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a Missing Link

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The Role of Governance in Cluster Typologies: A Missing Link

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1. Introduction

The main purpose of the paper is to develop the analysis of governance structures within clusters. This requires digging further into the analysis of power relations than, according to our knowledge, done previously in the literature. The ultimate aim of the research is to facilitate internationally comparative studies of cluster architectures and the main factors behind cluster evolution within comparable industries and technologies.

A considerable amount of confusion is surrounding the definition and use of the term cluster. A plethora of papers have applied different definitions of clusters, c.f. Martin and Sunley (2003). Our suggestion is to apply a fairly narrow delimitation in terms of geography as well as involved industries and technologies. This can be boiled down to put the main focus on a joint labour market as a focusing device. There are on the other hand only a rather limited amount of contributions to more systematic studies of typologies of clusters in the literature. Among these, power relations usually play only a minor or an implicit role.

The aim of the paper is to integrate some of the typology efforts with an approach that explicitly integrate power relations among the various cluster actors. A model will be presented and illustrated by a case study of the effect of EU 6th Framework IST projects within the region of North Jutland in Denmark.

It appears rather obvious that large locally headquartered firms may have a more significant role to play in cluster evolution than small local players. However, it is probably in a rather limited amount of cases that power relations may be represented as a simple function of firm size. Among the contributions in the literature to cluster/district typologies the now classical paper by Markusen (1996) on 'Sticky Places in Slippery Space' takes firm size and, accordingly, power into account. Besides the well known 'Italian district', she introduced power derived from large scale in terms of private firms (hub-and-spoke districts) or government bodies (state anchored districts). The opposite of the latter two categories, regions with many affiliates of firms headquartered elsewhere, she dubbed satellite platform districts.

From the perspective of the present paper we have found these categories to be too stereotyped. Many real world clusters/districts may be more amply characterized as various kinds of mixes in between these four stylized categories. Markusen's paper opens for this perspective and that will be pursued more syste-

matically below. In Section 2 we give a short overview of the literature on definition and typologies of clusters. We will restrict the vocabulary to either rather large regional innovation systems (Braczyk, Cooke, & Heidenreich 1998;Cooke 1992) or rather narrowly defined industrial clusters. I Section 3 we integrate the analysis of global production networks (GPNs) in the discussion of power relations between locally owned firms and local affiliates of multinational enterprises (MNEs). Section 4 contains a more systematic discussion of the role of power relations inspired from political science and sociology. The discussions aims at putting forward an encompassing model serving as an analytical tool for analyzing cluster typologies as well as evolution patterns of clusters, including analysis of how various policy measures may affect their development potential.

The model is illustrated in Section 5 by a case study of the influence FP6 RTD projects within ICT in one Danish region, North Jutland.

2. Cluster definitions and typologies

Two issues seem appropriate to clarify before moving on to the specific agenda concerning the role of governance in cluster evolution. First, ***how are clusters defined*** in the literature? The most widespread definition has been put forward by Porter:

> "Clusters are geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (for example, universities, standards agencies, and trade associations) in particular fields that compete but also corporate." (Porter 1998, p.197-198)

This specification is very broad and elastic.[1] The intensive interest in the concept and applied research in the field from many different academic directions have resulted in a literature, which to a certain extent can be characterized as a terminological soup (Lorenzen 2005). According to Martin and Sunley at least the following concepts are at play: 'industrial districts', 'new industrial spaces', 'territorial production complexes', 'neo-Marshallian nodes', 'regional innovation milieu', 'network regions' and 'learning regions'.

We will argue for a fairly pragmatic – but rather narrow - application of Porter's definition. Clusters are geographic concentrations of firms and closely related institutions (such as universities and trade associations) within the same 'sphere of businesses'. The term cluster should be reserved for only those agglomerations of firms that share a rather well defined common knowledge base and a joint labour market. The term has been abused for all sorts of initiatives in the aftermath of the Porterian fashion wave in cluster development efforts. Although it has received a kind of miracle drug status in the general public, we are still convinced that sober and modest application of the term may actually serve as a valuable analytical tool for applied oriented research in the field of industrial development and economic geography.

In a recent paper, Belussi (2006) presented a rather extensive analysis of the potential semantic ambiguity observed in the literature on clusters versus industrial districts. Belussi observed that many contributions apparently consider the terms clusters and industrial districts to be substitutes. However, the term industrial district appears, at least in the Italian literature, to be reserved for agglomerations dominated by small firm networks with considerable social interaction between the actors.

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[1] (Martin & Sunley 2003) presents an extensive and critical review of the literature of cluster definitions, although they do not themselves offer an operational definition.

Although the critical remarks on the plethora of different versions of Porter's clusters may be well taken, the paper does not leave the reader with a clear point of departure concerning the second issue to be clarified in the present paper concerning ***cluster typologies***. Belussi (2006, p.85) claims that the advantage of her approach is to "…avoid fanciful typologies, like the one proposed by Markusen (1996)."

On the contrary, we find that Markusen's paper still holds the key to the most relevant classification scheme. She introduced a typology of four districts (not 'clusters') based on extensive empirical research. The categories were:

(1) The Marshallian New Industrial District (NID) with its recent 'Italianate form'.

(2) Hub-and-spoke districts.

(3) Districts based on satellite industrial platforms.

(4) State-anchored districts.

Markusen opens for analyzing the real world districts as 'sticky mixes' of the four categories as well as some features of dynamics over time in terms of districts on the move from one category to another.

The more recent contributions to the typology literature may at first glance appear more theoretically sophisticated, but do not necessarily lead to more applicable categories for empirical studies. Immarino & McCann (2006) presents a transactions cost based classification as the baseline and extends and transforms it into a 'knowledge based taxonomy of clusters' containing: (1) pure agglomeration, (2) industrial complex and (3) social networks divided into so-called (3a) old social networks and (3b) new social networks. This contribution is primarily a deductive effort and is rather loosely illustrated by a set of pretty broadly defined cases of 'clusters', such as Silicon Valley, Silicon Glen in Scotland, biotechnology and media clusters, Italian industrial districts and the City of London. The categories appear too broadly defined and the examples vary a great deal in their level of aggregation.

From our point of view it may be more fruitful – and necessary – to disentangle the perception of e.g. the 'cluster above all clusters', Silicon Valley. It actually presents itself as consisting of seven industry clusters of which the most famous is semiconductors (ex. Intel, AMD and Allied Materials).[2] Even at this more disaggregate level a lot of borderline issues may be raised; no objective or 'scientific' methodology can claim to be the best fit for such delimitation efforts. At the bottom line this will have to be a practical issue guided by a combination of knowledge about given industries, their business environment and the applied technologies. To claim close connections between, say, Intel and Google in the Silicon Valley case does not appear to be a workable point of departure for more focused cluster studies. They can, however, more fruitfully be claimed to be components of a larger *regional innovation system* (encompassing either Santa Clara County or maybe more relevant the entire Bay Area) as originally coined by e.g. Cooke (1992; 2001) and applied extensively in a European context in e.g. Brazcyk et al. (1998).

[2] www.siliconvalleyonline.org. The remaining six are: Computers and Communications Hardware (ex. HP, Cisco, Sun); Other Electronic Components (ex. Flextronics, Solectron); Software (ex. eBay, Google, Symatec, Siebel and Borland); Biomedical (ex. Genencor, Varian Medical); Innovation & Creative Services (ex. Electronics Arts, DreamWorks Animation) and Nano-bio-info Technology Convergence .

In another recent paper aiming at constructing a new typology of industrial districts, Paniccia (2006) flagged a pretty high level of ambition in the title: "Cutting through the chaos". Both Markusen's and a predecessor to Iammarino and McCann's paper, c.f. Gordon and McCann (2000) are referred to as 'milestone', but they are basically not discussed. Instead is presented a typology that is "intended to encompass the largest possible number of real forms in different socio-cultural contexts" (p. 92), although the typology is not claimed to be exhaustive. What then is presented are six categories of clusters or industrial districts (IDs): (1) (semi)canonical IDs[3], (2) diversified or urban IDs, (3) satellite platforms or hub and spoke agglomerations, (4) co-locations areas, (5) concentrated or integrated agglomerations or IDs and (6) science-based or technology agglomerations. Although it is a merit of the paper that it offers a detailed scheme of factors that vary between these six categories, the reader appears to be left with a typology with many overlaps between the categories and a peculiar reservation of science-based IDs in one category of its own.

In our view the original Markusen classification is still the most appropriate for applied comparative research on clusters. We see no specific merit in isolating the science-based clusters in one category. On the contrary, this part of the industrial spectrum may have many common features with other kinds of clusters. Our point of departure will be that a classification effort should cut across the entire industrial spectrum.

In our reading of the literature there is however a missing link in these classification exercises. The power relations within clusters have not been dealt with systematically *per se*, apart from taking firms size into account. Our main focus is to explicitly discuss the role of multinational companies (MNCs) in the evolution of regional clusters. We will distinguish between clusters anchored around one MNC with or without a home base in the region, and clusters containing several affiliates of MNCs mixed with local SMEs.

While there appears to be a lack of focus on this kind of power relations in the literature on clusters and industrial districts, a body of literature dealing with global production networks has approached this phenomenon.

3. Global production networks and clusters

According to Coe et al. (2004) we can understand an industry as a collection of global production networks (GPNs). Some of these intersect at some points creating connections between different GPNs within one industry. An example could be within telecommunications where some of the large wireless equipment vendors (Nokia, Motorola, Samsung, etc.) may share some component suppliers. In other cases we may see GPNs within the same industry not directly connected. Coe et al. (2004) defines regional development as:

"... a dynamic outcome of the complex interaction between territorialized relational networks and global production networks within the context of changing regional governance structures" (Coe et al. 2004, p.469 Original Italics)

Regional development is shaped by both regional and extra-regional firms, such as focal firms.[4] For economic development to occur in this framework, a given region has to contain assets valuable for the actors in GPNs as well as regional institutions that can support the coupling between these local assets and the

[3] Part of the terminology appears pretty inside Italian for the international audience.

[4] (Coe, Hess, Yeung, Dicken, & Henderson 2004, p.473) defines focal firms as "...dominant firms spearheading the global organisation of production networks through their corporate and market power..." (p. 473)

GPNs. Regions have to contain assets of value to focal firms to attract activities. This fits with findings from the literature on MNCs, such as (Cantwell & Santangelo 2002):

"In analysing MNCs' internationalisation strategy, it emerges clearly that multinationals target local *spatial areas* where they can enjoy externalities and knowledge spillovers as well as corporate control and a dynamic environment" (Cantwell & Santangelo 2002, p.167)

It is also widely recognized in the literature that MNCs may shape the evolution of regions as well as these, the other way around, may shape or at least influence the evolution of MNCs. The territorial embeddedness of GPNs, regional institutions and regional assets are different. The basic point is that power is distributed between the region and the GPNs, and that the power tends to be allocated towards focal firms. The result is that:

"The more a region is articulated into global production networks, the more likely it is able to reap the benefits of economies of scale and scope in these networks, but the less likely it is able to control its own fate" (Coe, Hess, Yeung, Dicken, & Henderson 2004, p.475)

Institutions play a role in shaping the evolution of the interaction between GPNs and regional assets, and thereby take an active role in shaping the 'fate of the region'.

Let us initially look at clusters as black boxes. A cluster may (or may not) be valuable for players in the industry because of the presence (or absence) of some valuable 'externalities'. In the first round we consider clusters as black boxes containing some blank dynamics. This view is inspired by (Brenner 2004) discussion on the self-augmenting processes that apparently occur. If these dynamics may be valuable, activities will be attracted to the cluster. In other words, the GPNs constituting the industry at hand will be attracted to the cluster causing it to grow. In the opposite case, the GPNs will loosen their relations to the cluster, causing decline. A cluster containing the headquarters of one or more focal firms may have relatively large power to define it own fate, despite being deeply embedded within the GPNs constituting the industry. On the other hand, a cluster containing only externally controlled departments owned by foreign focal firms in the industry may lack sufficient power to control its own fate.

In the first case, the region possesses the power to change the capabilities. This could be a region containing a MNC that works on technology X utilizing capability A and B. The region possesses through the presence of the MNC the ability to decide whether capability A or capability B should be enhanced or whether the companies in the region should switch focus away from technology X towards other technologies.

In the second case, the region does not possess the power to shape its future. We can think of a region containing R&D departments owned by MNCs with headquarters located outside the region. The departments may work with technology X utilizing capabilities A and B, but they may not have power to decide whether to invest in enhancement of capability A on behalf of B or the other way round. In the same token, the region may end in a situation where the MNC decides that technology X should be replaced by, say, technology Y, and therefore decides to close the departments in the region. The region will find itself in a difficult situation unless capabilities within technology Y or other technologies have been developed in parallel with the utilization of technology X. Whether or not this is the case, depend on the management of the R&D departments as well as local institutions, such as universities. The departments may not have resources or power to develop new technologies if for example they are run with the single goal of utilizing

technology X. Universities may not have the power to develop new competences because of lack of funds etc.

Regions, due to the configuration of their industries, can possess different amounts of power to shape their future. The problem in creating a classification according to this line of thought is, that we cannot equal the resources present in the region to its ability to shape its own future. We can, however, say that regions containing the headquarters of a large player in the industry at hand possess greater resources and may possess greater power in shaping their own future, compared to regions containing only few small players within the industry. Further, a region containing a cluster may be in a better position to shape its future than a region with only a few small firms.

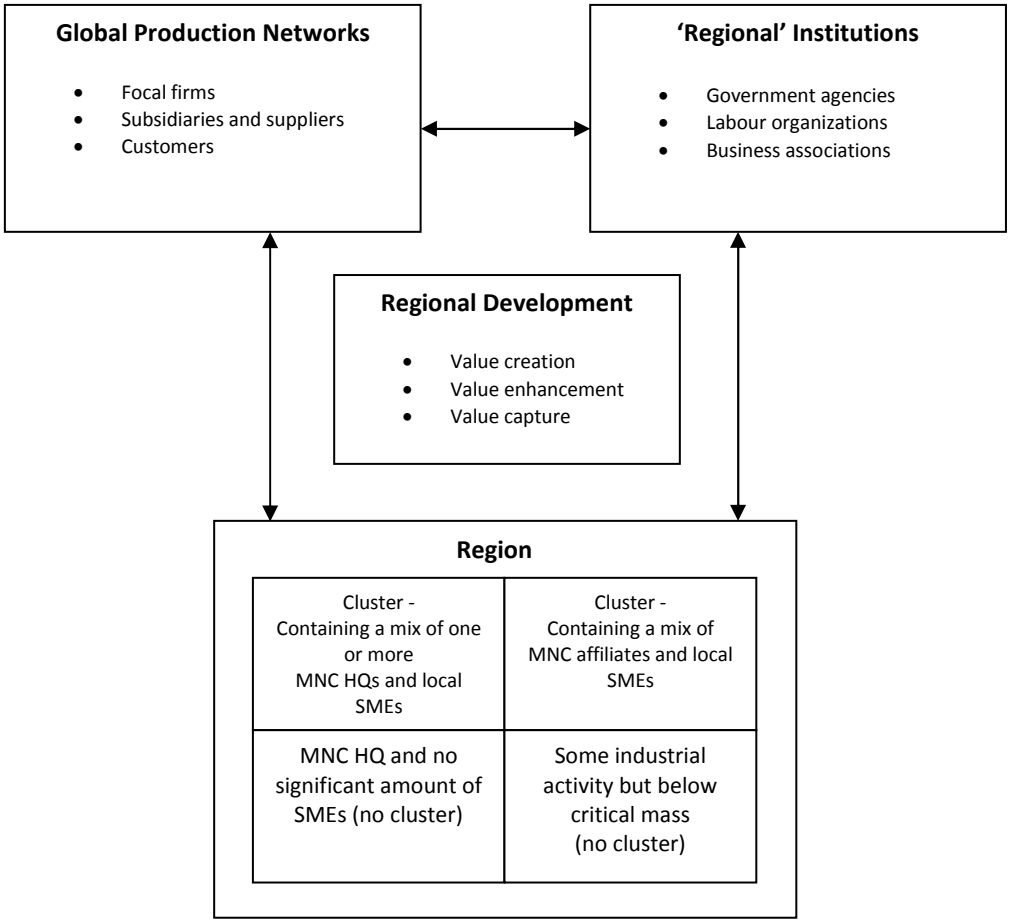

Figure 1 Interaction between global production networks and clusters. The model is inspired by (Coe, Hess, Yeung, Dicken, & Henderson 2004)

We distinguish between four types of regions divided according to two dimensions. The first is whether the region possesses the headquarters or home base of a large MNC within the industry. The second dimension focus on whether the region contains a cluster or not, as illustrated in Figure 1.

The first type is the region in the upper left corner, that possesses both a cluster as well as headquarter or home base of one or more large MNCs within the industry at hand. The second type in the upper right corner contains a cluster but without the presence headquarters or home base of a large MNC. The third type in the lower left corner contains the headquarters or home base of a large MNC but no cluster. This is the

case of large company without a critical mass of smaller companies within the same or related industries around it. The fourth (lower right corner) possesses neither headquarters nor a critical mass of activities within an industry or related industries that can support self-augmenting processes.

These four types of regions possess different resource bases and thus potentially different amounts of power to shape their own future. However, we can not deduct a priori that one of the four possesses more power than the others. What we can say, is that policy initiatives and therefore funding must play different roles in the shaping the power in each of the four types.

4. Power relations within clusters

The cluster literature has largely ignored the notion of power and focused mainly on how location in a cluster enhances the creation of knowledge in firms. One of the exceptions is Bathelt & Taylor (2002), who states:

"... we argue that a deeper appreciation of the nature of the power that bind them together is key to understanding how clusters function – including how they might emerge and how they might decline" (Bathelt & Taylor 2002, p.94)

We can, as Clegg (1989) argues, trace the roots of different theories of power back to the writings of either Hobbes or Machiavelli. The classical theories on power presented by Floyd Hunter and Robert Dahl, the theories on non-decision by Peter Bachrach and Morton Baratz, the theory on the third dimension of power by Steven Lukes and finally the structuralist views presented in for example the Marxian theory, can all be traced back to Hobbes' view on power (Clegg 1989;Flyvbjerg 1998a). These theories are preoccupied with possession, sovereignty and control. Opposing this line of thought is the post-structural theory presented by Foucault who builds on views presented by Machiavelli, and focuses on exercise, strategy and struggle in his theory on power (Flyvbjerg 1998a;Foucault 1998).

4.1 Power according to Foucault

According to Foucault it is wrong to talk about 'power', we should instead focus on relationships of power (Flyvbjerg 1998a). Further, power is not a resource that is possessed:

"…power is exercised rather than possessed; it is not the 'privilege', acquired or preserved, of the dominant class, but the overall effect of its strategic positions – an effect that is manifested and sometimes extended by the position of those who are dominated."(Foucault 1991, p.26-27)

Foucault also argues that "Power is everywhere; not because it embraces everything, but because it comes from everywhere" (Foucault 1998, p.93). In his work we can distinguishes between two categories, disciplinary versus bio-power. Disciplinary power is targeted at individuals and groups whereas bio-power is targeted at entire populations (Buchanan & Badham 1999).

Bio-power work through *discursive practices* in society, in which it becomes established what is right and wrong, how people should act in different situations, what is normal and abnormal and, accordingly, what is acceptable in thought and behavior (Buchanan & Badham 1999). The discourses in society shape the actions of actors through techniques of self regulation. Actors are always situated in a number of discursive practices that are constantly evolving (Foucault 1998).

Disciplinary power works through disciplinary practices at the level of each subject. To be useful in society, the actor has to be subjected to disciplinary practices, so that it fits into the rest of society, be that at school or in a company. This also leads to the notion of routines. Clegg (1989, p.167) argues: ”Disciplinary power works exactly through the construction of routine”. Subjects are disciplined into specific routines, be that the routines necessary at school, the university, the assembly line or R&D labs. The subject is exposed to disciplinary practices in a number of different settings (Clegg 1989) and is accordingly, rarely exposed to one systematic disciplinary force or one systematic discourse, but rather bits and pieces of different ones (Foucault 1991). One can argue that these disciplinary practices also affect the elements of discourse in society since the disciplinary practices and routines a subject is molded into affect which discourses the subject is exposed to and how.

Subjects in society are, thus, entangled in a web of power relations, involving different discursive elements causing them to regulate their actions. They are also affected by a number of different disciplinary techniques, which affect their actions. This is why Foucault argues that power comes from everywhere. All relations and all discursive elements are continuously used in power struggles between subjects in society. In this constant evolving mass of discursive elements the ‘truth’ is also defined, as Foucault argues:

”…power produces knowledge (and not simply by encouraging it because it serves power or by applying it because it is useful); that power and knowledge directly imply one another; that there is no power relation without the correlative constitution of a field of knowledge, nor any knowledge that does not presuppose and constitute at the same time power relations.” (Foucault 1991, p.27)

All power relations are both intentional and non-subjective (Foucault 1998). They are the result of calculations of subjects at the micro level, and therefore relatively meaningful configurations of power relations may emerge; not the result of one or more subjects defining this specific configuration, but from numerous strategies made by subjects imbued with calculation. This is important, and relates to both bio- and disciplinary power. No specific group defines a dominant discourse, and hence controls the outcome of bio-power in society. Instead different groups create different discursive elements and combine them with existing elements in the quest to reach their goals. This process will, however, be challenged by other groups pursuing other goals using other discursive elements and so forth.

In society you may recognize is an ever changing multiplicity of power relations that are “changeable, reversible and unstable” (Flyvbjerg 1998a, p.113). These relations may vary between temporary stability and open antagonistic confrontations. But it should here be noted that stable power relations are not necessarily relations in balance or anything like an equilibrium (Flyvbjerg 1998b).

When the power relations are stable, people to a certain extent follow the same routines (Becker 2004;Nelson & Winter 1982). However, power relationships may evolve into antagonist confrontations, such as workers may strike or managers may quit in anger. The outcome could be a return to the original power relations in the case of workers stopping a strike and going back to work without changing anything or a reconfiguration of power relations leading to evolution in the discourses and disciplinary practices, for example in the case of the board pushing for fundamental changes in a corporation being able to reconfigure the organization.

The notion of different coalitions in companies pursuing different goals was already discussed by (Cyert & March 1992) and the literature on organizations and power highlights the political games that take place

within organizations (Buchanan & Badham 1999). Further a number of power relations to external actors also affect the routines within the company, for example national rules on work environment, customer protection, anti trust, etc.

Therefore it makes sense to argue that the discourses and disciplinary practices in a company at any given point in time are the results of a complex interplay of multiple power relations and discourses within and outside the company. The CEO or headquarter try to steer the evolution through establishment of disciplinary practices though strategies utilizing different discursive elements originating inside or outside the company. The employees on the other hand have bargaining power vis-à-vis the CEO since they can bend and circumvent disciplinary practices.

4.2 Clusters in a Foucauldinan perspective.

To understand the powers that shape clusters, we will take point of departure in the broad pool of employees that constitute the clusters. To understand power in cluster, we may firstly focus upon the discourses affecting employees in clusters.

4.2.1 Discourses in clusters

The geographical extent of bio-power is not restricted to the spatial reach of the cluster boundaries. On the contrary, many discourses are of a global or national character. However, some discourses are mainly local in reach, for example on how given clusters should evolve, which competences are or should become the core of the cluster, which initiatives should be launched, how universities or science parks should support the cluster etc.

The theory of bio-power and the understanding of how multiple discourses affect the actions of employees in clusters, presents potentially a more holistic and detailed theoretical understanding of the powers that shape the evolution of clusters, than the current focus upon knowledge and information flows as presented in the theory of 'buzz and pipelines' put forward by (Bathelt, Malmberg, & Maskell 2004;Maskell, Bathelt, & Malmberg 2005).

The evolution of discourses in clusters can be shown in Figure 2. The model shows a cluster consisting of three local companies (circles), three MNCs (rectangles) and a university (triangle). Each of these may cause the creation and survival of some discursive elements, indicated by the small circles, rectangles and triangles. The employees of each organization can produce and sustain multiple elements, and they can also be created in corporation between members of different organizations and institutions within the cluster.

Discursive elements originating outside may also have an influence, for example originating in regional government institutions (diamonds), in the industry (hexagons) or in the global economy (pentagons). The important point is that some elements become more used than others. They get a status where they are incorporated in the majority of the discourses, and therefore also become difficult to avoid when persons within and outside the cluster create new strategies.

In the evolution of a cluster a number of discursive elements become dominant through their utilization in different strategies by the actors, whereby a discourse dealing with the future of the cluster emerges. This is illustrated by the dotted circles. Such elements can for example deal with which technologies that should be the core of the cluster.

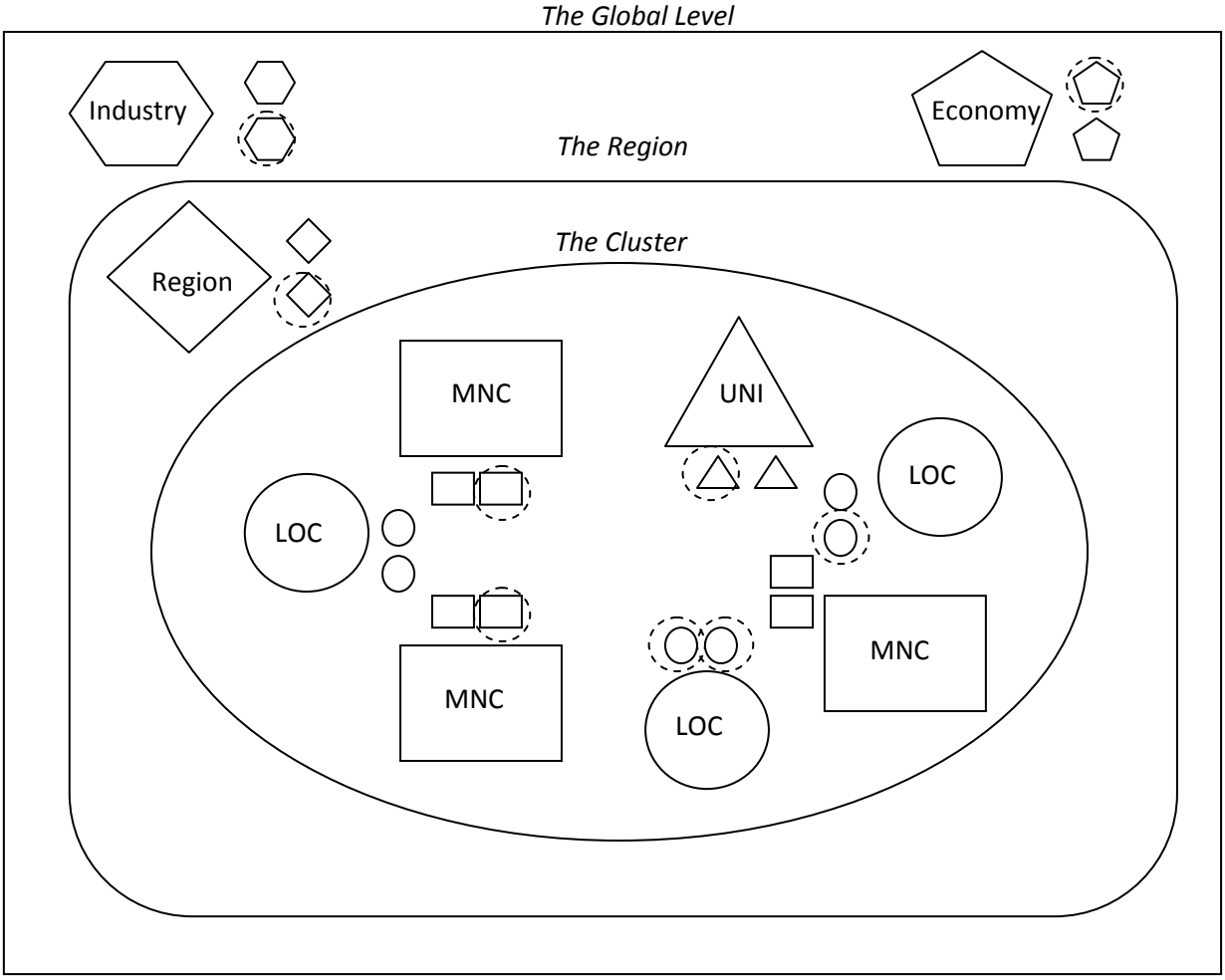

Figure 2 Model of cluster discourses – with MNC headquarters

The discourse is in constant evolution, new elements might be added, other might be left out, some might change a bit etc. Further all persons might not subscribe to all elements, rather some persons subscribe to some elements, other persons to other elements. Therefore we call it a fuzzy discourse. The fuzzy discourse can contain some elements that support each other and other elements that work against each other. Seen as a whole, the collection of discursive elements constituted in numerous strategies pursued by subjects within and outside the cluster defines the future evolution of the cluster.

4.2.2 Different types of clusters – different discourses

We now turn to the different roles of MNC affiliates and headquarters versus local companies. A local company is able to decide for itself which strategies to pursue. It is relatively free to make strategies, which can then be challenged by other persons within and outside the company, be that a single person, a coalition or a number of coalitions pursuing the same goals, utilizing discourses they find relevant for their strategies. For the headquarters the challenge is the same, the CEO or board set a strategy, which can be challenged by people within the organization. An affiliate is in a different situation. The manager does not have the same freedom in setting strategies compared to a local company of similar size. The strategic possibilities of the manager vary according to whether the affiliate is relatively controlled from above or is a relatively autonomous within the MNC.

This difference between local companies, affiliates of MNCs and MNC headquarters is illustrated in Figure 3, which shows a cluster containing two local companies (circles), two affiliates of MNCs (rectangles) and a university (triangle). There is no MNC headquarters within the cluster. They are located outside in the 'global industry'. The dotted lines show which MNC each affiliate is part of, and the double pointed arrows indicate the power relations between the affiliate and MNC headquarter.

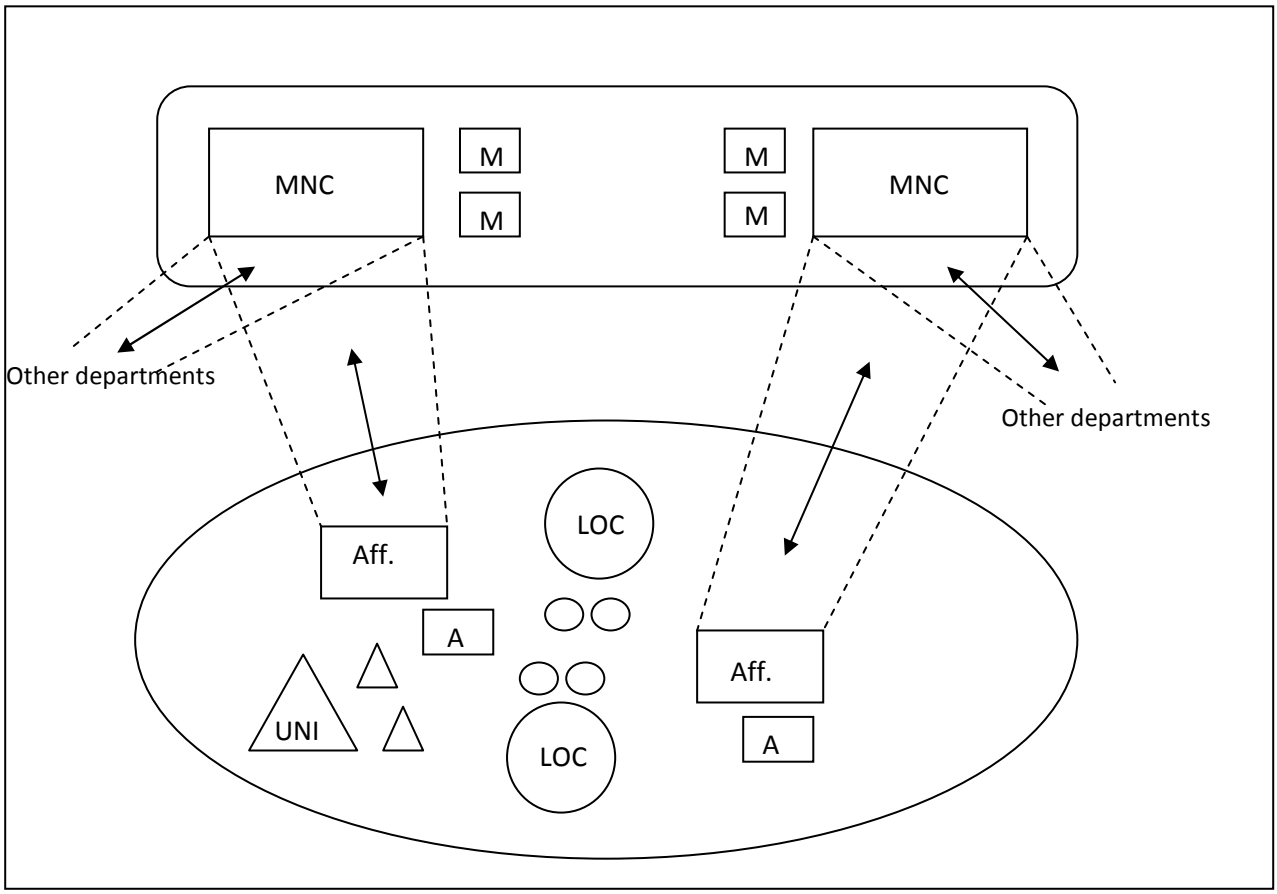

Figure 3 Model of cluster discourses – without MNC headquarters

The affiliates within a cluster can be understood as coalitions within a MNC that do not necessarily share all the goals of the MNC. An example of a goal not necessarily shared by the headquarters is to stay alive.

An affiliate can be understood as an organisation forced to follow some of the discourses produces by the headquarters. As mentioned by (Becker 2004) rules, by their very nature, leave some room for manoeuvre, due to the discretion found in every rule. The employees in affiliates have some possibilities of creating discourses and routines on their own. This is illustrated by discourses created by the headquarters are shown as the rectangular boxes marked M. Depending on whether the affiliate is relatively controlled or autonomous, the employees can create discourses on their own, indicated by the boxes marked A.

Although employees in affiliates are under control of the headquarters, they still have possibilities of creating discourses on their own. They may have some possibilities of setting and pursuing strategies not part of the official strategies pursued by headquarter. It may, thus, be dubious to perceive affiliates of MNC as

'black boxes' that are controlled completely from outside the cluster. This is apparently implicitly the case in Markusen's description of the satellite platform type of industrial districts.

5. Case Study – EU ICT 6th Framework projects within one region

Above a typology was discussed, highlighting clusters as part of GPNs and differentiated between clusters anchored around one or more headquartered MNCs, and those containing several affiliates of MNCs mixed with local SMEs but with no MNC headquarters. We are focusing on two fields within ICT at a fairly detailed level. The most salient segments of the North Jutland ICT sector are the NorCOM wireless communications cluster (c.f. Dalum, Pedersen, & Villumsen 2005) and the biomedical 'cluster initiative', BioMed Community (c.f. Stoerring 2007;Stoerring & Dalum 2007).

5.1 The ICT sector in Northern Jutland, Denmark

The regional employment specialisation of the ICT sector in Denmark is shown in Figure 1. The data are based on private sector employment at the municipal level. The ICT sector is spatially concentrated in the regions surrounding the three university towns of Copenhagen, Aarhus and Aalborg, while no specialisation can be detected for the fourth university town of Odense.

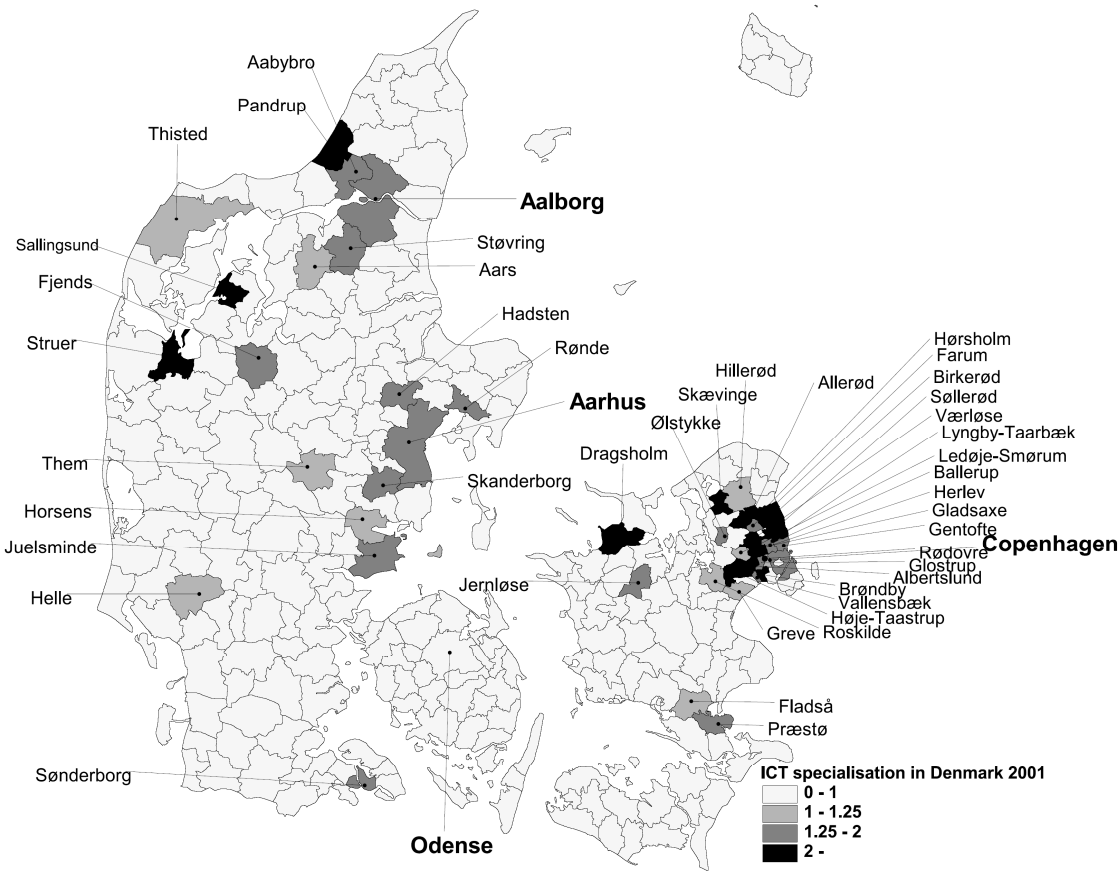

Figure 4 Geographic specialization of the Danish ICT sector 2001 – private sector employment. Source: (Pedersen 2005).

5.2 Case study methodology

We have selected interviews according to the model presented in Figure 5. The arrows indicate where there are overlaps between discourses in the region. The actors within the NorCOM cluster have relations

to actors at Aalborg University (AAU) as well as to actors within the biomedical industry. Actors within the BioMed Community have relations to actors within the NorCOM cluster, the university and the hospital. To evaluate how EU funding affects the NorCOM cluster and the BioMed cluster initiative, we have chosen the following interviews.

Within the wireless communications field, respondents from two local companies, one MNC affiliate and AAU have been interviewed.

- Managing director of GateHouse (www.gatehouse.dk) Niels Buus. Present chairman of NorCOM (www.norcom.dk). Gatehouse is Danish owned and has 75 employees. The firm is active within e.g. satellite communications (BGAN solutions) and Automatic Identification Software (AIS).
- Cofounder of RTX Telecom (www.rtx.dk), which includes RTX Health Care, Jens Hansen. Previous chairman of NorCOM. RTX is Danish owned, dominated by the founders and has 200+ employees and was founded in 1993 as a DECT cordless phone developer. RTX is one of the leaders within DECT development and has a rather wide portfolio of development activities within Bluetooth, VoIP telephony, WLAN and mobile phones.
- Managing director Kim Breum Christensen, Texas Instruments Denmark (http://www.ti.com/europe/docs/sites/denmark.htm). The firm is owned by Texas Instruments, USA and has 200+ employees in Aalborg. Originally a spinoff, ATL, from a Danish owned mobile telephony firm, Cetelco. Texas Instrument acquired ATL in 1998 with 35 employees. The Aalborg firm develops e.g. protocol stacks for GSM and UMTS.
- Professor Ramjee Prasad, director of Center for TeleInFrastruktur (www.ctif.aau.dk), which is a 120+ research centre in wireless communications focused at 4G technologies. CTIF participates in some major 6th Framework IST projects and is a coordinator of one of these, My Personal Adaptive Network, MAGNET (www.ist-magnet.org).

Within the BioMed field, interviews have been made with two central actors who both are professors and company founders.

- Professor Thomas Sinkjær (http://www.smi.hst.aau.dk/members/ts/) Department of Health Technology, Aalborg University and Center for Sensory Motory Interaction (www.smi.hst.aau.dk), which is a major research centre and an international PhD school with biomedical engineering and research in neuroscience. SMI was founded in 1993 and counts 80 researchers and PhD students. TS is also a founder of Neurodan (www.neurodan.dk), an electromedical spinout from AAU which has been acquired by the German company Otto Bock in 2005.
- Professor Egon Toft, Department of Health Technology, Aalborg University and Center for Sensory Motory Interaction (www.smi.hst.aau.dk). Originally professor in hearth surgery at the Aalborg Hospital, but recently professor at AAU in charge of building a new medical engineering master programme. ET is a cofounder of various electromedical companies, e.g. Mermaid. EG has been one of the founders of BioMed Community.

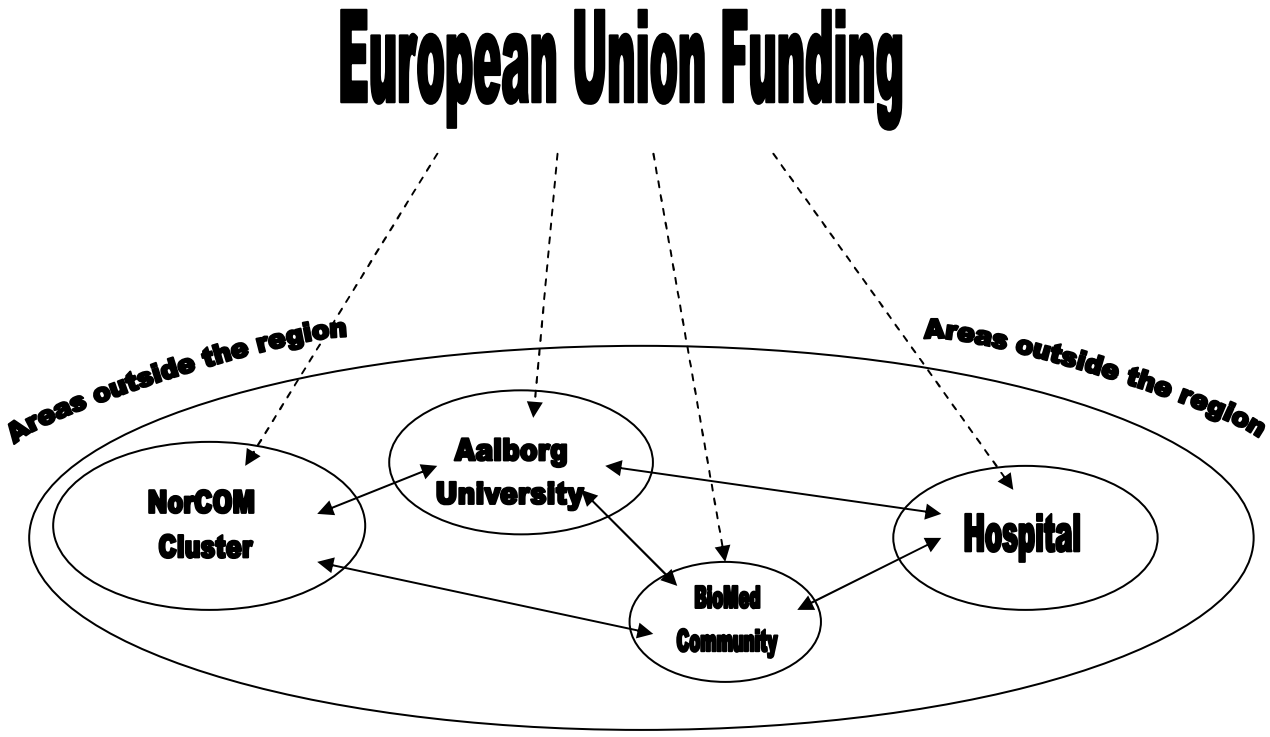

Figure 5 Receivers of EU FP6 RTD funding within ICT in North Jutland, Denmark.

5.3 The NorCOM cluster case

5.3.1 The wireless telecommunication industry

The concept of technological life cycles fits neatly the evolution of mobile communications technologies, c.f. Dalum et al. (2005). The significant changes in the basic technology from the first generation 1G technology, of which the Nordic Mobile Telephony system (NMT) became a leader, to the second generation 2G systems, GSM and CDMA, constitute a major shift of the technological life cycle. Similarly, the third generation systems UMTS and CDMA2000 represent the present cycle, which is close to a real take-off. The pattern shown in Figure 6 includes a sketch of the present perception of 4G version of the most dominant trajectory within mobile communications, the so-called 'ETSI-track', due to the dominant position of the EU European Telecommunications Standard Institute. At present a view of transformation of the 3G UMTS system into a so-called Long Term Evolution, LTE, has acquired considerable attention to be taken seriously.

The 1G cycle consisted of analogue mobile systems, of which the Nordic NMT became very successful. The disrupter and subsequent new technological life cycle was the pan-European GSM, which was a shift to digital technology and required a new infrastructure. The disruption caused by GSM did not only lead to replacement of NMT; GSM also became the dominant world standard. The massive investments required to build the new 3G infrastructure and the slow down of the international ICT industry during 2001-2003 has increased the focus on what is coming next in the horizon. Is there such a thing as a 4G system? How can it be defined? What are the options for a regional cluster of the NorCOM type to become competitive in this field? These are some of the most salient questions discussed in recent years within the industry and more broadly in the surrounding society at large. The questions are naturally reflected in some of the interviews.

Originally 4G has loosely been defined as the complete integration between the wired and the wireless spheres of telecommunications with speeds of data communications of 100 Mb/s and in operation in, say, 2010. There is however a certain ambivalence prevalent in the terminology at present. 'Premature' versions of 4G are much closer – in fact already available consisting of combinations of technologies based on wireless internet access technologies, such as WLAN (IEEE 802.11x) or WiMAX (IEEE 802.16x), embedded in laptops or mobile phones.

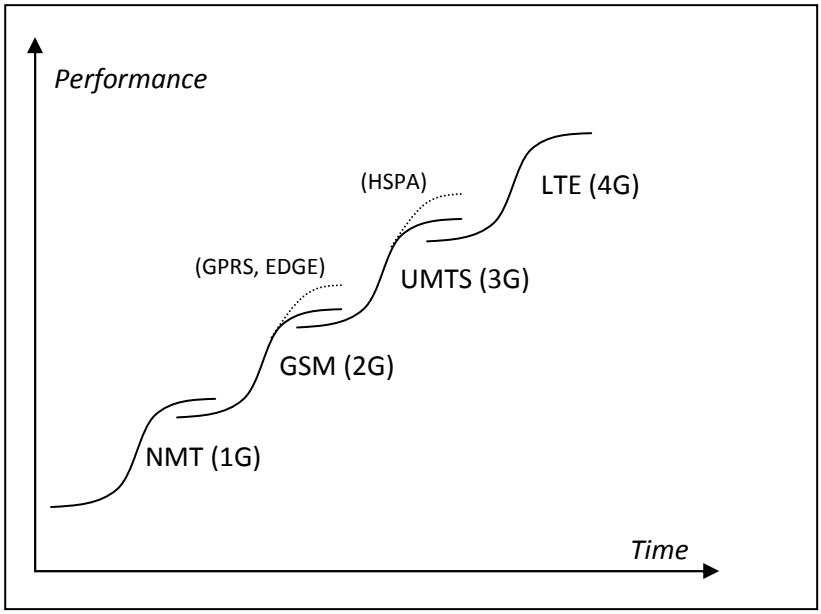

Figure 6 Technological life cycles in the 'ETSI-track' of wireless communications

Given that the US is lagging behind the European mobile telecom infrastructure, with recognizable implications for the US mobile equipment industry, there are strong incentives in the US market to promote decentralised WLAN based wireless Internet access solutions. The latter should be conceived as a supplement to the ordinary wired telecom infrastructure.[5] On this background there is a rapid process of technological change going on at present.

WLAN is, opposite to UMTS or CDMA2000, using unlicensed spectrum and is highly deregulated. One of the attractions is the possibility to build up small range high-speed wireless networks for low cost and avoiding the problem of carriers controlling the 'last mile'. But there are advantages and disadvantages with 3G as well as WLAN solutions. To summon a few, WLAN has higher speed, but is limited to hotspots, while the mobile networks are significantly slower but have much better coverage. The mobile networks allow the user to be moving.

[5] A WiFi network starts with a DSL or other high-speed connection to the wired infrastructure. The connection is then linked with an access point allowing wireless access to the Internet by a WLAN card in the computer.

The technological development within the convergence between wired and wireless communications is one of the fastest expanding areas with the ICT sector. Radically new products, applications and concepts are emerging nearly every week.

5.3.2 The NorCOM Cluster

The NorCOM consists of two related fields: mobile telephony (development and production of hardware and telecom services) and equipment for maritime communications and navigation. This cluster, called NorCOM from 1996, originates back to the mid 1960s when the 'mother' company SP Radio switched from being a consumer electronics producer for the domestic market to radio telephones for small ships. This firm quickly became one of the world leaders in its field.[6]

During the 1970s a few maritime communications firms emerged as spinoffs from SP Radio. At the beginning of the 1980s North Jutland had become visible in an industrial context as a maritime communications and printed circuit board concentration. At the university the first M.Sc.'s in electronic engineering graduated in 1979 and research activities were growing rapidly. From the early 1980s the wireless communications industry embarked on a fast growth track initiated by the establishment of the first international cellular telephone system, the Nordic Mobile Telephony (NMT), which covered five Nordic countries. Demand grew very fast in these countries becoming the home nations for some of the world leaders in the field, especially Ericsson and Nokia.

Employment in the NorCOM cluster peaked in 2004 with 4,300 jobs. A major manufacturing plant of Flextronics was closed and the end of 2004. Around 1,500 jobs were laid off. Nonetheless, apart from the end of manufacturing of mobile terminals the NorCOM cluster has increased employment in development activities. Of the present 3,000 jobs the majority is development related jobs. Today NorCOM is a rather small, though internationally visible, development hub for wireless communications equipment. Many of the big international players are represented in the region, such as Motorola, Texas Instruments, Infineon, RF Micro Devices, Analog Devices, Nokia Siemens Networks and Rohde & Schwartz.

As a major prerequisite for the evolution of NorCOM has been the build up of Aalborg University (AAU) since 1974. Two major research centers, Center for PersonKommunikation (CPK) 1993-2003 and Center for TeleInFrastruktur (CTIF), have been decisive behind the growth of the cluster.

5.3.3 The role of funding in the NorCOM cluster

RTX Telecom has, to the knowledge of Jens Hansen, not been involved in any EU funded projects in recent years[7]. Texas Instruments Denmark is, according to Kim Breum Christensen, not been involved in any EU funded projects either, but the company is involved in one project at Aalborg University funded by Danish government, the Wireless Access Networks, Devices & Applications project (WANDA)[8]. Gatehouse is involved in several EU funded projects, the most important being Airborne New and Advanced Satellite techniques and Technologies in a System Integrated Approach, ANASTASIA, which is a project under the sixth framework programme, in which 31 companies and institutions are involved.[9] Gatehouse is also involved in

[6] For details of the firms and the history of the cluster including a 'family tree', see www.norcom.dk.
[7] RTX Telecom A/S was maybe involved in some EU funded projects at the time of the Target Two funding.
[8] WANDA is a research project focusing on future of wired and wireless networks with emphasis on devices, protocol architectures and applications. Four NorCOM firms are involved in the project: Texas Instruments, Motorola (previously Siemens), RF Micro devices and BLIP Systems as well as Technological Institute and Aalborg University (http://ctif.aau.dk/projects/wanda/)
[9] http://www.gatehouse.dk/news/pdf/gh_home_anastasia_newsrelease.pdf

projects with European Space Agency (ESA), and some of ESA's projects are funded by the EU. From these three company cases it can be concluded that there is a rather limited enrolment in projects funded by the EU among the NorCOM companies. Interestingly the interviews revealed that the consequence of EU funding is not direct development of new technologies or deployment of new technologies in the companies, but rather creation of visibility among the companies and a supply of skilled workers to the companies.

The case of Gatehouse illustrates this visibility aspect. Gatehouse is a relatively small company employing around 90 persons. According to Niels Buus, the most important consequence of the ANASTASIA project so far, is that it has created global awareness of Gatehouse and its competencies:

Buus, GateHouse: "Commercially it does not have a large direct significance, but it has indirectly, because we joined at a moment where the different players involved in the project became aware of the technology we possesses. Later on we have got quite substantial commercial benefits of this awareness. *But it is more knowledge about the project and the fact that we were an important partner in the project because of our competences, than it was the project itself directly, that has given commercial benefits*. But we have a hope that the project in itself will spawn commercial activities in the future." (Emphasis added)

In other words due to the discourses created by and surrounding the EU funded projects, within and outside the NorCOM cluster, companies that participate in the projects becomes known around the world.

EU funding may also have an effect on the companies in NorCOM, even though they are not directly involved as funding receivers. A substantial amount of EU IST funding has been allocated to AAU. At CTIF there is a number of EU funded IST projects, the largest are MAGNET and CRUISE. CTIF has smaller shares in HIDENET, WINNER, E-SENSE and SIDEMIRROR. Almost no local telecommunication companies are involved directly in these projects who on the other hand involve several of large international players in the industry. The funding of university projects supports the local industry, because it enhances the quality of the university research and thereby the quality of the candidates leaving the university. Around 50% of the workforce in Texas Instruments Denmark and RTX Telecom is educated at the local university (Reinau 2007), and therefore the companies see EU funding to the university as very important. A salient feature is that the technical core of the research at the university is not as important for the companies as is often believed:

Breum Christensen, Texas Instruments Denmark: "One can say, that there is a lot of different aspects regarding the fact that EU funding reaches the university. I think that it has an incredible positive influence in creating better development conditions for the students and thereby make them much more qualified for the companies, than the university succeed without such funding. Some specific projects are launched and they would probably not have been realised without this funding. In that sense it has a clear significance for us, I believe. *Concerning the WANDA project, we don't have any specific expectations about major development breakthroughs. Our involvement is mainly purely to support the university and to make sure we will get some good candidates in the end*." (Emphasis added)

Hansen, RTX: "One can say that in the days of the early GSM development the university and the companies were maybe closer to each other technologically. There were developed some technologies etc. that could be applied directly in the products in the companies. Maybe the gap between the university and the industries is typically a bit larger today. This is my feeling anyhow. But it is clear that there can be some of the companies that are closer to what the university is doing today regarding 4G than we (= RTX) are. And regarding UMTS there were also some companies in the area, typically the semiconductor companies, but many other companies could maybe not use it directly. But what is clear is that we can always use the good engineers."

Possibly, this situation is due to the fact that development of contemporary phones is big business, and only strong equipment manufacturers such as Nokia, Motorola, Samsung, and Sony-Ericsson as well as strong semiconductor companies such as Texas Instruments, Qualcomm, Infineon and Freescale Semiconductors can compete in this field. This has left the telecommunication companies in the region in one of two possible positions. Affiliates of large multinational corporations such as Texas Instruments or Motorola apparently conduct their own research activities, and draw on research and resources found within the organization globally. It seems reasonable that the affiliates are forced to this due to discourses originating in headquarters around the world and power relations to these. Therefore affiliates of MNCs do not utilize or need technical knowledge from the local university. Relatively small local companies presumably focus on niche markets utilizing wireless communication technologies, and hence not directly the technologies the local university is focusing on. This could possibly explain why there may be a lower direct relationship between the research done at the university and the research applied in the companies than was the case for example 10-15 years ago, where a larger share of the companies in the cluster were local companies with focus on the development of 2G terminals.

Although the technical core of the research conducted at the university is rather unimportant for the MNCs and local companies within the cluster, the fact that they are part of a cluster and the discourses this give access to play a role for the companies, refer to section 4. The situation can be illustrated by the case of Texas Instruments Denmark and Figure 3. TI Denmark possesses some power relations to the headquarters of Texas Instruments, and people in TI Denmark can utilize discourses emerging within and outside the cluster in their strategies. One feature that can be used in relations to headquarters and other partners is that the cluster contains a research active and vibrant university that produces good candidates, and hence it makes sense for the managers to participate in projects that support the local university. Another element is that the cluster is vibrant which is illustrated by the presence of multiple large players within the wireless telecommunication industry:

Breum Christensen, Texas Instruments Denmark "…and it also means something for a company like ours, in positive direction, that another big American company [Motorola] enters the field in our little area here. Because, world wide people sometimes ask themselves why are we actually in such a backwater, where it is so difficult to get to?... …and there it is clear that it have a positive signal value, also in our own ranks, that another big American company comes and set up activities here."

As explained in relation to Figure 2, the presence of MNCs and the discourses they create can also be utilized by local companies. RTX for example also utilize the presence of large players within the cluster in their strategies:

Hansen, RTX: "We have of course used that about being located in an area here, where there are a lot of companies and a lot of engineers with knowledge about the field. It gives, you can say, a certain base to work from, people can see that there is more than one company that happens to have some engineers, instead it is the whole area which posses knowledge within the field. It has a certain value in marketing."

Another important point is, according to Ramjee Prasad at AAU-CTIF, that although the companies in the region are not directly involved in most EU funded projects at the university, their very presence in the region supports the university in its efforts in attracting EU funding, because the NorCOM cluster is recognized globally, refer also to the quote by Kim Breum-Christensen. Having earlier discussed how funding reaching the university supports the companies in the region, we here see the other side of the coin: that

people in the university can draw on the discourses originating within the cluster in their strategies, and hence use the reputation of the cluster in its quest for EU funding. We can therefore say that in relation to how EU funding affects the cluster, a symbiotic interplay between university and companies within the cluster seem to exist.

5.4 The Biomedico cluster initiative

5.4.1 The Initiative

During the most recent 3-4 years several projects have been initiated to promote regional development in biomedical technology in North Jutland. These projects resulted in a political initiative to promote and develop a cluster within the life sciences, presented as the Biomedico Cluster Initiative[10]. The main actors involved have been:

- Aalborg University (AAU). Research within the electro-medical area at the Centre for Sensory Motor Interaction (SMI) has developed new methods for stimulating and treating electrical signals from muscles, measuring and activating the motor system and locating pain. Another potential research field at AAU is biotechnology. The university has started a centre for research into stem cell technology to determine how stem cells may be used to develop human 'spare parts', and the cluster initiative actors also include build up of nanotechnology competences.

- Aalborg Hospital[11] obtained university hospital status in 2003 as an affiliate of Aarhus University, based on its own research efforts and a tradition of co-operation with Aarhus University.[12]

- Companies in the region. In The Competences Catalogue about 35 companies have been identified. However, their profiles can only to some degree be described as biomedical technology companies. The list contains some electro-medical device companies representing the core competence of the region, a cosmetics products firm (Beaute Pacifique), some IT service companies and several distributors and wholesalers of health care equipment. Three of the biggest are production subsidiaries of large Copenhagen companies: Oticon in hearing aids, Novo Nordisk in pharmaceuticals and Coloplast in utensils. Bang & Olufsen Medicom from the Ringkoebing County is another larger player. If the latter big companies as well as the trading companies are excluded, the remaining core consists of small development intensive companies employing up to 5 people, of which several are spinoff from university research. Among these are three medical technology companies employing more than 5 people, Judex, Neurodan and RTX Healthcare.

The cluster formation initiative was started in 2000 by the Aalborg Commercial Council with the Industrial Liaisons Office at Aalborg University, joined later on by the North Jutland County and Aalborg Municipality and industry representatives. This initiative was further formalized in 2003 with the establishment of The BioMed Community: Science & Innovation for the Living representing the main actors in the region.

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10 www.biomedcom.dk

11 Denmark has a public health system and hospitals are under county authorities (in this case North Jutland County jurisdiction).

12 The co-operation with hospital gave Aalborg University the access to perform clinical tests and provide documentation, thus it plays also a very important role for the university's research.

Publishing promotional material, marketing, attracting new firms and the promotion of new and established companies have been the main activities of the BioMed Community during the first three years. This may be understood in relation to figure 2, as a situation, in which different persons in the regions, though the strategies they each are pursuing, are in the process of creating a fuzzy discourse about the technological capabilities found in the local university and the relatively few small companies, and hence shapes the possible emergence of a cluster. As we also stated in section 4, this might characterize the first phase of cluster emergence, where the actual business activities within the region is rather limited, but where discourses in the region are gaining momentum and hence attracting both attention and funding, as we shall return to.

The so-called 'Firms club' was established for companies from the whole of North Denmark, whose co-operation should establish synergies between companies in the region, especially by learning of each other's existence, identifying and discussing common problems, and influencing their co-operation with Aalborg University's Liaisons Office and Aalborg Hospital, to be able to support innovative activities within the industry more efficiently.

The cluster initiative actors have mobilized some financial resources that should be used for consulting activities and the 'Research House' initiative. The present nurse and radiography school is being transformed into the 'Research House', including laboratories, to localize 10 to 15 research groups from the Hospital. This should also be the location to establish new companies close to the hospital (e.g. clinical testing), as well as an area dedicated to group rooms for students. The idea is to concentrate the innovation environment at one location and serve as a kind of incubator.

5.4.2 The role of funding in the Biomedico cluster initiative

According to the knowledge of Thomas Sinkjær, no biomedical companies in the region have received EU funding, with one exception of a small company Judex. To understand how EU funding affects this industry it is therefore necessary again to turn focus to the local university. There are three different master programmes at the university with relation to the industry. As in the case of the telecommunication industry, the university supports the industry by supplying competent labour. A very strong research environment in the biomedical field exists at the university, the most influential being SMI, which has received EU funding on several occasions. Generally, according to Thomas Sinkjær, the fifth framework programme gave more resources and was more tailor-made to SMI, than the sixth framework programme. The reason was that the fifth framework programme favoured more classical medical engineering projects, an area in which SMI is strong, compared to the sixth framework programme, in which focus was directed to biotechnology such as stem cell research and telecommunications. During the sixth framework programme SMI has been involved in 5 to 6 projects, and has further gained resources through the Marie Curie PhD training programme.

Looking at the consequences of the EU funding one obvious consequence is that it enables the SMI to initiate and run different projects. Funding also makes the SMI visibly globally, i.e. enhances the role played by SMI in discourses in the academic world, but according to Thomas Sinkjær not more than funding from other sources. CYBERHAND[13] is an example of a project which created visibility. Afterward CYBERHAND SMI got two new projects, one which according to Thomas Sinkjær has been at a direct consequence of the CYBERHAND, and another resulting from the global visibility the project created.

[13] The goal of CYBERHAND was to create an artificial hand and connect it to the nerve system, so that it could be controlled by the power of a thought.

Participation in EU funded projects also supports network creation. This was however most important in the early years of SMI, according to Thomas Sinkjær. EU projects have also raised SMI's awareness about the industries in the field. To apply for EU funding, it has been necessary to incorporate companies in the projects, and this has led to a growing focus in SMI on industry over time. It should be clarified, that SMI is not focusing especially on local or national industries, but rather pick up the best partners over the whole of Europe. However, local or other Danish companies have been used in many projects because of SMI's knowledge about these companies.

Regarding the interaction between the telecommunication industry and the biomedical industry, two things are interesting. Firstly, there are relations between the two research areas at the university. SMI for example is involved in a research project at CTIF. Secondly, there are also relations between the industries. This is shown by the fact that a number of telecommunications firms in the NorCOM cluster have shown interest in entering the biomedico area. One firm illustrating this is the company RTX Healthcare A/S. The point worth noticing here is the apparent synergy that exists between these two industries. Also 1-2 companies that Egon Toft has been involved in starting up have relations to the wireless field.

The BioMed Community, according to Egon Toft, is doing a considerable effort to solve some of the institutional problems, which has involved a conflict between The University Hospital of Aarhus and Aalborg University. There are still some major institutional obstacles to be solved.

6 Conclusion

The aim of the paper was to put the notion of governance, of power, into typologies of clusters. The categorization of clusters presented by (Markusen 1996), the best typology presented so far as we see it, is relatively well suited to categorize snapshots of the cluster types we might encounter around the world. However, it falls short on two dimensions, and in this paper we have therefore elaborated on these two. The first dimension is the world outside clusters, and how this world affects the evolution of cluster. The second dimension is the powers that are shaping the evolution of clusters.

In cluster studies we need to be aware of the world outside the cluster we are studying. Cluster of different types do not exist in vacuum, i.e. we don't see clusters sounded by a homogenous grey mass we in models can treat as the "surrounding world". Instead, clusters are, as illustrated and discussed in figure 1, parts of complex networks of localities, and we have to see this network and its evolution as a whole. One event in one locality, be that for example a region containing only one headquarter of a MNC, might cause things to change in other localities within that industry, be that for example a region containing a cluster consisting of local companies and MNC affiliates. We have discussed the power of the surrounding world in section 4, where we explicitly underlined that discourses originating outside as well as inside a given cluster shape its evolution. This importance of this was further underlined in the case study, where we deliberately explored the state of the wireless semiconductor industry to thereby uncover the context in which the NorCOM cluster exists.

The second dimension on which we wish to elaborate the category of cluster presented by Markusen (1996) is the power dimension. Explicitly it seems that Markusen equals company size to power, and for example argues that the powers shaping the evolution of satellite platforms are located outside these. Our discussion of power in a Foucauldinan perspective proved that it is impossible to equal company size to power. Such a conclusion is too simplistic. Using the notion of bio-power and disciplinary power we argued,

that in all clusters it will to some extent be possible for actors in cluster of all types to create discourses and pursue strategies on their own. This argument was also supported empirically by showing how the notion of discourses pursued by different actors can be used to understand the evolution of a cluster - in our case how EU RTD funding may affect the evolution of a cluster. We also showed in the case the Biomedico cluster initiative, how discourses apparently play a crucial role in the first phase of cluster emergence.

For future research we would urge for more focus on the discourses within cluster and how they may shape their evolution. We believe that this would represent a supplement to the current literature on cluster emergence which tend to focus on the 'hard facts' of regions, i.e. the knowledge resources available in the regions, related variety etc., because it is clear that political discussions and decisions also play a crucial role in the evolution process.

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