INNOVATION IN MARINE BIOTECHNOLOGY: CLUSTERING OR TRUST AND ENTREPRENEURSHIP? AN EXPLORATIVE STUDY OF AN ISSUANT INDUSTRY IN THE HIGH NORTH

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1. Introduction

"Entrepreneurs play a special role in cluster formation. […] Through their individual decisions in creating and developing new companies, entrepreneurs may collectively also spark regional industrial transformation." (Feldman and Francis 2006:115).

Norwegian regional development policy is not particularly focused on entrepreneurship. Cluster development is among the most prevalent tool in the Norwegian regional and local industrial policy (St.meld. nr. 7/2008-9, Finsrud 2009:82, Isaksen and Onsager 2004). Cluster policy aims to strengthen interaction between enterprises, research and development units, and stimulate innovation through public development schemes. This are schemes such as NCE (Norwegian Centres of Expertise), the Arena-programme and Programme for Regional R&D and Innovation (VRI). Cluster development is not a distinctively Norwegian phenomenon. It is promoted globally as panacea for economic development, increased innovation and competitiveness in small and large regions. According to the theory, clusters consist of related enterprises located in geographical proximity and this is supposed to stimulate innovation through facilitating networking, flow of knowledge, interaction and new ides.

This study started out with the aim of exploring cluster development in marine biotechnology in an attempt to answer the working question *how does geographical proximity stimulate innovation in marine biotechnology in Troms?*

[1] The paper is based on material the research project "Fra nettverk til klynge? Utvikling gjennom samhandling" translated to "From network to cluster? Development though interaction " in the research program Virkemidler for regional FoU og innovasjon (VRI) – Troms, co-financed by the Norwegian Research Council

One finding was that geographical proximity and local interaction appeared to have minor importance as impetus for innovation in most of the studied enterprises. Local knowledge infrastructures are of importance. The informants reported that their major impetus for innovation was customer relations. Customers and networks for customer driven innovation are mainly located nationally and internationally. This implies that the expected flow generated through cluster processes is to a minor extent based on geographical proximity. Our data indicate that relations and not localisation are the important focus for studying the impetus for innovation. Relations are dependent on actors and to study relations, focus has to be moved form geography to actors, which in this case are the firms in marine biotech. Trust is the foundation of social relations and study of relations have to incorporate development of trust as one element. Our data indicated that company strategies had impact on innovation and the industrial pattern in the sector. Focus on strategies and relations reveals different dynamics than focus on cluster and local ties.

A closer look on the marine biotech companies made us aware that the founder still had an influential role as either manager or leader of the board in almost every company. Is a founder of an enterprise an entrepreneur? Entrepreneurs are supposed to assess new opportunities, take risks and start new businesses. The founders of the case companies more or less have the characteristics of entrepreneurs (this is further discussed in section 5). This paper aims to discuss how entrepreneurship and trust affects innovation on company level and on industrial pattern on sector level.

Cluster studies represent one major stream of innovation studies. A number of studies however question the cluster concept and its suitability as a tool for innovation and economic development. One major criticism is that cluster theory poorly describes the relation between cluster and innovation (Depret and Hamdouch 2010, Cooke 2008, Rosiello 2008, Martin and Sunley 2003, Simmie 2004, Wolfe and Gertler 2004, Tödtling and Tippel 2004). Most cluster and innovation studies (in economic geography) discuss innovation from a macro perspective using quantitative data. This paper takes a different approach based on qualitative data and grounded theory (GT),

an inductive methodological approach. Thus, the study is not testing hypothesis but grounds the concepts in empirical findings and presents an explorative, micro level study of the issuant marine biotechnology industry in the High North, in practise the Tromsø region. Focus is on the enterprises; their entrepreneurial strategies, cooperation, trust and capability for innovation. The aim is that the discussion of grounded concepts in relation to existing theory will contribute to expand the knowledge about entrepreneurship and innovation as social processes on micro level.

Regional context and paper structure

Tromsø, often named the capital of Northern Norway, is an administrative and trading centre situated within 2 hours flight time to Oslo, the capital of Norway. Tromsø is a former fishing village with weak industrial traditions. In 1972, it became a university town and has now approximately 10.000 students in addition to 67.000 inhabitants. Trade and industry in Northern Norway have mainly been raw material based and export-oriented concentrated around fishing industry, energy-intensive industry and engineering. The region is rich on marine resources and the university supplies highly skilled labour and researchers.[2] Marine biotech firms can easily get necessary resources, for instance by-products from fish processing factories. The first marine biotech firms were founded in the mid eighties. Tromsø is a well-suited location for research on cold adapted marine bio-organisms and development of marine biotech industry. Leading research infrastructure in marine biotechnology is located in Tromsø[3] and there is a well-developed public industrial support system. Development of marine biotechnological industry is among the target groups of the national support system. Marine bio prospecting, that is exploring and mapping of marine organisms, is one research area and a national strategic focus. Marine biotechnology in Tromsø is a relevant case to study in innovation, entrepreneurship and cluster processes in new

[2] Marine biotechnical academic resources are for instance The Faculty of Biosciences, Fisheries and Economy (former Norwegian College of Fishery Sciences) which offers study programs with high qualified expertise on marine biotechnology, Nofima – the Norwegian Institute of Food, Fisheries and Aquaculture Research, the governmental Institute of Marine Research with its department in Tromsø and the Norwegian Polar Institute.

[3] This is the Mabit research program, the MarBank national marine bio-bank and MarBio laboratorie.

knowledge based industry and this kind of industry as target for regional development initiatives. Our main working question is what characterize the marine biotechnological industry in the high north with regard to innovation, entrepreneurship, cooperation and trust?

The paper draws on a fieldwork autumn 2009 with the aim to explore cooperation and cluster processes of marine biotech firms. Exploring implies here to do a mapping of strategies, production, markets, research and development (R&D), innovation, competences, cooperation and networks in enterprises belonging to the FNB[4] (now BNN) network. One of our findings was that the regional industrial pattern, with a few exceptions, was characterised of low growth in the enterprises, few replacements and few start-ups. Why this stable industrial pattern? From an economic geographical perspective, possible explanations are lack of cluster dynamics, peripheral location, weak industrial culture and structural dynamics in the biotech sector (Karlsen et al. 2009). A sector characterised of high entrance costs, long development processes and high risk. In addition to discussing cluster dynamics in marine biotech in Tromsø, our study suggests entrepreneurial strategies as an additional explanation of the industrial pattern.

The paper has the following structure; section two presents GT as methodological approach and our main finding is the conceptualisation of *entrepreneurial strategies*. Section three present the empirical context; sector dynamics in biotechnology and characteristics of marine biotechnology cluster in Tromsø as context of the entrepreneurial strategies. Section four present and discuss empirical findings – the entrepreneurial strategies, trust and innovation. Section five concludes with a discussion of the relation between dynamics on micro level and macro level effects.

[4]FBN – Forum for Bioteknologi, BNN – Bioteknologi i Nord-Norge

2. Grounded theory as methodological approach

Joseph Schumpeter, the main figure in entrepreneurship literature, argued that "the theory on entrepreneurship should be based on the actual activity of the entrepreneur" (Svedberg 2000:17). This fits very well in with using grounded theory as methodological approach. Grounded Theory is an exploratory method for collection and analysis of empirical data. Even though the methodology is contested and have huge variation in practices, GT has now become one of the major approaches in qualitative research (Charmaz 2009, Charmaz 2008, Hood 2010, Bryant and Charmaz 2010). GT aims to generate concepts and theory from empirical data through systematic comparative analysis and *grounding theoretical* statements in the data (Glaser 1978:115). The term *theory* as used in grounded theory does not mean formal, logical statements for empirical testing but statements that explains or predicts a social process. Developing theory is a creative and systematic process, and it implies 'conceiving or intuiting ideas (concepts) but also formulating them into a logical, systematic, and explanatory scheme' (Strauss & Corbin 1998:21). According to Strauss & Corbin (1998:21), a theory 'denotes a set of well developed categories (e.g., themes, concepts) that are systematically interrelated through statements of relationships to form a phenomenon'. A theory develops when categories and concepts are related into an explanatory framework and a theory offers an explanation of the studied phenomenon. A successful application of generative theory in the study of a subject will result in concepts or a theoretical framework that explains particular processes in that particular substantive field. Developing concepts is the core activity in GT (Glaser 1978:64). Theory develops through systematisation and categorisation of the empirical material and by relating categories and concepts into a framework explaining the studied phenomenon. GT concepts are dynamic and ever-developing frameworks as new data extend and specify the concept further. Further specifications give better 'fit' between data and analysis. In this study, *entrepreneurial strategies* are examples of conceptual specifications grounded in empirical data. Further studies of marine biotechnology or other sectors will contribute to expand and detail the specifications of entrepreneurial strategies and related social processes.

Most GT studies are on *substantive* level, which is theory and concepts developed for a particular empirical field, for instance entrepreneurial strategies in marine biotechnology.[5] The main working question was:

Which processes contributed to facilitate or hamper clustering in the marine biotech industry in the Tromsø region?

To answer this question, we had to map various aspects of the marine biotechnological industry. Through this work, we discovered the three entrepreneurial strategies, which appear to hamper as well as facilitate clustering. In addition; the strategies appear to affect the innovation process in the companies.

The empirical data are from a various sources; interviews, documents, observations, and statistics. We have interviewed 16 out of a total of 26 enterprises (managing directors or research directors) and 9 informants from policy and research infrastructure. In addition, we have accounting information from 2004-2008. Based on a combination of initial knowledge of the field marine biotechnology and general sociological knowledge we made an interview guide with a few rather huge thematic subjects. The collection of data focused on four social processes: *clustering, entrepreneurship, innovation and trust* and are guided by the following open questions:

- Is the marine biotech industry a cluster? What characterises this cluster – who is a part of it, what kinds of transactions and relations do we find? Which processes are facilitating and hampering the clustering process?
- What is the role of entrepreneurship in marine biotech enterprises? What characterises entrepreneurship in this sector?

[5] There are few GT works as *formal teory* (Ellingsen 2010). GT as *formal theory* has broad applicability, is abstract and removed from the raw data grounding the theory. The entrepreneur typologies are possible elements in a formal theory about entrepreneurship and strategic leadership – but this has to be further explored.

- Innovation is to make something new, to create a change. What processes goes on “in” this black box of innovation among the marine biotechnological companies? How is innovation and clustering related in this sector?
- Trust is a prerequisite for change – how is trust processes unfolding in the marine biotechnological context?

We collected data about products, local and global collaboration, entrepreneurs, strategy, future development, innovation and competence.

Data was coded into categories according to properties and dimensions. The category stands by it self as a conceptual element of a theory while a property is a conceptual aspect or element in a category. Both categories and properties are concepts *indicated by the data* and *not data by itself*. Thick descriptions elucidate the categories. Categorisation, coding, analysis and supplementary data collection are going on in an iterating process until one reach a point of *saturation* – this is the stage in category development where no new information appearss to emerge during coding or, as in most cases (and this case too) there are practical reasons for stopping, such as time and money. Generation of theory is an iterative interaction between data, categorisation and development of concepts and theory. Through is dynamic process the ‘fit’ of the theory improves, it works better to explain the empirical processes.

A successful application of grounded theory will result in concepts or a theoretical framework that explains particular processes in that particular substantive field. These explanations will have their roots in the informants’ voices even though the conceptualisation is the result of a double interpretation (hermeneutics). Firstly, of the material (the informants’ own categories and theories) and secondly, through the sociological concepts and theories either adopted from existing literature or developed by the researcher as part of the research process.

The following discusses core categories: the three typologies of entrepreneurial strategies, their relation to innovation, and trust as a link between innovation and

entrepreneurial strategies. This is grounded theory in progress and an explorative framework for explanation. Further collection of data from marine biotech will strengthen the theory on substantive level. Collecting similar material from other sectors can contribute to extend the theory towards a formal level theory – that is a more general theory about entrepreneur strategies and innovation.

3. Marine biotechnology – a global pattern

To get a better understanding of innovation and the role of the entrepreneur in the marine biotechnology sector it is necessary to describe the dynamics in this sector. Thereafter follows a discussion of marine biotech in the High North and finally a brief discussion of this sector as a cluster. Cluster processes were the aim of the study, but those findings are not focused in this paper apart from as an element in the final discussion of entrepreneurial strategies.

Biotechnology or *life science*, is ”the application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services” (OECD 2009:3). Biotechnology is an enabling technology and the sector spans from medicine and food to chemicals, oil and environmental cleaning. The sector covers a wide range of raw materials, industries, research, and production technologies. The common denominator is the use of living organisms as a basis for further processing. In the High North, the biological material is cold adapted organisms. Cold adapted organisms have different properties than other biological material and represent a huge unexplored biological potential.

In biotechnology research is a key element of the value chain. The research-based part of the industry is located in knowledge communities in close proximity to universities and laboratories (Cooke 2008, Isaksen 2009, Depret & Hamdouch 2010). Industrial development in biotech is long-term processes and it is useful to divide the development of commercial biotech products into three phases. These are: 1)

exploration, that is, basic research to detect, determine and identify a potential ingredient/structure/process that may have commercial potential 2) *examine*, investigate, process and eventually test the effects of the ingredient and 3) commercial *exploitation* of the discovery (Cooke 2004a, 2008). The two first phases in particular, are highly dependent on research. Internationally there is a financial division of labour where publicly funded basic research dominates in the *exploration* phase. In this research-intensive phase focus is on discovery of biological material and potential possible industrial use. In marine biotechnology, marine bioprospecting[6] is an important element of the discovery process. In addition to being located in proximity to scientific communities, the access to public funding of basic research, research infrastructure, tax incentives, regulations, and international patent rights (IPR) are incentives for attracting biotech firms. The *examination* phase takes to a larger extent place under the direction of investor funding and industrial partnerships. A development period may last for 10 to 15 years for drugs that have to pass three laps of testing. Making food based on known technology can at best take 2-3 years. In addition to knowledge facilities, industrial facilities and relations to industrial partners are vital as well as access to long-term public and private funding. Network to public financing, funding agencies and relevant commercial sectors such as health, pharmacy or agro-business is vital for biotechnological enterprises in the development phase. In stage three, the enterprises are commercial companies. Previously, a larger part of the research took place under the auspices of large companies, but is now largely taking place in smaller, (less than 10 employees) specialized research firms selling research to large so-called dedicated biotechnology companies responsible for commercialization (Cooke 2004, 2008).

This division of labour - publicly funded basic research, industry-funded development and commercialization through dedicated companies, characterize the development of

[6] Marine bioprospecting can be described as purposeful and systematic exploration for constituent parts, bioactive compounds or genes in marine organisms. These are charted to identify whether they have an impact/activity which can be exploited for medicines or at the point of intersection between other important industries such as oil and gas, renewable energy, chemical and food industry (Prospects within Biotechnology in the Tromsø region , Prospects, Mabit, Tromsø 2010)

the biotech sector. Other characteristics of the industry are high specialization, global ties, weak local networks and closer integration with the scientific communities than in other industries. Biotech is deeply embedded in public funded science, has high entrance costs and little market driven 'creative destruction' (Cooke 2008). In biotechnology functional and knowledge based proximity are more relevant than geographical proximity as basis for cooperation (Cooke 2008). Studies of the industry show that being located in the same geographical area does not imply increased interaction or spill-over effects (Rosiello 2008:514, 2008 Leibovitz, Wolfe and Gertler 2004:1076). The findings indicate that cluster formation in biotech has dynamics different form clustering in traditional, raw material dependent industries.

4. Marine biotech in Tromsø – an industry interwoven in a global industrial pattern

Our data indicates that the marine biotech industry in Tromsø has much the same sector characteristics as described above and as referred in the research literature about this sector globally (Cooke 2003, 2004, 2008, Leibovitz 2004, 2008, Rosiello 2008).

The common denominator for the Tromsø marine biotech sector is the processing of cold adapted marine organisms. This is an industry still in the embryonic stage; there is a huge undiscovered biological potential. Marine biotech in Tromsø is in the lead nationally and globally in some niches in the research on cold adapted biomaterial. In early 2010 there was 27 marine biotech firms with a total turnover in 2008 of approximately 600 million Norwegian kroner. The firms are highly specialised; most of them are small with below 10 employees and a turnover below 10 millions a year. The exception is one major company that has 2/3 of the sale. The industry employs approximately 300 person-years, included 40 outside Tromsø. In addition, approximately 500 researchers are engaged in biomarine science and there is a well-developed technical research- and support infrastructure. A few of the production and sales companies are located in other parts of the county. The research-intensive companies are located in the university town Tromsø, which has a well-functioning knowledge and laboratory infrastructure open for the industry and academia.

Research-intensive firms are connected to this infrastructure, while those in the examination and exploitation phase make use of it in lesser degree.

The biotek industry is characterised of high risk. There is a long time and a capital demanding research process from the discovery of a marine ingredient and to a commercial product (Spilling 2008, Spilling og Godø 2007). This implies that the industry is dependent on supply of long-time capital. Huge financially strong locomotives are absent as larger firms traditionally have been owned by concerns with head office and ownership located outside the region. Capital accumulation is outside the region, there is shortage of venture capital and private funding for long-term target areas as marine biotechnology is almost lacking. In addition to public financing of research in the exploration phase, access to public venture capital is necessary to co-finance examination and parts of the commercialization process. National and international venture capital is more accessible in pharmacy than in other sectors. Supply of capital is also dependent on strategic decisions on company level, a point that will be further commented below.

The average firm age is 13 years. Risk, inflow of expertise and high entry costs probably contribute to survival of the fittest. Accounts provide a picture of an industry earning money and building up equity, with a predominance of stable rather than fast growing firms. The stability indicates that the businesses have been able to innovate, adapt to change and have had access to equity capital. A major number of the companies have moved from the exploration and examination phases and is over in the exploitation phase. They manufacture and commercialise highly specialised products for a global marked. Considering the long-term development process this is a capital-intensive structure. Small firms in the marine product groups commercialise by themselves. Researchers with entrepreneurial spirit established these companies. Public research funding and equity finance the exploration phase while a combination of equity and public support finance the examination phase. In the exploiting phase, funding is a combination of equity, and public and private venture capital. Important here is that the entrepreneur is the major owner and either the manager or the leader of

the board. The entrepreneur is controlling the company. In firms financed through share capital, to retain control over the company through processes of increase in share capital have been important to the entrepreneur. Firms in the in the pharmacy segment have links to major industrial partners for production and commercialization. These links might be established during the exploration phase; usually the financial links are developed in the examination and exploitation phase. In the exploration phase, the funding pattern is independent of product sector. Marine biotech firms related to the pharmacy sector, appear to accept stronger external control, probably a necessity to access capital. In addition, there is highly possible that a product will be sold out or licensed in the exploitation phase. However it is too early in the development phase for several of the firms to make any particular conclusions about this, apart from the observation that the local pattern of biotech pharmacy are similar to the structural descriptions for the biotech pharmacy sector globally.

The enterprises in Tromsø can be characterised as heterogenic specialists. They process on cold adapted materials but there is a huge variation in in-put materials, in processes and in product. This varies from enzymes and proteins to lipids, from dietary supplements and medicine to feedstock for use in aquaculture. The huge variations have the implications that there are rather few common grounds for local cooperation neither about input material, processes nor on global marked access. There is few vertical and horizontal value chains. With some exceptions, the local links are mainly between firms and the research community. These links for exchanging knowledge contribute to innovation and are gateways to international knowledge communities as well. The most important stimulus for innovation, according to our data, is customer relations. New products, improvements and adaptations are developed in close collaboration with customers and as response on their feed back. Few businesses, apart from small firms in the service industry, can survive only in local markets. Research based and knowledge intensive businesses with high entrance costs and niche products are dependent on global markets to achieve profitable volumes. As a whole the biotech industry in Tromsø have their main markets in Europe, USA and to some extent Asia. This means that the industry has global networks for customer driven innovations.

What are the implications of being a globalized sector in a cluster perspective? According to the world famous cluster guru M. Porter (1998:78) cluster is *"… geographic concentrations of interconnected companies and institutions in a particular field. Clusters encompass an array of linked industries and other entities important to competition"*. Clusters are geographic concentrations of businesses within the same industry with vertical and/or horizontal relationships. A cluster needs to have a so-called *critical mass* of companies that rival, compete and cooperate to become an competitive and innovative cluster according to the theory. Critical mass is an unspecified concept, the geographical span of local ties is not specified and the composition of a cluster is not discussed, whether it is a functional entity or a collection of firms. Despite this fuzziness and the lack of empirical evidence of the coherence between cluster and innovation, cluster has become a widespread recipe for regional economic development (Martin and Sunley 2003, Hendry and Brown 2006, Depret & Hamdouch 2010). Academics criticize Porter's cluster concept for being imprecise and not specifying the concept geographic concentration or critical mass. The relation to non-local ties are not clarified, time and sector dynamics are poorly integrated and the theory does not specify how clusters contribute to increased innovation (Martin and Sunley 2003, Bathelt et al 2004, Leibovitz 2004 , Leibovitz 2008, Simmie 2004, Wolfe and Gertler 2004, Immarino and McCann 2006, Cooke 2009, Depret and Hamdouch 2010, Moral 2009). In particular, the hypothesis about local concentration and local ties as foundation for cluster-based innovation has poor empirical evidence. Studies show that market-leading, innovative companies are part of larger, internationally distributed innovation systems while local connections appears to be of minor importance for innovation (Simmie 2004:1111, Cooke 2008, Hamdouch et al 2008). There is less interaction between businesses located in the same area than predicted in the theory and the importance of over-local relations are far greater than the cluster theory assumes (Maskell 2004, Wolfe and Gertler 2004, Bathelt et al 2004).

A simplified interpretation of the cluster recipe (often done by policy makers) is that a critical mass of successful businesses in one industry is an indication of an innovative and successful cluster. And contrary – too few firms and local connections among them indicates no cluster – and by that no industrial potential. The focus on geographical conditions and local ties contribute to mask the importance of global networks and the complexity of relations new knowledge-based firms are embedded in, discussed by Depret & Hamdouch (2010) as multi scalar networks.

Cluster theory fits better to analyse and function as recipe to redevelop traditional raw material based industry than modern knowledge-based industries. Marine biotech in Tromsø analysed as a cluster of biotech firms, shows an industry with a low cluster potential, below an unspecified critical mass and with few local value chains and little local cooperation and spill-over effects (Karlsen et. al. 2009). Extending the cluster to include research and research infrastructure, the sector is above critical mass and the pattern of local cooperation is denser. Extending the local cluster will not capture the global ties, which are fundamental for the survival of the firms and for their innovative capacity. The global ties together with decisions and strategies on firm level are of analytical importance to understand innovation and dynamics in the sector. One-sided focus on geography and cluster is insufficient to understand innovation and growth in marine biotech as this sector has global clusters as well as local ones. Global clustering needs further exploration, as do the strategies of local firms. These strategies affect the local industrial pattern and cluster formation. Focus in the rest of the paper is on decisions and strategies on firm level as these are the foundations for developing global ties and innovation.

To conclude, cluster dynamics appear not be the most prevalent explanation of industrial pattern in marine biotech. Cluster is a geographical concept that applied to explain social processes such as interaction and innovation. Focus on the local aspects of exchange and flow contributes to make the importance of relational ties invisible. Not geographical proximity but functional and relational proximity is important. Relationships and social chemistry has a greater impact on cooperation than

geographical proximity (Depret & Hamdouch 2010). Belonging to a common community of some kind is the foundation for flow of knowledge in a wide sense. Mutual understanding, which is the foundation for trust, is the basis for developing a common community (Ellingsen 2010). To understand and explain industrial dynamics it is necessary to focus on actions and social practise. The following discussion of entrepreneurial strategies is an example of that.

5. Entrepreneurial strategies, innovation and trust

The grounded theory approach identified the three core categories called entrepreneurial strategies. These categories are *the industrial developer, the steady entrepreneur* and *the dynamic business manager*. The statement here is that these strategies influence innovation and the industrial pattern in the biotech sector in Tromsø. The categories are in an early development phase and need further exploration. Additional data will contribute to refine the categories as will a discussion of the findings in relation to existing theory. A discussion of grounded theory concepts are in relation to existing theory is rare (Ellingsen 2010).[7] From my point of view, such a discussion will be fruitful and contribute to expand our knowledge of the relation between entrepreneurship, innovation and trust.

Introductorily is a discussion of entrepreneurial strategies as a concept thereafter follows a presentation of the strategies and finally a discussion of some of the main element of the strategies in relation to existing theory on the field.

Entrepreneurial strategies and core categories

The term entrepreneurial strategies refer to analytical constructs as ideal types grounded in empirical data. The ideal type strategies are constructed by emphasizing aspects of behaviour and meaning systems identified in the firms. The strategies do not correspond to all of the characteristics but make visible common features of

[7] Such a discussion will by grounded theory purists perhaps be considered as contrary to the basic principles of the method. This is not the case; grounded theory concepts are not a separate universe of knowledge, even though it might have been treated as such (Ellingsen 2010).

entrepreneurial strategies. Are the concept *entrepreneurial* strategies a contradiction? . Entrepreneurs may have strategies, but can long lasting companies be characterised as entrepreneurial? According to Schumpeter's early works (2000:60) is an entrepreneur one who "actually carries out new combinations". Innovation is another word for new combinations, whether this is new enterprises or development of the existing. According to Schumpeter (op.cit) "being an entrepreneur is not a profession and as a rule not a lasting condition". This implies that entrepreneurship is temporarily, a condition or social role that changes if the enterprise is a success and the operations transformed into a routine. When is a company in the routine phase and is it possible to survive in today's business life being a routine processing company? Innovation and renewal is a necessary precondition to survive, not at least in the biotech industry. All the biotech companies in our sample are engaged in development work and aims at continuous improvement and renewal of products. This qualifies for the label entrepreneurial. The famous business guru Peter Drucker asserted that "Innovation is the specific tool of entrepreneurs, the means by which they exploit change as an opportunity for a different business or service" (P Drucker 1985, in Bessant and Tidd 2009:11). In this perspective is a surviving company innovative and entrepreneurial. Others emphasise different aspects of entrepreneurship. Swedberg (2000:11 with reference to Hoselitz 1951) relates the term entrepreneur to "a person who is active, who gets things done". This is perhaps a too wide perspective to be analytically fruitful, but it focuses on action as an entrepreneurial element. In later works also Schumpeter (2000:17) places emphasis on the importance of behaviour of an actor or an organisation. Entrepreneurial *strategies* refer to goal-oriented action initiated and carried out by an actor. In the marine biotech companies, it turned out that, with a few exceptions, the entrepreneur still had major influence either as manager or as leader of the board. His (they were all men) actions, visions, strategies and plans were directing the companies.

Entrepreneurial orientations (EO) is another concept for "characterising and distinguishing key entrepreneurial processes" and "refers to processes, practises and decision-making activities that lead to new entry" (Lumpkin and Dess 1996:136).

What is a *new entry* - a new enterprise, a new product, process or a new organisation? The orientations aim at explaining entrepreneurial behaviour and "involves the intentions and actions of key players" (op.cit). Intentions are analogous to business level strategy and the term key players comprise individuals and or firms playing an entrepreneurial role. EO has five dimensions describing attitudes that guide practises and decision-making (ibid). These dimensions are *autonomy, innovativeness, risk taking, proactiveness* and *competitive aggressiveness*. All or some of the dimensions may be present in the new venture, the relationship between EO and performance is context specific and the dimension may vary independently of each other (Lumpkin and Dess 1996:137).

The entrepreneurial strategies (ES) have much in common with EO's, both comprise intentions and actions. There are differences between the two. In ES all the three defining elements *growth, knowledge* and *trust* and their two sub categories are present. The configurations of these elements vary among the firms and create different innovation paths. Further, the ES are not particularly related to new entry, but may as well be applied to analyse innovation paths in mature companies. The strategies indicate possibilities for maintaining entrepreneurship and innovation Lastly, the ES can be extended by new categories and subcategories to give further knowledge about elements influencing innovation paths.

On the basis of the discussion above I maintain the concept entrepreneurial strategy as a core category describing practises and guidelines for action and how these affect the innovation path in a particular company.

The Empirical findings: Entrepreneurial strategies

The three entrepreneur strategies or categories are *the industrial developer, the steady entrepreneur* and *the dynamic entrepreneur*. Strategies, visions and activities influence on the business. In small business firms, which are our data, the entrepreneur has usually an influential role and marks the company. ES represent an analytical transformation of the informants, mainly entrepreneurs, perspectives on business and

attitudes towards innovation. Business perspectives affect innovation, attitudes to knowledge-sharing, risk taking, cooperation, ambitions of growth and the return on investment. The various companies in our study have different configurations of the strategic elements. Taken together the categorisation of these elements indicated three different patterns of trust and attitudes towards growth and knowledge.

Data indicated that perspective on growth was one strategic element. The informants expressed explicit their perspectives on growth and future development of the firm. The category *growth* is divided into two subcategories, perspectives on *development* and attitudes towards *control.* Development refers to strategies and time for growth and readjustment of the company, while control is about ownership, financial structure, partners, and management. The configuration of these elements affects the future development of several parts of the firm.

Information about research and development work, competence profile in the firm and prevalent development work is basis for construction of the *knowledge* category. This category has two subcategories; *sharing of knowledge* and *mode* o*f knowledge.* Knowledge and biological material is the raw material in marine biotech firms. The attitude towards sharing this knowledge is relevant for access to other communities of knowledge such as customers, competitors or R& D organisations. Access to other communities of knowledge is a prerequisite for innovation. Form of knowledge refers to the prevalent kind of knowledge-input in production and innovation. The configuration of experience based, engineering- and scientific knowledge is important input in the innovation process. Jensen et. al (2007) discuss two ideal models for learning and innovation, the Science, Technology and Innovation (STI) mode and the Doing, Using and Interacting (DUI) mode. STI is based on production and use of codified, scientific and technical knowledge and DUI mode is based on experience and elements of tacit knowledge. STI is research based, located in R&D departments or organisations and knowledge is transmitted in the global scientific community. The experience based DUI knowledge develops mainly as a response on practical challenges and the knowledge flow in the value chain, in particular between customer

and producer. The two modes co-exists, but not necessarily in harmony. Jensen et. al (ibid) concludes that mixing the modes of knowledge stimulates innovation. The STI and DUI modes correspond well with our findings. Data indicates that our in-between category, engineering, have elements from STI and Dui modes, and supplement these.

Trust is an analytical category constructed as a combination of attitudes towards risk and cooperation and the informants' description of interaction. Starting a new enterprise is risky, and the entrepreneur has to have a general trust that the new enterprise will survive. Entrepreneurs are expected to take risk (Lumpkin and Dess 1996) and the willingness to take risks varies among entrepreneurs (utdypes). Trust is first and foremost a social quality, established and maintained through social interaction. To trust implies to belief that the other part will act in a predictable way, that the other will make efforts fulfil ones expectations. This presupposes a mutual understanding of the social situation. The participants in the interaction have to confirm the mutual understanding. A confirmation of mutual understanding is a platform for the leap of faith, that is to trust. The foundation of mutual understanding can be divided into three analytical categories: *Precontractual, relational* and *structural* (Ellingsen 2010). Norms and taken for granted social codes are the *precontractual* bases of trust. We acquire these codes through socialisation into a community. To be accepted i.e. trusted as a competent member of a community implies to internalise the common social codes. The threats of social rejection contribute to secure fulfilment of expectations. Social interaction is the basis for *relational* trust. Interaction implies a possibility to build new trust relations, to develop mutual understanding through step-by-step fulfilment and confirmation of expectations. Social interaction contributes to maintain, rebuild or break trust. Laws, contracts, rules and regulations represent *structural* bases for trust. Structural bases clarify expectations, rights, and obligations and violation result in sanctions. Legitimate sanctions contribute to secure fulfilment of expectations. Entrepreneurship implies new entry and new actions. The entrepreneur has to obtain trust from the marked, partners, financial institutions, knowledge communities and other relevant

actors. Together with risk attitude, the entrepreneurs' ability to build trust, to trust and to cooperate influences the firms potential for innovation and growth.

What characterises the entrepreneurial strategies in Tromsø marine biotech companies and how is the local industrial pattern?

The industrial developer

The industrial developer is rooted in the region, the enterprise has local owners and local/regional development is one of the development aims. *"We will contribute to develop this region"* as one informant said. Industrial developers are innovative enterprises with capital, industrial traditions and ability to adapt to industrial transformations. The industrial developer is visionary, has equity and willingness to pursue innovations. Focus is on long term-growth and long-term industrial development in the region. Local control is and explicit strategy and local financial partners are accepted. These entrepreneurs has financial strength through equity, they can go for organic growth and not be quoted on the stock exchange. Industrial developers are oriented towards the market and adapts step-by-step to market changes. The entrepreneur work close to the customers and responding to customer needs is one drive for innovation in addition to internal research. Innovation is motivated of satisfying customer needs and of further development of the company. The production of knowledge is pragmatic, based on practise and experience. Engineer knowledge is combined with research based knowledge developed either in collaboration with research companies or in internal research departments, depending on the firms actual need for knowledge. The transition from being a company in the exploration phase to the examination or exploitation phase may imply a shift from research to engineering based knowledge. The industrial developer has a pragmatic attitude towards openness. This implies that knowledge can be shared with others if necessary to strengthen the enterprise and to innovate, and the entrepreneur goes for cooperation if this benefits the firm. The industrial developer is a moderate risk-taker and possible long-term benefits for the company are weighted against possible risk. This indicates a medium trust attitude and a pragmatic innovation strategy

The steady entrepreneur

The steady entrepreneur aims at stability and control of product and enterprise. He has been/is strongly involved the enterprise, has developed the product and will owe the business by him self. The steady entrepreneur have weak ambitions of growth. Focus is on the product. Slow growth through refining and adapting the product to the market is the typical attitude towards growth. Some of these firms are typical livelihood enterprises; as one informant explained: *'growth has more costs than benefits.'* Several of the informants later categorised as steady entrepreneurs expressed this attitude explicit. Steady enterprises had a maintenance perspective on knowledge. The aim of knowledge development is to secure market adaption; the aim for new entrances was low. Experience based and engineering knowledge was prevalent. Scientific knowledge could have been applied the initial knowledgebase and in these cases, necessary research to maintain market position was undertaken. Steady entrepreneurs were unwilling to share knowledge; it may represent a competitive threat. They are risk aversive and growth is organic. Maintenance of the existing, security and control are prevalent attitudes. As consequence of these attitudes, external cooperation and innovation is on a minimum. The steady developer can be characterised as a low trust and a minimum innovation strategy.

The dynamic entrepreneur

The dynamic entrepreneur has founded a modern knowledge based company, he takes risks and pursues growth and development. This entrepreneur has ambitions of internationalisation and aims at attracting external shareholders. He is willing to share knowledge, has an active, inviting and cooperative attitude and invites to local cooperation and international partnerships.. As one informant said: "*one has to share to get"*. Prevailing knowledge is a combination of research-based knowledge developed in internal research department and in collaboration with external researchers. Systematic focus on innovation, value creation and customer benefit is a hallmark of dynamic entrepreneurs. Innovation is research driven and considered as continuous processes and a prerequisite to consolidate and grow. Dynamic

entrepreneurs are open towards the market and incorporate market signals in innovation and development: *"it is a manifestation of our led-by-innovation strategy to create true customer value."*[8] The dynamic entrepreneur has the strongest impetus for innovation of the three entrepreneur types. The largest firms in the marine biotech cluster are founded by dynamic entrepreneurs who had explicit strategies and goals for growth and takeovers from day one. These enterprises grow organic and through acquisition. They have stock owners and financial investors in their boards and cooperates with global partners. Dynamic entrepreneurs are characterised of high trust and dynamic innovation strategies.

How static are the entrepreneurial strategies? We do not have longitudinal data, but if we take into consideration the age of the companies and their growth, it seems that the strategies of the individual entrepreneur are quite firm. Steady entrepreneurs have a rather stable turnover; the industrial developers may have a fluctuation in their development while the dynamic entrepreneur has growth. In this case, data indicates that a high trust attitude is one of the factors that stimulate innovation and growth as active openness towards collaboration and partnerships function as an impetus to innovation. Moreover, low trust and high control with a restrictive attitude towards cooperation, seem to characterise entrepreneur with a minimum level of innovation.

Why this focus on trust? Trust is a prerequisite for taking risk and for collaboration – two important elements for being innovative. Innovation is a social process based on interaction and sharing of knowledge – processes dependent on trust. Innovation processes require openness and cooperation - this is anchored in trust. Confidence builds a bridge over risk and between present and future. In addition, innovation and development are dynamic, long-term and risky processes. New products, processes, modes of action and interaction patterns take time to establish and it takes time for the results of innovations manifest themselves. It is necessary to build trust between people within the organisation, between organization and environment and to current

[8] Quoted from an interview of the manager of one on the dynamic entrepreneurial companies, in Nutraceutical Business and Technology, May/June 2010

and potential customers. Trust from financial institutions, investors, research and development units and public support system are necessary to survive.

So far, the data material is not large or strong enough to generalise about the relation between trust and innovation. Further research is necessary to explore whether the findings from this case is typical for marine biotechnology or they indicate a general pattern. If the trust-effects indicated here express a general pattern, one should perhaps explore further whether it possible to take any actions to increase trust in low trust enterprises as an element in innovation stimulating policy. But if trust is considered as an individual quality attached to the entrepreneur, is it thereby a quality outside the realm of social science and the public support system? Is it possible (or right) to stimulate enterprises with a low trust strategy to act in a collaborative and open manner to stimulate innovation? These questions are related to the borderland of innovation policy.

On the next page, there is a figure summarising the entrepreneurial strategies.

Entrepre-neurial strategies	Growth		Knowledge		Trust		Innovation
	Perspectives on development	**Attitudes towards control**	**Sharing of knowledge**	**Prevalent form of knowledge**	**Risk attitude**	**Collaboration**	
Industrial developer	Long-term regional development, visionary, adaption to new conditions, organic growth and creation of local value, acquisition?	Local ownership, has equity, not on the stock exchange, local partners	Pragmatic, sharing if necessary	Practise and engineer based, supplied with research if necessary	Moderate	Pragmatic, collaborate if necessary to develop, Openness towards environment	Moderate
Stable entrepreneur	Stability, security, livelihood-enterprise, slow and organic growth in production	Control, not on the stock exchange, careful with partners	Do not share, fear of competition and loss of control	Practice based, founded on and supplied with research and scientific knowledge	Risk aversion	Reserved, collaborate if strategic, closed	A necessary minimum
Dynamic entrepreneur	Create value, ambitious growth financially and in production, acquisition and organic growth	Listed on the stock exchange, financial partners, patents	Share knowledge to increase value	Based on science and leading research, experience and engineering if necessary	Risk willing	Active and open, collaborate to increase value	High, continuing a precondition for growth

6. Concluding analyse and further research

To round off, entrepreneurial strategies represent different ways of exploiting opportunities; of exploiting and adapting to markets, collaboration, knowledge, financial opportunities and regional conditions for development. Realisation of entrepreneurial strategies moulds regional industrial development. Industrial patterns are a mix of entrepreneurial strategies, regional policy, global industrial trends and global policy trends. A macro- and structure approach to the study of regional industrial patters makes it difficult catch sight of the impact of actors on the moulding of industrial patterns.

To day the pattern in the marine biotech industry in Tromsø ca be characterised as a mix of entrepreneurial strategies, perhaps with a small majority of steady entrepreneurs. An industrial pattern is not static, it may change through entrances of new entrepreneurs, of development and maturing in the sector and shifts in strategy. In the 1980ties and 1990ties, the pattern consisted mainly of steady entrepreneurs; these are the surviving companies. Predominance of steady entrepreneurs resulted in an industrial pattern characterised of slow growth rate and little focus on cooperation and sharing of knowledge. This was probably not an inviting culture towards dynamic entrepreneurs. The rise of dynamic entrepreneurs gradually transforms this structure, they contribute to legitimize growth ambitions and increase the sector turnover.

In a historical perspective, Tromsø has weak industrial traditions and the whole region is based on small-scale economy. This implies a lack of industrial and financial "locomotives" and there is limited private venture capital. This structure (and culture!) facilitates risk aversion and slow, organic growth – typical for a low trust and steady entrepreneurial strategy. From the late 1970ties and onwards Tromsø has become a pool of knowledge- and labour with formal competence, and there is a well-developed research infrastructure. During the last 10-15 yeas, there has emerged a national innovation policy focusing on knowledge intensive industry followed by access to research funding and public venture capital. These initiatives facilitate growth

ambitions, innovation and risk taking – that is high trust and dynamic entrepreneurial strategies as well as industrial development strategies.

As pointed to above, our data are from a particular substantial field, which is not sufficient for making strong generalisations. Nevertheless, one may propose some hypothesis for further research. It is likely that the pattern of entrepreneurial strategies varies in different industrial sectors and regions, and the mix of strategies will influence regional growth and development. Dynamic regions will probably have a substantial proportion of dynamic entrepreneurs. Is regional development policy and framework an important condition for shaping regional development processes? How does regional innovation policy influence on various industrial patterns? Are to-days policy for regional development and innovation best fitted for industrial developers, steady entrepreneurs or dynamic entrepreneurs? How does regional context influence the regional industrial pattern? These questions have to be explored with a combination of micro and macro approach. Better knowledge of actual industrial patterns and processes will contribute to the development of a more precise and goal-oriented regional policy.

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