netherlands TNO Centre for Technology and Policy Studies has carried out Porter analyses for 63 clusters. Because the Dutch cluster approach is in line with Porter's way of thinking, it is also called 'the value chain approach'. Accordingly, Roelandt (1997) defines clusters as being '... economic networks of strongly interdependent firms, knowledge producing agents and (demanding) customers, linked to one another in a value-adding production chain'.

In summary, with the help of different concepts (the diamond, the value chain, the value system), Porter stresses the importance of clusters to create and sustain competitive advantage, not only for individual firms, but also for a nation as a whole.

3.4 Various dimensions of clusters

The cluster approaches emphasize several cluster dimensions

Considering the overview of cluster approaches presented above, it can be stated that each approach tries to combine several dimensions of clusters. The approaches differ in the degree of emphasis on one or more dimensions in particular. Jacobs and De Man (1996) argue that this subjectivity in defining clusters should not be seen as a disadvantage of the concept. Instead, by combining the three approaches a multi-dimensional cluster approach is created that can take into account the pluriformity of clusters in economic reality. From the approaches mentioned we can derive the following dimensions for defining clusters (cf. Jacobs and De Man, 1996):

(1) a **geographical** dimension: localised clustering of economic activities, mainly in a region, with the presence of a skilled labour pool and firms providing specialised inputs;

(2) an **institutional** dimension: clustering as an interactive learning process between economically competent firms and other institutions generating and utilising new technologies;

(3) a **horizontal** dimension: clustering of firms that perform similar activities and that are direct competitors outside the cluster on the product market;

(4) a **vertical** dimension: clustering of synergetically interdependent firms (suppliers, main producers and users) in a value chain of a certain product.

In practice, clusters are multi-dimensional concepts

The various cluster dimensions can be illustrated with many examples of existing clusters. Here we will discuss three Dutch examples, viz. the Océ-cluster, the TIMP-cluster and the 'Mass Individualisation Network' (see Klein Woolthuis et al., 1996 and EZ, 1997).

The Océ-cluster is an example of a geographically concentrated cluster in which networks of small supplying firms co-operate with a large company (Océ) in the development of new products. Océ makes use of up to date digital technologies to be able to develop new colour printers and colour copiers. To remain competitive in the industry this company co-operates with about 45 supplier networks in the south-east of the Netherlands. Each network of suppliers has the task of developing a module for a new product, such as the control panel of a copier. Thus, Océ wants its suppliers to combine both the R&D and the production of the module. By this way of co-operating Océ has been able to shorten the product development time and ultimately to produce better printers and copiers.

The TIMP-cluster illustrates all the cluster dimensions mentioned before. The cluster is situated in the region of Twente and is composed of parties maintaining both horizontal and vertical technological relations with each other. In the cluster two main producers, six small suppliers, two economic development agencies and the University of Twente contribute to the development of new medical technologies for home care and rehabilitation. The cluster is successful because the co-operation reduces the lead times and the costs of new technologies. Klein Woolthuis et al. (1996) argue that this success can be explained by economic and regional factors. The economic factors include the joint interest of the parties in exploiting market opportunities and the availability of subsidies for co-operation. But also the regional aspect is important for the cluster's success. Because the parties involved have the same cultural, educational and professional background, they feel strongly connected with each other.

The Mass Individualisation Network is a national cluster in which the Ministry of Economic Affairs and about 50 large and small competitors (e.g. retailers) participate. The cluster is based on the observation that consumer behaviour is becoming more and more individual and unstable. This trend of 'customisation' clearly creates economic opportunities for the market parties. However, responding to different customer needs requires a more flexible organisation of

firms and a good network for the provision of information. Therefore, with the assistance of the Ministry, the firms co-operate with each other in projects to find solutions to handle the trend of customisation. This example illustrates two points regarding clusters. First, though clusters are often regionally embedded, this is not always the case. Second, the innovations resulting from clusters are not restricted to new technologies. The co-operation can also be aimed at the development of innovative services that are important in the field of retailing.

The examples make clear that a cluster is composed of several parties (e.g. large firms, small firms, public institutions) and can be understood as a combination of different dimensions. It is important to realise that each of these dimensions requires 'tailor made'-firm strategies related to clustering (Jacobs and De Man, 1996). In consequence, a multi-dimensional cluster approach is necessary to account for the variety of clusters.

3.5 Conclusion

In this chapter we showed that industry clusters can be characterised with the help of different approaches. Concepts from literature on industrial districts and systems of innovation and from the work of Porter are useful starting points to analyse industry clusters. The approaches try to combine various dimensions of clusters, namely the geographical, institutional, horizontal and vertical dimension. In the practice of clustering all these dimensions appear to play a role. From this chapter it has also become clear that clustering is a phenomenon which is relevant not only for large firms, but also for SMEs. The performance of industrial districts (e.g. Emiglia Romagna) and clusters such as the Océ-cluster shows that by participating in a cluster small firms can improve their competitiveness.

Although the cluster approaches provide convincing insights concerning co-operative activities, they can be criticised for their lack of theorising. The approaches are rather conceptual frameworks than formal theories, because they do not give logical propositions which can be tested empirically (see for instance Edquist, 1997). Therefore, in the following chapter we will turn to contributions from economic literature that elaborate some of the ideas the cluster approaches suggest, such as the role of externalities and institutions in industry clusters.

4 Theoretical and empirical insights regarding industry clustering

In chapter 3 we have described some approaches that can be used to characterise industry clusters. The purpose of the present chapter is to deepen the understanding of clusters by outlining insights that can be derived from economic theories. In this respect the following theories are discussed:

– the industrial-organisation theory which focuses on market failures;
– the transaction cost-theory taking transaction costs into account;
– the industrial-network theory that examines relationships in clusters.

In the next three sections (4.1, 4.2 and 4.3) we present these theories in succession. Section 4.4 describes the findings of empirical studies that have been conducted to test various aspects of the theories mentioned. In section 4.5 we give a conclusion to this chapter.

4.1 Industry clustering in the industrial-organisation theory

The first theory that can be used to investigate industry clusters is the industrial organisation theory. This theory associates interfirm cooperation with the characteristics of the market for innovation.

Failures in the innovation market discourage firms to innovate

The industrial-organisation theory assumes that firms decide whether they innovate or not on the basis of a cost-benefit analysis. From a theoretical point of view, firms have several reasons to invest in research and development (R&D) or to innovate more generally. First, by investing in R&D, firms can raise their productivity and thereby their competitive advantage in the market (Nadiri, 1993). Furthermore, an innovating firm can guarantee its future profits, because innovations lead to an increase of its market share or to barriers of entry for other firms (Geroski, 1993). Finally, firms performing R&D increase their ability to learn from the R&D-activities of other firms (Cohen and Levinthal, 1989). In short, innovations contribute to a firm's goal of maximising profits. Although it seems that firms are highly motivated to invest in R&D, the industrial-organisation theory argues that failures in the market for innovation can pre-

vent firms from innovating as much as they would like to. These 'market failures' are caused by the characteristics of R&D-results and by the features of the innovation process.

The first source of market failure is that the outcome of R&D can be interpreted as a piece of new knowledge. Unlike private goods, knowledge has characteristics of a public good. Thus, knowledge is considered to be of a non-rival and partially excludable character (Arrow, 1962). Non-rivalry means that knowledge can be used by one person without reducing its value for someone else. In economic terms, the marginal cost of using knowledge is only the cost of its transmission to another person which often can be assumed to be zero. Partial excludability refers to the property of knowledge that the one who has created knowledge can appropriate only a fraction of its total economic value. In other words, R&D-activities generate positive externalities (spillovers) for other parties in the market. These knowledge spillovers and their effects decrease the incentives for firms to invest in R&D in three ways. First, as the research done by a firm will to some extent leak to other parties, the individual private returns of this research are lowered. The innovator cannot ask payment from other firms that 'free ride' on its R&D thanks to spillovers (Katz, 1986). Second, the R&D-spillovers available to competitors in the market will strengthen the competitive position of the recipient at the cost of the innovating party (Kamin et al., 1992). Third, even if the innovator is able to sell its R&D-results to other firms (licensing) or to consumers, he cannot appropriate all the surplus of the innovations. This problem has to do with the fact that innovating firms are not able to apply perfect price discrimination in the market, because quality improvements, the result of R&D, are not proportionally translated in the prices at which the innovations are sold (Mohnen, 1996).

The second reason why firms are discouraged to invest in R&D is the nature of the innovation process. First, this process involves scale and scope-effects (Van Dijk and Van Hulst, 1989). Because the same piece of new knowledge does not need to be produced more than once, its production can be seen as a fixed cost-component for the innovator. Generally speaking, these fixed costs are so high that firms can cover them only by producing on a large scale. In addition to these scale effects there are scope-effects with respect to R&D. The R&D-activities of two firms, each operating in a different technological area, can be conducted more efficiently by one firm that can make use of synergy possibilities. Thus, the scale and scope-effects of innovation require sufficiently large scale and efficiency of opera-

tion. When firms do not meet these requirements, innovating can be too expensive for them. Furthermore, the market for innovations is surrounded by uncertainty (Stoneman and Vickers, 1996). Innovation is often a process of trial and error: it is difficult to predict whether R&D-efforts will generate the technology for which they are intended. Apart from this technological uncertainty innovating firms face market uncertainty, i.e. the difficulty to see in advance, whether there is a profitable market for the innovations developed. So, the uncertainty in the innovation process can deter firms from performing the amount of research they would like to.

Several authors of industrial organisation-literature argue that firms themselves can correct the market failures they are confronted with during the innovation process. They can do this by participating in a co-operative R&D-agreement, for example in an industry cluster. In this respect the following benefits of clustering can be derived from the theory.

Industry clusters internalise knowledge spillovers

The first benefit of co-operation in industry clusters has to do with the existence of knowledge spillovers in the market. Clusters can serve as mechanisms internalising the externalities created by knowledge spillovers while continuing sharing new knowledge (Katz, 1986; Weder and Grubel, 1993). This internalisation of externalities is achieved if partners agree to share the research cost before the R&D-investment is actually realised. Because the firms know that, in the cluster, there will be no free riding on their investment, they are prepared to commit themselves to R&D-expenditures before spillovers of the R&D can appear. In addition, if the parties in the cluster also agree to share all the results generated by the co-operative R&D, they are highly motivated to invest in R&D on behalf of the cluster (Kamien et al., 1992). Clusters in which the costs and results are fully shared among the partners thus preserve the private incentives to conduct R&D. At the same time sharing the new knowledge eliminates potential wasteful duplication of R&D (Dasgupta, 1996). In this case fewer activities are necessary to realise a given level of effective R&D and innovating can take place more efficiently. This duplication argument makes sense if firms in the market try to accomplish innovations that serve the same purpose, i.e. substitutes (horizontal co-operation). But if market parties develop innovations that are complementary to each other, for example an automatic focus device and an automatic light adjustment in photography, R&D-co-operation in clusters is also very useful, according to Baumol

(1993). This 'vertical co-operation' enables firms to profit from their complementary knowledge, thus stimulating them to undertake R&D in the cluster.

In industry clusters parties can exploit scale- and scope-economies and reduce uncertainty

The second benefit for a firm of participating in a cluster is related to both the scale and scope-effects and the uncertainty involved in innovating. In a cluster firms can collectively exploit economies of scale that cannot be achieved by a firm alone (Oughton and Whittam, 1997). The parties of the cluster together can realise the large scale of production needed to cover the R&D-expenditures. Further, if capital markets are assumed to function imperfectly a cluster is a means for the participants to obtain the necessary capital by pooling their financial resources (Jacquemin, 1988). The idea here is that investors are more willing to invest in a risky R&D-project conducted by a group of firms than one conducted by one firm only. By combining their R&D parties can also make use of economies of scope (DeBresson, 1996). The synergetic effects arising from clustering stimulates the efficiency of R&D and, in addition, may enlarge the scope of feasible and profitable R&D-projects. Beside this, collaboration between parties in a cluster can be seen as a response to the uncertainty which characterises the innovation process (Dodgson, 1994). By sharing the risk of R&D firms participating in a cluster can reduce the uncertainty in the innovation market. This uncertainty is further reduced if the participants not only share risks, but also work together with the purpose of establishing a technical standard in the market.

In summary, the industrial-organisation theory argues that co-operation of parties in a cluster can be seen as a mechanism to correct market failures (spillovers, scale and scope-effects and uncertainty) that prevent market parties from investing in R&D.

4.2 Industry clustering in the transaction costs-theory

In the industrial-organisation theory the institutional aspects of industry clusters are largely ignored. A theory that does pay attention to these aspects is the transaction-costs theory. In this theory industry clusters are approached from a comparative institutional point of view.

Transaction costs determine the choice for market, hierarchy or hybrid forms

The focus of the transaction-costs theory, which was developed by Coase (1937) and notably by Williamson (1975, 1985), is to explain the organisation of economic transactions between parties. The unit of analysis is the transaction. 'A transaction occurs when a good or service is transferred across a technologically separable interface. One stage of activity terminates and another begins' (Williamson, 1985). If parties execute transactions with each other they incur transaction costs, i.e. the costs of information and communication needed to find, negotiate, agree upon and monitor contracts. Then, the transaction-costs theory proposes that the choice of parties for a certain institution (governance structure) to co-ordinate their transactions is determined by the efficiency of the institution in question. Parties will choose that institution in which the sum of both transaction costs and production costs is minimised. In his first book Williamson (1975) follows Coase (1937) and sees only the market and the hierarchy (merger) as alternative governance structures. In his later work (1985), however, he replaces this dichotomy with a continuum on which 'hybrid forms' (co-operation structures such as industry clusters) are positioned between the poles of market and hierarchy. According to Williamson (1985) the question which of these governance structures is the most efficient one depends on the properties of human behaviour and on the characteristics (dimensions) of transactions.

The assumptions of the transaction-costs theory regarding human behaviour are bounded rationality and opportunism. Bounded rationality means that individuals have restricted cognitive capabilities so that their behaviour can be seen as 'intendedly rational but only limitedly so' (Simon, 1961). Opportunism is a form of strategic behaviour and reflects the incentive for individuals to cheat if this will improve their position. In consequence, Williamson (1985) defines opportunism as 'self-interest seeking with guile'. Both the bounded rationality and the opportunism of individuals result in costs in executing transactions. The height of these transaction costs is determined by three dimensions of transactions, viz. their asset specificity, uncertainty and frequency. The first dimension of a transaction is its asset specificity, being the degree to which the transaction has to be supported by investments in special assets which have no or little use outside the transaction. These investments create a relationship of dependency between the transaction partners. An example of a transaction specific investment is a mould a supplier develops to

cast the coach-work of a special model of a car on behalf of a customer. The second dimension is the frequency of a transaction, referring to the question how often it takes place. The last dimension, the uncertainty surrounding transactions, is inherent in economic activities because human behaviour is bounded rational.

Markets and hierarchies are not always efficient governance structures

The transaction-costs theory predicts, then, that the market is the most efficient governance structure to co-ordinate transactions if the degree of asset specificity, the frequency and the uncertainty of a transaction is relatively low. In this case the transaction costs for parties are low because the price mechanism can co-ordinate their transactions. However, when the transactions are characterised by both a high asset specificity, frequency and uncertainty, the market is no longer efficient. In this case internalisation of the transaction in a hierarchy, i.e. an organisation which is governed by authority, involves lower transaction costs for the transaction partners. For the less extreme, intermediate cases hybrid forms between market and hierarchy are suitable mechanisms to handle transactions (Williamson, 1991).

The general ideas of Williamson have also been applied in the field of R&D-activities. According to several authors a hybrid form is often the most efficient means of organising transactions with respect to R&D. They reach this conclusion after having compared the market, the hierarchy and hybrid forms as alternative governance structures. In the domain of innovative transactions the market generally is considered as an unsuitable governance structure. Innovating often requires high transaction specific investments and frequent interactions between partners. Furthermore, the uncertainty of innovative activities is high. The market allows for the frequent switching of contacts, but this flexibility is too high for the specific and long-term relationships needed in the innovation process (Jacquemin, 1988). In addition, because market transactions involve ad hoc-relations, they are expected to be affected by opportunistic behaviour of the market parties. In particular in the field of R&D, where no simple relationship between input and output exists, there is plenty of opportunity for one of the transaction partners to cheat (Tripsas et al., 1995).

In terms of the transaction costs-theory one would expect that because of their transaction specific, frequent and uncertain character, transactions regarding R&D could better be co-ordinated in a hier-

archy in which parties merge and integrate their activities. However, in literature it is argued that this is not always an efficient way to organise innovative transactions. First, mergers or in-house developments tend to create very rigid structures in which there are no simple mechanisms for switching research capability, strategy and partners over time (Jacquemin, 1988). Second, transaction cost savings of integration in one large firm can be cancelled out by the increasing costs of management and co-ordination within this firm (Gerybadze, 1994). Finally, because the 'market test' is no longer relevant in a hierarchy, inefficiencies in its functioning can emerge (Jarillo, 1988).

As hybrid forms industry clusters can reduce transaction costs

As an intermediate form between market and hierarchy a co-operative R&D-agreement, such as a industry cluster, combines 'the best of both worlds'. First, such agreements are considered to be efficient for innovative activities because they maintain the cost discipline that may be absent in a hierarchy, while at the same time they reduce the high transaction costs associated with the use of the price mechanism (Jarillo, 1988). If a party can obtain better trading terms elsewhere, the co-operative agreement cannot stop parties from making alternative arrangements. Second, when parties co-operate, they obtain access to complementary assets and can reduce their production costs through specialisation effects (Teece, 1986; Jarillo, 1988). Since the co-operating parties do not have to link all their internal activities to the cluster, they can specialise in those activities in which they have a competitive advantage. The other activities can be farmed out to members of the cluster that carry them out more efficiently. The complementary assets these parties possess are for instance complementary technologies, service or specialised distribution channels. Finally, a cluster can reduce the problems of opportunistic behaviour which can occur on the market (Zagnoli, 1988; Klein Woolthuis, 1996). During co-operation cluster parties control the opportunism of their colleagues by mutual commitment and by building up bonds of trust with them.

To come to a conclusion, the transaction costs-theory considers industry clusters as hybrid forms between market and hierarchy. By choosing for co-operation in the field of R&D parties can reduce the high costs connected with the use of the market or hierarchy.

4.3 Industry clustering in the industrial-network theory

Unlike the industrial-organisation theory and the transaction costs-theory which focus on the firm respectively the transaction, the industrial-network theory takes the network itself as the unit of analysis. In this theory an industry cluster is analysed as a set of different relationships.

Industry clusters are made up of actors, activities and resources

The industrial-network theory has been developed by the 'Nordic School', notably by Håkansson with other Swedish researchers (1987, 1989, 1992, 1995). They present a model of what they call 'an industrial network', i.e. a group of actors which are related to each other because they use or produce complementary or competitive products. The aim of this model is to give an integrated analysis of the stability and the development of such networks. According to Håkansson (1987) these dynamic aspects have been neglected by the theories mentioned before, but are important for a good understanding of networks. In order to model a network he distinguishes three concepts, namely actors, activities and resources. Actors are (groups of) individuals or firms performing activities and/or controlling resources. In activities actors make use of resources to change or exchange other resources. Resources are the means that actors use when performing activities. It is clear that through these 'circular definitions' the elements are related to each other, together modelling the network.

Actors, being individuals and firms alone or in a group, that participate in a network have several characteristics (Håkansson and Johanson, 1992). First, they decide alone or jointly which activities are performed and controlled and which resources are to be used for this. Second, the actors are embedded in a network of relationships which are created through exchange processes. Third, the activities of the actors rest on their control over resources. This control can be based on ownership or on relationships with other actors. Fourth, the actors are goal-oriented, meaning that they aim at increasing their control over the network. Fifth, actors have developed knowledge about activities, resources and other actors in the network through experience.

From the characteristics of actors it can be seen that relationships between actors ('actor bonds') play an important role in a network. Håkansson and Snehota (1995) argue that these bonds which are

necessary for the stability of a network evolve in a slow process in which actors have to build up identity and create mutual trust. This implies that a network that has been constructed in a short period is likely to be unstable and probably fails.

Activities take place when one or more actors combine, develop, exchange or create resources by making use of other resources. Håkansson and Johansson (1992) argue that a difference can be made between transformation activities and transfer activities. Through the former activities actors change (transform) resources in some way, whereas transfer activities are performed to link (transfer) the transformation activities of different actors to each other. This transfer creates relationships between activities ('activity links'), leading ultimately to a mutual adaptation of the activities of the actors in question. These links can refer to technological, administrative, commercial or other activities.

Resources can be considered as the inputs for the activities in the network. Håkansson (1989) distinguishes five resources: input-goods, financial capital, technology, labour and marketing. Since actors often do not possess sufficient amounts of all these resources, they are partly dependent on other actors. Håkansson and Snehotta (1995) emphasise two characteristics of resources. First, a resource is a relational concept, indicating that it derives its value only from the possibilities it has for its users. Second, resources have a heterogeneous character. This means that the possibilities for their use are unlimited, because it is not possible to identify all the ways they can be combined with other resources. This characterisation of resources implies that they can be adapted to each other to a certain extent. In that case relationships between resources ('resource ties') emerge in which actors interact with each other to make use of the heterogeneity of their resources.

Clusters develop through relationships between their constituting elements

By identifying actor bonds, activity links and resource ties Håkansson and Snehota (1995) show that each element maintains relationships and forms its own network within the industrial network as a whole. At the same time, however, the three elements are interwoven with each other in a the industrial network by the following forces (Håkansson and Johanson, 1992):

(1) **functional interdependence.** Actors, activities and resources are related to each other in a functional way. Jointly they make up a system that can satisfy heterogeneous demands by heterogeneous resources.

(2) **power structure**. The power relations between actors determine to some extent the performance of the activities. The actors can base their power on the way they succeed in controlling activities and/or resources.

(3) **knowledge structure**. What activities are developed and which resources are used for that purpose depends on the knowledge and experience of present and past actors. In addition, the knowledge of those actors is connected with each other.

(4) **intertemporal dependence.** The network is the outcome of contacts, activities, knowledge and experience in the past. Because changes in the network have to be accepted by large parts of its elements, the changes are only small and closely related to the history of the network.

According to the authors the last point suggests that the issues of stability and development within a network are connected with each other. Development in certain areas requires stability in other areas of the network and vice versa.

Pavit's taxonomy can be used to analyse innovative relationships within clusters

The model of Håkansson et al. stresses the importance of various relationships in clusters. However, the model does not pay much attention to the question what role these relationships play in innovation oriented networks, like industry clusters (Oerlemans, 1996). To answer this question we make use of the so called taxonomy of Pavitt who did research among 2,000 innovating firms in Great-Britain (1984, 1994). The taxonomy generally is used to classify firms into five categories based on a variety of technology-related characteristics such as the main sources and channels of innovation for a firm (see e.g. Jacobs, 1995 and Oerlemans, 1996). The taxonomy is reported in table 4.1. As we can see from this table the following categories of firms can be distinguished (Pavitt, 1994):

(1) **supplier dominated firms.** These firms obtain their innovations mainly from other sectors by purchasing equipment and related services. Many small and medium-sized enterprises operating in traditional sectors like agriculture, housing, private services (clothing, shoes), traditional manufacturing (furniture, paper) fall in this category.

(2) **science based firms.** Such companies are large and are mainly 'self-supporting' as regards innovation. Because new (fundamental) developments in science are important for these firms, they have a large in-house research unit and have contacts with experienced scientists. Usually science based firms are to be found in the electronical and (petro)chemical sector.

(3) **scale intensive firms.** These are large, production intensive firms that have to manage complex systems, e.g. producers of bulk materials (steel, glass), consumer durables, automobiles, food/drink and civil engineering. Mostly these firms search for process innovations and realise them by in-house development and by purchase of specialised equipment.

(4) **specialised equipment suppliers.** These firms supply capital goods, instruments and software to other firms. In most cases they are production intensive and have a relatively small size. Their focus is on product innovations, which can be realised by making use of internal knowledge and of the knowledge their buyers have.

(5) **information intensive firms.** Generally firms in this category are large and operating in the financial, retailing, publishing and travel sector. They are not actively involved in innovating themselves, but realise process innovations (in particular in the field of information technology) through the purchase of specialised equipment and software.

Table 4.1 Pavitt's taxonomy

Characte-ristics	Supplier dominated firms	Science based firms	Scale inten-sive firms	Specialised suppliers	Information intensive firms
Firm size	Small	Large	Large	Small	Large
Main sources of innovation	Suppliers	Corporate R&D	Production engineering	Design & development Advanced users	Corporate software and systems engineering
Main direction of innovation	Process techno-logy & related equipment (upstream)	Technology related products (concentric)	Process technology & related equipment (upstream)	Product impro-vement (concentric)	Process technology & related software (mixed)
Main channels of innovation	Purchase of equipment and related services	In-house R&D Hiring experienced scientist	Purchase of equipment In house R&D	Learning from advanced users In house R&D	Purchase of equipment and software

Source: Pavitt (1994).

In sum, the industrial networks-theory highlights the importance of relationships between the constituting elements (actors, activities, resources) of an industry cluster. What is the nature of these relationships depends on the characteristics of the firms participating in the cluster.

4.4 Empirical studies

Although theoretical notions regarding clustering abound, few empirical studies have been conducted in this field. Furthermore, the existing studies test only some aspects of the theory and are often of an anecdotal character (Van de Klundert, 1997). However, some empirical evidence on R&D-co-operation in industry clusters is worth mentioning.

Knowledge exchange and spillovers play a role in clusters

The study of Von Hippel (1988) focuses on the influence of R&D-co-operatives on the performance of its partners. The author researched a sample of eleven very successful American steel minimills, which were regarded as world leaders in labour productivity at that time. Through a series of interviews Von Hippel (1988) found out that all but one of the firms in his sample regularly exchanged valuable technical knowledge with the others. To the question why they did this, the firms answered that knowledge exchange is simply a form of trade. Thus, one firm explained: 'How much is exchanged depends on what the other guy knows: it must be reciprocal'. The firms interviewed considered this 'informal know how trading' as the most important factor for their successful performance.

The relationship between spillovers and co-operative R&D was examined by Veugelers and De Bondt (1992). Using results from previous research done by other researchers (e.g. Bernstein, 1988) they classified industries on the basis of the importance of spillovers and tested whether R&D-co-operation took place more in high spillover industries. High spillover industries include (tele)communications, semi-conductors, instruments, chemicals and electronics. The transport equipment industries are characterised by medium spillovers. Low spillovers occur mainly in the food/drink-industry. To test their hypothesis Veugelers and De Bondt (1992) used a database containing all co-operative agreements that were established in the period 1986-1988. The hypothesis appears to be supported empirically: in high and medium spillover industries the frequency of R&D-co-operatives is significantly higher than in low spillover industries.

By clustering firms improve their competitive and innovative performance

In order to investigate the importance and the rationale of interfirm co-operation Commandeur (1994) developed a framework in which parts of the transaction-costs theory were integrated. To demonstrate the usefulness of this framework the author conducted seven in-depth case studies among Dutch companies. These case studies indicated that since the eighties the number of interfirm relationships had grown in comparison to the strategic options of market and hierarchy. In addition, the market and competitive positioning of the firms examined had been strengthened by their participation in co-operative agreements. Finally, Commandeur (1994) found that the contents of the core activities that the firms brought into the co-operative had increased when comparing it with the past.

Oerlemans (1996) utilised the industrial-network theory of Håkansson (1989) and Pavitt's taxonomy (1984) to design a model of industrial networks. With the help of this model the hypothesis whether firms are more innovative when participating in an industrial network was tested. Basing his analysis on surveys with about 700 mainly small and medium sized enterprises in the province of Brabant in the period 1987-1992 the author came to the conclusion that a significant positive correlation existed between the results of innovating and the joint R&D-efforts of suppliers and users. More generally, it was found that an innovative relationship between firms influences the innovation process in a positive manner. According to Oerlemans (1996) this outcome is due to the fact that co-operating firms can use knowledge from their environment more efficiently than firms innovating in isolation. In a study by Gemünden et al.

(1996) similar conclusions were drawn. Also this research, which was conducted among 321 German high-tech companies, suggests that innovation success is significantly correlated with a firm's industrial network.

Recently Muizer (1998) has investigated the participation of Dutch small and medium sized enterprises in innovative clusters and their experiences with this form of co-operation. He finds that 17% of the co-operatives in which firms participate are innovative clusters. Most clusters contain five or more firms that often operate in the same sector or in the same product chain (user-supplier relationships). In most cases these clusters are established with the goal of jointly developing products or services. According to the firms participation in an innovative cluster has given them a better competitive position and better exporting possibilities.

In spite of the impressionistic character of the empirical evidence, it seems that the theoretical arguments for clustering do really play a role in the practice of innovating. There are clear indications that participation in a cluster is an important tool for improving a firm's innovative performance and thereby its competitive performance.

4.5 Conclusion

The general conclusion of this chapter may be that industry clustering matters: co-operation in the field of innovation yields advantages for a participating firm that could not be achieved by operating in isolation. We arrive at this conclusion on the basis of insights of the industrial organisation theory, the transaction costs theory and the industrial-network theory and empirical studies that have been conducted in this respect.

Until now the analysis of industry clusters has not explicitly focused on differences that may exist between firms participating in an industry cluster. However, the taxonomy of Pavitt (1984, 1994) already suggested that firms, depending on their characteristics, differ in the way they realise innovations. For a better understanding of industry clusters we have to investigate these differences more profoundly. In particular differences in firm size (large firms versus small firms) seem to be relevant in assessing the position and role of firms participating in an industry cluster (see also Nooteboom (1993) and Oerlemans (1996)). Do SMEs have other motives than large firms for joining a cluster? What advantages and disadvantages do SMEs have in comparison with large firms when co-operating in a cluster? These questions will be answered in the following chapter.

5 SMEs in industry clusters

In the previous chapters of this study several market trends, cluster approaches and economic theories were described to provide an understanding of the phenomenon of industry clusters. In this chapter we will specify the insights from these chapters and concentrate on the issue of industry clustering and size of the firm. Starting with a description of factors that generally stimulate large firms and small firms (section 5.1), the advantages and disadvantages of both kinds of firms when innovating will be discussed in section 5.2. Section 5.3 deals with success and failure factors concerning the participation of SMEs in industrial clusters. The available empirical material in this field will be reported in section 5.4. Finally, we come to a conclusion in section 5.5.

5.1 SMEs versus large firms

Generally speaking, small firms differ from large companies in a lot of respects (You, 1995). In order to clarify the relative differences resulting from firm size, Thurik (1994) identifies factors stimulating largeness (a large firm size) and factors stimulating smallness (a small firm size). In table 5.1 these factors are summarised.

Table 5.1 Factors stimulating largeness and factors stimulating smallness

Factors stimulating largeness	Factors stimulating smallness
• economies of scale	• effect of transportation
• economies of scope	• effect of market size
• effect of experience	• effect of adjustment
• effect of organisation	• effect of effectiveness
	• effect of control
	• effect of culture

Source: Thurik, 1994.

Factors stimulating a large firm size

Economies of scale. The effect of scale is usually interpreted as the fall of average costs per unit of product with an increasing volume of output. This mechanism occurs in many business functions (e.g. the productive and administrative function) and on different levels of aggregation (e.g. in business units and enterprises). Sources of economies of scale are the indivisibility of people and facilities, specialisation and laws of mathematics and physics. Indivisibility involves 'threshold costs', meaning that a minimum capacity of people or facilities is needed to produce, no matter how small the output may be.

Economies of scope. The effect of scope is usually observed when the average costs of a product fall if the number of different products increases. Its sources can be the use of indivisible resources, complementarity and interaction of production factors.

Effect of experience. This effect is defined as the decline of average costs with increasing production volume accumulated over time. The experience effect is the outcome of doing more of the same, whereby one can eliminate redundant activities. Therefore, this effect can be regarded as a process of elimination.

Effect of organisation. This effect refers to outsourcing activities. By outsourcing production to other organisations firms can attain scale effects due to specialisation. At the same time, however, transaction costs will be incurred with respect to the outsourced activities. According to Nooteboom (1993), these costs per unit will be higher for smaller firms.

Factors stimulating a small firm size

Effect of transportation. Production and organisation costs are only part of the total cost structure. There are also the costs of delivering output to customers or bringing customers to the place where services are provided (Scherer and Ross, 1990). Prospective customers assess these transportation costs when looking for supplies. Therefore geographic dispersion of demand co-exists with a geographic dispersion of supply and thus smallness, at least at an establishment or plant, has a chance.

Effect of market size. Small markets require small firms. In general, small markets exist where scale economies have no meaning because they will not be obtained. Although the unit production costs of a space rocket would drop if fifty such rockets were produced yearly instead of ten, this demand does not exist. Markets which are highly fragmented, such as the textile and clothing market in which many designs and varieties are offered, have less room for large firms than for small firms.

Effect of adjustment. There is a trade-off between efficiency (production costs given some output level) and adjustability (the cost of adjusting a certain level of output). Large firms can produce at lower unit costs than small firms As small firms are either more labour intensive or use different equipment, they can adjust their output level at lower costs than large firms (Mills and Schumann, 1985 and

Brock and Evans, 1989). Therefore, there is no advantage for large firms in markets which are fragmented in time.

Effect of effectiveness. This effect favours a small firm size because different goods and services have different meanings for different people (Brock and Evans, 1986). It is much cheaper to produce a standard uniform than unique clothing in terms of design or colour, but the latter product is more effective in meeting the individual demand of a buyer. The fact that both large firms (factories) and small firms (e.g. tailors) exist can be explained only if output is measured in terms of effective units of products instead of just products.

Effect of control. The effect of control refers to the idea that in a small business environment entrepreneurial and organisational energy flourishes and can be better controlled. The mutual proximity of production floor, management, ownership and customers, and suppliers stimulates the motivation and effectiveness of the labour force firms possess (Nooteboom (1987) and Evans and Leighton (1989)).

Effect of culture. This cultural effect considers the societal perspectives of entrepreneurial activities and small business as well as their use for productive achievements (e.g. innovations) or unproductive ventures (e.g. rent seeking). These perspectives vary across societies and determine the supply of small firms and their productive contribution to the economy (Baumol, 1990).

5.2 Advantages and disadvantages of SMEs in innovating

The factors stimulating largeness and smallness discussed above reflect some general advantages and disadvantages for small firms compared with large firms. Although small firms cannot profit from economies with regard to scale, scope, experience and organisation, they are often more rapid, flexible and effective than large firms in coping with demands from the market. These relative advantages and disadvantages are clearly visible in the field of innovative activities (White, 1988; Karlsson and Olsson, 1998). In this connection Vossen (1998) provides an overview of relative advantages of small and large firms with respect to innovation that can be found in literature (e.g. Rotwell and Dodgson, 1994). As the advantages of large firms are generally the disadvantages of small firms and vice versa, he presents his findings as the relative advantages of small and large firms in innovation (table 5.2).

Table 5.2 Relative advantages of small and large firms in innovation

Small firms	Large firms
Little bureaucracy	Formal management skills
Rapid decision making	Able to control complex organisation
Risk taking	Can spread risk over a portfolio of products
Motivated and committed management	Functional expertise in staff functionaries
Motivated labour	More specialised labour
Rapid and effective internal communication, shorter decision chains	Time and resources to establish comprehensive external Science and Technology networks
Fast reaction to changing market requirements	Comprehensive distribution and servicing facilities
Can dominate narrow market niches	High market power with existing products
R&D efficiency	Economies of scale and scope in R&D
	Can support the establishment of a large R&D laboratory
	Access to external capital
Capacity for customisation	Better able to fund diversification, synergy
Capable of fast learning and adapting routines and strategy	Able to obtain learning curve economies through investment in production
	Capacity for absorption of new knowledge/technology
Appropriation of rewards from innovation through tacit knowledge	Able to erect entry barriers

Source: Vossen (1998).

Although SMEs have material disadvantages, they have behavioural advantages

The table shows that the innovatory advantages of large firms are predominately **material** (economies of scale and scope of R&D, easier access to technology, finance and other resources), while the innovatory advantages of small firms are mainly **behavioural** (flexibility, dynamism and responsiveness) (Rothwell, 1995).

According to Vossen (1998) these results explain the finding of most empirical studies that SMEs can conduct R&D more efficiently than large firms and that they are disproportionately responsible for significant innovations. Several of these empirical studies can be mentioned in this field. For instance, Acs and Audretsch (1990) have found that small firms contribute approximately 2.4 times more innovations per employee than larger firms. Other empirical studies also concluded that smaller firms produce more innovations than one would expect on the basis of their input (Kleinknecht et al., 1991; Acs, Audretsch and Feldman, 1994; Vossen, 1996). To note an example, Acs, Audretsch and Feldman (1994) come to the conclusion that small firms more effectively take advantage of knowledge spillovers from corporate R&D laboratories and universities.

The fact that smaller firms develop relatively more innovations than would be expected, however, does not say much about the quality of the innovations. Nooteboom (1994) adds the quality element to the discussion. He concludes that both small and large firms are probably good at different kinds of innovation. Large firms are likely to be more suited for developing innovations that are based on economies of scale and scope or that require large teams of specialists. Such innovations include fundamental new, science-based products or processes and large-scale applications, which mostly have a high average economic value. Small firms are probably better in developing innovations where effects of scale are not important and where they can use their flexibility and proximity to market demand. Examples of these innovations are new products or product-market combinations, modifications to existing products for niche markets and small-scale applications.

In industry clusters SMEs can exploit their advantages and compensate their disadvantages

The relative advantages of large and small firms in realising innovations suggest that firms that can combine the material and behavioural advantages can establish a very strong position in terms of techno/market dynamism. Rothwell (1995) considers large/small combinations in particular as helpful in overcoming the disadvantages and providing complementary benefits for the participating firms. Also Nooteboom (1993) suggests that by co-operation small firms can try to achieve the advantages of large firms collectively. Identification of their most important advantages and disadvantages helps firms to formulate a co-operation strategy. As long as ten years ago White (1988) stated in this respect: 'The ideal innovative SME utilises its behavioural advantages and reduces its disadvantages' and also: 'An ideal type of innovative SME devotes effort to develop external business contacts and links, exploits its network to get new product ideas and technical information, avoids being dominated by local customers and industries, and uses its product capability to diversify and export'. In other words, by participating in co-operatives such as industry clusters SMEs are not only capable of benefiting from their behavioural advantages, but also capable of compensating their material disadvantages.

5.3 Prospects and problems of clustering for SMEs

In the previous section we saw that industry clustering instead of innovating in isolation seems an appropriate option for SMEs.

Although an industry cluster is able to offer various benefits for the small firms that participate, it can also entail some problems for them. In theoretical terms, the prospects of clustering for SMEs are of a technological, economic and strategic character, while problems are appear in the informational, contractual and managerial field. We will discuss these prospects and problems briefly in succession (for an extensive discussion see for instance Klein Woolthuis, 1996: Gomes-Casseres, 1997 and Hospers, 1998).

Prospects of clustering for SMEs

Technological prospects. In an industry cluster small firms can gain access to complementary technological knowledge and the know-how of other parties. Through R&D-co-operation with these parties small firms may increase their innovative potential and can develop new products and processes faster. Because they can accelerate the innovation process, these firms 'buy time' and are more likely to realise first mover advantages in the market (Bidault and Cummings, 1994). The combination of the technological knowledge of different parties can also lead to an improvement of the quality of the innovation process (Nueno and Oosterveld, 1988).

Economic prospects. As has already been mentioned, by co-operating small firms can overcome their material disadvantages and try to achieve economies of scale and scope in R&D. Joint R&D-activities help to share fixed costs, improve the efficiency of the innovation process and obtain market access. By combining their forces firms can realise a certain quantity and quality (critical mass) of human, financial and material resources needed to make innovating possible As SMEs generally are not able to constitute this critical mass on their own, clustering can be a means to do so (Bidault and Cummings, 1994; Klein Woolthuis, 1996).

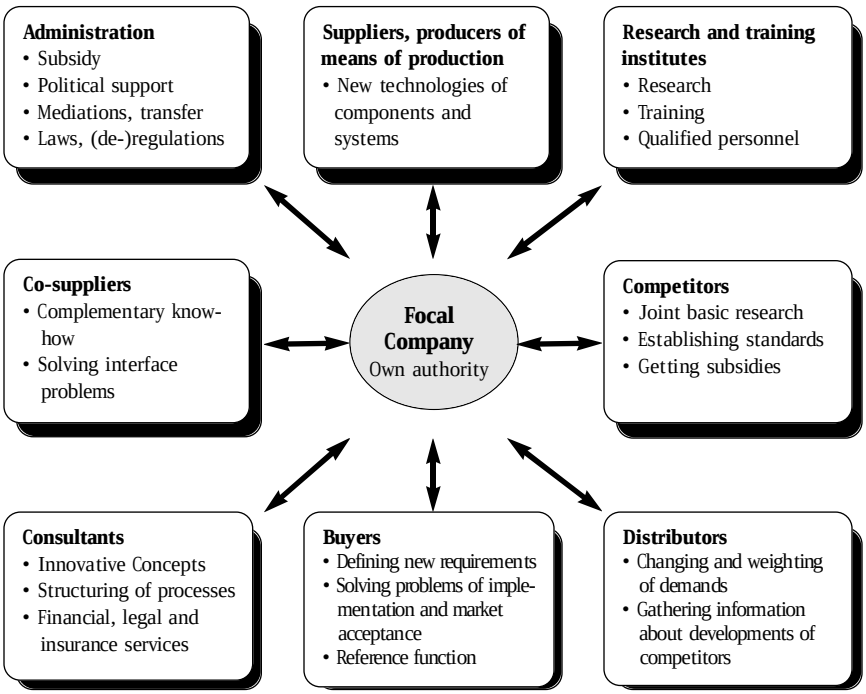
Strategic prospects. Through clustering small firms can obtain access to another geographic or technological area, thus maintaining or improving their market share (Klein Woolthuis, 1996). In addition, the long-term access to critical external resources in industry clusters may exclude market entry of future competitors. Furthermore, a group of cluster parties is more powerful than each individual party. Small firms can use this power to claim subsidies from the government and implement norms and standards. Finally, an industry cluster can fulfil a reference function for small firms: they can profit from the reputation and relationships of a customer in the industry cluster ('image transfer') (Gemünden and Heydebreck, 1995).

Though the potential benefits of industry clustering for SMEs are clear, one cannot ignore the problems it can involve for these firms.

Problems of clustering for SMEs

Information problems. SMEs that want to participate in an industry cluster have to search and review partners offering the desired knowledge. Figure 5.1 shows that a small firm ('the focal company') can choose between many potential partners (Gemünden and Heydebreck, 1995). Because SMEs do not possess all this information and often lack time and money to conduct partner search and partner review, they sometimes do not know interesting clustering possibilities about or are discouraged from initiating an industry cluster (Hospers, 1998).

Figure 5.1 Cluster parties of SMEs



Source: Gemünden and Heydebreck (1995).

Contractual problems. After having found appropriate cluster parties, the firms have to negotiate a co-operation contract. For small firms this negotiation stage can be too costly in terms of time- and money-consuming decision procedures (Tripsas et al., 1995). On the one hand parties will try to agree on many aspects (goals, organisa-

tion, sharing of costs and benefits, protection of knowledge) in order to cover themselves against the risks of co-operation. On the other hand, the parties will try to preserve their independence as much as possible. The necessary compromise that has to be reached between co-operation and independence poses problems of high contractual costs for SMEs.

Managerial problems. Even when a solid contract exists, there may still be problems during the co-operation. Conflicts can arise between partners as to the goals, organisation, sharing of costs and benefits and the knowledge transfer. Next, partners can behave opportunistically, thus inducing instability in the industry cluster. Cultural differences, lack of hierarchy and lack of commitment can also disturb the co-operation. Inequality between partners in terms of firm size and thus in resources may cause problems for participating small firms. This inequality can lead to less control over the co-operation or even dependency of SMEs upon larger firms in the industry cluster (Jacobs, 1995; Gomes-Casseres, 1997).

In short, from a theoretical point of view it seems that industry clustering provides a strong tool for SMEs to improve their innovative power. At the same time, however, they have to be aware of the costs and the loss of independence such a co-operation involves.

5.4 The role and position of SMEs in industry clusters

It is clear that the benefits en difficulties SMEs are confronted with while co-operating are not the same in each industry cluster. The presence of one or more of the prospects and problems of clustering is related to the position and role SMEs have in a particular industry cluster. Although literature does not provide us with a clear insight in this issue, a few comments can be made in this respect.

SMEs are likely to participate in vertical technological relationships

As we saw in section 4.4 the taxonomy of Pavitt (1984, 1994) classifies firms into five categories on the basis of characteristics such as firm size and the main channels of innovation. The taxonomy indicates that two categories of firms, namely supplier dominated firms and specialised supplier firms, often have a small size. These SMEs do not realise innovations on their own but rather in close co-operation with related firms. In supplier dominated firms (e.g. firms operating in traditional manufacturing and private services) innovations

originate mainly from suppliers of equipment and related services. Specialised suppliers (for instance firms producing capital goods and instruments), however, use the knowledge of large customers they are linked with as the main channel of innovation. Thus, Pavitt's taxonomy suggests that both categories of small firms innovate by making use of vertical relationships with their suppliers or customers. In consequence, it is likely that SMEs often participate in industry clusters in which the vertical cluster dimension dominates (Maier, 1988; Jacobs, 1995; Praat, 1995). Several authors argue that in such industry clusters asymmetries between the participants in terms of firm size and power can result in dependency relationships of the participating SMEs upon large firms. This dependency can lead to a situation of 'interfirm Taylorism' or one of 'large firm paternalism' (Hancké, 1998). Both situations will be described below.

Interfirm Taylorism or large firm paternalism?

One view regarding the position and role of SMEs in industry clusters has been called 'interfirm Taylorism' (Rochard, 1987). In this case the large firms in the industry cluster provide the participating SMEs with very detailed specifications for the job that needs to be done by them. The SMEs have an extremely dependent position in the industry cluster and their role is therefore limited to carrying out the instructions from their larger counterparts. As the co-operation in such an industry cluster is hierarchy-based, managerial problems are likely to occur for the SMEs.

Another view in this connection is more favourable for SMEs and has been termed 'large firm paternalism' (Hancké, 1998). The links between the large firms and the small ones in the industry cluster are more symmetric and closer than in the situation of 'interfirm Taylorism'. Instead of only instructing the SMEs, the large firms invest in the SMEs' operations. Although the SMEs in this setting still remain dependent on the large firms, they have a more autonomous position and role during the co-operation. Large firms help the small firms to upgrade their operations, but by doing so they also make them more dependent upon their own operations. In this case SMEs are likely to control the managerial problems co-operation implies more easily, because they have a less dependent position and role in the industry cluster. The leading mechanism in this industry cluster is inter-firm trust. However, it is very hard for SMEs to construct such trust-based relationships between the participants. Establishing trust takes a long time and requires an active attitude of all the cluster's parties (Klein Woolthuis, 1996).

Examples of the position and role of SMEs in industry clusters

To illustrate the possible position and role of SMEs in industry clusters, we present some ways large and small firms can interact in practice: manufacturing subcontracting relationships, producer/customer relationships, collaborative R&D and large/small firm joint ventures (Rothwell and Dodgson, 1994).

(1) **manufacturing subcontracting relationships.** In this case SMEs supply components and sub-assemblies to large firms. During this process the large firms often transfer technical, manufacturing and quality control know-how to their small suppliers.

(2) **producer/customer relationships.** Here SMEs supply finished products to large firms in the industry cluster. To control the suppliers the large firms transfer technological knowledge and suggest improvements to them on the basis of user experience.

(3) **collaborative R&D.** This co-operation mode refers to the situation in which large and small firms collaborate in the research and development of a new product or process for the large firms. As an example one can think of small design houses co-operating with automobile manufacturers.

(4) **large/small firm joint ventures.** The aim of these joint ventures is the joint development of an innovative product or process containing technology new to the large firms. The large partners provide financial, manufacturing and marketing resources, while the small firms provide specialist technological knowledge and flexibility.

The examples show that the position and role of SME relationships is more likely to result in hierarchy and 'inter-firm Taylorism' in industry clusters in which the vertical dimension is dominant, as is the case in manufacturing subcontracting relationships and producer/customer. In industry clusters in which one or more of the other cluster dimensions dominate, such as for instance in collaborative R&D and large/small firm joint ventures, SMEs are likely to have a more autonomous position and role, giving trust and 'large firm paternalism' a better chance.

In short, the role and position of SMEs in industry clusters in which the vertical dimension prevails, often will be determined by the larger partners.

5.5 Empirical studies

The prospects and problems of clustering for SMEs mentioned in literature also seem to play a role in the practice of clustering. To illustrate this we discuss several empirical studies that have been conducted on the issue co-operation and SMEs (Lawton Smith et al., 1991; Prince and Braaksma, 1995; Stringer, 1995; Klein Woolthuis, 1996; Hulshoff and Snel, 1998; Muizer, 1998).

The main motives for SMEs to participate in an industry cluster are technology-based

Prince and Braaksma (1995) combine the results of various empirical studies on participation of SMEs in co-operatives. The main motives for companies to co-operate, or at least the most often emerging motives, are technology-based (Kleinknecht, Reijnen and Verweij, 1991). Driven by the increasing importance of innovative activities together with the high risks and the need for resources, co-operation activities are to a growing extent focused on R&D-activities. As a matter of fact, retrieving and extending technological know how and increasing the speed of innovation form the most important motives for firms to co-operate. But also strategic prospects such as a shortening of the time-to-market and a quick entry on new markets stimulate companies to look for partners. Further, the economic motives are mostly directed towards obtaining economies of scale and scope (Brockoff, Gupta and Rotering, 1991 and Commandeur and Den Hartog, 1991).

SMEs often meet managerial problems when participating in an industry cluster

The overview of Prince and Braaksma (1995) also includes empirical evidence on bottlenecks that are relevant in co-operatives:

- unwanted knowledge transfer
- reduction of flexibility (especially in long-term co-operation agreements)
- chance of being exploited by the co-operation partner
- lack of commitment
- time loss due to discussions and meetings between the partners.

According to the authors these bottlenecks are due to (1) cultural differences between the partners leading to communication problems: (2) objectives and agreements which require commitment of the partners and (3) the way information is transferred in the co-operative increasing the chance of unwanted knowledge transfer.

Stringer (1995) carried out a similar analysis, but focused explicitly on co-operatives of SMEs from various European countries. The co-operating firms faced the following bottlenecks during the co-operation: language and communication problems, lack of resources, costs, payment problems, problems with respect to different business cultures, difficulties in finding a partner, lack of commitment and administrative and bureaucratic problems. Although international co-operatives are different from national ones, Stringer's research makes clear that informational, contractual and managerial problems really play a role in the practice of clustering. The responding SMEs tried to resolve these problems by building up relationships which become open over time, where each firm recognises the need to make profit. As one SME put it: '..we've moved beyond them and us sitting on opposite sides of the table negotiating, to both of us sitting on the same side of the table working out how to sell to the customers out there'.

Klein Woolthuis (1996) examined in depth two cases of industry clustering in the Dutch welding industry. She found that the main motives for SMEs to join these industry clusters were (in order of importance): improvement of technological knowledge, striving for synergy, getting to know each other, striving for flexibility and information gathering. The problems these parties encountered in the co-operative were (also in order of importance): unwanted knowledge transfer, opportunism, time consuming decision procedures, controlling problems and communication problems. According to Klein Woolthuis (1996) these findings suggest that firms mainly seek technological gains in R&D-co-operation, but that managerial problems can hinder the achievement of these gains.

The research on motives and problems of R&D-co-operation has been complemented by Hulshoff and Snel (1998). They reveal the following success factors with regard to technological co-operation:

- a clear and complementary contribution of knowledge by all partners
- clear objectives of the co-operative efforts
- a shared goal or interest of the co-operation
- good project management (involvement of employees with expertise and knowledge)
- commitment among partners and employees
- a clear and good financial arrangement with sufficient resources.

In addition, the authors suggest that mutual trust, formalising of agreements, commitment to agreements and openness are consid-

ered important success factors of co-operatives. It is clear that the failing factors are inversely related to these success factors.

Large firms often take more initiatives to cluster than SMEs

Besides empirical material on motives and problems industry clustering, there is also some empirical evidence regarding the initiatives parties take in an industry cluster. For example, Lawton Smith et al. (1991) conducted a study into the electronics and biotechnology industry and found that the financial constraint of raising capital and generating cash flow was chiefly a small firm problem. Nevertheless, the initiatives to collaborate appeared to be shared almost equally between the large and the small firms in the electronics industry. In biotechnology co-operatives, however, the larger firms approached the smaller firms. According to the authors this result suggests that large firms are aware of the opportunities presented by smaller firms, and that technologically active small firms recognise the need for external inputs (Lawton et al., 1991).

An empirical study among Dutch firms by Muizer (1998) suggests that large companies in technological, longer term co-operation networks take more initiatives than smaller companies: 67% of large companies has taken the initiative to form their most important technological co-operation arrangement, while the corresponding percentage for SMEs is only 50%. Furthermore, SMEs are more often involved in an co-operation arrangement as a supplier. The major objective for SMEs and large companies to join the co-operation networks is to develop new products. As a second important objective SMEs specifically mention the improvement of products/services, while large companies mention the improvement of the production process as a second important objective for co-operation.

In summary, the available empirical evidence on technological co-operatives in which SMEs participate suggests that these firms can anticipate many benefits from clustering, such as technological gains, provided that they are able to resolve some problems that are inherent in co-operation.

5.6 Conclusions

In this chapter we focused on the issue of industry clustering and firm size. After having discussed factors that stimulate large and small firms in general, we examined advantages and disadvantages of small firms in innovation. It was found that the innovatory advantages of SMEs are mainly behavioural, while their disadvantages are

predominately material. As a tool to overcome these disadvantages SMEs can think of clustering. Theoretical and empirical insights in this connection suggest that SMEs seek mainly technological gains in co-operation agreements. However, because of managerial problems, these gains are sometimes rather difficult to achieve for SMEs.

Of course, large firms also have an interest in joining or starting an industry cluster. It is interesting to see what the role and position of SMEs is when SMEs and large firms are both participating in the same industry cluster. Although the literature on this subject is rather rare, it has been found that the role and position of SMEs in industry clusters will often be determined by the larger partners. This will especially be the case in industry clusters which are dominated by the vertical dimension, such as in manufacturing subcontracting relationships and in producer/customer relationships. In industry clusters which are set up for collaborative R&D efforts and for large/small firm joint ventures in the technological field, the horizontal, geographical and/or institutional dimensions dominate. In such cases the SMEs are likely to have a more autonomous role and position.

This chapter indicates that motives for clustering differ along with firm size and that characteristics of the industry clusters may provide an explanation for the role and position of SMEs in these clusters. Therefore, we shall integrate the aspect of firm size in the analysis of industry clusters. This will be done in the following chapter.

6 Synthesis

6.1 Towards a definition of modern industry clusters

A universal cluster definition is lacking

In order to be able to assess the position and potential role of SMEs in industry clusters, we have to come to a definition or at least a classification of industry clusters. In the previous chapters we saw, however, that the formulation of one clear and widely accepted definition of industry clusters is hampered by the different approaches and theories that abound in literature on clustering. A wide variety of industry cluster definitions are used. One of these definitions is the following: industry clusters are networks and value chains of suppliers, customers and/or knowledge institutes aiming to create innovative value added (EZ, 1997). In the absence of a universal definition of industry clusters, policy makers often make use of a working definition. In that case they set some preconditions technological co-operation arrangements should meet before they can be characterised as industry clusters. The strategic and long term character of the co-operation and the number of participants may be applied as criteria for the identification of these industry clusters. For instance, in a study by Muizer (1998) the following conditions set by the Dutch Ministry of Economic Affairs are used:

- an industry cluster includes at least 4 partners with at least 3 companies co-operating in the technological field
- the choice for partners to join an industry cluster is a strategic one
- the co-operation arrangement is not limited in time.

Based on such stringent criteria, it appears that 17% of co-operative activities in the technological field in the Netherlands can be characterised as an industry cluster (Muizer, 1998)[1]. Working with such conditions may be useful for a specific study or for specific policy measures, but at the same time it involves the risk of excluding some co-operation arrangements relevant for other study or policy purposes. A stringent working definition of industry clusters could limit a further study on the role and position of SMEs in these co-operatives. In the next part we will come to a working definition which can be used for this purpose.

1 In this case the criteria applied were (1) there are four or more partners in the co-operation network of which three have to be companies; (2) joining the network is a strategic choice; (3) the network does not have a temporary character.

Towards a working definition of industry clusters

From chapter 2 it can be concluded that nowadays firms have to maintain and enhance their competitiveness as a response to rapidly changing developments in the business environment. This competitiveness, in turn, increasingly depends upon the firms' ability to innovate and, as they often do not possess all resources needed for innovation activities, upon their ability and willingness to co-operate. As a result, firms have to pursue innovation and co-operation strategies to survive in the market. Thus, industry clustering has become a strategic choice for market parties.

In chapter 3 this phenomenon of industry clustering is characterised with the help of different ways of cluster thinking or cluster approaches. These approaches can be regarded as conceptual frameworks and differ from each other in the emphasis they place on one or more dimensions of industry clusters.

Instead of choosing one of the cluster approaches we suggest a multidimensional approach that combines various dimensions (cf. Jacobs and de Man, 1996). In this view, industry clusters can be classified by one or more of the following cluster dimensions:

(1) a **geographical** dimension: localised clustering of economic activities, mainly in a region, with the presence of a skilled labour pool and firms providing specialised inputs;

(2) an **institutional** dimension: clustering as an interactive learning process between economic competent firms and other institutions generating and utilising new technologies;

(3) a **horizontal** dimension: clustering of firms that perform similar activities and that are direct competitors outside the cluster on the product market;

(4) a **vertical** dimension: clustering of synergetic interdependent firms (suppliers, main producers and users) in a value chain of a certain product.

The desk research described in chapter 2 and 3 also revealed that industry clusters are often directed towards innovative activities. In our view, these activities are part of the general strategy of firms to differentiate themselves from their competitors in order to maintain or enhance their competitiveness. Because of this strategic character

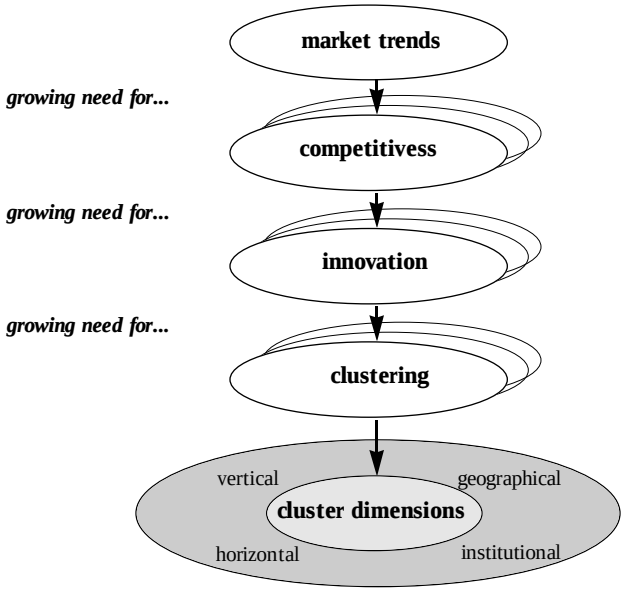
of the co-operatives we suggest defining industry clusters in a broad way. Therefore, we do not intend to limit ourselves to co-operative activities in the technological field. Other co-operative activities that serve the competitiveness of the participants (e.g. joint-purchasing) can also lead to a certain kind of industry clustering. Similarly, we do not want to restrict the analysis of clusters by focusing on co-operation arrangements for a certain period. In our opinion, a short term co-operative may provide the basis for a long-term strategic co-operation arrangement and, as such, may go beyond its short term objective.

For a further analysis of industry clusters, however, we do have to set some limitations to our working definition of an industry cluster. For the assessment of the role and position of SMEs in industry clusters, it is evident that one or more SMEs should actually participate in industry clusters. Furthermore, we want to exclude all bilateral co-operation agreements by setting a condition for the number of participants.

Consequently, as a starting point for an assessment of the role and position of SMEs in industry clusters, we define an industry cluster as a co-operation arrangement with the strategic objective of maintaining or enhancing the competitiveness of its participants. Such an industry cluster includes at least 4 partners one or more of which being SMEs. It may consist of horizontal, vertical, institutional and/or geographical dimensions.

In figure 6.1 the classification of industry clusters in this report is justified. As we have seen in the first two chapters, market trends have resulted in the growing strategic need for firms to increase their competitiveness. One of the most important ways of doing so is to develop an innovation strategy. However, because of a lack of resources and in order to obtain economies of scale and/or scope in their innovation activities, firms and especially SMEs are increasingly forced to cluster (see also chapter 5). Finally, the classification of industry clusters is based on the four cluster dimensions, which were found in our overview of cluster thinking in chapter 3.

figure 6.1 Framework for defining industry clusters



Source: EIM.

6.2 Linking industry clusters to SMEs: towards a theoretical framework

A preliminary framework has been developed (figure 6.2) for the assessment of the role and position of SMEs in industry clusters in future research. The framework is based on insights derived from the industrial-organisation theory, the transaction costs theory and the industrial-network theory and from empirical studies that have been conducted in this respect. The theories have in common that they all arrive at the general conclusion that industry clustering matters: co-operation in the field of innovation[1] yields advantages for a participating firm which it cannot achieve by operating in isolation. In addition, it can be concluded that clustering has become of strategic importance to maintain and enhance a firm's competitiveness.

In chapter 5 it is shown that clustering is an important tool for SMEs to overcome the disadvantages of their small scale. A lack of economies of scale and scope in the technological field seems to be an important motive for SMEs to cluster and to co-operate with large

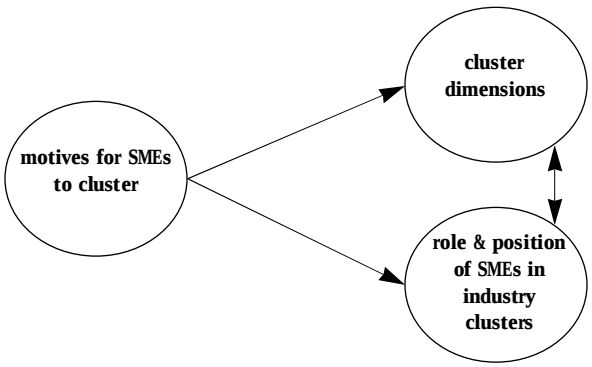
1 In the theories about clustering the focus is often on innovation. However, the assumption is that the framework, following from these theories not only holds for innovation activities in industry clusters, but also for activities which drive companies to cluster.

firms, which, in turn must have other motives for their co-operative efforts. Therefore, it can be concluded that motives for clustering may differ along with firm size. Another conclusion of the desk research carried out in chapter 4 is that especially differences in firm size (large firms versus small firms) seem to be relevant in assessing the position and role of firms participating in an industry cluster (see also Nooteboom (1993) and Oerlemans (1996)).

These conclusions lead to the hypothesis that the theories investigated can be applied for the analysis of industry clusters and that firm size is relevant in explaining differences between small firms and large firms in their motives for clustering and their role and position in industry clusters.

Of course, many other variables such as competences of the various partners, their resources, technology and demand and supply characteristics can influence or form explanations for various morphologies of industry clusters. However, for a thorough understanding of the various links of the framework all possible explanatory and influencing variables have been left out. In this paragraph the various links will be described.

Figure 6.2 Preliminary framework for the assessment of the role and position of SMEs in industry clusters



Source: EIM, 1998.

Motives for SMEs to cluster ⇒ Cluster dimensions

Although literature does not provide many insights in this relationship, some preliminary remarks can be made.

SMEs co-operate to compensate for their material disadvantages. What a co-operation arrangement looks like and what characteristics and cluster dimensions it has, depends on the competences of its

participants and their resources, and on specific demand and supply characteristics of the value chain, such as the production process, volatility of demand, supply structure, etc. It may also depend on the R&D-characteristics such as R&D-intensity. A highly innovative industry, for instance, corresponds to a rapidly changing business environment and a basic need for SMEs and large firms to innovate and co-operate.

Our assumption is that the prevailing dimension(s) within an industry cluster depend(s) on the motives of the initiating firm or institution along with its own competences and available resources and those of the other participants; with specific demand and supply characteristics of the value chain, its R&D intensity and with the firm size of the participants.

In an industry cluster where a large outsourcing company forces its suppliers (often SMEs) to co-operate, the vertical dimension is predominant, leaving most market power in the hands of the initiating company. In contrast, if supplying SMEs try to compensate for their material disadvantages, and start an industry cluster within one branch of industry, the horizontal dimension will dominate in the industry cluster. In a third example, not a firm but a regional government body may be the initiator of an industry cluster with the aim to enhance the competitiveness of a region. It is clear that in such a case the geographical dimension will dominate. In a final example, a knowledge institution is the initiator, striving for the commercial exploitation of an R&D-invention. Here, the institutional dimension will dominate.

More dimensions may play a role within an industry cluster. Furthermore, the predominance of a cluster dimension such as described in the preceding examples may differ along with the motives of the participants. In the case of the first example, not the vertical dimension but a horizontal dimension would prevail when suppliers in the same industry took the initiative to join forces in response to a growing market power of the main client firm. This example demonstrates how motives, initiatives and cluster dimensions may be related along with firm characteristics.

Motives for SMEs to cluster ⇒ Role and position of SMEs in industry clusters

This link is based on theoretical insights and empirical evidence and refers to three propositions:

1) By participating in an industry cluster SMEs try to overcome their material disadvantages.
2) The role and position of SMEs in an industry cluster depends to a large extent on the motives for participating in such an industry cluster.
3) The role and position of firms in an industry cluster is reflected in the question which party has taken the initiative to cluster.

Ad 1) By participating in an industry cluster SMEs try to overcome their material disadvantages

In chapter 5 we concluded that SMEs in general have material disadvantages compared to large firms, such as a lack of financial resources and a lack of technological knowledge. However, SMEs possess behavioural advantages which can be described as flexibility, dynamism and responsiveness to changing market conditions (Rothwell, 1995). These behavioural advantages seem to correspond with the factors that make up the 'entrepreneurial economy' as described in chapter 2 (Audretsch and Thurik, 1997).

Motives for SMEs to participate in industry clusters are often related to the wish to deal with material disadvantages. Clustering is often driven by the prospect of technological gains (Klein Woolthuis, 1996). By co-operating SMEs hope to obtain economies of scale, economies of scope and an acceleration of the innovation process (Prince and Braaksma, 1995). In other words, motives for clustering match with the factors stimulating largeness and thus with the disadvantages SMEs incur compared with large firms.

Ad 2) The role and position of SMEs in an industry cluster depend to a large extent on the motives for participating in such a cluster

A second proposition is that the role and position of SMEs in an industry cluster largely depend upon the motives of SMEs to participate and, at the same time, upon the motives of other participants to look for partners. In this context, Jacobs (1995) indicates two different types of companies with respect to the emergence of industry clusters:

A) Companies which have innovative ideas but do not know how to execute them.

In this case a company does not possess all the basic competences required to develop new products and to produce, market and distribute them. A lack of one or more of these competences may be the reason why this company starts looking for partners. The way in

which the co-operation arrangement is completed, could be an explanation for the relationships between this company and the participating SMEs.

B) Companies concentrating on their core competences and outsourcing activities to a limited number of suppliers (main suppliers).

Often the outsourcing company is large, whereas its main suppliers are small or medium-sized. This is confirmed by Muizer (1998) who found that SMEs are more often involved in a co-operation arrangement as a supplier. It appears that the major objective for SMEs and large companies to join an industry cluster is to develop new products. As a second important objective SMEs emphasize the improvement of products or services, while, in contrast, for large companies this is the improvement of their production process.

Ad 3) The role and position of firms in an industry cluster may depend on which party has taken the initiative to cluster

It is proposed that the initiating party influences the role and position SMEs have in the cluster. This initiative is thought to be directly linked to the motives the party has for clustering. Empirical material on this issue suggests that large companies take more initiatives than smaller companies (Muizer, 1998): 67% of large companies has taken the initiative to form their most important technological co-operation arrangement, while only 50% of the SMEs has done this.

An empirical study on the electronics and bio-technology industry (Lawton Smith et al., 1991) reveals that the initiative to collaborate is shared almost equally between the large and the small firms in the electronics industry. In bio-technological co-operatives, however, the larger firms mainly approached the smaller firms. According to the authors this suggests that large firms are aware of the opportunities presented by smaller firms, and that technologically active small firms recognise the market power of large firms and their own need for external inputs.

Cluster dimensions ⇔ Role and position of SMEs in industry clusters

Although, literature on this subject is scarce, it can be learnt from chapter 5 that, in industry clusters in which the vertical dimension prevails, the relationships between SMEs and their larger partners are more likely to be determined by the latter firms. For instance, if a large outsourcing company forces its suppliers (often SMEs) to co-operate, the vertical dimension is predominant, leaving most market power in the hands of the initiating large company at the expense of the market power and position of the SMEs in the cluster.

In contrast, in industry clusters in which one or more of the other dimensions prevail, SMEs are more likely to have a more autonomous role and position. For instance, if supplying SMEs try to compensate for their material disadvantages and start an industry cluster within one branch of industry, the horizontal dimension will dominate in the industry cluster. In this situation the initiating company is likely to take a predominant role and position in the cluster. This leads to the conclusion that an interrelationship exists between cluster dimensions and the role and position of SMEs.

6.3 Conclusion

In this chapter we proposed a working definition of modern industry clusters. Furthermore, it is concluded that the theories dealt with in the preceding chapters can be applied for the analysis of industry clusters and, most importantly, that firm size seems to matter when explaining differences between small firms and large firms in their motives for clustering and their role and position in industry clusters. For the assessment of the role and position of SMEs in industry clusters, the preliminary framework of figure 6.2 is proposed. Knowing more about their role and position, their motives and the prevailing dimensions could be useful for identifying the different needs of SMEs which do, or intend to, participate in a certain type of industry cluster.

The complexity of the subject and the large number of potentially explanatory variables may necessitate a stepwise approach in future research. An example of a stepwise approach is to study each link as described in the preceding section separately. However, the various links and interrelationship of the framework may necessitate a more integrated approach. A first step in such an approach is to identify different industry cluster types. In a second step one cluster type can be chosen for an integral and in-depth analysis of the various links

in the framework, the explanatory variables and, finally, the assessment of the role and position of SMEs in such an industry cluster type.

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