

DANISH **R**ESearch **U**NIT FOR **I**NDUSTRIAL **D**YNAMICS

DRUID Working Paper No 02-08

**Global Strategy and the Acquisition of
Local Knowledge: How MNCs Enter
Regional Knowledge Clusters**

by

Mark Lorenzen and Volker Mahnke

Global Strategy and the Acquisition of Local Knowledge: How MNCs Enter Regional Knowledge Clusters

Mark Lorenzen, Department of Industrial Economics and Strategy

Volker Mahnke, Department of Informatics

Copenhagen Business School

mark@cbs — vm.inf@cbs.dk

Abstract

The paper addresses two recent interrelated phenomena: High-tech regional knowledge clusters, and globalization of R&D activities by multinational corporations (MNCs). Combining MNC literature; regional development literature; and literature on social networks, the paper discusses determinants of entry modes used by MNCs that localize R&D units in regional knowledge clusters. The paper states that the entry mode used by a MNC depends upon the type of agglomeration economies the latter seeks to appropriate: Those related to network relations; to local labor market specialization; or to institutional specialization. The paper adds theoretical insight into advantages and disadvantages of different entry modes with respect to appropriation of agglomeration economies, and special attention is dedicated to discussing acquisition. Through the use of an empirical case — the entry of five MNCs into the Danish telecommunications cluster in Aalborg, — the paper exemplifies its theoretical observations, but also points to how the evolution of a knowledge cluster may be severely affected by MNCs that enter through acquisition.

Keywords: MNCs; entry mode; acquisition; explorative R&D; regional clusters; localized learning; networks; telecommunications industry; North Jutland; Denmark.

JEL: O18, O32, L22

ISBN 87-7873-124-0

1. Introduction

The governance of knowledge production and use is central to the theory of *multinational corporations* (MNCs). For example, Vernon's (1966) product life cycle theory suggests that MNCs' ability to exploit home-based knowledge abroad is key to understanding their strategies. Foreign direct investment (FDI) is also often driven by firms' knowledge assets developed at home (e.g. Hymer 1959; Buckley and Casson, 1976; Teece, 1986). Other scholars recognize that knowledge production takes place not only at home, but is also dispersed in the global networks of MNCs. This idea, for example, is central to Perlmutter's (1969) *geocentric firm*; Bartlett and Ghoshal's (1989) *transnational corporation*; and Hedlund's (1994) *N-form*. The perspective of global knowledge production also increasingly influences literature on internationalization of technological activities (Cantwell, 1995; Grandstrand et al. 1992; Pavitt and Vega, 1999).

This paper focuses upon how MNCs increasingly internationalize their knowledge development activities by 'plugging into' knowledge production activities at particular locations abroad by locating plants or facilities here. Hence, the paper addresses two recent interrelated empirical phenomena that concern the governance of knowledge production by MNCs: (a) the emergence and evolution of regional high-tech *regional clusters* and (b) the globalization of *explorative R&D* (Kuemmerle 1998) by MNCs. Explorative R&D units are increasingly located in particular clusters, because MNCs seek to take advantage of their constitutions of local firms; institutions; and labor markets.

The paper has two main aims. First, it contributes to the MNC literature by developing propositions about MNCs *strategies* in governing global knowledge production networks. Whereas current MNC literature does pay attention to MNCs choice of entry modes when tapping into regional clusters, there is still scope for the current paper to add nuance to this literature by investigating reasons for the choice of other entry modes than those usually emphasized. Second, the paper aims at contributing to the literature on *regional development*. While this literature does acknowledge that FDI plays an increasing role for some clusters, it contains only limited insight into how the entry of MNCs influence the evolution of regional knowledge clusters. The paper aims at adding to such insight.

In order to do this, the paper combines the literatures on MNCs and regional development, adding observations from economic sociology ('network') literature. From these literatures, we extract theoretical pros and cons for different modes of MNC entry into a cluster: Greenfield investment; joint venture; and acquisition. Whereas MNC theory often supports greenfield investment; our use of supplementary literature also yields theoretical

arguments for acquisition. In order to illustrate these theoretical arguments, the paper then outlines an explorative case study of MNC entry into the Danish telecommunication cluster in North Jutland. Here, MNC entry has been based upon acquisitions as well as greenfield investment, and MNC entry has greatly influenced cluster evolution.

The remainder of this paper is organized as follows. In section 2, we describe more closely what may attract MNCs to regional knowledge clusters, and present the problem of entry modes. In sections 3 and 4, we theoretically investigate possible determinants of entry modes. Section 5 contains the empirical case study, where after a short general introduction to the North Jutland cluster, we discuss the entry modes of five selected MNCs, and investigate their reasons for entry and choice of entry mode. We argue that in the North Jutland case, the MNCs that chose acquisitions did so in order to gain speedy access to the local labor market. Even if this entry mode has also allowed the MNCs access to local networks, local networking should not be viewed as a determinant of entry mode. Subsequent to entry, the MNCs focused their acquired North Jutland units on internal competencies, neglecting — even restraining — local network relations. Finally, section 6 discusses the relevance of our theoretical propositions and expands upon them. The North Jutland case suggests that the observations in MNC literature of greenfield investment and the observations in regional development literature on inter-organizational networking may not be generally applicable. We also comment upon the notions of absorptive capacity and network barriers.

2. Knowledge Clusters and MNC Entry

Knowledge clusters

Within a range of industries, the bulk of innovative economic activity — sometimes also growth — takes place within *regional clusters* (e.g. Arthur 1990; DeBresson 1996; Staber et al 1995; Steiner 1998; Roelandt and Hertog 1999, Porter 1998; Schmitz 1999).¹ Regional clusters denote groups of interconnected firms (both suppliers, customers, and competitors); labor; and private and public institutions (educational institutions; specialized public and private service suppliers; and labor market and employers' associations), specialized within a few and related economic activity areas and are located together in particular regions or urban areas. Some such clusters are distinctively *high-tech*. Here, technology-leading firms; highly skilled labor (often engineers); and knowledge institutions (typically universities and research facilities)

¹ Examples include auto equipment in Detroit (US)(Porter 1998); textiles in Prato (North Italy)(Piore and Sabel 1984); surgery equipment in Sialkot (Pakistan)(Schmitz 1999); and furniture in West Jutland (Denmark)(Lorenzen and Foss 2002).

cluster together, often in connection to urban areas.² Such clusters will be referred to here as *knowledge clusters*.³

Agglomeration economies and MNC entry

Regional concentrations of economic activity yield *agglomeration economies* — essentially positive externalities that benefit local firms. Some of these agglomeration economies may be termed *external scope* economies — competitive advantages that local firms may enjoy from their access to suppliers, in the guise of specialization and flexibility.⁴ However, other agglomeration economies are related to local knowledge sources — innovative suppliers; customers or competitors; labor, and knowledge institutions — and are constituted by the ample opportunities for local firms for knowledge production and use, expressed in their high product and process innovation rates.

This second category of agglomeration economies, which is typical for knowledge clusters, often attracts direct investments from outside. Notably, MNCs enter particular knowledge clusters in order to benefit from the agglomeration economies that they facilitate (Porter, 1990, 1998; Saxanian, 1994; Krugman, 1991; Frost, 2001). As suggested by Kümmerle (1998; 1999) and Patel & Vega (1999), MNCs increasingly place small-scale R&D units in knowledge clusters to augment the MNCs' knowledge bases through monitoring regional knowledge bases. Frost (2001) has found that such local knowledge sources are particularly important for *explorative* innovation and e.g. Saxenian (1990); Almeida and Kogut (1999); and Patibandla (1998) have illustrated this for high-technology industries. Almeida (1996) shows that the US subsidiaries of foreign MNCs draw heavily upon the technology of local companies. Shan and Song (1997) find that foreign MNCs make equity investments in US biotechnology firms with high levels of patent activity, thus sourcing firm-embodied technological advantages located away from the MNCs' host countries.

On the other hand, Shaver & Flyer (2001) propose that technological strong MNC may sometimes have disincentives to enter into clusters, because they may less benefit from knowledge spillovers compared to weaker firms. They may, in fact, suffer diseconomies of agglomeration, because local competitors located may imitate competitive relevant technological know how. However, Frost (2001) argues with Cantwell and Janne (1999) that

² Good examples are microelectronics in Silicon Valley (US)(Saxenian, 1994) equipment in Cambridge (UK)(Keeble and Wilkinson, 1999); and ICT in Bangalore (India).

³ These clusters are sometimes referred to as *regional innovation systems* or *technological districts* (see e.g. Braczyk et al 1998; Malecki and Oinas 1999).

⁴ For example, the literature on *industrial districts* (typically SMEs within traditional industries) describes how firms that are specialized and participate to local flexible supplier networks are able to produce in shifting volumes while offering broad and flexible product ranges (see e.g. Piore and Sabel 1984; Scott and Storper 1986).

MNCs that are technologically strong possess so high absorptive capacities that they are indeed able to benefit from knowledge-related agglomeration economies in clusters.

The problem of entry mode

How do MNCs, then, enter knowledge clusters to maximize their appropriation of agglomeration economies? They essentially have a choice of three entry modes: *Greenfield investment*, *joint venture*, and *acquisition* (or, sometimes, *merger*) (e.g. Caves, 1996; Hennart and Park, 1993; Mansfield, 1984; Williamson, 1996).

MNCs that enter clusters to benefit from agglomeration economies are in search of collective rather than firm-specific assets: They often want access to a whole group of suppliers or customers, and to knowledge institutions which are not owned by any particular firm. This is the reason that the MNC literature downplays the role of acquisition or merger as an entry mode. MNCs that enter knowledge clusters are rarely after a particular product or product market owned by one firm. On the contrary, acquisition can be inappropriate if the firm subjectable to acquisition possesses a high ratio of undesired R&D resources relative to those desired by the MNC (Hennert and Reddy, 1998)⁵. In addition, acquiring explorative R&D sites may yield difficulties in terms of post-merger integration (Kümmeler, 1999). The MNC literature also outlines a range of internal governance and management problems in joint ventures, emphasizing their low success rate (e.g. Hennart, 1988). By implication, greenfield investment in R&D sites is often seen as the most viable governance choice when investing in explorative R&D abroad. In a 1994-1995 survey of 32 MNCs, Kümmeler (1999) finds that that greenfield investment is the preferred mode of entry for 79%, while acquisitions and joint ventures account for 15% and 6%, respectively.

Nevertheless, to shorten the process of accessing some local collective assets, it may be an advantage for an entering firm to 'plug into' the cluster *via* a local firm. For example, an acquisition or a joint venture may provide instant access to network relations and labor, while a greenfield investment needs to gradually develop its own network relations and go through hiring processes. When are these advantages of joint venture or acquisitions so significant that MNCs will choose these entry modes instead of greenfield investment? In the following sections, we shall extract some propositions from literature on what determines the choice of entry mode when MNCs enter knowledge clusters. We suggest that the type of agglomeration economies that MNCs want to appropriate is key, and that *liabilities of foreignness*; the need to minimize *diseconomies of agglomeration*; and *time compression diseconomies* when seeking to appropriate these agglomeration

⁵ Hennart and Reddy (1998) find that Japanese firms were inclined against acquisitions as an entry strategy into US, avoiding acquiring non-desired assets along with those desired.

economies may all influence MNCs to choose acquisition rather than greenfield investment or joint venture.

We shall distinguish between two main types of agglomeration economies in a knowledge cluster: Those arising from network relations (direct and indirect) between local firms; and those arising from local specialization of labor market and institutions (associations; educational and other institutions). We address these in turn: Section 3 outlines agglomeration economies related to networks; while section 4 outlines agglomeration economies related to specialization of labor and institutions. Both sections discuss how problems of appropriating these agglomeration economies may influence MNCs' choice of entry mode.

3. Network-related Agglomeration Economies

Network types and agglomeration economies

A first category of agglomeration economies arise through *direct relations* between firms in a cluster — i.e., bilateral business relations (e.g. supplier relations or strategic alliances). Regarding knowledge production and use, there may be agglomeration economies within clusters stemming from both horizontal and vertical direct relations among cluster participants. *Vertical* relations between firms in a cluster often lead to knowledge spill-overs, as demands and feedback from customers and specialized suppliers may push and pull incremental upgrading of a firm's knowledge base and lead to process or product innovations (von Hippel 1988; Lundvall 1988). This process is eased by the geographical proximity of cluster firms, because some types of knowledge — spanning from subjective advice to technical knowledge — are best transferred through direct observations and face-to-face interactions. The costs of exchanging such knowledge are relatively low within clusters, allowing for frequent face-to-face meetings and on-site observations. *Horizontal* knowledge spillovers in clusters occur between firms that share non-strategic knowledge or, alternatively, engage in strategic R&D alliances (von Hippel 1988; Lundvall, 1988). Hence, direct vertical or horizontal relations between firms may yield both transfers of existing knowledge, and joint creation of new knowledge. However, both these types of processes are much more complex than transferring bits of *information*, and hence necessitate firms to build mutual trust and common cognitive platforms. This may take considerable time and investments (Lorenz and Lazaric 1999; Lorenzen and Foss 2002).

A MNC wanting to appropriate agglomeration economies related to direct network relations needs to plug into existing supplier networks, or enter into alliances with incumbent firms. In other words, a 'network strategy' of an incoming MNC is to take active steps to fill the clusters' *structural holes* (Burt, 1992), establishing redundancy of ties in the knowledge cluster.

A second category of agglomeration economies relates to *indirect relations* between firms in a cluster. This denotes cases when there are no business relations between firms, albeit common ‘third part’ relations (such as common suppliers; service providers; or employees), or some social interaction of employees or managers (e.g. in local clubs or associations).⁶ Such indirect relations, in both professional and social life, facilitate mutual monitoring between firms, both in the guise of planned environment scanning and accidental observations (e.g. gossip). Information stemming from monitoring of competitors’ experiments with markets and technologies may be an important input to a firm’s own knowledge production. Monitoring is facilitated in clusters, because indirect relations between people — in business and in private life, and planned as well as coincidental — are more frequent with geographical proximity. Whereas direct relations between firms (at least, in the successful cases) allow for in-depth transfer of knowledge, indirect relations hence allow firms to monitor a wide and flexible range of information (Granovetter 1973; 1982). This information also includes what is not expected nor searched for, which may have a greater potential for inspiring change and innovation in firms than “the provincial news and views
tter 1982: 106). In Marshall’s (1891) words, information relating to the dominant type of industrial activity is simply “in

A MNC may hence benefit from establishing a mix of direct and indirect relations in a knowledge cluster, in order to benefit both from in-depth knowledge transfers or joint knowledge development through alliances and supplier relationships; and from monitoring a diverse array of information as inspiration to its in-house knowledge development through indirect relations.

However, benefiting from knowledge and information abundant in local networks may not be so simple. In some literature, it seems to be indicated that simply ‘being there’ within a cluster enables a firm to appropriate agglomeration economies related to local networks. However, some firms — and particularly newcomers to a cluster — may enjoy lower network-related agglomeration economies relative to incumbent firms. Liabilities of foreignness and potential diseconomies of agglomeration may influence MNCs’ choice of entry mode, and will be outlined in the following.

The problem of absorptive capacity

It may be costly for a MNC to gain access to network-related agglomeration economies in *cognitive* terms. On one hand, Frost (2001) holds that technological strong MNCs will benefit from entering into clusters, because their technological and competitive strength allows them to particularly well absorb technological knowledge and innovative ideas that weaker firms in the

⁶ The sociological network literature — exemplified here by Granovetter (1973; 1982), refers to indirect relations as ‘weak ties’.

cluster might develop, but are unable to exploit by themselves. Cantwell and Janne (1999) agree, arguing that MNCs with home base in 'centers of excellence' have better possibilities for tapping knowledge in clusters elsewhere, because they have a relatively high *absorptive capacity*. This will augment their capacity to benefit from agglomeration economies by locating explorative R&D abroad. On the other hand, very specific technical details related to other firms' technologies might be difficult to absorb even with a high *general* absorptive capacity (the 'not-invented-here' syndrome). Incumbent firms in a knowledge cluster often have a good understanding of technologies that originate within the cluster (they may have participated to inventing the technologies themselves), but a MNC that enters to obtain that technology may experience some liabilities of foreignness in terms of poor capacity to absorb all the relevant technical details. The technology may be 'coded' in ways that are comprehensible to only those firms that share 'code books', i.e., particular ways of formulating it, contextualizing it, sharing it and using it. It may take a substantial period of time for a newcoming firm to build a codebook that allows it to understand local knowledge and putting it to productive use. Possessing a high absorptive capacity may be helpful in this respect, but local codification of knowledge — and ways of sharing it — may be highly endemic and take more than technical skills to master.

Such cognitive entry barriers may be particularly severe for MNCs that enter through *greenfield investment*, as greenfield firms may need to go through a long process of constructing relevant code books (through experimentation and hiring of relevant people), and gradually building mutual understanding of particular partners' technologies (through interaction). A *joint venture* with a local firm that possesses the local codebook, on the other hand, provides the MNC with an 'interpreter'. However, a joint venture may suffer from severe cognitive problems *between* the MNC and the local firm — different managerial or technical cultures — making it costly or impossible to transfer locally obtained knowledge to the global network of the MNC (Lam, 1997; Hamel, 1991; Lyles and Stalk, 1996; Inkpen and Beamish, 1997). Furthermore, as pointed out by Caves (1996), there may be incentive conflicts between partner firms. If a MNC judges the risk of imitation by potential local partner firms high, it may, to avoid diseconomies of agglomeration, refrain from joint ventures, since these may expose it to substantial knowledge expropriation risk. This may be especially the case if explorative R&D is mainly established to develop process rather than product innovation, because the latter is better protected by law compared to the former (Williamson, 1996). *Acquisition*, offering the same possibilities as joint venture for utilizing a local firm's codebook for interpretation, allows for better alignment of communication as well as incentives between the local

unit and the global network of the MNC. It may hence be a preferred alternative to joint venture.⁷

The problem of social entry barriers

When a MNC enters a cluster, agglomeration economies — and their distribution — often shift. Technologically strong MNCs may bring novel knowledge to the cluster that increases the cluster's knowledge diversity. If such knowledge spills over to incumbents, they may benefit from a higher potential for innovation because greater diversity of knowledge leads to new knowledge combination possibilities. On the other hand, if entrants are technologically strong MNCs with high absorptive capacities, incumbent firms may have more to lose than to gain from MNC entry. Further, if local competition for qualified labor is fierce, entrants increasing this competition are likely to be unwelcome. Finally, if there are dominant incumbent firms that strategically intervenes, invests and centrally coordinates inter-firm relations in the cluster — what Rugman and D'Cruz (2000) coin *flagship firms* —, these will be less interested in MNC entry, if this challenges their dominating power positions. On the other hand, firms in a more 'symmetrical' cluster are likely to focus less upon power relations and may welcome the entry of a source of knowledge to the cluster.

In any case, incumbents may meet MNC entry with suspicion, and this may raise *social entry barriers*. While it is possible for most newcomers to establish direct relations to a few firms (Dyer and Nobeoka 2000), invest heavily in them and hence build mutual trust and shared understanding, it may be much more difficult to become part of a network of indirect relations, because such networks are often 'identity based' (Hite and Hesterly, 2001), i.e. based on social conventions and ambiguous ways of qualifying for trust and acceptance. MNCs may be excluded from some indirect relations, such as membership to industrial associations or social clubs, or incumbent firms may 'hide' social norms or principles for communication, possibly allowing the newcomer into social networks, but refraining from explaining how, where and when local information sharing takes place. Hence, social entry barriers may constitute a serious barrier to reaping some agglomeration economies.

The severity of social entry barriers depends upon how incumbent firms view newcomers. Consequently, some barriers may apply to all newcomers, while some are more strategic and depend upon whether newcomers are perceived as a potential competitive threat or as a potential source of knowledge. Especially if MNCs are perceived as technological advanced, whether they will be viewed as mainly appropriators or contributors of local agglomeration economies may be determined by their entry mode. Thus, if they want to minimize social entry barriers, MNCs may enter through only gradually increase their commitment to the cluster, in

⁷ However, Foss and Pedersen (2002) point towards the communication problems that may remain between a MNC and an acquired local firm.

order to evoke a reputation of a complementary and contributing actor in the generation rather than the expropriation of agglomeration benefits. Excessive investments may be viewed as a threat, it high commitment results in depletion of skilled labor, attraction of valuable employees from incumbents, pre-empting valuable supplier relations, or otherwise seeking to assume a flagship position too early. By implication, *greenfield investment* seems to be an appropriate entry mode, as it signals commitment to the cluster. However, it may be a long and costly process for a greenfield to gradually build trust in its newly established relations to incumbent firms, and in an identity-based cluster, it may flunk the necessary 'rites of passage'. *Acquisition* of an incumbent firm that is already socially accepted in the cluster may allow a MNC to override social network barriers — through, in addition to acquiring existing supplier and customer relationships, also acquiring the social relations that exist between that firm's personnel and managers or employees in other incumbent firms. However, the very acquisition act may be viewed as hostile, and strain the social acceptance of the acquired firm. The local supplier and customer relations that were acquired with the incumbent firm may be strained and lost. Furthermore, as suggested by Kummerle (1999), a MNC also loses the acquired social networks, if key personnel choose to leave after the take-over. Hence, a *joint venture* may be chosen as a first step towards acquisition. Signaling a MNC's commitment to add to agglomeration economies while not entering too forcefully, it allows for quick entry and access to existing social relations while retaining the local 'partner firm, keeping social barriers down.

4. Agglomeration Economies Related to Specialization of Labor Market and Institutions

Another type of agglomeration economies arises not through relations between firms, but is constituted by 'external scale' economies. A large number of technologically related firms that are co-located represent a large local market, allowing for supply side *specialization*. Examples of such specialization encompass a specialized local pool of labor and labor market institutions; specialized local public or semi-public R&D facilities; education organizations (such as universities); and a range of other public and private services (e.g., finance). MNCs' choice of entry modes may be influenced by problems of appropriating some agglomeration economies related to such local specialization.

Labor market specialization and competition for labor

Within a cluster, specialization of economic activity within a few related areas is often accompanied by specialization of local labor. A high demand for particular qualifications helps in targeting public (and sometimes private) educational institutions; plus boosting political will to expand upon particular

educational activities. For knowledge clusters, specialization and upgrading technical schools and universities is most important. In-job training further adds to skill levels in the local labor force. Finally, good employment opportunities mean that labor tends to migrate to the cluster (at least, to most urban clusters).⁸ The result is a specialized local labor market that in skill levels and functioning of its institutions accommodates the cluster's dominant type of economic activity. Such a labor market functions both as input to single firms' internal search activities (providing R&D personnel), and — when people shift job often within the cluster — a mechanism for transferring knowledge between firms. To a varying degree, labor market institutions (unions, and employment services) play important roles in facilitating the flow of labor between firms.

Educational institutions augment the pool of qualified labor in a cluster, but also improve upon communication and mutual monitoring between local firms. First, this is because many both direct and indirect relations where business managers or employees of different firms in a cluster continuously meet and exchange information are based on social ties originating from their days in the local school; college; or university. Such social ties also often facilitate trust between people. Second, it is because educational institutions create common code books for communication, both as similarities in skill bases (which, according to Lane & Lubatkin, (1998) enhance firms' relative absorptive capacity), and as shared social conventions and frames of reference, functioning as normative and cognitive frames that ease interaction and communication between people and firms (Scott 1995; Lorenzen and Foss 2002).

However, many clusters often (at least in periods) experience more economic growth and entry than local educational institutions and immigration of qualified labor can accommodate. Hence, competition for qualified labor may be intense between local firms, and latecomers may experience difficulties of getting qualified labor. Patibandla (1998) points out that MNCs may be less subjectable to such time compression diseconomies on local labor markets, as they can attract from weaker incumbent firms key employees that like to work for well-reputed MNCs. This is an advantage for MNCs that enter clusters through *greenfield investment*. However, as mentioned, attracting labor from incumbent firms is likely to be strongly condemned by incumbent firms and followed by social sanctions. If local labor is not readily available and cannot be attracted from incumbent firms, or if the MNC wants to avoid raising social entry barriers, *acquisition* may be a quick way of acquiring a labor force. However, Kuemmerle (1999) points out that greenfield investment may be a slower, albeit less insecure way of establishing a local labor force, because a MNC may risk that key personnel quits after their work place has been acquired by a foreign company. A *joint*

⁸ Most knowledge clusters are located in connection to urban areas, as highly qualified labor (e.g. engineers) tends to prefer a high level of urban services.

venture may also provide quick access to a local labor, albeit with few possibilities for the MNC to determine the use of the entire local partner firm's work force. If the MNC quickly wants to achieve scale in production, joint venture may hence be a more costly alternative than acquisition.

An alternative to cutthroat competition for local labor is inter-firm collaboration with universities on upgrading educational activities, or on boosting immigration of qualified labor. For example, knowledge clusters that are located in distance from major urban agglomerations often have severe problems in attracting qualified labor because of the low local levels of public services relative to major cities. Hence, local firms join often forces to provide services such as schools, day care, or recreational facilities. This collaboration often takes place mediated through local employers' associations or industrial development boards. Such specialized institutions and the role of firms' participation (membership) shall be dealt with below.

Institutional specialization and membership

In a knowledge cluster, the agglomeration of specialized firms boosts a range of other specialized institutions than educational institutions. For example, research institutions (including universities) are central to many knowledge clusters — and many firms in knowledge clusters have originated from spin-offs from such institutions. Universities and other research institutions facilitate general technological upgrades in a cluster, through providing technological services. They are often also partners in technologically important direct relations, in the guise of co-operative R&D projects with firms. Such projects may be in the guise of bilateral university-firm collaboration, targeted towards the development of a particular product. They may also take the form of a larger project group of university researchers and local firms, aimed at developing technologies or technological standards that may benefit a broad range of local firms.

Other local institutions that become specialized to accommodate local industry include employers' associations and other associations that represent 'joint action' (Schmitz, 1999), created by local economic agents to promote strategic goals for common benefit — for example, industrial development boards or think tanks. Such institutions may seek to improve upon the local labor market as mentioned above, attract FDI into the cluster, lobby for regional or national policies, etc.

Meetings and joint projects mediated through universities or local associations bring local industrialists and researchers together, and allow them to gradually build shared codebooks and trust. The result is that when people have participated to joint projects, they tend to pick each other as partners for new projects. Hence, even if university projects or local associations may formally be open for all, newcomers to a cluster may still experience significant time compression diseconomies related to local 'membership'. In addition, if there are general suspicions towards newcomers, social entry barriers to membership may also be raised. Because

acquisition allows a MNC to acquire membership of local associations or university research quickly, through acquiring well-connected key persons, this entry mode may stand out as a viable alternative to *greenfield investment*. This advantage may also be obtainable through *joint venture*. However, the internal incentive problems mentioned above could make the local partner firm appropriate the benefits of local memberships itself, rather than communicating them to the partner MNC.

— INSERT FIGURE 1 HERE —

5. Empirical Case

To illustrate the relevance of the above suggestions on agglomeration economies and entry modes, this section will outline some results of an interview-based case study of the entry of five selected MNCs into the Danish telecommunications cluster around Aalborg in North Jutland.⁹

The North Jutland cluster and agglomeration economies

Like Sweden and Finland, Denmark is specialized within development of mobile phones, due to growing agglomerations of firms in the urban areas Copenhagen, Aarhus, and Aalborg.¹⁰ The emergence of the latter — the small North Jutland telecommunications cluster — has been well documented elsewhere (see e.g. Dalum, 1995; Dalum et al, 1999; Dahl and Pedersen, 2002). It originated from one radio producer (founded in 1948) that specialized within radiocommunications during the 1960, and spurred a range of successful local spin-offs during the 1970s. A range of new local firms specialized within telecommunications have since sprung up, notably developing mobile phones and chips, components, or supporting technologies

⁹ The case firms — selected on account of their global presence and their recent entry into North Jutland — were picked using bibliographic research (annual reports and other material obtained electronically) during 2001. Semi-structured interviews with managers of the North Jutland MNC units were carried out during Wither 2002, aiming at uncovering determinants of MNC strategies of entry into knowledge clusters. Questions encompassed the relevance for entry strategies of (a) the structure of local networks in the cluster; (b) local institutional specialization; (c) social entry barriers; (d) technological strength of MNCs. The case study was partly funded by the Danish Research Center on Management, Organization and Competence (LOK). The study is a part of a research project on the role of MNC entry for the evolution of ‘new economy’ knowledge clusters, exemplified by biotechnology and IT clusters. This research project ‘triangulates’ research methods: Bibliographic research; interview-based case studies of selected firms in the clusters; and broader telephone surveys within the clusters. Research assistance from Katrine Bendix Mortensen; Anne Jørgensen; and Sophie Lose is gratefully acknowledged.

¹⁰ Whereas Sweden and Finland are also specialized in *production* of mobile phones, Denmark is only visible within development processes.

for telecom. A science park, NOVI and an association for local economic agents, NorCOM, have also been established. Today, Aalborg and surrounding municipalities hold 35 telecom firms with 3,900 employed, accounting for 1.6% of total employment in the area (but 40% of ICT employment)(Dahl and Pedersen 2002). During the period 1992-1999, employment in ICT (IT services; telecommunications; and electronics) in the entire North Jutland county increased by 63.5% (30% more than the Danish average) to 8,304 (Dalum and Pedersen 2002).

The cluster has been propelled by the creation of Aalborg University in 1974. Its research and course offer has since been specialized to meet the demands of the emerging local telecommunications industry (for example, through establishing a Center for Personal Communication). There are significant agglomeration economies on the local labor market. Engineers tend to stay in the Aalborg area, shifting jobs between local firms. The local offer of engineers with training targeted at telecommunications and practical experience attracts more firms, and upgrades the local job offer, making it still more attractive for engineers to settle around Aalborg. Further, the engineers interact socially as well as professionally, facilitating informal exchange of knowledge between firms (Dahl and Pedersen, 2002). However, local competition for qualified engineers is intense, which has raised wage levels well above the national average. To meet the demand for labor, the University (often in cooperation with local firms) strives to expand on educational activities, and NorCOM seeks to promote the immigration of qualified labor to North Jutland.¹¹

Since the 1980s, the cluster successfully specialized within mobile phone development, and came on the forefront of the development of new technologies, such as first- and second-generation mobile phones (NMT and GSM). It has also developed competencies within cordless phone (DECT) and Bluetooth technologies. The cluster now also houses specialized consultant firms carrying out R&D support functions for larger companies, for example software development. However, the major capabilities of the cluster are related to development of hardware — particularly, for GSM. Some important technological achievements have been accomplished through direct horizontal network relations between firms. Competing firms joined forces in project groups developing common technologies or standards (for example, GSM) that were utilized by all participants afterwards. These networks were typically governed as joint ventures, and some led to formation of new local firms. Even if such horizontal network relations played a larger role for local innovation than vertical relations did (many of which are still formed with suppliers external to the cluster), their extent remains very limited, and seems to be decreasing. Today, the University as well as NorCOM seek to boost

¹¹ The current international recession in the telecommunications industry, causing plant closures and layoffs, also in the North Jutland cluster, has relaxed competition on labor markets, at least for a period.

horizontal networking, through inviting firms to participate to university course development, joint initiatives for promoting the cluster politically, etc. The success of stimulating new joint research projects (e.g. on development of next-generation mobile phone technology, UTMS), however, remains modest.

MNC entry to the North Jutland cluster

The ownership structure of the cluster has shifted significantly since the 1990s, as a range of MNCs currently enter the cluster. This entry is propelled by a lack of local capital in North Jutland, and takes two main forms. The first, and most recent, form of MNC entry is constituted by alliances made by local industrialists and external MNCs (typically, the latter are relatively small global players in need of building competencies in new fields related to telecom development). This form of entry infuses capital to the cluster, and typically results in small greenfield plants with relatively high autonomy, dedicated to explorative R&D and thus of high importance to the MNCs. Today, thus form of MNC entry accounts for the bulk of greenfield firm formation within the telecom industry around Aalborg.

The second type of MNC entry to the North Jutland cluster is constituted by a wave of acquisitions by MNCs that has swept the cluster during the 1990s. As many incumbent firms — including the former technology leaders — experience financial trouble due to declining markets or a general lack of R&D funds for new technologies (such as UTMS), the sope for MNC acquisition has been large.

The five MNCs that were interviewed in connection to the case study all entered the cluster since 1991.¹² Four acquired an incumbent firm or existing project team; while one made a greenfield investment. They have come for different reasons.

Two of the MNCs are relatively small global players within telecom development (one is a small player altogether, the other is larger, but has competencies within component production rather than telecom development). These corporations have chosen acquisition because they need to appropriate very specific competencies of local firms — including the capacity of these firms to take advantage of knowledge sharing and cooperation with other local firms. The acquired firms are small (around 40 employees), and have grown only slowly since. The local units have remained relatively autonomous, and the MNCs profit from their codebooks, their network relations to other local firms and the University, and their membership of NorCOM. Neither the network relations nor the memberships of the local firms have been strained by the take-over, as key employees have remained within the firms to nurse social relations.

The other three MNCs are much larger global players within telecom development that have been driven to North Jutland by the global scarcity of

¹² After agreement with their management, the firms are kept anonymous in this paper.

R&D personnel. As many large telecom producers expand their R&D capacity and cannot find a sufficient number of experienced ICT engineers at their home base, they have to spread R&D activities geographically. Hence, much of the entry to knowledge clusters around the world is not to get access to any country-specific markets or competencies, but to the place-bound skills found in local labor markets. These three MNCs have entered North Jutland on a larger scale. One decided, on grounds of its previous unsuccessful experiences with acquisitions, to make a greenfield investment in North Jutland, and quickly managed to attract 40 employees due to its strong company brand (and had plans for expanding to 300). The second MNC acquired an incumbent project group of five key persons, and quickly expanded to 125 employees. The third acquired a local plant with 300 employees. Acquisition was chosen by these two firms to quickly gain key employees and build up a labor force.

The entry of the first two MNCs to the North Jutland cluster focused upon particular local competencies; network relations; and memberships, and they constitute a global presence in the cluster that infuses both capital and competencies into the cluster with relatively little risk for disrupting local agglomeration economies. However, the latter three MNCs were much more focused upon appropriation of labor and entered on a larger scale. The local units constitute replaceable assets in their global networks.

This has two main implications. First, as North Jutland has a small local labor force and high wages compared to other knowledge clusters in which telecom firms are also present¹³, some MNCs of the latter type may choose to withdraw from North Jutland in times of crisis or restructuration. In fact, during the current world market recession, one of the three MNCs that entered in order to appropriate labor transferred UTMS development back to its home base, canceling a planned expansion of its North Jutland unit. The other two have already virtually shut down local operations due to general cutbacks and changes of technological focus of their R&D.

The second implication is that MNCs that have acquired local firms to appropriate labor have little focus upon local networking. Even if acquisition has gained the MNCs access to both direct and indirect networks in the cluster, as well as codebooks for appropriation of knowledge from other firms, the management of the MNCs has hampered the local units' networking. More effort has been spent on aligning the local units with the global network of the MNCs than on nursing local supplier relations, participation to joint research projects with other firms, or informal interaction with engineers from other firms. In several cases, joint projects or informal networking has even been actively discouraged.¹⁴

¹³ For example, there are large telecom clusters in the US; France; Japan; Sweden; and UK.

¹⁴ One interviewee claims: "The large companies superimpose safety procedures upon the local branch plants, making them unable to work together with other locals". Another interviewee adds: "People in the region cooperate, but the MNCs do not ... The region has

Even if some famous joint research projects have greatly stimulated technological development in the North Jutland cluster in the past, Danish owned firms, as well as MNCs, present in the cluster remain poor at networking.¹⁵ As mentioned, some local industrialists and policymakers now attempt to boost joint research projects and other types of local networking that may be crucial if North Jutland is to sustain its development potential within telecom technologies. However, for those MNCs having acquired local firms to appropriate labor, the incentives to invest in local networking are neglectable, as the MNCs are transforming the nature of R&D in the acquired units from exploration of new technologies to exploitation of existing technologies, notably GSM.¹⁶ The development of the very complex UTMS technology is an expensive and risky affair, and MNCs choose to centralize this R&D in their home base. Partly, this is to obtain scale economies, partly, it is because decentralizing R&D of UTMS to units in different knowledge clusters would necessitate the units to network horizontally (in the guise of joint research projects) with other local firms — including firms that are subsidiaries of some of the MNCs' global competitors. If firms in the North Jutland cluster are to succeed in setting up joint projects like the famous earlier GSM research projects, the smaller MNCs that have come to appropriate local competencies rather than labor, may be better project partners.¹⁷

6. Discussion and Conclusion

The empirical case outlined above provides illustration of some of the theoretical observations made in sections 2 through 4. The case also allows for some further observations.

First and foremost, the case supports our claim that *the nature of agglomeration economies within knowledge clusters influences MNCs' modes of*

changed a lot. Decision rights are localized outside the region and that influences the possibility for local development. The possibility to cooperate locally in projects is crucial. What happened about GSM development ... could not happen today". (Quotes translated from Danish.)

¹⁵ One recent UTMS development project set up by both MNCs and Danish owned firms was terminated because one of the *Danish-owned* firms pulled out.

¹⁶ Particularly, in times of recession, MNCs may be prone to use subsidiaries to profit as much as possible from existing technologies, rather than use them for explorative R&D.

¹⁷ It should be noted, however, that recently, the managers of the branches of larger, labor appropriating, MNCs, have been persuaded into participating to strategic meetings with other local industrialists. NordCOM hopes that these managers, even if being constrained by their foreign owners, are inclined to think more *strategically* than some local managers of small independent firms.

entry. The case suggests that appropriation of agglomeration economies related to specialized local labor markets, rather than networks or specialized institutions, might be an important reason for one particular type of MNC entry in knowledge clusters, and that this type may take the form of acquisitions rather than greenfield investments. This insight is at odds with Kuemmerle's (1998) suggestion that skilled labor mainly attracts MNCs carrying out *explorative* R&D: We argue that MNCs may enter into new clusters due to shortages of labor for exploitative R&D in their home base.

Second, the case provides some insight into *the importance of technological strengths and global networks of MNCs for entry modes*. Concerning the problem of absorptive capacity, the case demonstrated that even technologically strong MNCs with high general absorptive capacities may lack relevant code books for appropriating localized labor from a knowledge cluster, and this may be another reason for acquisition. On the other hand, MNCs with large global networks and strong R&D presence at many locations may be less impacted by cognitive problems related to small knowledge clusters such as North Jutland. As they concentrate their explorative R&D and efforts of strategic networking with other firms elsewhere, in other and stronger knowledge clusters ('centers of excellence', often related to their home base), they simply ignore network possibilities within the smaller clusters.

Hence, the case also demonstrated that for such MNCs, the problem of *social entry barriers* is also less relevant. In North Jutland, incumbents did not raise social network barriers against entering MNCs, as MNCs acquired existing social networks along with key personnel when they took over local firms. On the contrary, the MNCs created social barriers themselves. Their focus upon utilization of internal competencies direct the networking efforts of local personnel towards the global networks of the MNCs rather than local firms, and in some cases the MNC management even prohibit interaction amongst local engineers or managers.

Finally, the case exposed the vulnerability of knowledge clusters that experience MNC entry targeted at appropriating local labor. Local R&D plants that represent exploitative R&D capacity rather than exploration of new technologies, are the first to go when MNC cut back on global activities. And the overall explorative capacities of clusters may be hampered by MNC acquisitions aimed at appropriating labor, because it breaks up patterns of networking amongst incumbent firms. According to some interviewees, the changing social make-up of the North Jutland cluster makes local agglomeration economies less diversified. Ironically, many local firms in North Jutland choose to be acquired by MNCs to gain funds for future development — for example, to be able to develop UTMS technology. However, according to the interviewed managers, the growing local presence of MNCs seems to undermine the role of network-based agglomeration economies, rendering joint efforts at developing UTMS technology even less likely than before.

This paper's combination of theoretical literatures has added nuance to the standing debate of MNC entry into knowledge clusters. In particular, addressing in some detail the question of agglomeration economies has proved fruitful for explaining various entry modes. Furthermore, the explorative case study outlined in the paper has not only illustrated some of the theoretical points, but also pointed towards a necessity of dealing empirically with the question of how MNCs behave *after* entry to a knowledge cluster, and how such behavior varies with entry mode.

Literature

Almeida, P., B. Kogut. 1999. The Localization of Knowledge and the Mobility of Engineers in Regional Networks. Forthcoming, *Management Science* 45, 7: 905-918.

Arthur, Brian. 1990. 'Silicon Valley' Locational Clusters: When Do Increasing Returns Imply Monopoly? *Mathematical Social Sciences* 19: 235-51.

Bartlett, C.A., S. Ghoshal. 1989. *Managing Across Borders: The transnational solution*. Harvard Business School Press, Boston, MA.

Bartlett, C A and S Ghoshal (1990), Managing innovation in the transnational corporation, in *Managing the global firm*, Bartlett et al (eds.), London: Routledge.

Braczyk, Hans-Joachim et al, eds. 1998. *Regional innovation systems*, London: UCL Press.

Buckley PJ, Casson M. 1976. *The Future of Multinational Enterprises*. Holmes & Meier: London.

Burt, Ronald. 1992. *Structural Holes: The Social Structure of Competition*. Cambridge: Harvard University Press.

Cantwell, J.A., 1995. The globalization of technology: what remains of the product cycle model. *Cambridge Journal of Economics* 19, 155-174.

Cantwell, J (1998), The globalization of technology: What remains of the product-cycle model?, in *The dynamic firm*, Chandler et al (eds.), New York: Oxford University Press.

Cantwell, J and O Janne (1999), technological globalization and innovative centres: The role of corporate technological leadership and locational hierarchy, *Research Policy* 28: 119-144.

Caves, R. E. 1971. International corporations: The industrial economics of foreign investment. *Economica*, 38: 1-27.

Dahl, M S and Christian Ø. R. Pedersen (2002), Informal networks in a dynamic regional cluster, Paper presented at the DUID Winter Conference 2002, Rebild, Denmark, 17-19 January 2002.

- Dalum, B (1995): 'Local and global linkages: The radiocommunications cluster in Northern Denmark.' *Journal of Industry Studies*, Vol. 2, No. 2.
- Dalum, B, Magnus Holmén, Staffan Jacobsson, Mette Praest Annika Rickne, Gert Villumsen (1999): 'The Formation of Knowledge-based Clusters in North Jutland and Western Sweden. 'Paper to the DRUID Conference on National Innovation Systems, Industrial Dynamics and Innovation Policy, Rebild, June 9-12, 1999
- Dalum, B et al (2002): *Vision Nordstjernen: Strategiske overvejelser vedrørende den nordjyske IKT sektors fremtid*, Aalborg: Aalborg University.
- DeBresson, Christian. 1996. *Economic Interdependence and Innovative Activity*. Cheltenham, UK: Edward Elgar.
- Dyer, J. and N.I. Nobeoka. 2000. Creating and managing a high-performance knowledge-sharing network: The Toyota case; *Strategic Management Journal*, 21, 3: 345-365.
- Florida, R (1997), The globalization of R&D: Results of a survey of foreign-affiliated R&D laboratories in the USA, *Research Policy* 26: 85-103.
- Foss, Nicolai and Torben Pedersen (2002), Transferring Knowledge in MNCs: The Role of Sources of Subsidiary Knowledge and Organizational Context. forthcoming in *Journal of International Management*.
- Frost, S.T. 2001. The geographic sources of foreign subsidiaries' innovation: *Strategic Management Journal*, 22, (2), 101-123.
- Gerybadze, A and G Reger (1999), Globalization of R&D: Recent changes in the management of innovation in transnational corporations, *Research Policy* 28: 251-274.
- Granstrand, O., E. Bohlin, C. Oskarsson and N. Sjoberg (1992), "External technology acquisition in large multi-technology corporations," *R&D Management*, 22(2), pp.111-133.
- Granovetter, Mark (1973): The Strength of Weak Ties, *American Journal of Sociology* 78/6: 1360-1380.
- Granovetter, Mark (1982), The strength of weak ties: A network theory revisited, in *Social structure and network analysis*, Marsden & Lin (eds.), Beverly Hills: Sage.
- Hamel, G. 1991. Competition for competence and inter-partner learning within international strategic alliances. *Strategic Management Journal*, 12: 83-103.
- Hedlund, G. 1994. A model of knowledge management and the n-form corporation. *Strategic Management Journal*, 15: 73 - 90.
- Hennart, J. F. (1988), A Transaction Cost Theory of Equity Joint Ventures, *Strategic Management Journal*, 9, 361- 374.

- Hennart, J.-F., Y.-R. Park (1993), Greenfield vs. Acquisition, *Management Science*, 39, 1054 - 1070.
- Hennart, J.-F., S. Reddy (1998), Why Japanese Investors in the U.S. choose Joint Ventures over Acquisitions, In: M. G. Colombo (ed.), *The Changing Boundaries of the Firm*, London.
- Hite, J. and W. Hesterly, 2001. The evolution of firm networks: From emergence to early growth of the firm. *Strategic Management Journal*, 22 (3): 275-286.
- Hymer, S., 1959. *The international operations of national firms: A study of direct investment*, Ph.D. Dissertation, MIT.
- Håkanson, Lars (1990), International decentralization of R&D — the organizational challenges, in *Managing the global firm*, Bartlett et al (eds.), London: Routledge.
- Inkpen, A. C. and P. W. Beamish (1997). Knowledge, Bargaining Power and International Joint Venture Instability. *Academy of Management Review*, 22(1): 177 - 202.
- Keeble, D and F Wilkinson (1999), Collective learning and knowledge development in the evolution of regional clusters of high technology SMEs in Europe, *Regional Studies*, vol. 33, 4, pp. 295-304.
- Krugman P. 1991. Increasing returns and economic geography. *Journal of Political Economy* 99(3): 483-499.
- Kuemmerle, W (1998), Strategic interaction, knowledge sourcing and knowledge creation in foreign environments — an analysis of foreign direct investment in R&D by multinational companies, in *Managing strategically in an interconnected world*, Hitt et al (eds), Chichester: Wiley.
- Kuemmerle, W (1999), Foreign direct investment in industrial research in the pharmaceutical and electronics industries — results from a survey of multinational firms, *Research Policy* 28: 179-193.
- Lam, A (1997), Embedded firms, embedded knowledge: problems of collaboration and knowledge transfer in global cooperative ventures, *Organisation Studies*, vol 18 no.6.
- Lane. P.J. and M. Lubatkin. 1999. Relative absorptive capacity and inter-organisational learning. *Strategic Management Journal*. 19: 461-477.
- Lorenz, E H and N Lazaric (eds)(1998): *Trust and economic learning*, Cheltenham: Edward Elgar.
- Lorenzen, Mark and Nicolai Foss (2002), Cognitive coordination, institutions, and clusters: An exploratory discussion, in Brenner (ed.): *The Influence of Co-operations, Networks and Institutions on Regional Innovation Systems*, Cheltenham: Edward Elgar.

- Lyles, M. A. and J. E. Stalk (1996). Knowledge acquisition from foreign parents in international joint ventures. *Journal of International Business Studies*, 27(5): 877-904.
- Lundvall, Bengt-Åke (1988), Innovation as an interactive process: From user-producer interaction to the national system of innovation, in G Dosi et al (Eds.) *Technical change and economic theory*, London: Pinter.
- Malecki, E and P Oinas, eds. 1999 *Making connections: Technological learning and regional economic change*, Aldershot: Ashgate.
- Mansfield, E. (1984). R&D and innovation: Some empirical findings. In Z. Gilches (Ed.) *R&D, Patents, and Productivity*. Chicago: University of Chicago Press.
- Marshall, Alfred (1891), *Principles of Economics*, London: Macmillan.
- Meyer-Kramer, F and G Reger (1999): New perspectives on the innovation strategies of multinational enterprises: Lessons for technology policy in Europe, *Research Policy* 28: 751-776.
- Patel, P. & M. Vega (1999) Patterns of internationalization of corporate technology: Location vs. home country advantages. *Research Policy*, 28: 145-155.
- Patibandla, M. 1998, Structure, Organizational Behavior and Technical Efficiency: The Case of an Indian Industry, *Journal of Economic Behavior and Organization*. March, 34(3) 419-434.
- Pearce, R D (1999), Decentralized R&D and strategic competitiveness: Globalized approaches to generation and use of technology in MNEs, *Research Policy* 28: 157-178.
- Perlmutter, H. 1969. The Tortuous Evolution of the Multinational Corporation. *Columbia Journal of World Business*: 213-232.
- Piore, Michael J and Charles F Sabel, C.F (1984), *The Second Industrial Divide: Possibilities for Prosperity*, New York: Basic Books.
- Porter M. 1990. *The Competitive Advantage of Nations*. Free Press: New York.
- Porter ME. 1998. Clusters and the new economics of competition. *Harvard Business Review* 76(6): 77-90.
- Roelandt, Theo J. A., and Pim den Hertog, eds. 1999. *Cluster Analysis and Cluster-based Policy: New perspectives and Rationale in Innovation Policy*, Paris: OECD.
- Ronstadt , R C (1984), R&D abroad by US multinationals, in *Technology crossing borders*, Stobaugh and Wells Jr. (eds.), Boston: Harvard Business School Press.
- Rugman, A. and J. D'Cruz (2000) *Multinationals As Flagship Firms*. Oxford: Oxford University Press, 2000.

- Saxenian, A. 1990. Regional networks and the resurgence of Silicon Valley. *California Management Review*, Fall, pp. 39-112.
- Saxenian A. 1994. *Regional Advantage*. Harvard University Press: Cambridge, MA.
- Schmitz, Hubert (1999), Collective Efficiency and Increasing Returns, *Cambridge Journal of Economics* 23: 465-483.
- Scott, W. Richard. 1995. *Institutions and Organizations*. Thousand Oaks: Sage.
- Scott, Allen J. and Michael Storper, M., eds. (1986), *Production, work and territory: The geographical anatomy of industrial capitalism*, London: Allen & Unwin.
- Shan, W., J. Song. 1997. Foreign direct investment and the sourcing of technology advantage: An evidence from the biotechnology industry. *Journal of International Business Studies*, 28: 267-284.
- Shaver, J. M. & F. Flyer (2001) Agglomeration economies, firm heterogeneity, and foreign direct investment in the United States. *Strategic Management Journal*, 21 (12): 1175-1193.
- Staber, U et al (Eds.)(1995), *Business networks: Prospects for regional development*, Berlin: De Gruyter.
- Steiner, M (Ed.)(1998): *Clusters and regional specialization: On geography, technology, and networks*, London: Pion.
- Teece, D. (1986), "Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy," *Research Policy*, 15, pp.285-305.
- Vernon, R. (1966) International Investment and International Trade in the Product Cycle. *Quarterly Journal of Economics*, 80, 190-207.
- von Hippel, E (1988): *The sources of innovation*, New York: Oxford University Press.
- Williamson, O. (1996). *The mechanisms of governance*. Free Press
- Zander, I (1999), How do you mean 'global'? An empirical investigation of innovation networks in the multinational corporation, *Research Policy* 28: 195-213.

* * *

Figure 1. MNC entry modes in knowledge clusters and problems related to appropriation of agglomeration economies

Entry mode	Problem	Advantages	Disadvantages
Acquisition	Assets	Quick acquisition of valuable assets	Risk of acquisition of non-valuable assets
	Absorptive capacity	Acquisition of code books	
	Social entry barriers	Acquisition of direct networks Acquisition of indirect networks through employees' social relations	Hostile acquisition may raise social entry barriers Direct networks may dissolve after acquisition Employees key to indirect networks may leave after acquisition
	Local labor market	Acquisition of labor	Knowledgeable employees may leave after acquisition
	Institutions and membership	Acquisition of membership through employees	Employees key to membership may leave after acquisition
Greenfield investment	Assets	No risk of unwanted assets	Slow and expensive asset building process
	Absorptive capacity		Slow and expensive communication process May fail to build own code books
	Social entry barriers	Lower social entry barriers through signaling commitment	Slow and expensive trust-building process May remain an outsider
	Local labor market		Slow hiring process
	Institutions and membership		Slow and expensive process of becoming a member
Joint venture	Assets	Access to only selected assets	Internal governance and management problems
	Absorptive capacity	Access to local 'interpreter'	Internal communication problems Risk of imitation by partner firm
	Social entry barriers	Lowering social barriers through preserving local 'flavor' Access to indirect networks through local partner firm	
	Local labor market	Access to partner firms' labor	Scale problems
	Institutions and membership	Access to membership through local partner firm	Risk of partner firm appropriating benefits

Danish Research Unit for Industrial Dynamics

The Research Programme

The DRUID-research programme is organised in 3 different research themes:

- *The firm as a learning organisation*
- *Competence building and inter-firm dynamics*
- *The learning economy and the competitiveness of systems of innovation*

In each of the three areas there is one strategic theoretical and one central empirical and policy oriented orientation.

Theme A: The firm as a learning organisation

The theoretical perspective confronts and combines the resource-based view (Penrose, 1959) with recent approaches where the focus is on learning and the dynamic capabilities of the firm (Dosi, Teece and Winter, 1992). The aim of this theoretical work is to develop an analytical understanding of the firm as a learning organisation.

The empirical and policy issues relate to the nexus technology, productivity, organisational change and human resources. More insight in the dynamic interplay between these factors at the level of the firm is crucial to understand international differences in performance at the macro level in terms of economic growth and employment.

Theme B: Competence building and inter-firm dynamics

The theoretical perspective relates to the dynamics of the inter-firm division of labour and the formation of network relationships between firms. An attempt will be made to develop evolutionary models with Schumpeterian innovations as the motor driving a Marshallian evolution of the division of labour.

The empirical and policy issues relate the formation of knowledge-intensive regional and sectoral networks of firms to competitiveness and structural change. Data on the structure of production will be combined with indicators of knowledge and learning. IO-matrixes which include flows of knowledge and new technologies will be developed and supplemented by data from case-studies and questionnaires.

Theme C: The learning economy and the competitiveness of systems of innovation.

The third theme aims at a stronger conceptual and theoretical base for new concepts such as 'systems of innovation' and 'the learning economy' and to link these concepts to the ecological dimension. The focus is on the interaction between institutional and technical change in a specified geographical space. An attempt will be made to synthesise theories of economic development emphasising the role of science based-sectors with those emphasising learning-by-producing and the growing knowledge-intensity of all economic activities.

The main empirical and policy issues are related to changes in the local dimensions of innovation and learning. What remains of the relative autonomy of national systems of innovation? Is there a tendency towards convergence or divergence in the specialisation in trade, production, innovation and in the knowledge base itself when we compare regions and nations?

The Ph.D.-programme

There are at present more than 10 Ph.D.-students working in close connection to the DRUID research programme. DRUID organises regularly specific Ph.D-activities such as workshops, seminars and courses, often in a co-operation with other Danish or international institutes. Also important is the role of DRUID as an environment which stimulates the Ph.D.-students to become creative and effective. This involves several elements:

- access to the international network in the form of visiting fellows and visits at the sister institutions
- participation in research projects
- access to supervision of theses
- access to databases

Each year DRUID welcomes a limited number of foreign Ph.D.-students who want to work on subjects and projects close to the core of the DRUID-research programme.

External projects

DRUID-members are involved in projects with external support. One major project which covers several of the elements of the research programme is DISKO; a comparative analysis of the Danish Innovation System; and there are several projects involving international co-operation within EU's 4th Framework Programme. DRUID is open to host other projects as far as they fall within its research profile. Special attention is given to the communication of research results from such projects to a wide set of social actors and policy makers.

DRUID Working Papers

- 96-1 **Lundvall, Bengt-Åke:** The Social Dimension of the Learning Economy. (ISBN 87-7873-000-7)
- 96-2 **Foss, Nicolai J.:** Firms, Incomplete Contracts and Organizational Learning. (ISBN 87-7873-001-5)
- 96-3 **Dalum, Bent and Villumsen, Gert:** Are OECD Export Specialisation Patterns 'Sticky?' Relations to the Convergence-Divergence Debate. (ISBN 87-7873-002-3)
- 96-4 **Foss, Nicolai J.:** Austrian and Post-Marshallian Economics: The Bridging Work of George Richardson. (ISBN 87-7873-003-1)
- 96-5 **Andersen, Esben S., Jensen, Anne K., Madsen, Lars and Jørgensen, Martin:** The Nelson and Winter Models Revisited: Prototypes for Computer-Based Reconstruction of Schumpeterian Competition. (ISBN 87-7873-005-8)
- 96-6 **Maskell, Peter:** Learning in the village economy of Denmark. The role of institutions and policy in sustaining competitiveness. (ISBN 87-7873-006-6)
- 96-7 **Foss, Nicolai J. & Christensen, Jens Frøslev:** A Process Approach to Corporate Coherence. (ISBN 87-7873-007-4)
- 96-8 **Foss, Nicolai J.:** Capabilities and the Theory of the Firm. (ISBN 87-7873-008-2)
- 96-9 **Foss, Kirsten:** A transaction cost perspective on the influence of standards on product development: Examples from the fruit and vegetable market. (ISBN 87-7873-009-0)
- 96-10 **Richardson, George B.:** Competition, Innovation and Increasing Returns. (ISBN 87-7873-010-4)
- 96-11 **Maskell, Peter:** Localised low-tech learning in the furniture industry. (ISBN 87-7873-011-2)
- 96-12 **Laursen, Keld:** The Impact of Technological Opportunity on the Dynamics of Trade Performance. (ISBN 87-7873-012-0)

- 96-13 **Andersen, Esben S.:** The Evolution of an Industrial Sector with a Varying Degree of Roundaboutness of Production. (ISBN 87-7873-013-9)
- 96-14 **Dalum, Bent, Laursen, Keld & Villumsen, Gert:** The Long Term Development of OECD Export Specialisation Patterns: De-specialisation and “Stickiness”. (ISBN 87-7873-014-7)
- 96-15 **Foss, Nicolai J.:** Thorstein B. Veblen: Precursor of the Competence-Based Approach to the Firm. (ISBN 87-7873-015-5)
- 96-16 **Gjerding, Allan Næs:** Organisational innovation in the Danish private business sector. (ISBN 87-7873-016-3)
- 96-17 **Lund, Reinhard & Gjerding, Allan Næs:** The flexible company Innovation, work organisation and human resource management. (ISBN 87-7873-017-1)
- 97-1 **Foss, Nicolai J.:** The Resource-Based Perspective: An Assessment and Diagnosis of Problems. (ISBN 87-7873-019-8)
- 97-2 **Langlois, Richard N. & Foss, Nicolai J.:** Capabilities and Governance: the Rebirth of Production in the Theory of Economic Organization. (ISBN 87-7873-020-1)
- 97-3 **Ernst, Dieter:** Partners for the China Circle? The Asian Production Networks of Japanese Electronics Firms. (ISBN 87-7873-022-8)
- 97-4 **Richardson, George B.:** Economic Analysis, Public Policy and the Software Industry. (ISBN 87-7873-023-6)
- 97-5 **Borras, Michael & Zysman, John:** You Don’t Have to Be A Giant: How The Changing Terms of Competition in Global Markets are Creating New Possibilities For Danish Companies. (ISBN 87-7873-024-4)
- 97-6 **Teubal, Morris.:** Restructuring and Embeddeness of Business Enterprises- Towards an Innovation System Perspective on Diffusion Policy. (ISBN 87-7873-025-2)
- 97-7 **Ernst, Dieter & Guerrieri, Paolo:** International Production Networks and Changing Trade Patterns in East Asia: The case of the Electronics Industry. (ISBN 87-7873-026-0)
- 97-8 **Lazaric, Nathalie & Marengo, Luigi:** Towards a Characterisation of Assets and Knowledge Created in Technological Agreements: Some evidence from the automobile-robotics sector. (ISBN 87-7873-027-9)

- 97-9 **Ernst, Dieter.:** High-Tech Competition Puzzles. How Globalization Affects Firm Behavior and Market Structure in the Electronics Industry. (ISBN 87-7873-028-7)
- 97-10 **Foss, Nicolai J.:** Equilibrium vs Evolution in the Resource-Based Perspective: The Conflicting Legacies of Demsetz and Penrose. (ISBN 87-7873-029-5)
- 97-11 **Foss, Nicolai J.:** Incomplete Contracts and Economic Organisation: Brian Loasby and the Theory of the firm. (ISBN 87-7873-030-9)
- 97-12 **Ernst, Dieter & Lundvall, Bengt-Åke:** Information Technology in The Learning Economy – Challenges for Developing Countries. (ISBN 87-7873-031-7)
- 97-13 **Kristensen, Frank Skov (p):** A study of four organisations in different competitive environments. (ISBN 87-7873-032-5)
- 97-14 **Drejer, Ina, (p) Kristensen, Frank Skov (p) & Laursen, Keld (p):** Studies of Clusters as a Basis for Industrial and Technology Policy in the Danish Economy. (ISBN 87-7873-033-3)
- 97-15 **Laursen, Keld (p) & Drejer, Ina (p):** Do Inter-sectoral Linkages Matter for International Export Specialisation? (ISBN 87-7873-034-1)
- 97-16 **Lundvall, Bengt-Åke & Kristensen, Frank Skov (p):** Organisational change, innovation and human resource Development as a response to increased competition. (ISBN 87-7873-036-8)
- 98-1 **Præst, Mette (p):**An Empirical Model of Firm Behaviour: A dynamic Approach to Competence Accumulation and Strategic Behaviour. (ISBN 87-7873-037-6)
- 98-2 **Ducatel, Ken:** Learning and skills in the Knowledge Economy. (ISBN 87-7873-038-4)
- 98-3 **Ernst, Dieter:** What Permits Small Firms to Compete in High-Tech Industries? Inter-Organizational Knowledge Creation in the Taiwanese Computer Industry. (ISBN 87-7873-039-2)
- 98-4 **Christensen, Jens Frøslev:** The Dynamics of the Diversified Corporation and the Role of Central Management of Technology. (ISBN 87-7873-040-6)
- 98-5 **Valente, Marco (p):** Laboratory for Simulation Development. (ISBN 87-7873-041-4)
- 98-6 **Valente, Marco (p):** Technological Competition: a Qualitative Product Life

Cycle. (ISBN 87-7873-042-2)

- 98-7 **Lam, Alice:** The Social Embeddedness of Knowledge: Problems of Knowledge Sharing and Organisational Learning in International High-Technology Ventures. (ISBN 87-7873-043-0)
- 98-8 **Jørgensen, Kenneth M. (p):** Information Technology and Change in Danish Organizations. (ISBN 87-7873-044-9)
- 98-9 **Andersen, Esben Sloth:** Escaping Satiation in an Evolutionary Model of Structural economic Dynamics. (ISBN 87-7873-045-7)
- 98-10 **Foss, Kirsten:** Technological Interdependencies, Specialization and Coordination: A Property Rights Perspective on The Nature of the Firm. (ISBN 87-7873-046-5)
- 98-11 **Andersen, Poul H:** Organizing International Technological Collaboration in Subcontractor Relationships. An Investigation of the Knowledge-Stickyness Problem. (ISBN 87-7873-047-3)
- 98-12 **Nymark, Søren (p):** Billeder af strategi i forandringsrige organisatoriske omgivelser: 3 cases fra DISKO studierne. (ISBN 87-7873-048-1)
- 98-13 **Andersen, Esben Sloth:** The Evolution of the Organisation of Industry. (ISBN 87-7873-050-3)
- 98-14 **Foss, Kirsten & Foss, Nicolai J.:** The Market Process and The Firm: Toward a Dynamic Property Rights Perspective. (ISBN 87-7873-051-1)
- 98-15 **Lorenz, Edward:** Societal Effects and the Transfer of Business Practices to Britain and France. (ISBN 87-7873-053-8)
- 98-16 **Ernst, Dieter:** Catching-Up, Crisis and Industrial Upgrading. Evolutionary Aspects of Technological Learning in Korea's Electronics Industry. (ISBN 87-7873-054-6)
- 98-17 **Kaisla, Jukka (p):** The Market Process and the Emergence of the Firm: Some Indications of Entrepreneurship Under Genuine Uncertainty. (ISBN 87-7873-055-4)
- 98-18 **Laursen, Keld (p):** Do Export and Technological Specialisation Patterns Co-evolve in Terms of Convergence or Divergence?: Evidence from 19 OECD Countries, 1971-1991. (ISBN 87-7873-056-2)
- 98-19 **Foss, Nicolai J.:** Firms and the Coordination of Knowledge: Some Austrian Insights. (ISBN 87-7873-057-0)
- 98-20 **Mahnke, Volker (p) & Aadne, John Harald:** Process of Strategic Renewal, Competencies, and the Management of Speed. (ISBN 87-7873-058-9)

- 98-21 **Lorenzen, Mark (p):** Information, cost learning, and trust. Lessons form co-operation and higher-order capabilities amongst geographically proximate firms. (ISBN 87-7873-059-7)
- 98-22 **Lam, Alice:** Tacit Knowledge, Organisational Learning and Innovation: A Societal Perspective. (ISBN 87-7873-060-0)
- 98-23 **Lund, Reinhard:** Organizational and innovative flexibility mechanisms and their impact upon organizational effectiveness. (ISBN 87-7873-061-9)
- 98-24 **Christensen, Jesper Lindgaard & Drejer, Ina (p):** Finance and Innovation System or Chaos. (ISBN 87-7873-062-7)
- 98-25 **Laursen, Keld (p):** How Structural Change Differs, and Why it Matters (for Economic Growth) (ISBN 87-7873-063-5)
- 98-26 **Holmén, Magnus & Jacobsson, Staffan:** A method for identifying actors in a knowledge based cluser. (ISBN 87-7873-064-3)
- 98-27 **Richardson, G. B.:** Production, Planning and Prices. (ISBN 87-7873-065-1)
- 98-28 **Foss, Nicolai J.:** Austrian Economics and Game Theory: a Preliminary Methodological Stocktaking. (ISBN 87-7873-067-8)
- 98-29 **Foss, Nicolai J. & Mahnke, Volker (p):** Strategy Research and the Market Process Perspective. (ISBN 87-7873-068-6)
- 98-30 **Laursen, Keld (p):** Revealed Comparative Advantage and the Alternatives as Measures of International Specialisation. (ISBN 87-7873-069-4)
- 99-1 **Lorenz, E.:** Organisationaal Innovation, Governance Structure and Innovative Capacity In British and French Industry. (ISBN 87-7873-070-8)
- 99-2 **Ernst, Dieter:** Responses to the Crisis: Constraints to a Rapid Trade Adjustment in East Asia's Electronics Industry. (ISBN 87-7873-071-6)
- 99-3 **Foss, N. J. :** Understanding Leadership: A Coordination Theory. (ISBN 87-7873-072-4)
- 99-4 **Foss, K & Foss, N. J:** Understanding Ownership: Residual Rights of Control and Appropriate Control Rights. (ISBN 87-7873-073-2)
- 99-5 **Foss, K & Foss, N. J:** Organizing Economic Experiments: The role of Firms. (ISBN 87-7873-075-9)
- 99-6 **Jørgensen Kenneth. M. (p) :** The Meaning og Local Knowledges. (ISBN 87-7873-076-7)
- 99-7 **Foss, N. J.:** Capabilities, Confusion, and the Costs of Coordination: On Some Problems in Recent Research On Inter-Firm Relations. (ISBN87-7873-

077-5)

- 99-8 **Lund, Reinhard:** Tillidsrepræsentantsystemet og de fleksible virksomhedsformer. Juli 1999. (ISBN887-7873-078-3)
- 99-9 **Nymark, Søren:** Organisatorisk læring gennem den værdibaserede organisations fortællinger. (ISBN 87 -7873-079-1)
- 99-10 **Laursen, K. & Meliciani, V.:** The importance of technology based inter-sectoral linkages for market share dynamics. (ISBN 87-7873-080-5)
- 99-11 **Laursen, K., Mahnke, V., Vejrup-Hansen, P.:** Firm growth from a knowledge structure perspective. (ISBN 87-7873-081-3)
- 99-12 **Lundvall, Bengt-Åke, Christensen, Jesper. L.:** Extending and Deepening the Analysis of Innovation Systems - with Empirical Illustrations from the DISCO-project. (ISBN 87-7873-082-1)
- 00-1 **Llerena, Patrick & Oltra, Vanessa:** Diversity of innovative strategy as a source technological performance. (ISBN 87-7873-085-6)
- 00-2 **Llerena, Patrick & Mireille Matt:** Technology policy and cooperation: A paradigmatic approach. (ISBN 87-7873-086-4)
- 00-3 **Cusmano, Lucia:** Technology Policy and Co-operative R&D: the role of relational research capacity. (ISBN 87-7873-087-2)
- 00-4 **Mikkola, Juliana Hsuan:** Modularization assessment of product architecture. (ISBN87-7873-088-0)
- 00-5 **Yvrande, Anne:** The new British railways structure: A transaction cost economics analysis. (ISBN87-7873-089-9)
- 00-6 **Dijk, Machiel van & Nomaier Önder:** Technological diffusion patterns and their effects on industrial dynamics. (ISBN 87-7873-090-2)
- 00-7 **Storper, Michael & Chen, Yun-chung with De Paolis, Fernando:** The Effects of Globalization on Location of Industries in the OECD and European Union (ISBN87-7873-091-0)
- 00-8 **Sanders, Mark & Weel, Bas ter :** Skill-Biased Technical Change: Theoretical Concepts, Empirical Problems and a Survey of the Evidence (ISBN87-7873-092-9)
- 00-9 **Tomlinson, Mark:** Innovation surveys: A researcher's perspective (ISBN87-7873-093-7)
- 00-10 **Nymark, Søren:** Value-based management in learning organizations through 'hard' and 'soft' managerial approaches: The case of Hewlett-Packard

(ISBN87-7873-094-5)

- 00-11 **Yoguel, Gabriel; Novick , Marta & Marin, Anabel:** Production Networks: Linkages, Innovation Processes and Social Management Technologies (ISBN87-7873-095-3)
- 00-12 **Yoguel, Gabriel & Boscherini, Fabio:** The environment in the development of firms' innovative capacities: Argentine industrial SMEs from different local systems (ISBN87-7873-096-1)
- 00-13 **Arocena, Rodrigo & Sutz, Judith:** Interactive Learning Spaces and Development Policies in Latin America (ISBN87-7873-098-8)
- 01-01 **Mathews, John A.:** Competitive Interfirm Dynamics within an Industrial Market System (ISBN87-7873-099-6)
- 01-02 **Giarratana, Marco & Torrisi, Salvatore:** Competence accumulation and collaborative ventures: Evidence from the largest European electronics firms and implications for the EU technological policies (ISBN 87-7873-100-3)
- 01-03 **Nemirovsky, Adolfo & Yoguel, Gabriel:** Dynamics of high-technology firms in the Silicon Valley (ISBN 87-7873-101-1)
- 01-04 **Castellacci, Fulvio:** A 'technology-gap approach to cumulative growth': toward an integrated model. Empirical evidence for Spain, 1960-1997 (ISBN 87-7873-103-8)
- 01-05 **Nuvolari. Alessandro:** Collective invention during the British industrial revolution: The case of the Cornish pumping engine (ISBN 87-7873-104-6)
- 01-06 **Costa, Ionara:** Ownership and technological capabilities in Brazil (ISBN 87-7873-105-4)
- 01-07 **Foss, Nicolai J.:** Economic organization in the knowledge economy: some austrian insights (ISBN 87-7873-106-2)
- 01-08 **Cantwell, John & Kosmopoulou, Elena:** Determinants of internationalisation on corporate technology (ISBN 87-7873-107-0)
- 01-09 **Loasby, Brian:** Industrial dynamics. Why connection matter (ISBN 87-7873-108-9)
- 01-10 **Jeppesen, Lars Bo:** Making Consumer Knowledge Available and useful (87-7873-109-7)
- 01-11 **Laursen, Keld:** The Importance of Sectoral Differences in the Application of (Complementary) HRM Practices for Innovation Performance (87-7873-110-0)

- 01-12 **Johnson, Björn & Segura-Bonilla, Olman:** Innovation Systems and Developing Countries: Experience from the SUDESCA Project (87-7873-111-9)
- 01-13 **Foss, Nicolai J. :** Bounded Rationality in the Economics of Organization: Present Use and (Some) Future Possibilities (87-7873-112-7)
- 01-14 **Reichstein, Toke & Dahl, Michael S.:** Patterns and Dependencies of Firm Growth (87-7873-113-5)
- 01-15 **Foss, Nicolai J. :** The Problem With Bounded Rationality: On Behavioral Assumptions in the Theory of the Firm (87-7873-114-3)
- 01-16 **Foss, Nicolai J. :** Selective Intervention and Internal Hybrids: Interpreting and learning from the Rise and Decline of the Oticon Spaghetti Organization (87-7873-115-1)
- 02-01 **Foss, Kirsten, Nicolai Foss, Peter G. Klein & Sandra K. Klein:** Heterogeneous Capital, Entrepreneurship, and Economic Organization (87-7873-117-8)
- 02-02 **Foss, Kirsten & Nicolai J. Foss:** Creating, Capturing and Protecting Value: A Property Rights-based View of Competitive Strategy (87-7873-118-6)
- 02-03 **Laursen, Keld & Ammon Salter:** The Fruits of Intellectual Production: Economic and Scientific Specialisation Among OECD Countries (87-7873-119-4)
- 02-04 **Foss, Nicolai J.:** The Strategy and Transaction Cost Nexus: Past Debates, Central Questions, and Future Research Possibilities (87-7873-120-8)
- 02-05 **Arocena, Rodrigo & Judith Sutz:** Innovation Systems and Developing Countries (87-7873-121-6)
- 02-06 **Lundvall, Bengt-Åke:** The University in the Learning Economy (87-7873-122-4)
- 02-07 **Tomlinson, Mark:** The Academic Robotics Community in the UK: Web based data construction and analysis of a distributed community of practice (87-7873-123-2)
- 02-08 **Lorenzen, Mark & Volker Mahnke:** Global Strategy and the Acquisition of Local Knowledge: How MNCs Enter Regional Knowledge Cluster (87-7873-124-0)

All correspondence concerning the DRUID Working Papers should be send to:

Jeanette Hvarregaard
Fibigerstræde 4
DK-9220 Aalborg OE

Tel. 45 96 35 82 65

Fax. 45 98 15 60 13

E-mail: druid-wp@business.auc.dk