Mari Nilsen, Frank Halhjem and Thorvald Gran

Innovationsystem at micro level: From public medical research to marketable production. The creation of the NorDiag Corporation

DAO, UiB, Bergen, Norway August 2006

Abstract

This research proposal paper reflects on the characteristics of innovation systems conducive to friendly and synergetic relations between public authorities, universities and corporations exploiting instrumentation developed in basic research in universities. It tries to develop a fruitful problem formulation through preliminary empirical information on one case, the formation of the commercial company NorDiag from basic and methodological knowledge developed in a medical research institute at the Haukeland Hospital in Bergen, Norway and the mediation of that formation through a local-regional innovation system in Bergen, at present with a non-profit commercial company, BTO as a key mediator. The paper suggests an analysis from three angles: a theory of public sector bureaucracy and the tension between a focus on rules and an interest in specific consequences of action in such bureaucracies, Hirschman's theory of loyalty, voice and exit as strategies of action in organisations and politics and thirdly, Chris Freeman's theory of non-standardised networks as a condition for efficient public support of innovative firms/organisations.

How was the mediation between university and market organised over time in the Bergen area in the case of NorDiag, a firm selling cancer diagnostic technology? What effects did the mediation process have in the knowledge producing university hospital research institute, on the learning process in the Technology Transfer Office (TTO) and on the entrepreneurial organisation of NorDiag? How and to what degree did Government innovation policy influence and infiltrate into the local innovation system that supported the NorDiag process?

NorDiag, or the Norwegian Centre for Gastro-Intestinal Cancer Diagnosis, became a registered company in 1999. Its product is a method for human cancer diagnosis, called Genefec. It is a method for cancer diagnosis based in analysis of excrement. The knowledge and the technology was developed in the university hospital Centre for Genetics and Molecular Medicine (here called GM), at Haukeland Hospital in Bergen. A number of national and regional entrepreneurs (Slagstad 1998) were in the 1990s engaged in developing the connection between university research and industrial-economic development in Norway

– and in Bergen. Our task here is to contribute to the description and analysis of the innovation system that was active and powerful in the development of the diagnostic idea, in the mediation between the university and markets for diagnostic products and in the formation and later management of NorDiag. NorDiag was registered at the stock exchange in late 2005. The company was valued then valued at 230 million NOK (Norwegian Kroner, 1 dollar, 6,5 kroner).

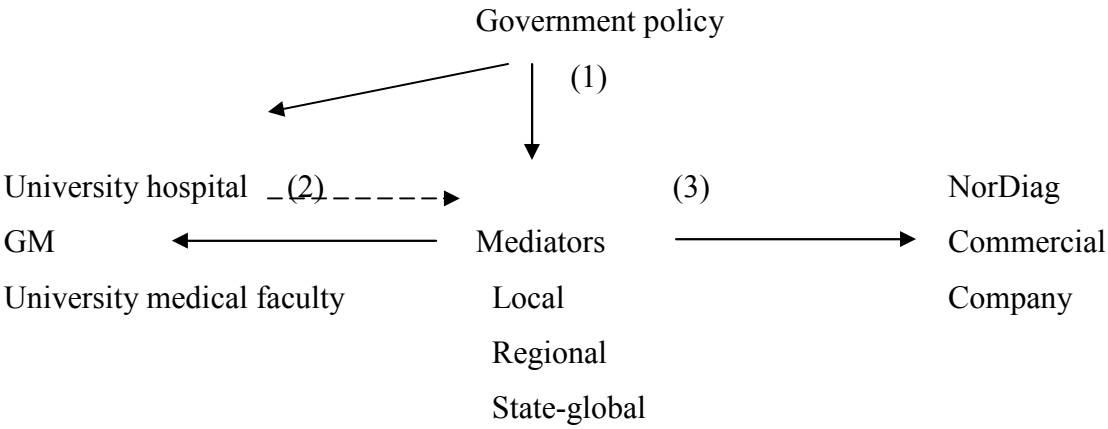
We are interested in three connected processes between three nodes. First the research process at GM, and the relation between basic and applied research there in the development of Genefec; second the process of transforming the knowledge produced at GM into a viable company in the market for diagnostic technology and thirdly the organisation of the mediation, that is the conscious, strategic organisation and the evolutionary development of the mediation between university and market through the TTOs and the learning process there. It is this total process minus the specific innovations in each node we call an innovation system at micro-level.

At the macro level it is probably correct to say that the connection between knowledge production in the (Oslo) university in Norway and industrialisation has been of high importance at the evolutionary level, but an indirect relation. The industrialisation and technology development entrepreneurs and system strategist were not located in the University. The university was important in many processes, in the formation of a national identity; it was a school for new secular professionals, but primarily professionals recruited into the new Norwegian state (Norway became an independent state in 1814). However, (some of) these professionals left the University and became entrepreneurs in the industrialisation process form from the 1840s and forward. From the 1860s new public technical directorates were created to manage the development of infrastructure for the new industrial economy. However, the (Oslo) university resisted first the incorporation of natural sciences and later the entry into applied research. New academic institutions emerged: The agricultural college at Ås (1900), the technical university in Trondheim and the trade and management college in Bergen in the early 20th century. The historical and biological museum in Bergen was an important research centre on the west coast from the 1860s. First in 1948 did it expand into a new (Bergen) University. This evolutionary specialisation process is important, because it indicates a division of labour: the universities were engaged in basic research, in connecting Norway into the global disciplinary knowledge production, while knowledge institutions related to the emerging sectors of the new industrial economy were more engaged in applied research (agriculture, trade and industry).

In medical research in Bergen GM straddles the basic-applied research divide or the divide between laboratory and clinical work. A section of the medical faculty at the University works primarily with clinical data, with new diagnostic methods and improved treatment. The section evaluates the value of new medicines and treatments. According to one of its professors (Apold), the knowledge production of the section has limited relevance for commercial exploitation. Then there is the centre, which is financed primarily by the hospital, much larger than the section and engaged in more basic research that might well be of interest for commercial exploitation. The close cooperation between the two units of the GM is important. As Helse Sør, Bjørn Eriksten argues: Cooperation between clinical and laboratory research is important for the testing of the relevance of laboratory findings and to bring experience from the clinics back into the laboratory (Helse Sør 18.05.04).

We are interested in (1) How Government innovation policy has created a national and regional set of institutions engaged in the support of university-market relations. (2) How does the new demand for and interest in commercialisation of knowledge produced in public institutions affect knowledge production there and what kind of knowledge - produced in our case in GM - becomes a starting point for commercialisation. (3) How is the commercialisation process from university to market organised and how is it mediated strategically.

Figure 1. Field of study. Nodes in the system



To be able to analyse the effect of the strategic mediation, we would need analyses of the interaction between university and industry over time. Only that way can we say something about the effect of the strategic interventions in the support of commercial enterprises. Did the strategic interventions produce change that was unlikely from the evolutionary point of view? Only that way can we evaluate the effect, whether it was constructive on commercialisation or

destructive, in the sense that the strategic intervention ruined existing productive innovation networks. We do as of now not have that historical analysis of commercialisation of basic knowledge in the medical genetic field. Our investigation is therefore a first description of the strategically mediating system, or the innovation system at the micro level.

An innovation system is a network of organisations-persons engaged in the support of innovations, innovations seen as the breaking out of routines and establishing new ones. An innovation system is a set of organisations, engaged consciously, strategically in such support or engaged as a by-product of other activity or contingencies over time. In our case we are interested in the system, the network that supported a number of connected innovations: developing Genefec, engagement of an entrepreneur in GM working there more or less consciously to commercialise Genefec, the entrepreneur's exit as a step in the commercialisation process, establishing patents for Genefec and the actual formation of NorDiag. This was a process over some 10 years. We assume that over those years there was a changing network of organisations-persons connected with the mentioned innovations. Our task is to describe that changing network and to evaluate its competence as an innovation system, that is also to attempt to draw lessons concerning the more general definition of network characteristics conducive to the mentioned, micro-level innovations from Genefec as idea to Genefec as saleable commercial product.

With the mentioned data limitations, our approach is to study the main strategic choices that the actual innovators-entrepreneurs made in the process from idea to company. These choices, we assume are both responses to inputs from the innovation system and independent selective impulses into the innovation system. The actual innovators are not properly defined yet, but we assume they are people in the GM centre, the entrepreneur we have identified and the top managers of NorDiag. Actors in the innovation system are the management of GM, perhaps all the way up to the University Rector and Director, the medical and company personnel surrounding GM interested in the Genefec product and process, the public patent office, in Oslo and Bergen, the TTO at UiB and its supporters and those critical of its activity in and outside the UiB and representatives of different commercial banks and companies, interest organisations and public authorities that in some way make decisions on the Genefec-NorDiag process. What competence did the innovation system have? How important was strategic actions in the innovation system for the progress of the Genefec-NorDiag process? What strengths and weaknesses can we suggest that the innovation system had?

Obligations are the materials of rational action

We want to describe and analyse the innovation system from dataon strategic and tactical decisions of central organisations-persons over time in the Genefec-NorDiag process. We want to develop those descriptions and analyses making some Searlean assumptions as first principles in the study. They are 1. that human consciousness incorporates the ability to make status assignments, that is to assign functions to persons and things that have no relation to physical traits of those persons and/or things. 2. that human consciousness incorporates rationality, that is the intention to implement chosen goals with efficient means. And 3. that the main materials for rational action are the webs of obligations that a person is located in. (Searle 1995, 2001).

These assumptions suggest that peoples' rational actions are never determined by rules or other structures in society or in specific organisations. That follows from the idea that a conscious person's location in multiple obligations makes for choices in the empty spaces between those different obligations. If a person follows a rule, it is the person that makes a choice among several obligations to follow the rule. The person is in this sense a free person and therefore a responsible person. Decisions in such settings are in principle innovative, in the sense that they are always original, in the sense that there is not a rule system that in some way makes the decision for the person. Even the most routine of actions is a chosen action. The person is therefore always to some degree responsible for his/her actions. These assumptions suggest that it is the network or web of obligations and the chosen obligations to make good on in each decision setting that should be the prime material gathered on persons and organisations engaged in the support of the Genefec-NorDiag process.

Jacobsen and Eckhoff (1960) suggested that there were two types of primary obligations among persons working in organisations of high importance for the organisations ability to adjust to a changing environment and to independently develop new, more goal-efficient methods of work. Those obligations were rule-orientations and consequence-orientations. Rule-orientation meant a primary focus on classifying problems and finding the established rules or procedures for solving them. Consequence-orientation meant defining how the world should change to solve a problem and to engage knowledge and politics to implement the change. These obligations affected organisation strategies. Rule-orientation meant looking backwards in time for how similar problems were solved earlier. Consequence-orientation meant looking forward to actual consequences of organised actions and using different types of knowledge to develop programmes for actually changing the world. Rule-orientation meant a closed relation to the environment. Consequence-orientation meant an

open, investigative relation to the environment. The orientations suggest the kind of criticism that in each case would be effective. Rule-orientations make for system conservative organisations. Consequence-orientations make planning and innovation more likely characteristics of the organisation..

Innovation systems, the network hypothesis

Moving from organisations to an innovation system, it is not as obvious that consequence orientations in the system will guarantee the most efficient functioning of it. Idealised wanted consequences of an innovation system, for example the development of knowledge and transformation of that knowledge to commercial companies, may as strategy hamper the functioning of the system. Focus on wanted consequences may reduce interest in the refinement of an organisation's knowledge and technology base. Focus on certain consequences, for example focus of an innovation system on diagnostic methods, may downplay foci on other objectives and reduce the organisational competence variation in the system. Stimulated by Chris Freeman 1995, we might formulate the network hypothesis. An innovation system functions best when nodes in the system develop their idiosyncratic activity to highest possible quality. Standardisation in an innovation system, either in the form of specific objective-foci for the system or standardised knowledge bases for decision-making threatens the functionality of an innovation system. It is the variation in competence in the system, the autonomy of each of the nodes in the system and the flexibility in the system to mobilize objective-relevant competence that determines the quality, the functionality of the innovation system.

Closed and open mediation systems

Each of the nodes in the system consists of certain actors which in turn are characterized by both standard regulations with expressed rules and goals, and a certain amount of turnover. What we suggest is that these expressed rules and goals are not necessarily consistent with the functionality of the innovation system. Based on an article on the subject of organizing industrial liaison offices (Evans et al. 1999) we are able to divide the organization or mediation of the commercialization prosess in two directions which we label the closed and the open models If the mediation effort is focused internally, the mediating institution is closed, trying to mediate the whole process. An example of this type of organizing is when expertise from the university is hired out to industry. In this way the expertise is strategically under university control. Theoretically this is a way of organizing which can be found in

countries without a liberal economy. Countries with a liberal economy should then show signs of external focus, with mediating organisations as open systems (Scott 1987). The Nordic countries have liberal economies under social democratic regimes. Open organisations, communicating with both state and market actors should be common. The mediating organisations between universities and markets we might expect to be conducive to multiple forms of support to commercialisation of knowledge and to encourage moving knowledge from universities and into viable commercial firms. Evans et. al. (1999) suggested that mediating organisations in Sweden were as expected. They did not monopolise the mediating function. When a project deserved support, the mediating institution (TT0) would mobilise a cascade of actors in some way willing to assist the project. In Ireland the investigated TTOs were more monopolising and had less success. By comparing successful and failed projects in Bergen we want to contribute to the investigation of this hypothesis. Were successes a product of a cascade of different support activities while failures lacked such multiple supports?

We suggest, with Searle (2001), that obligations are a primary material for determining the contents of decisions and the social orientation of actions. Or, that people usually have desire-independent reasons for acting.

Obligations can be made at macro system level, for example obligations felt towards a political regimes, at mesosystem level, obligations to people in specific regions or people in specific difficulties or at micro-system (individual decision-making and speech-acting and acting) levels. Looking at each node or each of the innovative organisations in our study, GM, the Transfer Offices and NorDiag, it is interesting to study the set of obligations and the hegemonic obligations in each, and how differences in obligations are important when there is interaction between nodes and organisations. How do obligations to profits balance the obligation to knowledge of valid diagnosis in NorDiag? How do obligations to publicly available basic research balance or collide with interest in commercial application of research in the medical centre? And how do hegemonic obligations in the TTOs orient its role as mediator? Reiterated obligations create institutions. Institutions are human power. The power of TTOs can then be measured in the institutionalisation of the TTOs. Where and to what degree do the TTOs muster legitimacy? How does the TTOs hegemonic obligations fit into or conflict with obligations in nodes and participating organisations in the innovation system? Power in the sense of getting A to do what A otherwise would not do, is what we might call externalised power, which in the long run is a costly form of regulation. However, we might need concepts assisting us in understanding in more detail how persons in the innovation system move, choose and act in the open spaces between qualitatively different obligations,

when they are finding out what to do. We suggest that Searle 2001 and Hirschman 1970 might be of value.

Norwegian Government policy on innovation and technology transfer

The Norwegian government has in the last years increased its funds for industry-related research and innovation with approximately 650 million NOK. The total funds for research and innovation will then reach almost 5 billion NOK r. The most important areas of expanded funding are.

- 20% increase in funds for industry related strategic research in the Norwegian Research Council.
- 42% increase in funds to the organisationInnovation Norway. - 102 millionNOKincrease in funds for research and development contracts- 68 millionNOKincrease directed at innovation, internationalization and program development.*(Pressrelease Odin October 2005)*

All six Norwegian universities have established Technology Transfer Offices (TTOs). That has been a response to increased Government funding to innovation and commercialization of knowledge and to a change in Norwegian patent legislation. The Bergen TTO, which is object of our investigation, was privatised in 2004 and changed its name to Bergen Technology Transfer, BTT or BTO. The task of the TTOs is to promote commercializartion of university produced knowledge and assist in establishing new enterprises. The TTOs are funded mainly by The Research Council of Norway through the FORNY programme.

Triple Helix

Triple helix theory connects universities with industry and development policies of public political authorities. It seeks to specify the role of the universities in that triangular relation. The Triple Helix thesis suggests that the university together with public political authorities can play an enhanced role in innovation in industry in increasingly knowledge-based societies (Leydesdorff and Etzkowitz 1997). The new emphasis on knowledge production and technology transfer from research to industry demands more specific and powerful planning of research and education in the universities. Earning money on research has become legitimate and important. Where the old model saw the autonomous university funded by the state, the new situation is described as a triple helix, and interaction between state, university

and industry. From knowledge production publicly available universities now are seen as suppliers of knowledge for innovations, patented ideas and for the organisation of commercial firms. Through the task of commercialising knowledge, access to some university knowledge becomes restricted, but also in one sense more available. If the knowledge does lead to commercial production, at least the products of that production become publicly available (to those who have money to pay for the products). This restriction or enclosure of knowledge might affect those sections and tasks of the university that are not directed at commercialisation. This is the theme of our investigation of GM. Through engagement in commercialisation of knowledge the universities (in part at least) become competitors in commercial markets.

Scientists and the TTOs

The purpose of the TTOs is to be a link between the scientist, the entrepreneur, the authorities and the market. There is general agreement that the transformation of knowledge into technology and the actual application of technology in production are tasks in need of public strategic attention. (Mjoset 1992 in Evans et. al. 1999) There is also agreement that universities should have a strong role in those transformation prosesses (Olsen 2004, Parliament white paper 20 2005 and Fontes 1997 in Evans et. al. 1999). The organisation and role of the TTOs vary strongly across countries (Evans et. al.1999, Cecaroni 2005).

As the new task of transforming knowledge to technology and technology to industrial production is complex, the (small) TTOs need expertise in finance, patent legislation, juridical contracts, subsdial agreements, marketing, business planning, network establishment and building databases. There have been reports from scientists that the TTOs lack much of this competence (Klitkou 2006). Private actors in the process have experienced the TTOs as costly. The Evans et. al. article on the organisation of TTOs in Sweden and Ireland demonstrates that Sweden has a significantly larger percentage of GDP spent on Research &Development. This difference seems to be stable (OECD 2005). Another difference between the two countries is that the TTOs in Sweden generally were larger organisations, each TTO with more autonomy from the state, In Ireland the university has tended to have one industrial liaison officer operating as the sole gatekeeper to academic departments, whereas in Sweden, the ILO is only one of a group of specialists.(Evans et. al. 1999:51). The TTOs in Sweden were engaged in network construction while the TTOs in Ireland were engaged in promoting university expertise in markets. The Swedish model gave the TTOs a more autonomous, proactive role as mediator, with the task of stimulating new knowledge production in the

universities and new entrepreneurs willing to make use of that knowledge in building new commercial activity. The Irish model defined the TTOs more as a marketing institution for commercialisation of university knowledge. In Sweden TTOs operated in close cooperation with the university departments, both research departments and administrative offices. In Ireland TTOs were more often controlled and managed by their host university. The Irish TTOs were perhaps for that reason used by existing large firms to expand their activities. In Sweden there was more autonomy and a larger focus on the creation of new commercial enterprises. Irish TTOs represent marketing institutions for existing industry while Swedish TTOs are agents for new knowledge production and new enterprises. One sign that this is true that Swedish TTOs develop growth programmes and educational courses for entrepreneurs in new and small knowledge and technology-intensive companies (Evans et. al. 1999:5).

However, Evan's (et. al.) research demonstrated what the Swedish and Irish TTOs had in common.

- Marketing the university and the industrial liaison function, both internally within the universityand to other interested partners in markets and civil society.
- Responding to inquiries about university participation in commercial enterprises
- Building information systems such as web pages, databases on client search and expertise and comptence in other universities
- Producing information on commercially relevant postgraduate studies, distance learning, co-operative education, work placements, commercialisation in the EUand international benchmarking *(Evans et. al. 1999 :52)l*

Thus we can suggest that the Irish model is closed and conservative to the existing market-state-university structure while the Swedish model is described (by Evans et. al. 1999) as a more open, autonomous model directed at supporting new knowledge production in the universities and at mobilising and supporting new entrepreneurs.

The area of responsibility can also vary, In sweden marketing of science projects was performed by the department themselves or by the university information department. In Irland it was the responsibility of the TTO officer as an important part of the competition between national universities. In Ireland the TTOs are in a bigger sense connected to larger international companies, while in Sweden as well as in Norway the TTOs are more focused in

establishing new enterprises. We will try to place the NorDiag case in Bergen into this continuum between the open Swedish and closed Irish models. .

Local TTOs and innovation initiatives

The BTO corporation was created 22 December 2004. The TTO was privatised. The direct cause was an alteration in the Norwegian patent legislation. The right to a patent, which previously was accredited to the researcher or producer of the invention alone, was with the new law transferred fully to the university. At the same time commercialisation of knowledge was added to the three other aims of the university (science, teaching and public information) in the University Statute. That change stimulated universities to establish TTOs. BTO is a non- profit company established to promote a commercialisation culture within university departments and in the holding companies, the owners of BTO. BTO's task is to coordinate and manage the commercialization process, register projects, clarify intellectual property rights, and assist in patenting .

BTO (2006) consists of three consultants, a special advisor and three administrative staff. The owners of BTO are Helse Bergen, the management company for health-hospital institutions in the city, with 40 % of the stock, the University of Bergen (UiB) with 40 % and the Institute for Marine Research (located in Bergen) with 20 % of the stock. Forinnova was a predecessor to the TTO and BTO. Forinnova was active in the commercialization of Genefec into NorDiag in the early 2000's. Forinnova was established in 1999 and functioned as the TTO until the establishment of BTO. Forinnova has supported 155 commercialization projects originating in research at the University of Bergen, including research at the Haukland Hospital and in the Institute of Marine Research. In 2004, with the new patent legislation in place, Forinnova merged with the investment company Sarsia. Sarsia is owned by the University of Bergen and local-regional commercial companies. Sarsia has a capital base of approximately 140 million NOK . Sarsia's tasks include both investments and project development. Sarsia has been involved in over 24 new knowledge based enterprises that together employ some 100 persons. One of Sarsias successes to date is the NorDiag project.

After the establishment of BTO, the responsibility for the FORNY programme was transferred to Sarsia. From 2006 that included the management of FORNY's project funds. During 2006 Sarsia has been reorganised to manage seed - and venture funds. A major concern has been to separate the public funding of viable commercialisation projects from the

actual investments into commercial firms, a separation that these data indicate has not been fully implemented.

Research and commercialization at the Haukeland University Hospital

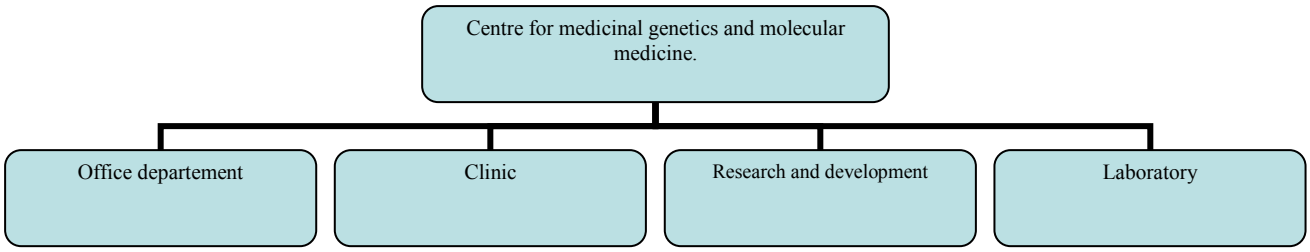
How was the commercialisation of research results at Haukeland Hospital and the exit of researchers from GM with the new technology, experienced in GM and in the Hospital management? Our presentation here is focussed on the questions we want to or should ask. Our database is limited. The conflict of values, the different obligations, the process that led to the exit and the exit's consequences within the Haukeland research institute is what we want to describe.

Haukeland University Hospital is the largest health care institution in the province of Hordaland. It has (in 2006) some 8465 employees and a budget of five billion Norwegian kroner. The Hospital is a university hospital engaged in research and education. the Centre for medicinal genetics and molecular medicine (GM) has both university (section) and hospital (centre) personnel. Research and education are main tasks of the section and the centre.

Centre for medicinal genetics and molecular medicine (GM)

The Centre does research on hereditary genetic diseases. It consists of a clinic for patients, a laboratory for DNA and chromosome analyses. A section of the medical faculty at UiB is organised separately and is mainly responsible for research on clinical materials (may be inaccurate). The Centre does research on hereditary genetic diseases. It consists of a clinic for patients, a laboratory for DNA and chromosome analyses. Important tasks are genetic guidance and the diagnosis of hereditary diseases. The main patient group is pregnant women in need of amniocentesis and patients with a suspicion of hereditary cancer. The Centre has 56 employees financed by the Hospital and 25 financed by the University of Bergen. The Centre is organised in four divisions

Figure 2 GM



(www.helsebergen.no)

NorDiag

The initiative occurred in 1994, when Professor and medical doctor Dagfinn Øgreid and some of his colleagues at the "Centre for medicinal genetics and molecular medicine" (GM) developed a method for an early diagnosis of cancer in the digestive system. With funds from The Norwegian Cancer Association, the Hospital and other private research funds, the scientists-doctors discovered that they with a simple stool sample could register cancer in the colon in an early stage, several years before it ends in a tumour. The method was later named Genefec. In 1995 Unifob, a university connected department for the management of externally financed research, announced a competition for commercialising university produced knowledge. . Professor Øgreid and his team won that competition. The prize (of NOK //?) was used to implement the commercialisation of Genefec.

The patent was regstered in USA and Europe in 1995 on positive test results. NorDiagor the Norwegian Centre for Gastro – intestinal Cancer Diagnostics AS, was established in1999. Sarsia Innovations and Såkorn Invest, two investment firms, invested in NorDiag AS. In 2002 the first product was launched on the norwegian market, with assistance from the Swedish firm Capio AB. That year NorDiag became part of Novel Diagnostics ASA. The merger would give NorDiag valuable knowledge about business management. In 2005 NorDiag AS was released from Novel Diagnostics ASA, and key personnel were transferred to NorDiag. In December 2005 there were 13 employees in NorDiag AS. The firm was listed on the stock exchange with an assumed capital value of 230 million NOK. The manager expected the company to grow quickly to between 30 and50 employees. The founder, professor Dagfinn Øgreid withdrew from the company. He is (in 2006) employed in the

cancer department of the Stavanger University Hospital. In 2006 NorDiag had problems in producing a profit.

Genefec and further research at GM

Genefec is a new and patent - protected technology of cancer- analyses. "The greatest benefit with Genefec™ is its user – friendliness. It is a non – invasive method. It is cost effectiveness, and accurate, even in early stages of cancer." Genefec has been improved upon. It is a second generation product which in 2006 is on the market. The test is done by the patient at home. The materials are sent to a laboratory for analysis. Researchers believe that the method can be developed further, also for diagnostics of other types of cancer, for example, cancer in the pancreas. NorDiag has started a programme for diagnosis of lung cancer. A problem with Genefec is that it finds more results than necessary. NorDiag's greatest challenge is to isolate the indicators better, to make a more specific and accurate test. Genefec was launched in Sweden in 2005 and in Denmark spring 2006.

The conflict of interest between NorDiag and Haukeland University Hospital.

Several of the staff in NorDiag were previously employed by the "Centre for medical genetics and molecular medicine" (GM) at Haukeland University Hospital. How did the exit from GM happen and what effects did the exit have on the GM? From interviews it seems that the exit generated conflict. The hospital did not appreciate losing valuable staff. We will try to interpret the exit as a single – actor design, "in which single individual actors or collectivities that act as single actors, specify designs in an effort to achieve some fairly well – specified objectives" (March and Olsen, 2005:14). The exit group generated conflict. At the time of the exit the University had no leverage on the exit or on profits that might accrue.. The 2003 patent law ensured the university, the institute and the researcher-entrepreneur one third each of the value of the commercialized product.

The effect on GM

The GM is a large medical treatment and research institute, with 81 employees in all. Our impression (so far) is that the hegemonic obligation is towards patients and their struggle against cancer. How strong the obligation is to the medical discipline and the search for a better description and understanding of the sickness cancer we do not know. That obligation can weaken the obligation towards patients, changing them from the prime receiver of the services of the centre to objects of study, where advance in basic knowledge for some

researchers is more important than specific services to struggling patients. The service and the research obligations can have symbiotic relations, work within them serving both specific patients and the basic advance of knowledge about cancer. A third obligation within the centre is the obligation to the Hospital, the obligation to adjust work and organisation of the Centre to the interests and obligations of the Hospital, resource limitations, service deliveries to other departments of the Hospital etc. Our interest is how the obligation to commercialisation of knowledge and technology developed in the centre affects the work culture, other obligations and the organisation of the Centre.

Rosenberg (1994:250) argues that in the natural and medical sciences development of measurement technology is an important aspect of the production of new knowledge. "I will further suggest that the emergence and diffusion of new technologies of instrumentation (as well as new research methodologies) are central and neglected consequences of university basic research."

The specificity of hypotheses is limited by the strength of measurement technology. The more detail measurements produce the more specific hypotheses can be formulated. The measurement technology and instruments can often be commercialised. It is in this sense typical that the NorDiag company's product is Genefec, exactly a technology for better registration of a certain kind of cancer. The obligation to commercialise such technology can be seen as an unobtrusive expansion of the field of activity of a treatment and basic research medical institute. Commercialisation can itself improve the technology and make it available externally, to the benefit of cancer patients. Commercialisation can be an example of Schumpeter's creative destruction (Aghion and Howitt 1992). Marketing a technology developed at the Centre can destruct an established research community. But in its wake the community can fill the emptied space with new personnel, with new ideas that strengthen the research community and opens for new knowledge innovations.

However, the commercialisation interest can be obtrusive. It diverts attention internally from contributing to the common search for improved knowledge, to extracting produced knowledge, technology and personnel from the Centre into external commercial companies. This we call an exit interest. Such an exit formation within the Centre can change internal relations from open exchange of new knowledge to an interest in exploitation, using the Centre to develop knowledge without returning findings to the collective, monopolising that knowledge and thus making it possible to take the knowledge out of the Centre and putting it into for example NorDiag. The same kind of fragmentation of publicly run research centres can follow from the struggle for fame and career advancement of the individual

researchers in the centres. The interest in commercialisation of measurement instruments can affect the patient obligation negatively. Patient needs can be subordinated the interest in technology development. Patients who actually do not need the measurement data are all the same exposed to the measurement instruments. Interests in external commercial activity can divert the exit formation from improving work conditions and efficiency within the Centre. Its interest is building an efficient commercial organisation outside the Centre.

The exit formation, the group working on Genefec with the intention of commercialisation, had (perhaps) a given intention of exit. That is at least partly a destructive intention in relation to the publicly owned research community in the Centre. In Hirschman's terms exit was, in case, not used as a threat to realise other interest within the Centre. Voice was for that reason neither a strategy (making commercialisation of technology a task for the Centre was probably not an option). We would however, expect that the Centre's demand for loyalty from those employed there would bother the group working intentional for external commercialisation of Genefec. The reason would be that the development of the technology was (- most likely -) highly dependent upon the collectively produced knowledge over a long time within the Centre. The commercialisation group was in this sense dependent upon the Centre as a collective research community for the development of the measurement technology that it wanted to monopolise and bring into NorDiag.

Conclusion

The Genefec-NorDiag commercialisation process was a success. We want to investigate to what degree the success was a consequence of a cascade type of networking, or a cascade type of innovation system, or consistent with Evan's (et. al.) description of the Swedish model for successful commercialisation of publicly, university-produced knowledge. We want to look closer at the innovation system (cf. process model Figure 1). What role did the strategic mediator, the liason offices have? What role did the exit formation play within GM during the knowledge production phase? What effect did the exit have on work conditions and problem orientations in GM? How was the exit actually organised? How important was the innovation system and the liaison office for the successful formation of NorDiag? How dependent was NorDiag, at least in its early phases, on willing investors and on publicly organised economic and organisational support? As we accumulate knowledge about the NorDiag process we want to expand the investigation into other cases of both successful and aborted commercialisation processes. We want to investigate more closely the network hypothesis: Is it true, as Chris Freeman has suggested, that effective innovation systems are characterised by

a large degree of autonomy for public institutions, organisations and firms participating in the network. Is it important to avoid standardisation and heavy central management of the network? Is it important that the network allows each participant to develop its specific competence, according to its own self-development, its ideas of methods, its own organisation and goals. Is it important to avoid making the network a neat, rationally organised network with each node doing a job defined centrally, in a central plan or project, and demanding that each node speak the "network language"?

References

Aghion, Philippe and Howitt, Peter 1992 "A model of growth through creative destruction" Econometrica, Vol 60, No. 2. pp323 – 351

Evans, Dylan Jones. Klofsten, Magnus. Andersson, Ewa. Panyda, Dipti (1999). Creating a bridge between university and industry in small european countries: the role of the industrial liason office. *R&D Management* 29. Blackwell Publishers Ltd. Oxford

Freeman, Chris. 1995. The national system of innovation in historical perspective. Cambridge Journal of Economics. 19. 5-24.

Hirschman, Albert, (1970). Exit, Voice and Loyalty. Responses to Decline in Firms, Organizations and States, Harvard Press, 1970

Jacobsen, K. and Eckhoff, T. 1960 Rationality and Responsibility in Administrative and Judicial Decision-making. Munksgaard, Copenhagen .

Klitkou, Antje. Gulbrandsen, Magnus og Eric Iversen (2006). "*Patentering fra norske universiteter, høyskoler og forskningsinstitutter*". NIFU STEP Arbeidsnotat 14/2006.

Leydesdorff, Loet and Henry Etzkowitz (1997). "*Universities and the global knowledge economy, A Triple Helix of University-Industry-Government Relations*" Science, Technology and the International Political Economy Series. Pinter, London.

March, James G. and Olsen, Johan P. 2005, Elaborationg the "New institutionalism" Working paper, Oslo, Arena

Rosenberg, N. (1994). Exploring the black box. Technology, economics and history. Cambridge University Press

Sampat, Bhaven N. Nelson Richard R (1999). "*The Emergence and Standardization of University Technology Transfer Offices: A Case Study of Institutional Change*". Prepared for 1999 Conference of the International Society for the New Institutional Economics (ISNIE). September 16-18, 1999. World Bank, Washington, D.C.

Scott, W.R. (1987). Organisations. Rational, natural and open systems. Prentice Hall International.

Searle. J. (1995) The construction of social reality. The Free Press

Searle. J. (2001). Rationality in Action. MIT Press.

Slagstad, R. (1998). De Nasjonale Strateger. Pax Forlag A/S. Oslo. 1998

About the authors:
Mari Nilsen (mari.nilsen@student.uib.no) and Frank Halhjem (frank.halhjem@student.uib.no) are masters students at DAO
Thorvald Gran, Associate Professor DAO, responsible for the innovation seminar. (thorvald.gran@aorg.uib.no). Recent book manuscripts: Land is not a commodity, Land Reform politics in South Africa and – in Norwegian - Innovasjon i organisasjoner. Mellom kreativitet, social mobilisering og maktutøvelse.