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Abstract: We investigate the emergence of a spatial concentration of interconnected individuals and organisations in a new field. In contrast to approaches where clusters are perceived as collections of atomistic firms, we stress the role of individual agency and institutional embeddedness in the emergence and sustainability of clusters. We argue that our current understanding of cluster emergence can be advanced by extending the coupling metaphor as a conceptual tool for investigating cluster dynamics both at micro and system level. We contend that scientists, enabled by their network positions, act as institutional entrepreneurs to create tight couplings at the cluster level. Such individual level activity crosses industry and spatial boundaries and increases the innovativeness of the cluster. Based on a longitudinal case study of a cholesterol-lowering functional foods cluster in Finland, we propose a novel analytical classification of different roles for scientists along cluster emergence.

Key words: cluster emergence, social networks, scientists, coupling metaphor

INTRODUCTION

The last two decades have witnessed a rapid and simultaneous scientific and policy interest in the concept of cluster. Spatial clustering of innovative activity is crucial, particularly in the early stages of new industries (Audretsch & Feldman, 1996) and in science-based fields where knowledge plays an important role. It is argued that the physical proximity of related actors is important in enhancing legitimacy and in reducing the liability of newness as stressed by institutional scholars (Pouder & St. John, 1996, Aldrich & Fiol, 1994; Suchmann, 1995, Singh et al. 1986).

The starting points of this study are the centrality of knowledge creation and sharing in cluster emergence, and the scholarly consensus about how little is known both theoretically and empirically regarding how clusters emerge in the first place (e.g. Bresnahan et al., 2001; Feldman et al., 2005). We argue above all that current research is underdeveloped regarding how the micro processes of entrepreneurship, particularly scientific and institutional entrepreneurship, relate to cluster emergence (cf. Thornton & Flynn, 2003). More specifically, despite the centrality of scientists as knowledge producers, there is much to be learned and understood about the role of scientists in the emergence and dynamics of clusters (Håkanson, 1995). With the purpose of filling the identified gap in literature, this study is motivated by the following research question: *How does a science-based cluster emerge and what roles do scientists play in cluster emergence?* By answering this question we are able to provide new insights on the still unsettled role of individual scientists in cluster emergence and in scientific advancement in general.

We propose the concept of coupling (Orton & Weick, 1990; Weick, 1976) as an ideal analytical tool to provide us with clues on how clusters emerge as complex, multilevel (individuals, organisations, institutional logics) systems. Using qualitative procedures, we are able to unlock the micro-process of cluster emergence around cholesterol-lowering functional foods in Finland between the early 1970s and 2007. A longitudinal research design of this kind facilitates mapping of the roles of scientists in cluster emergence and avoids ‘temporal reductionism’, i.e. “treating relations and structures of relations as if they had no history that shapes the present situation” (Granovetter, 1992). Our case provides an intriguing setting for investigating the proximity of the emerging field to two different institutional logics, those of the pharmaceuticals and food industries.

This paper takes a sociological perspective in studying the role and mechanisms through which key scientists contribute to cluster emergence. Our research approach is a simultaneous and continuous dialog between theory and empirical data. We found that in order for a cluster to emerge, some parts of the system must be tightly coupled, and that in a science-based field individual scientists are in a natural position to build bridges between otherwise loosely coupled organisations. We argue that the position of scientists in social networks is tightly connected to their ability to create new knowledge and legitimacy, and their ability to bridge disciplinary, industry, and spatial boundaries. Based on our longitudinal case study of the emergence of cholesterol-lowering functional foods cluster in Finland, we are able to propose different roles for scientists in cluster emergence.

Our eclectic combining of different theoretical concepts to understand cluster emergence contributes crucially to the fields of cluster research and institutional theory. First, we complement the extant body of cluster literature in considering the role of scientists in cluster emergence and as a channel for non-local connections. Hence, we contribute to the scarce literature on the interaction between local and global in cluster dynamics (Coenen et al., 2006; Amin & Cohendet, 2005; Gertler & Levitte, 2005; Bathelt et al. 2004). Second, we contend that through their novel groundbreaking ideas, scientists may act as institutional entrepreneurs (DiMaggio, 1998): We thereby extend the conceptualisation of institutional entrepreneurs. Third, we contribute to the sociological institutional theory, which has been little used in analysing cluster emergence. Finally, we extend the use of the coupling concept to the cluster literature

We present our study in four sections. The first section starts by defining the key terms and thereafter elaborates our theoretical orientation and proposes an analytical model for the empirical analysis. In the second section we describe our research design and method. We then provide a longitudinal case study on cluster emergence that leads to a multilevel model of science-based cluster emergence. In the concluding section we discuss the theoretical contribution of our study and suggest some regional policy implications.

THEORETICAL FOUNDATION

Cluster Emergence as Social Network Emergence

In our definition of clusters we combine the definitions of Porter (1998) and Håkanson (2005), since neither of them alone is able to capture the two salient levels of clusters: organisations and individuals. Porter defines clusters as "geographic concentrations of interconnected companies and institutions in a particular field" (1998:78). Håkanson (2005) adds that clusters are also agglomerations of professionals belonging to the same or related epistemic communities, i.e. groups of peers working on a common knowledge problem (Amin & Cohendet, 2005). Practical evidence clearly shows that in science- and technology-based clusters, spatial concentrations of related actors are typically emerging rather simultaneously with new fields such as ICT. A field refers to "a community of organizations that partakes of a common meaning system and whose participants interact more faithfully with one another than with actors outside the field" (Scott, 1995:56). Hence, fields may cross traditional industry boundaries and stress socially constructed systems of common meaning. Hoffman (1999) suggests that new fields form around common issues (e.g. environmentalism or heart health), which may subsequently guide the attention process within an entire industry. Hence, while clusters typically refer to physical closeness, fields refer rather to functional and mental links. We contend, however, that the two are strongly interconnected and that cluster emergence may also be conceptualised as local field emergence. Based on our premises and with the aim of investigating the emergence of a science-based field, we refer with the concept of cluster to *a spatial concentration of interconnected individuals and organisations emerging around a common issue and developing in close interaction with other similar individuals and organisations outside the cluster.* We refer with the term interconnected to both the functionally interdependent value chain activities of firms and also to the mental closeness and personal ties of individuals.

The emergence of a cluster necessitates the emergence of new relationships between individuals and organisations, which brings us to the centrality of social networks and network emergence. Even though clusters and networks exhibit different systemic features e.g. clusters have open membership and entail local embedding (Rosenfeld, 1997; Nooteboom, 2004a), the concepts share many similarities. We suggest that there is a close connection between the emergence of a social network and that of a cluster because both tend to emerge from relations between specific individuals connecting organisations and relevant knowledge bases. Nohria (1992:4) contends that:

> "All organizations are in important respects social networks and need to be addressed and analyzed as such…The premise that organizations are networks of recurring relationships applies to organizations at any level of analysis- small and large groups, subunits of organizations, entire organizations, *regions, industries*, national economies, and even the organization of the world system…" (italics added)

The social-network model or 'club model' is perhaps the most recent analytical or ideal type of cluster (Breschi & Marleba, 2005, Gordon & McCann, 2000). A cluster may be thought of as consisting of multiple overlapping social networks where social interaction or 'social infrastructure' (Saxenian, 1994) forms the critical base for a cluster to emerge. However, the idea that social interactions or network effects are key mechanisms through which external economies benefit local firms is by no means new as the idea has long been shared by economic geographers (Brechi & Marleba, 2005).

The social networks approach originates from the sociological literature, primarily that of Granovetter (1992, 1985), and builds the argument that clusters not only reflect rational economic responses but also embeddedness in their social context. Even though the social network model is fundamentally aspatial, social connections tend to cluster in geographic and social space and foster trust relations (Cordon & McCann 2000). However, network emergence has typically been neglected in sociological research where network analyses typically model outcomes, i.e. network structures, and are unable to provide satisfactory understanding on why, how, and under what conditions such relationships emerge in the first place, hence neglecting 'network contextuality'. For instance, while Owen-Smith and Powell (2004) showed with great visual power how in the early emergence of the Boston biotechnology community public research organisations played a key role in bridging between private firms, their quantitative method was not able to tell a rich story of the mechanisms or conditions of such bridging behaviour. Indeed, although networks are crucial for the entrepreneurial advantages of regions (Saxenian, 1994), little is known about the underlying micro processes of network emergence and how networks act as carriers of institutions that shape the identities and behaviour of actors (cf. Thronton & Flynn, 2003). Indeed, the micro level processes resulting in critical ties that are able to draw together complex system such as clusters are not satisfactorily understood. Gulati and Gargiulo (1999) found that previous relationships (such as cooperation between researchers) explain tie formation, but not how such relationships emerged in the first place. Furthermore, it is relatively unclear how such boundary spanning social networks, which connect scientists, are regionally or nationally embedded (Liebeskind et al., 1996). While membership in a spatial cluster is not a requirement for succeeding in a new field, proximity lowers costs and risks such as gaining legitimacy and avoiding the liability of newness (Pouder & St. John, 1996). Sorenson (2005) argues that firms cluster not because geographic proximity improves efficiency, but rather because social networks constrain where entrepreneurs locate and what type of business they start. Such mechanisms operate through social networks that enable both opportunity identification and resource mobilisation.

Given the significant consensus regarding the fact that clusters do not emerge *'de nouveau,'* but are shaped by existing social structures, it is surprising how little we know about the nature and origins of such networks. For emergence paths of this kind, the existence of individuals who are able to identify and cultivate new opportunities is crucial (Jones, 2001). We suggest that in the emergence of a science-based field, members of distinctive epistemic communities, i.e. scientists, act as the key identifiers and promoters of novel ideas.

Epistemic communities in Science and Scientists as Institutional Entrepreneurs

Membership in specific epistemic communities is obtained through the mastery of the codes, theories and tools employed in a specific practice (Håkanson, 2005: 434). In the case of a complex science-based field, such mastery is largely a result of formal professional education and membership in respected research teams. Epistemic communities do not discriminate against either local or global members (Coenen et al., 2004), and hence do not neatly reflect any existing spatial scale (Spicer, 2006). However, we are inclined to believe that physical proximity does play a role in the emergence of a science-based cluster. Science is often conducted in research teams that typically have a 'physical home' and laboratory, as do the 'gurus' of a particular discipline. We suggest that the links within and across epistemic communities serve as conduits for two resources that are vital to a cluster's emergence and sustenance, namely *knowledge* and *legitimacy*.

Knowledge. Since the emergence of the knowledge-based economy in the mid-1990s, clusters have been increasingly explained in terms of localised *knowledge creation and sharing*. *Knowledge,* i.e. "a fluid mix of framed experience, values, contextual information, and expert insights that provides a framework for evaluating and incorporating new experiences and information," (Davenport & Prusak, 1998:5) is located at different levels within and outside the cluster. The dominant classification of knowledge distinguishes between tacit and explicit knowledge. Michael Polanyi's concept of tacit knowledge, i.e. knowledge that is important but which cannot be articulated, is assumed to be sticky in nature and thus, critical for cluster emergence. Explicit knowledge, by contrast, can be easily codified, stored, and transferred across time and space independent of individuals (Ipe, 2003). Another classification of knowledge is between an analytical knowledge base, related to more universal 'natural science', and a more practical problem-driven synthetic knowledge base, related to 'engineering science' (Coenen et al. 2006). While analytical knowledge is typical of epistemic communities, synthetic knowledge is also crucial for cluster emergence. Because analytical knowledge is easier to codify than synthetic knowledge, it allows ties at greater spatial distances (ibid).

Knowledge creation refers to "a process whereby knowledge held by individuals is amplified and internalised as part of an organization's knowledge base", while *knowledge sharing* is the act of making knowledge available to others – typically referring to sharing of knowledge between individuals within an organisation (Ipe, 2003: 340-341). Within the context of multinational corporations (MNCs), Makela et al. (2007) show how interpersonal similarity (national-cultural background, shared language, and similarity of organizational status) drive knowledge sharing. Individual level knowledge sharing also takes place between organisations, for instance in the inter-organisational innovation networks central for cluster emergence. Nonaka and Konno (1998) argue that knowledge is embedded in 'ba', i.e. in a shared space for emerging relationships that can be divided into physical, virtual (e.g. e-mails), mental (e.g. shared experiences, ideas, ideals), or any combination of them. Also, Amin and Cohendet (2005) stress the simultaneous mobilisation of multiple geographies of reach and connectivity for cluster dynamics. Unfortunately, however, local versus global learning is often unnecessarily juxtaposed and separated rather than perceived as complementary and interdependent (cf. Coenen et al., 2004).

We contend that in novel science-based fields, in addition to spatially flexible knowledge creation and sharing within distinct epistemic communities, interaction in transepistemic "issue spaces" is crucial. We suggest that as in knowledge production in general, new field emergence necessitates communication within and between multiple epistemic communities involving both perspective making, i.e. strengthening the unique knowledge of a community, and perspective taking, e.g. taking the knowledge of other communities into account (Boland & Tenkasi, 1995). Like Corley et al. (2006), we suggest that inter-disciplinary differences (e.g. different research methodologies or norms of interpreting results) may present significant obstacles for collaboration and necessitate negotiations between different cluster constituencies. Indeed, when a cluster emerges at the interface between traditional industries, actors face multiple operating and institutional logics such as legislation, values and beliefs or shared cognitive models (Porac & Thomas, 1995) of the adjacent industries. The larger the range of institutions faced by actors the more numerous the likely sources of inertia (cf. Nooteboom, 2004b).

Legitimacy. Complementary to knowledge flows, the other element that serves as "glue" to a cluster is its institutional legitimacy, its "*raison d'être*". Suchman (1995:574) describes legitimacy as "[…] a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions". In terms of institutional legitimacy, one can distinguish between purpose-based rationales – which typically reside at organisational level and are influenced by the industry to which the organisation belongs - and value based rationales, which are borne by individuals and their communication. In the case of a regional cluster, in other words, an organisational network consisting of a fairly heterogeneous set of organisational actors, the shared purpose-based rationale is frequently relatively weak, since the purpose is often industry-related. Hence, one can speak of a loose meta- institutional coupling between organisations in a cluster. However, individuals based in different organisations, but sharing membership of an epistemic community, can very effectively bridge the shortcomings of these loose couplings by establishing tight couplings in terms of both knowledge flow and of working for a common goal or a common issue.

Institutional entrepreneurship. The existence of the competing operating and institutional logics of the converging industries leads us to the importance of institutional entrepreneurship as a vital form of connecting dispersed components of the emerging system. Agency[1] in such a context makes institutional entrepreneurs, i.e. organized actors with sufficient resources who see an opportunity in new institutions, realise interests that they value highly (DiMaggio, 1988). Actors may escape the determining power of institutions by gaining agency from the presence of multiple institutional referents that overlap and conflict (Dorado, 2005). Scientists are often in a position to be able to identify new opportunities and envision new solutions to scientific problems and to a certain extent see over scientific and institutional boundaries. In effect, their network position, which bridges different fields and spatial scales, may lessen their institutional embeddedness by exposing them to inter-institutional incompatibilities (Greenwood & Syddaby, 2006). Surprisingly, however, literature in institutional entrepreneurship has neglected scientists as initiators of institutional change[2]. Nevertheless, our key argument is that scientific institutional entrepreneurs play key roles in sowing the seeds of future clusters. In line with Dutton (1993:207-208), such entrepreneurial individuals can be said to take the role of issue sponsors, i.e. "the individuals or groups who argue that an issue is important". Besides scientists who aim to create new knowledge, issue sponsors can also be parts of 'communities of practice' (Brown & Duguid, 1991), which are groups of people engaging in the same practice or business function. Coenen et al. (2004, 2006) contend that compared with epistemic communities, communities of practice are aligned with industries drawing on a synthetic knowledge base and suggest that knowledge dynamics and thus interpersonal networks are more localised. A vital prerequisite for institutional entrepreneurs in a cluster context is that they possess a network position that enables them to span disciplinary, organisational and industry boundaries (cf. Greenwood & Suddaby, 2006). Earlier research has shown that strong cognitive or knowledge boundaries as well as social or identity boundaries inhibit diffusion of innovative ideas (Ferlie et al., 2005). Hence, institutional entrepreneurs must be able to cross such mental and professional boundaries in order to create a base of support that is sufficiently wide for an innovation or an emerging cluster.

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[1] With the concept of agency we refer to (Emirbayer & Mische, 1998:970) "the temporally constructed engagement by actors of different structural environments- the temporal-relational context of action- which, through the interplay of habit, imagination, and judgment, both reproduces and transforms those structures in interactive response to the problems posed by changing historical situations" As such it refers "both to the motivation and the creativity that drive actors to break away from scripted patterns of action"(Dorado, 2005: 388).

[2] For an exception see Ritvala & Granqvist 2006

Our key notion is that the development of any cluster is influenced by entrepreneurial action. Besides supporting institutional structures, the degree of entrepreneurial orientation of the cluster environments is crucial for cluster dynamics. Håkanson (2005) argues that a high rate of new firm formation induced by factors such as positive attitudes towards entrepreneurship, growing demand and favourable technological regimes underline the cluster benefits to individuals by offering alternative employment when new ventures fail, as indeed most do. Also, Feldman et al. (2005) discuss the role of entrepreneurs in the formation of industrial clusters. Indeed, they criticize earlier cluster literature for ignoring the role of individual change agents. They argue that while adapting to 'constructive crises' and emerging opportunities, entrepreneurs contribute to the development of external resources and institutions that further the collective interest of their emerging field. Hence, entrepreneurs may act as institutional entrepreneurs, or in the cluster language 'clusterpreneurs' promoting cluster creation activities (Sölvell et al., 2003).

Notwithstanding the central role of individuals in creating new connections and acting as a cohesive force at the system level, cluster emergence is conditional on the approvals of public and private organisations. Public research organisations such as universities possess key roles in knowledge creation and dissemination as they adhere to the norms of the open information disclosure (Owen-Smith & Powell, 2004). With their long-term research activities around specific topics, they also contribute to the stability of clusters. MNCs and their counterparts at the non-profit sector, international non-governmental organisations (INGOs), not only provide resources and legitimacy, but also connect clusters to the outside world. Furthermore, a specific organisation mode having high involvement in cluster planning and coordination is a 'cluster initiative', i.e. "an organized effort to increase the growth and competitiveness of a cluster within a region, involving cluster firms, the government and the research community" (Sölvell et al. 2003:31). This form is rather the reverse of the mechanisms of the bottom-up cluster emergence discussed above due to its orchestrated, top-down nature. In order to investigate the complex interaction between different ties, nodes (individuals, organisations) and spatial scales, we now suggest the use of the coupling metaphor for understanding clustering dynamics.

Applying the Coupling Metaphor to Cluster Emergence

Previous cluster research has tended to consider and distinguish between only a few different types of firms. However, complex systems such as an emerging cluster consist of numerous, and highly heterogeneous, interacting organisations and individuals, with interactions taking place at many levels. We are dealing with a phenomenon that is characterised by multiplexity, i.e. by a large number of relationships and content of ties between actors (Scott, 1983 based on Barnes 1972; Sydow & Staber, 2002). Sydow and Staber (2002:414) explicate multiplex relations:

> "For example, individuals employed in the marketing and R&D departments of an organization have multiplex relations if they meet in different settings (conferences, professional associations, etc.) Interorganizational relations are multiplex through the linkages between boundary spanners representing different parts of each organization. A variety of resources may be exchanged in this way, with multiple uses and for different purposes, such as meeting the instrumental, affective, and legitimation needs of organisations and individuals".

Hence, multiplex relations may result in temporary clusters of professionals (e.g. in international conferences) and thereby enable access to distant markets and knowledge pools (Maskell et al., 2004). Because of this multiplexity, we need to understand the key elements that are tied together in field emergence and how they are coupled. We have earlier suggested that individuals and organisations form the two major classes of elements and knowledge (and other vital resources) and legitimacy the major inputs contexts for their interaction. It is here that the coupling metaphor can be of use. The coupling metaphor can be seen as a conceptual tool that enables the investigation of relational patterns (Beekun & Glick, 2001); by applying it to the present case we contend that cluster emergence is about the emergence of new relationships, or the modification of existing ones.

This notion of loose coupling has been used as a meta-concept in organisation theory when trying to understand complex, evolving networks consisting of heterogeneous members that are interdependent but have different local agendas. In brief, loosely coupled systems are characterised by relatively ambiguous structures, decentralisation, delegation of discretion on the one hand and responsiveness between distinct and relatively autonomous organisational units on the other (Orton & Weick, 1990). The concept conveys that even though coupled events are responsive, each event also preserves its own identity and some evidence of its physical or logical separateness

(Weick, 1976). Scholars have extended the metaphor and related terminology to industry-level (Dubois & Gadde, 2002a; Dorée & Holmen, 2004), to innovation networks (Freeman, 1991) and even to open source software development (Iannacci, 2005). In an interesting study on the construction industry, Dubois and Gadde (2002a) underline several advantages of loose coupling. First, loose coupling between organisational elements permits each element to adjust to local contingencies without this adjustment necessarily affecting the whole system. Second, they argue that loosely coupled systems are more sensitive to their environment as a whole because each system element conserves its own environmental sensing mechanisms. Third, "*loosely coupled systems preserve the identity, uniqueness, and separateness of elements and may therefore generate variety. The system can retain a greater number of mutations and novel solutions than would be the case with a tightly coupled system; The greater freedom in a loosely coupled system would imply that the actors deal with the problem in a multitude of ways, thus favouring variety and innovation*"(Dubois & Gadde, 2002a:623). Applied to the present case, this means that clusters, with the relatively loose couplings between them and their openness to the environment, are very well adapted to sensing environmental trends and to innovating based on these inputs. Furthermore, the metaphor also allows us to consider the simultaneous coexistence of competing logics of traditional industries, which may hybridise in field emergence.

There is, however, a need to focus on the links between individuals across organisations within a cluster. The reason for this lies in one of the inherent shortcomings of loose inter-organisational couplings: Two potential drawbacks of loosely coupled systems according to Weick (1976) are that they are vulnerable to faddism and that change is often slow to diffuse through the system. Especially the latter point can (and must), however, be countered through tight couplings at individual level. In a related vein, Lang (2004) has combined the concept of coupling with the social capital approach stressing the role of social relationships and organisational routines for cooperation and *sharing and creating knowledge*. Relational patterns between individual actors therefore are of prime importance in keeping loosely coupled clusters together and in offsetting some of the drawbacks of loose coupling related to information-flow. Individuals may also potentially act as arbitrators or mediators between the competing interests, agendas and beliefs of cluster participants. The arbitrage situation we examine in this study is the emergence of a science-based cluster between the food and pharmaceuticals industries.

In Figure 1 we present an analytic model that combines our conceptual discussion and suggests investigating clusters as variably coupled systems.

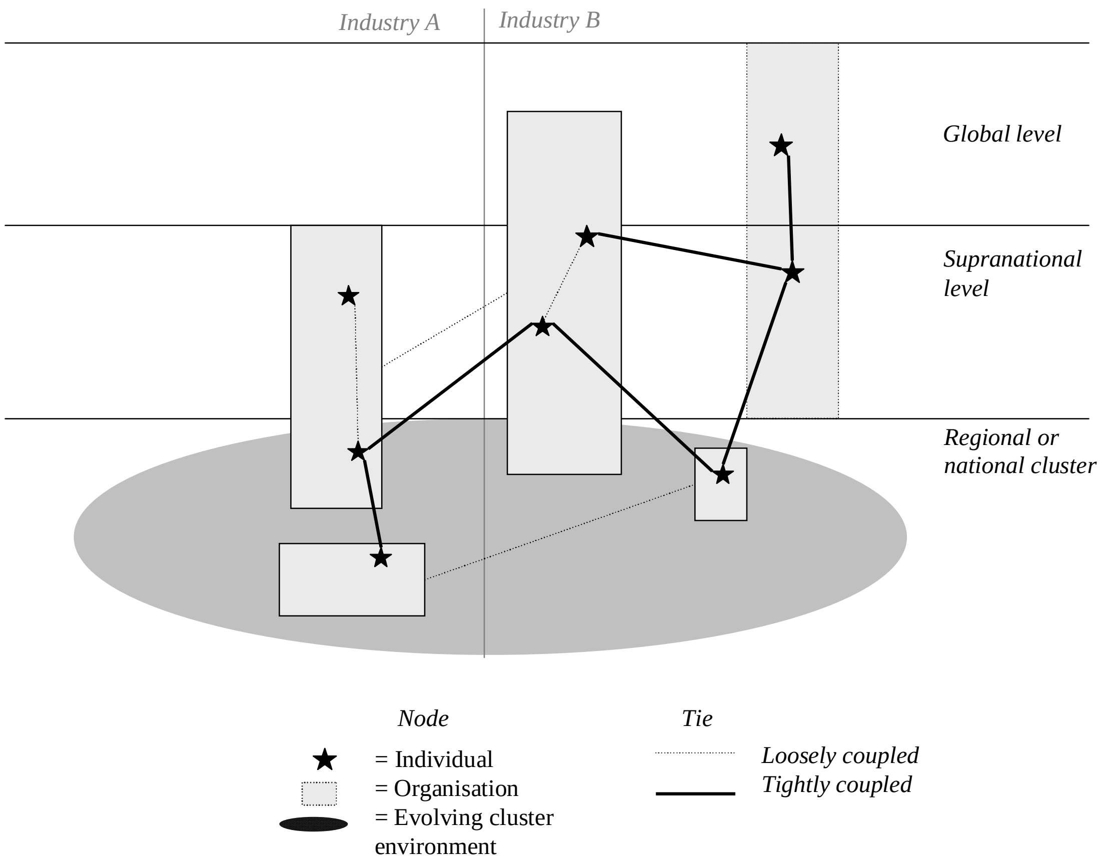

FIGURE 1 Spatial Cluster as a Variably Coupled System

An emerging cluster may be considered as an evolving network of relationships, which already displays certain interactional patterns. Both public and private organisations and specific individuals are key nodes in the system. Our key premise is that in order for the cluster to emerge some parts of the system must be relatively tightly coupled. We suggest that in science-based fields individual scientists act in the early cluster emergence as key bridging mechanisms between otherwise decoupled or loosely coupled organisations. Obviously, there also exist tight couplings between organisations in the task environment (e.g. critical resource providers) and also between institutional and task environment (e.g. regulation), as clusters are both production and social systems (Rosenfeld, 1997). However, our conception is that factor and demand conditions and rivalry (Porter, 1998) become increasingly crucial towards the later stages of emergence and subsequent cluster evolution. The proposed model contrasts traditional cluster studies that consider solely within the cluster links. We propose that scientists, through their membership in epistemic communities, also act as a key avenue for ties external to the cluster. *But what exactly triggers the emergence of new relationships, how are different elements coupled, and what roles do individual scientists possess in the emergence of a science-based cluster?* These are the type of questions that we now aim to answer with the help of our fieldwork data.

RESEARCH STRATEGY AND METHODS

Rationale and Research Design

This study is a part of ongoing research on field emergence during which we became interested in the role of spatial clusters in novel science-based fields. While we understood that scientists were crucial for the early cluster emergence, we lacked understanding on whether and how they connected with other cluster participants during the emergence process. Hence, we were lacking the micro-processes of cluster emergence. In contrast to commonly used quantitative techniques to identify clusters, we used qualitative longitudinal methods. Since the roles, motivations, and actions of scientists and other field participants were not immediately apparent, we considered only qualitative approaches as feasible. We selected an exploratory, longitudinal case study design. Such an approach avoids temporal reductionism and responds to increasing scholarly calls for longitudinal analysis to properly capture cluster emergence (Håkanson, 2005; McEvily & Zaheer, 1999; Wolfe & Gertler, 2004). Our case study is interpretive and seeks out the emic meanings held by the field participants (Stake, 2003). Hence we aim to create an 'insider view' of cluster emergence.

Data Sources and Analysis

We draw from three sources of data: interviews, participant-observation and secondary data. Data collection took place between late 2004 and early 2007. First, 32 semi-structured interviews were conducted between August 2004 and April 2007. We had an exceptional opportunity to interview those actors who were actively involved in the very early 'pre-cluster' stage. Informants included top management from food and pharmaceutical industries and public research organisations and program managers of cluster initiatives. The interview sessions lasted between one and three hours, the median being approximately nearly two hours, which altogether makes over 50 hours of interview tapes. The interviews were semi-structured. In the beginning of each interview the participants were given an opportunity to 'tell their stories' without limiting the questions too much. Such open-ended questions encouraged respondents to say more in a descriptive manner (Flick, 1998). The interviews were conducted in the mother tongues of the interviewees, in either Finnish or English.

Second, participant observation was undertaken within the Food and Nutrition Programme organised by the Finnish National Fund for Research and Development[3] and in the Health Claims Seminar organised by the Finnish Food Safety Authority[4]. Also, an on-demand webcast of the European Food Safety Authority's Health Claims Conference was used as background material[5]. Third, a multitude of secondary data was used, including documents relating to the cluster development in Finland such as the evaluation reports of technology programmes and meeting memorandums of the Finnish Novel Foods Board. Moreover, we draw from patent databases of the European Patent Office (EPO) and the United States Patent and Trademark Office (USPTO), as well as from PubMed, the publication database of medical sciences[6]. Patents and scientific publications are organised according to the names of inventors and/or authors and saved in the case study database. Table 1 provides a summary of a data sources used in mapping of the different roles of scientists during the cluster emergence.

Issue	**Measure**	**Data Source**	**Illustration**
Scientific discovery	Co-patents	esp@cenet/ European Patent Office	Miettinen TA, Vanhanen H, Wester I. Substance for lowering high cholesterol level in serum and methods for preparing and using the same. 2005-12-08
	Co-publications	PubMed/MEDLINE	Miettinen TA, Puska P, Gylling H, Vanhanen H, Vartiainen E Reduction of Serum Cholesterol with sitostanol-ester margarine in mildly hypercholesterolemic population. N Engl J Med. 1995 Nov 16;333 (20):1308-12.
Influence on regulation	Membership in food safety authorities	Internet pages of national and the European Food Safety (EFSA) Authorities	Out of the 14 members of the NDA (dietetic products, nutrition, and allergies) panel of EFSA (European Food Safety Authority) two come from Finland.
Pre-market safety assessments	Approved sterol and stanol ingredients	European Comission/ EFSA web pages	Comission Decision (2000/500/EC) on authorising the placing on the market of 'yellow fat spread with added phytosterol esters' as a novel food or novel food ingredient (Unilever U.K.)
Institutional entrepreneurship	Naming of central persons	Interviews with scientists, firms, and regulators	"[…] If I should name one central person it is Pekka Puska..absolutely, that Finland has become a model country for functional foods…His role since the 70s is truly unbelievable, he's a quite extraordinary Finn, truly."
Network building	Identification of bridge builders	Interviews with scientists, firms, and leaders of CI	"Ingmar Wester, the inventor, is the bridge builder"
Legitimacy	Field participant citations	Participant observation	"We should just have the credibility of Pekka Puska" (a workshop participant when explaining how to attain future success with new innovations)

TABLE 1 Summary of Data Sources in Mapping the Role of Scientists

[3] October 4, 2005
[4] December 12, 2006
[5] Bologna, November 8-10, 2006
http://www.flyonthewall.com/FlyBroadcast/efsa.europa.eu/NutritionAndHealthClaimsConference/
[6] NCBI National Library of Medicine and the National Institutes of Health
http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?DB=pubmed

The roles and activities of key individuals and organisations were investigated both retrospectively and in real-time to support the longitudinal analysis of cluster emergence. Transcribed interviews and participant observation memos were coded in NVivo (QSR 2), in order to help the authors to understand the data and find interrelationships between different concepts. Data analysis involved parallel investigation of different sources of empirical evidence in order to match individual and organisational agency with the structure and evolution of the surrounding institutional and task environment. We pursued our data analysis through an abductive theory-building approach with constant interplay between theoretical preconceptualisation and empirical data (Dubois & Gadde, 2002b). We combined different theoretical perspectives in order to gain a fuller and more meaningful understanding of cluster emergence. Thus, we acted as theoretical bricoleurs (Denzin & Lincoln, 2003) in a highly iterative process between existing theoretical understanding and the collected data. In the following, our aim is to craft a 'theorized storyline' (Golden-Biddle & Locke, 2006) where we endeavour to convert the relevant components of our conceptual framework and collected fieldwork data into analytical insights on the roles of scientists in cluster emergence. Such methodological logic contributes to a tight coupling between the empirical data and the emerging middle range theory.

CASE ANALYSIS

In this section we present our empirical insights and findings thematically. First we describe the two intertwined logics of the food and pharmaceutical industries converging in functional foods. Thereafter, we present different roles taken by key scientists along the cluster emergence. Finally, we build a model for cluster emergence where individual scientists act as the key triggering and perpetuating force in cluster emergence of a new science-based field.

Research Setting

Our setting is the emergence of a highly research-based cluster of cholesterol-lowering functional foods actors in Finland. High blood cholesterol level is a major causal risk factor for heart disease, the leading cause of death in both high and low- income countries (WHO, 2007). The patent application for the pioneering cholesterol-lowering functional foods concept was filed by Raisio Margarine at the Finnish Patents Office in 1991.[7] This event opened a new era of heart disease prevention. Functional foods have emerged in a ‘grey transition zone’ between food and medicine - at the intersection of two overlapping yet competing institutional logics (Friedland & Alford 1991, p. 248) of medical and nutritional philosophies. The local cluster acts as a forum where competing logics such as disease treatment and prevention meet. Table 2 depicts the position of cholesterol-lowering functional foods between traditional foods and pharmaceuticals.

Key aspect	***Traditional foods***	***Cholesterol-lowering functional foods***	***Pharmaceuticals***
Research intensity	Low		High
Patenting	Low		High
Epistemic community	Food and nutrition sciences		Medical science, pharmacy
Regulation	Safety and origin		Safety and efficacy
Legitimacy	Consumers		Medical community
Communication	Consumers (retail)		Medical professionals, patients

TABLE 2 Position of Cholesterol-lowering Functional Foods between Traditional Foods and Pharmaceuticals

At a general level, functional foods merge the analytical knowledge base of the pharmaceuticals industry (e.g. chemistry, biology and medicine) with the more synthetic knowledge base of the food industry (e.g. food technology) (cf. Coenen et al. 2006). Relatively high investments in basic and applied research and clinical tests, i.e. a rigorously controlled test of a new ingredient on human subject, in cholesterol-lowering functional foods resemble pharmaceutical development. Such investments necessitate global market scope and the use of patens for protecting intellectual property. As discussed, in the development of functional foods the epistemic communities of both nutrition and medical sciences meet. In terms of human health, the basic philosophies of the communities differ in important ways. In contrast to the pharmaceutical treatment of high cholesterol, cholesterol-lowering functional foods open a preventive approach. Functional foods have an additional safety requirement beyond traditional foods relating to the novelty of the raw material, production process and amounts used in the daily

[7] Cholesterol-lowering functional foods are based on plant sterols, which lower cholesterol levels by blocking absorption of cholesterol in the intestine (e.g. Law, 2000; Miettinen, Puska, Gylling, Vanhanen, & Vartiainen, 1995).

diet. Furthermore, a proof of the positive health benefits through scientific substantiation is required. Finally, in terms of legitimacy, functional foods actors have to communicate and promote their benefits both to medical professionals and final consumers. It is here where scientists act as key legitimators of functional foods.

Despite its small population of 5.3 million, Finland is said to be the world leader in the development of health-enhancing foods, the 'Silicon Valley of functional foods' (Dunn 2005, Heasman & Mellentin, 2001). In early 2007 we identified three regional research concentrations of functional foods in Finland: Helsinki, Turku and Kuopio. They consist of one to two dozen public research organisations and a few MNCs with R&D departments plus a relatively large number of smaller firms producing or using functional foods ingredients. Regardless of the grand Silicon Valley metaphor, the obscure boundary between food and medicine was noticed over 2000 years ago by Hippocrates, who preached: 'Let food be thy medicine and medicine be thy food'. But what roles did contemporary scientists take in bridging between foods and medicine?

Two critical events that took place in 1995 triggered the emergence of this cluster in Finland. The first was the creation and successful commercialization in Finland of Benecol®, the pioneering cholesterol-lowering functional foods margarine. First, Benecol was initially a success story and provided the seed for a cluster, thereby tempting new actors to join. Second, at macro level, a key impetus for naming functional foods as one of the strategically important sectors of the Finnish economy was the country's EU membership, which opened a market that was previously protected by high import barriers. In order to smooth the transition towards an open market, the Finnish government decided to invest significantly in national food R&D in the mid 1990s. Two four-year technology programmes entitled 'Innovation in Foods' (1996-2004) were coordinated by Tekes, the Technology Agency of Finland, the main public funding organisation for research and development in Finland. We use the Benecol case to illustrate the more micro-level emergence of links between food and pharmaceuticals industries and the public health system, and cluster initiatives to demonstrate more top-down approach to strengthen links between cluster participants.

Roles of Scientists in Cluster Emergence

Mobilising Institutional Change. The roots of Benecol go back in history to the 1970s. In 1972 the North Karelia Project was launched in the province of North Karelia in eastern Finland, which was at the time suffering from the world's highest coronary heart disease mortality rate among working-aged men. This severe local health issue (including a significant difference between the mortality rates of the eastern and western parts of the country) became a significant trigger for the Finnish nutrition and health related research. A young public health researcher named Pekka Puska was selected to lead the North Karelia Project aimed at preventing heart disease through a healthier diet and other lifestyle factors. In this demanding endeavour, its leader needed to challenge both the conservative medical community and the food industry. Instead of blaming the food industry, Puska started to challenge it to develop healthier food, hence acting as an agent for institutional change, an institutional entrepreneur in its literal sense. Framing and labelling an issue as an opportunity rather than a threat (Dutton, 1993) can, therefore, be done at industry level by individuals possessing social skills (Fligstein, 2001) and legitimacy, which was derived from Puska's membership in the medical community and the backing of the World Health Organization. Two decades later, more specifically in 1993-94, Professor Puska and his employer, the National Public Health Institute, were contacted by the Raisio Group to carry out a large clinical trial within the project to confirm the cholesterol-lowering effect of Benecol.

Scientific Exploration and Bridging. The development of the Benecol innovation was accomplished by a group of scientists working in the food and forest industries and medical science between the late 1980s and mid-1990s. The development project of Benecol was triggered by the need of UPM-Kymmene Kaukas Chemical Mill to find a suitable application and buyer for the surplus by-product of its milling process called sitosterol. The cholesterol-lowering effect of sitosterol was already known in the 1950s, but the problem had been the poor solubility of the substance. Professor Tatu Miettinen, a distinguished scientist in the field of cholesterol metabolism, his colleague Hannu Vanhanen at the Helsinki University Central Hospital (HUCS), and Ingmar Wester, a chemist acting as R&D Manager at Raisio became the key scientists to conduct further research. Earlier in 1988, Raisio financed an extensive clinical study carried out by the Faculty of Pharmacy at the University of Helsinki to demonstrate the favourable effect of the use of rapeseed oil on blood cholesterol-level. The project reached the goal of raising the low image of rapeseed oil, but it also provided Raisio with an excellent base for the subsequent more complex development process of Benecol. The Benecol research reached its major goal when Ingmar Wester made a significant technological breakthrough in finding the solution for converting plant stanols into a fat-soluble form. Besides their scientific exploration, the key scientists acted as bridge builders between previously decoupled organisations and fields. Miettinen and Vanhanen were responsible for early clinical testing at HUCS and during 1993-94 the LDL cholesterol-lowering effect of Benecol was tested by means of a larger population trial within the North Karelia project. Thus, only a handful of key scientists were able to create a new-to-the world- innovation. However, this required membership in epistemic communities and communities of practice that provided both knowledge and legitimacy for such a risky journey into uncharted waters.

During the early 2000s, Ingmar Wester has played a key role in transferring the research focus of Raisio Group towards more consumer-friendly product formats and actively built new research links abroad, most importantly to the University of Maastricht, to the research group of Professor Ronald Mensink, an acquaintance of Wester from the EU projects of the yearly 1990s. At the University of Helsinki, the Benecol innovation triggered wider interest among scientists in developing cholesterol-lowering concepts. Professor of Pharmacology Heikki Karppanen created the MultiBene concept, which besides lowering cholesterol level benefits blood pressure and bone health, and Professor Raimo Hiltunen at the Faculty of Pharmacy played a major role in developing Diminicol, a cost-effective way of producing sterols. Quantitatively, tight personal coupling between the scientists was reflected in numerous scientific co-publications and patents. Indisputably, besides Raisio Group the role of the University of Helsinki has been significant for the emergence of the cluster. The idea behind such a ‘hub institution’ in conducting, coordinating, and increasing stability for the research networks is analogous to the role of a hub firm (Jarillo, 1988) in innovation networks (Dhanaraj & Parkhe, 2006). To conclude, we identified two different communities: the epistemic community of scientists in cholesterol metabolism and the community of practice with a concrete problem-solving task related to food technology. The members of the two communities had to be able to understand each other and the related knowledge bases.

Legitimacy Building. The approval and recognition by the medical community was crucial for creating an environment of credibility for functional foods. The credibility of individual scientists was required for both internal and external purposes. For instance, the legitimacy of Professors Puska and Miettinen contributed to both the internal (Raisio Group) and external sales of the Benecol concept. Furthermore, since cholesterol-lowering functional foods implied a major shift in thinking from disease treatment towards disease prevention, changes in both cognitive frames and care practices were needed. Besides visible scientists acting as institutional entrepreneurs, clinical practice guidelines provided another channel. The Finnish Medical Society Duodecim (a task force of highly respected scientists) drafted the first national 'Current Care Guidelines on Dyslipidaemia' (high cholesterol) in 2004 with the aim of producing neutral and objective, systematically collected and critically evaluated medical data to be used by both health care professionals and patients and decision makers. Plant stanol and plant sterol based foods are suggested as one lifestyle treatment alternative in the guidelines. Besides locating at the interface between medical and nutritional sciences, in what we earlier discussed as a transepistemic issue space, such guidelines also indirectly connect to translocal guidelines given by the European Society of Cardiology and, thereby also to the U.S. Cholesterol guidelines. Yet, even though international guidelines are monitored carefully such coupling may be classified only as loose because of differences in local situation and health care systems, which in turn necessitate different treatments. Furthermore, since medical doctors have a high degree of autonomy and discretion it is relatively common that guidelines do not easily transfer into everyday clinical practice. On the private side, on the other hand, individuals with considerable scientific background also do marketing. Such a background enables credible communication of science to both authorities and customers, thus, supporting the commercialisation of innovations.

Advising and Representing. Due to the necessity of understanding underlying complex mechanisms, scientists have key roles as advisors to legislators and regulators. Scientific evaluations are important particularly in pre-market safety assessments and concerning the claims allowed in the marketing of functional foods. The panel on dietetic products, nutrition, and allergies (NDA) of the European Food Safety Authority

(EFSA)[8] deals with novel foods and possesses a significant role concerning these issues. The members of the NDA panel are selected based on scientific merits and its decision-making is based strictly on scientific evidence. However, NDA members are also embedded with their home country interests and regulative and normative institutions. Out of the 14 members of the NDA panel (and 27 EU countries) four come from the Netherlands, two from Ireland and two from Finland. Through these scientists, still somewhat loosely coupled regulative systems exhibit tighter links. The new EU nutrition and health claims regulation aims to harmonise health claims regulation across the member countries. In such a process of institutional bricolage (Campbell, 2004), some features may also be borrowed from outside the Union. For instance, in an international scientific conference, which was organized by EFSA in November 2006, the representatives from the U.S. (Food and Drug Administration) and Australia were also heard. Furthermore, participants from the European food and drink industries, consumer advocates, and ‘health lobbyists’ were present to actively further their own agendas. Notwithstanding multiple stakeholders and strong institutions, the inherent asymmetry of the system also leaves room for individual agency. What is interesting in terms of the cluster development is that the scientists at the NDA act as agents of a kind in transferring both codified but also tacit knowledge across the national and supranational systems. Scientists act as representatives with multiple positions, thus leveraging their personal relationships or bringing their social capital to other social contexts.

At the national cluster level, scientists have also led technology programmes, multidisciplinary research programmes and cluster initiatives and contributed to long-term couplings between public research organisations and firms, on an international basis as well. Building on the earlier national technology programmes, the Finnish National Fund for Research and Development (SITRA) launched its Food and Nutrition Programme for 2005-2009 aiming at creating a joint strategy for the Finnish food and nutrition industry, and an internationally competitive nutrition cluster in Finland. Supporting SITRA’s nutrition cluster, Raisio and Valio, Finland’s biggest dairy company, announced in late 2006 that they would begin research cooperation in the field of nutrition. It is noteworthy that even though Raisio had earlier licensed the

[8] EFSA was established by the European Parliament in 2002 following the food scares of the 1990s and the loss of confidence by the European public. http://www.efsa.europa.eu

Benecol concept to Valio, deeper cooperation between the two companies will be in research. Thus, scientists are playing a key role in creating tighter couplings between the firm level actors within the cluster. The cluster initiative intends to apply for 'cluster'status in 2007 from the governmental Science and Technology Policy Council of Finland, signifying that 'cluster' is also a linguistic marker. What is noteworthy is that boundary spanning individuals act as bridges between different cluster initiatives both nationally and internationally, for instance to a similar type of CI in Scania, the southernmost province of Sweden. Such links and benchmarking are crucial, since overall, we found surprisingly few links (mostly in research) between the Finnish cluster and a similar type of clusters abroad.

Symbolising. Finally, we found a peculiar role for scientists in cluster emergence, namely that of being an 'icon'. Icons are 'spiritual fathers' of clusters. In our case, the key person in sowing the seeds for functional foods is Professor Puska. Icons appear to be former institutional entrepreneurs of high visibility who came to take on a quasi-mythical status within a community to the extent that they are frequently referred to or quoted by others in order to gain legitimacy. We also recognised younger scientists that cooperate with and follow in the footsteps taken by key scientists such Professor Miettinen. 'Disciples' who follow their 'gurus' may later take the positions of their masters. It is perhaps typical of medical science, though we may also recognise a similar type of behaviour among scholars of organisation theory. In this respect, star scientists may be thought of as "the 'seeds' around which crystals form" (Zucker et al. 2002:630).

We have interpreted an emergence path of a science-based cluster. Our key argument is that early emergence, a type of a pre-cluster stage, is triggered by individual level links. Scientists were found to create tight couplings in the system, while organisational level links were found to institutionalise later. Our findings imply that such tight couplings at individual level are an indication that the highly specific expertise of scientists results in overlapping and consecutive research projects and in personal bonds between individuals. In the Figure 2 we visualise the interplay between start scientists at hub institutions and firms and how their network positions, knowledge and legitimacy give them different roles in cluster emergence. This interplay is grounded on the idea that the positions of scientists in social networks are a source of novel ideas and enable their groundbreaking scientific discoveries and subsequent communication of knowledge.

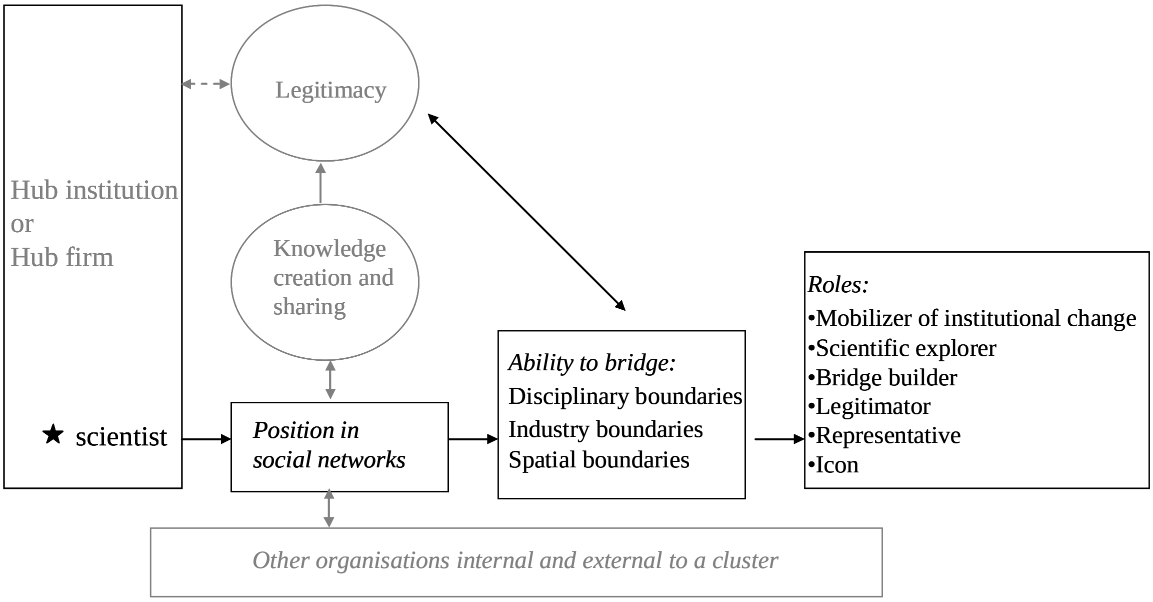

FIGURE 2 Roles of Scientists in Early Cluster Emergence

Increased knowledge was associated with enhanced legitimacy, which mirrors and reflects back to their home organisations. Network position, knowledge creation and sharing in intra-organisational and inter-organisational innovation networks and legitimacy enabled scientists to bridge between disciplinary, industry, and spatial boundaries. Enabled by these three factors, we identified different roles for scientists in the emergence of science-based cluster.

The network positions of the scientists were found to expose them to field level contradictions (Greenwood & Suddaby, 2006). More specifically, they were exposed to different institutional logics of the medical and nutritional communities (and pharmaceuticals and food industries). Hence, in contrast to earlier studies assuming relatively homogeneous cluster participants sharing similar mental models (e.g. Pouder & St.John, 1996), we found evidence for interdisciplinary negotiations within and between epistemic communities and communities of practice. Given the internationally relatively small size of the organisations, scientists were required to possess a wide competence base, which enabled them to see novel solutions at the interface between separate industries, disciplines and logics. This also enabled them to take network positions that bridge different fields. By participating in creating a radically new hybrid form of food and medicine, the scientists were found to act as institutional entrepreneurs. Their cooperation also broke down old boundaries between fields and created a more cooperative atmosphere in general, a "second-order" effect beyond the participating organisations (Lawrence and al. 2002). In our case, setting institutional and creative power was synonyms with specific individuals, thereby making the system relatively flexible and adaptable, but simultaneously also more vulnerable since knowledge and legitimacy were narrowly leveraged. Due to their profound understanding of specific issues, which are typically not accessible to others outside narrow epistemic communities, scientists also tend to hold central positions in crafting regulation of the emerging field.

When it comes to the role of spatial proximity in cluster emergence, we need to distinguish between scientific and business activities. On the one hand, science appears to have a strong spatial concentration effect, mainly resulting from knowledge externalities and concentration effect of scientists around a hub institution. On the other hand, we found fairly limited interaction between firms within the cluster, which probably reflects the global nature of firms' value chains and end markets.

Yet, overall we argue that space possessed a specific role in the emergence of the cluster as the heart health issue got its strongest manifestations in Finland. This triggered both new business and institutional entrepreneurship. The local institutional environment, for instance, the relative flexibility between different institutional logics and the public support for R&D contributed to the fact that Finland was the pioneer in cholesterol-lowering functional foods. This finding extends the argument of Spicer (2006) who argues that organisational logics 'transform' as they move across space. We contend that field level logics differ between spatial scale, making some localities more open to change and innovation than others. However, echoing Coenen et al. (2004:1005), we want to avoid 'spatial fetishism' i.e. "that proximity makes interaction better, faster, easier and smoother". Even though local advanced knowledge infrastructure is necessary, we found that such infrastructure is tightly coupled to global science base and that during their evolution clusters need increasing external links to avoid lockouts from the global market place. This is particularly the case during the maturation of the cluster and the organisational field. Hence, in contrast to studies advancing the dualism between local and global or spatially close and more distant learning (Bathelt et al., 2004), we argue for a highly intertwined nature between these spatial levels.

CONCLUSIONS

This paper has highlighted the role of individual agency in a situation when a cluster emerges at the interface between two traditional industries. Our key thesis is that cluster emergence at the intersection of multiple institutional logics necessitates strong institutional entrepreneurs who identify and are willing to justify and defend the new concept. Hence, metaphorically individual scientists act as midwives to novel concepts and cluster emergence. Collectively, such individuals form a 'meta' community or 'hybridised' community, where distinctive philosophies meet. The concept of coupling helped us to understand how such novel meta-community emerges by blending elements from different communities. Thus, we extend both institutional entrepreneurship approach and the use of coupling metaphor to cluster context.

More specifically, we conceptualised scientists as institutional entrepreneurs and identified the different roles that they possess during cluster emergence. We found that rather than the discovery activities that scientists are typically associated with, institutional entrepreneurs are needed to theorise the problems for which innovations are solutions from the deinstitutionalisation of previous understanding and behaviours until final commercialisation (see also Munir 2005). This contradicts Greenwood et al. (2002) who suggest that theorisation is merely one stage in an institutional change process. Hence, besides identifying scientists as central actors in science-based clusters and emerging fields, our study analytically divided between different activities, and their timing and duration along cluster emergence. Our argument that the ability of scientists to channel knowledge and legitimacy is related to their position in social networks is close to Podolny (2001). However, we contend that in the situations of high uncertainty both the social network positions of scientists and their status, represent assets. Podolny (2001), on the other hand, maintained that status often leads an actor to avoid uncertainty.

We also found that those scientists acting as institutional entrepreneurs had temporal orientations (Emirbayer & Mische, 1998) favouring the future. Yet, in contrast to the institutional entrepreneurship approach, which stresses calculative, interest-driven behaviour, we found that the behaviour of scientists appears to be much more unplanned and driven by scientific considerations related to problems, knowledge, intuition and ambition. Criticism of the overly rationalistic view of institutional entrepreneurs was pointed out earlier by Djelic and Ainamo (2005) and Hwang and Powell (2005). We suggest that analytically dividing between different types of institutional entrepreneurs and the motivations that drive their behaviour is worth future consideration. Only through such elaboration is it possible to evaluate the validity of the process models of institutional change (Greenwood et al., 2002) and institutional entrepreneurship (Greenwood & Suddaby, 2006). More research is also needed on the role of scientists acting as institutional entrepreneurs and in the emergence of science-based fields and clusters. Furthermore, as entrepreneurship literature recognises cases where individuals "happen into" their entrepreneurial role, future investigations could better elucidate transposition of such ideas to a wider conceptualisation of institutional entrepreneurship.

Even though we believe that this research contributes strongly in particular to the existing understanding of the role of individual agency in emergence of a cluster, the study is also subject to major limitations. The study was restricted to our interpretation of the single emergence path of a cluster in a unique institutional environment. Finland is more than usually supportive of boundary-crossing and novel ideas. The country appears to be distinct as a spawning ground for clusters where spanning of institutional boundaries is encouraged for instance through public financing. Moreover, the small size of the country where "every one knows everybody" and one central media dominates is supportive of the rapid emergence of new clusters. Thus, we invite further comparative research on the role of individuals and organisations in the early phases of cluster emergence, which could either prove or disprove our proposition of scientists creating tight coupling at the system level.

In terms of regional policy-making, our case portrayed innovation as a collective process characterized by both cluster policy initiatives and bottom-up serendipity where creativeness and discovery inherently resides with individual scientists. The challenge for knowledge-intensive clusters is how to establish structures that capture these generators of knowledge. Furthermore, we see a challenge regarding how to link various cluster initiatives more tightly together in a way that would produce synergies without unnecessary overlap. Regardless of the scientific innovativeness of the region, a major issue emerging from our fieldwork data is that of a lack of entrepreneurial spirit in a business sense. A sound and well-functioning incentive system that would support and promote commercialization of science is an important goal. If the country can combine entrepreneurship with the fortunes of the current dynamisms of Europe locating at fringes like in the Nordic countries as Michael Porter put it in a recent interview (Snowdon & Stonehouse, 2006), the local functional foods agglomeration may perhaps avoid the typical decline found along cluster life cycles.

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