

MONIT

monitoring and implementing horizontal innovation policy



The innovation process of the Norwegian electric car Think – a case study

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WORKING PAPER

MONIT is a collaborative project in the context of OECD to explore national capabilities in innovation policy and governance in the innovation driven economy

For more information, see www.step.no/monit/

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Foreword

The MONIT project was endorsed by the TIP working party in December 2002. Building on the results of the TIP NIS project, its main objective is to generate knowledge on how to improve innovation policy governance and create a more coherent and comprehensive innovation policy. The focus is on how to achieve a more horizontal innovation policy through co-ordination with non-core policy areas, vertical integration and coherence, and new forms of governance and policy making processes. More specifically it studies the foundations for innovation policy governance by highlighting issues such as political leadership, building effective co-ordination mechanisms, socio-political foundations for information exchange and policy learning, cultural factors in policy systems and related sources for coherent policy making.

The MONIT network consists of 13 countries, all devoted to generate knowledge to be shared by the others. The MONIT project is organized in 3 work packages (WP):

- WP1 consists of a broad analysis and assessment of the national policy profiles and challenges, as well as of key governance issues;
- WP2 includes policy case studies in the areas of information society, sustainable development and transport, and regional policy;
- WP3 will synthesize the results from WP1 and WP2 and draw the policy implications.

STEP is in MONIT studying the Norwegian innovation policy system through several inter-linked studies. A main focus is to better understand the underlying logic of the Norwegian system, its roots in terms of cultural traditions and the main priorities coming out of it. Both mapping studies and more detailed studies of parts of the innovation policy system are therefore covered in the project.

Norway is the lead country in this network, while Austria, Finland and Netherlands are co-leads. The Norwegian part of the project is commissioned by the Research Council of Norway (RCN), and funded by this council and the ministries of Science and Education, Trade and Industry and Regional Affairs. The project also consists of a learning arena organized by the users through which results and perspectives generated by MONIT is disseminated and discussed.

Svend Otto Remøe

Project responsible

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1. Introduction

This paper is a part of the WP2 on *sustainable development* study in the MONIT-project. WP2 is to analyse the role of innovation policy in different policy areas. A number of studies are to illustrate how innovation policy is coordinated and how better coordination may be achieved in the different countries that participate in the MONIT project.¹

Sustainable development and environmental policy have often been seen as opposed to an innovation-driven growth policy. Traditionally, the issue has been dealt with through various ‘end-of-pipe’ environmental measures. But environmental policy contains a number of innovation policy options in the area of sustainable development. The term “sustainable development” was introduced by the Brundtland Report in 1987, emphasizing the incorporation of environmental policy in economic and sector policy. As such, the goal was to create win-win-situations for the environment and for society as a whole². This concerns for example how governments design regulation regimes, how these are implemented and communicated vis-à-vis the private sector and how sustainable development is supported by R&D programmes.

This paper is a study of one particular innovation process: the development of the Norwegian electric car Think. The study is based on my post-graduate thesis in political science³ that was a case study of this innovation process. In my thesis, the focus was on which mechanisms respectively support and restrain start-ups in Norway. I found the development of Think interesting because it stood out as a unique start-up in Norway. The country has no traditions for car manufacturing, and the motor industry is dominated by global industrial actors. Norway has in general a low number of technological advanced start-ups compared to other OECD-countries. Besides, the electric car was an interesting product as an environmentally friendly alternative to the traditional car.

The thesis revealed several mechanisms that either supported or restrained the innovation process of Think, for example: the technological competence for developing an electric car in Norway, the entrepreneurial culture, the risk capital, the framework conditions, the “implementation” of innovation policy in the innovation policy institutions and how the specific company-directed innovation policy at Think came into being. However, *this* paper is not about all these mechanisms. Rather, it focuses on policy mechanisms for green innovations in particular.

In the MONIT project, Ruud and Larsen⁴ have studied the policy framework for green innovations. They discuss various initiatives from the Ministry of Environment and from the Ministry of Trade and Industry for promoting green industry and green technological innovations in Norway.

¹ STEP is participating on the WP2 study on sustainable development in Norway together with Program for Research and Documentation for a Sustainable Society (ProSus) at the Centre for Development and the Environment at the University of Oslo. In addition to this paper the study is presented in the ProSus report: Ruud and Larsen (2004): *Coherence of Environmental and Innovation Policy: A green innovation policy in Norway?* and the STEP-working paper Ørstavik (2004): *Governance of evolving systems: Innovation and sectoral policy conflicts in Norwegian aquaculture.*

² WCED 1987

³ Røste 2001: *Næringspolitikk for konkurransedyktige nyetableringer – en casestudie av den elektriske bilen Think fra idé til marked.*

⁴ Ruud and Larsen 2004

The Norwegian electric car Think might be defined as such a green technological innovation. Compared to traditional cars with combustion engines, electric cars are more environmentally friendly alternatives of transport. Electric cars are run on rechargeable batteries that make it possible to drive the vehicle for a certain distance before the batteries must be charged again. Compared to petrol, electricity is an energy source that does not give off any emission when the vehicle is running.

Of course, it might be claimed that the environmental impact varies with how the electricity is produced. In Norway electricity is mainly generated at hydroelectric power plants. Hence, it is a very clean energy source. However, the consumption of electricity has increased, and in periods of high consumption it has been necessary to import electricity from other countries where the production of energy is not as clean. Moreover, full development of watercourses is also harming the environment and the natural biodiversity, and other sources of energy production have been discussed and developed in Norway⁵. Anyway, the energy may be produced – to drive an electric car does not result in any direct harm on the local environment in contrast to the exhaust gases of the traditional cars. In addition, electric cars are quiet with only a buzzing sound compared to the noise of the traditional cars.

It might also be claimed that an electric car is not an innovation. Actually electric cars were produced as early as in 1884⁶. However, electric cars have never been produced as a real alternative to the traditional car, whereas Think was developed in an era where efforts were put into the development of new environmentally friendly means of transport. Think did also represent new green technology as the chassis is in thermoplastics. The chassis is produced of plastic material that is coloured with natural pigments in the moulding process. No lacquering or painting is therefore necessary. The chassis also has the quality that it does not become rusty or easily dented, and any form of antirust treatment, re-spraying and other traditional chassis services that might cause problems of pollution is therefore not needed. In addition, most of the electric car Think is recyclable.

However, the focus here is not on Think as a new green technological product, but on the innovation process leading to this product. The process started with the inventors' idea of an electric car and resulted in (mass-)production. More specifically, the focus here is on the policy mechanisms for green innovation processes; how the policy mechanisms supported and restrained the innovation process of Think as a green innovation.

The paper starts with the short version of the Think-story⁷. Thereafter there will be a discussion of which policy mechanisms supported and restrained this particular innovation process as a green innovation. The paper ends in some reflections on what the innovation process of Think tells about the innovation policy system in Norway and the co-ordination with the policy area of sustainable development.

⁵ Both based on renewable energy sources like for example windmill-technology, and on new methods for energy production like for example gas power plants.

⁶ Østby 1995

⁷ for a full version in Norwegian see Røste 2001

2. The history of Think

2.1 From idea to first prototype

The history of Think started as early as the oil crisis⁸ in 1973-74. At this time, Norway had not yet discovered the possibilities in its own oil resources and the authorities found it necessary to make strict restrictions on private motoring. These restrictions gave Mr. Lars Ringdal the idea of an electric car. An electric car would make it possible with private motoring in Norway in spite of an oil crisis. At this time, the country was more than self-sufficient regarding electric power.

Ringdal was the owner of Bakelittfabrikken AS in Aurskog-Høland⁹ that had made products in thermoplastic materials since the foundation in 1947. Ringdal's idea of an electric car was based on the possibility of using such materials in the chassis of the car. If this proved to be possible, the car would neither become rusty or dented. However, when the oil crisis ended the need and interest for an electric car vanished.

It was not until 15 years later that Lars Ringdal's son, Jan Otto Ringdal¹⁰, found that the green movement in the 1980s had made society ready for the idea of an electric car. One of the green movement's most pronounced themes was the greenhouse effect. Exhaust gas was put forward as a main contributor to the problem. In general, transport was regarded as one of the most central factors related to the environmental problems facing the cities, regarding both the health of the inhabitants and the general degradation of city life.

Ringdal found he needed assistance and financial support to develop his father's idea, and contacted the Norwegian Research Council for Scientific and Industrial research¹¹ (NTNF). At this time, the idea was broadly conceptual thoughts of developing a vehicle fitted for individual transportation in cities. The production technology was central. Ringdal's idea was to develop a totally new technology concept based on a combination of thermoplastics in the chassis and a frame of aluminium. Also, this car was to be constructed as a genuine "electric car", in contrast to the electric cars on the market that were mostly ordinary cars that had been rebuilt by replacing the combustion engines with batteries.

At the same time Ringdal was searching for potential supporters, partners and suppliers. Ringdal wanted to get in touch with Hydro because of their competence in aluminium, and with Statoil because of their competence in plastics. In addition, these companies were interesting because of their distribution systems in the gas stations. Ringdal imagined the gas stations as service stations also for electric cars, for reloading the batteries, hire and sale of electric cars etc. Hydro Automotive Structures got interested in the new technology concept of thermoplastics combined with aluminium, and signed a contract with Ringdal as developer of the frame. Ringdal also made contact with Statoil and the energy- and auto-mechanical company ABB.

⁸ The OPEC-countries demanded that Israel had to withdraw from the Palestinian areas they had occupied, and stop the production of oil for a period of five months. This resulted in sky-high oil-prices in the Europe, USA and Japan.

⁹ Aurskog-Høland is a municipality in a rural area approximately one hour's drive northeast of Oslo.

¹⁰ from here referred to as Ringdal.

¹¹ NTNF (*Norges Teknisk-Naturvitenskapelig Forskningsråd*), now a part of the Research Council of Norway, see the MONIT paper: Remøe and Røste (2004): *Agency level governance – a study of the Research Council of Norway*, for further information and analysis of the changes of the research council structure in Norway.

Ringdal founded the company PIVCO¹² in 1990, which at that time consisted only of Ringdal himself. He got financial support from NTNF and the three companies Hydro, Statoil and ABB to undertake a feasibility study in 1991. Then, in 1992 he developed the first prototype of this electric car: PIV 1¹³. Mainly, this prototype was financed by the Norwegian Government, more concretely NTNF, the Ministry of Transport and the Ministry of Petroleum and Energy. This first prototype was to test whether plastic in the chassis and aluminium in the frame was possible to combine.

2.2 Growing enthusiasm and involvement of new actors

Ringdal's contact person in NTNF was the national co-ordinator for EUREKA, a European joint programme for market related research and development. He requested Ringdal to apply to the programme, and PIVCO got a main role in an EUREKA-project in June 1992 with partners from Switzerland and Austria¹⁴. The Swiss partner had competence on accident research and crash tests, and the Austrian partner on vehicle engineering.

Regarding the financial basis for the development, Ringdal applied for an OFU-contract¹⁵ at *Industrifondet*¹⁶. An OFU-contract is an agreement between a company and a public institution, aimed at developing a product or a process needed by the public institution. Oslo Energi, the local electric producer and distributor in Oslo at that time, was the public institution in this contract¹⁷. *Industrifondet* refused PIVCO's application, but the cabinet minister of the Ministry of Industry set aside the decision and made the contract.

The second prototype was ready for the Olympic Games in Lillehammer in February 1994, where it was driven by three – at that time – dominant Norwegian companies that were supporters of the Olympic Games: Statoil, Posten and Televerket¹⁸. Statoil had been involved in the development of the idea of the electric car from the beginning, and the other two companies had become supporters of PIVCO's electric car during the development of the second prototype. The electric car's debut at the Olympics was a success and led to media events, increased enthusiasm, several new financial supporters and public support from the Norwegian Industrial and Regional Development Fund¹⁹ (SND). Against this background, PIVCO decided to develop the product further.

The third prototype, also referred to as CityBee, was finished by the summer of 1995, and it was produced a total of 120 vehicles. It was not a ready-made product, but mainly developed to gain experience with the production technology and the design and to get feedback on the

¹² acronym for Personal Independent Vehicle COmpany.

¹³ acronym for Personal Independent Vehicle.

¹⁴ the Eidgenössische Hochschule at the University of Zürich and the Austrian car engineering company Steyr-Daimler-Puch Fahrzeugsstechnik.

¹⁵ *Offentlig Forsknings- og utviklingskontrakt*

¹⁶ Industrifondet was one of several public funds that were reorganized into the Norwegian Industrial and Regional Development Fund (SND) in 1993. SND was, together with three other institutions, reorganized into Innovation Norway on the 1st of January 2004.

¹⁷ Oslo Energi was a producer and distributor of electricity in the area of Oslo, and was at that time wholly owned by the City Council of Oslo.

¹⁸ Televerket and Posten were at that time state monopolies, respectively offering national telephone services and national mail services in Norway.

¹⁹ *Statens Nærings- og distriktsutviklingsfond*

market potential of the car. Around 20 CityBees were used in security research, 40 in an environmental transport project in San Francisco²⁰ and 60 were driven in eastern Norway.

Oslo Energi built depots for battery charging in the centre of Oslo, and Statoil had CityBees for hire. Together they did a user survey on this electric car and the system they offered.

Several local politicians in Oslo declared themselves positive to PIVCO's electric car. They said that they would replace the traditional cars used in municipal activities when they got old with electric cars. In the Norwegian Parliament several new framework conditions were passed on order to enhance the use of electric cars in Norway. Examples are the exemption from one-off state tax when buying an electric car²¹, annual owner tax²², road tolls and from parking charge on public grounds.

Based on this growing enthusiasm PIVCO decided to develop the prototype into a vehicle for the commercial market. The financial basis was considered relative solid with the investors that had entered after the Olympics²³, and SND had made a financial arrangement of granted loans, subsidies and a new OFU-contract with the Norwegian Pollution Control Authority (SFT)²⁴ as public participant. SND was also involved in supporting the establishment of the factory at Bjørkelangen in 1996 together with the Municipality of Aurskog-Høland, the County authority of Akershus and some private companies.

PIVCO found they needed more competence on car manufacturing and made a contract with the British car-engineering company Lotus in 1996.

2.3 Trial and error, but the future is bright?

Lotus was involved in the development for two years. Their car-engineering services became a costly affair for PIVCO, and the development process was delayed due to a need for adjustments in the frame. PIVCO therefore came in need of more capital, and tried to make new share issues through the stock trading company DnB Markets in the autumn of 1997 and the winter of 1998. However, no new investors were interested and those involved were unwilling to contribute with more capital. In the end, PIVCO managed to gather some capital from some of the already involved investors and a new loan from SND.

On the 1st of October 1998, after a long and cumbersome development process, a type approved electrical vehicle named Think was introduced at an international exhibition for electric cars in Brussels. Think fascinated both established car manufacturers and electric car enthusiasts. However, the attention did not bring PIVCO new capital, which by this time was

²⁰ The Bay Area Rapid Transit-project organized by the consortium CALSTART, for testing the possibility of creating a system of public transport and zero emissions vehicles in the San Francisco bay are. The project was partly a test of how the act of "Zero emission vehicle" might work out in praxis. This act was a part of a public program in California that implied that a given percent of the cars sold each year should be zero emission vehicles.

²¹ *engangsavgift*

²² *årsavgift*

²³ Lots of big Norwegian companies entered at this stage as financial supporters of Think: the insurance companies Storebrand and Gjenside, the tobacco producer Tiedemanngruppen, the grocery manufacturer Hakon Gruppen and the investment companies Selvaag Invest and Møller Invest. Earlier involved were: Bakelittfabrikken AS, Hydro, Statoil, Oslo Energi, Posten, Televerket and some smaller companies.

²⁴ SFT (*Statens Forurensningstilsyn*) is a directorate under the Ministry of Environment that is to promote sustainable development.

desperately needed. PIVCO was now completely broke, and was enforced to declare the company bankrupt on the 29th of October 1998.

It was hard for Ringdal to accept that this was the end, at a time when Think almost was ready for mass production. He therefore decided to buy the bankruptcy together with some of the management team and employees, and established PIVCO Industrier AS in November 1998. The new company continued the search for new investors.

Already on the 5th of January 1999 it was announced that Ford Motor Company had bought 51 percent of the shares and changed the name of the company to Think Nordic AS. Putting the product into mass production was now economically feasible, and the factory works were opened at Aurskog-Høland on the 12th of November 1999.

Ford bought the rest of the shares in January 2000. However, Ford decided to withdraw from the Think-project in August 2002. The reason they gave was that electric cars had not been the success that Ford had hoped, and other environmentally friendly transport alternatives had been developed, for example the hybrid car. They also sought for more political initiative to enhance the market for electric cars, in Norway and in other countries. After another round with efforts to persuade the politicians to enhance the market for electric cars and to support Think directly, Ford sold the company to the Swiss company KamKorp Microelectronic on the 1st of February 2003. The new owner is now developing a new model of the old Think City model. The Think City model went out of production around Easter in 2002, after 1005 models of this type had been produced. The model is now only available on the used car market.

Figure 1: the innovation process of Think and the actors involved

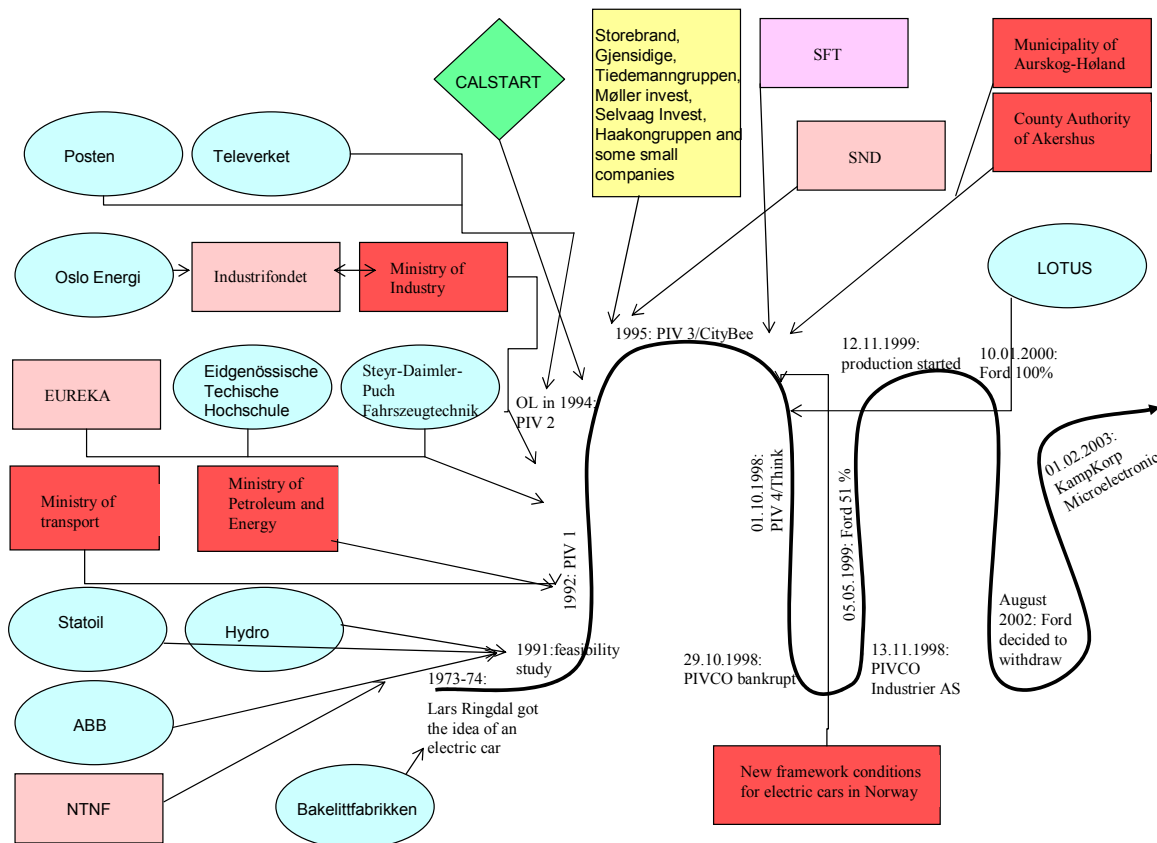


Figure 1 gives a picture of both the innovation cycle of Think and the policy actors, public institutions, partners and supporters that were involved at different times in the process. The figure will be further discussed later in the paper, but is placed here to illustrate the history of Think. The policy actors and public institutions are showed as square boxes, red for the decision-makers, bright red for the innovation policy institutions and pink for other public institutions²⁵. The partners and the companies involved in the process are showed as blue ovals. Mere financial supporters are listed in the yellow box and the consortium CALSTART as a green parallelogram.

3. Policy mechanisms for green innovations

The history of Think shows that both issues of innovation policy and environmental policy had a role in this innovation process. This section will discuss how these “two” policy areas interacted, by going more deeply into the policy mechanisms that supported and restrained the innovation process of Think.

The discussion will focus both on the implementation of existing innovation policy (section 3.1) and on how the specific company-directed innovation policy decisions at Think came into being (section 3.2).

The existing innovation policy is the established framework conditions, laws and regulations, the national budget, political objectives and priority programs that have an impact on the development of new technology, new production processes, services and methods in existing and new business. Such existing innovation policy is “the outcome of conscious policy decisions and investment programs”²⁶. In Norway several institutions have the responsibility for carrying out this innovation policy, for example the Research Council of Norway, Innovation Norway²⁷, the Advisory Institute in Northern Norway etc²⁸. These institutions are to help Norwegian entrepreneurs and companies to start up new business and to develop new products, services, production processes and methods in existing business.

Specific company-directed innovation policy is policy that is not already established in frameworks, laws and regulations, but rather policy that comes into being to support one particular innovation process. However, one company-directed decision alone can not be regarded as policy – it is only when grouped together such decisions have the character of being policy. Nevertheless, the decisions that are directed at one particular company may also have effects on the industry, the market, the geographical region where the company is localised etc. Thus, specific company-directed innovation policy might highlight shortcomings in the existing innovation policy and hence be the starting point for the creation of new innovation policy²⁹. In my thesis, specific company-directed innovation policy is the decisions politicians made to support the innovation process of Think.

²⁵ only SFT

²⁶ Smith 1997:88

²⁷ On the 1st of January 2004 the new state owned company Innovation Norway replaced the four organisations: the Norwegian Industrial and Regional Development Fund (SND), the Norwegian Tourist Board, the Norwegian Trade Council and the Government Consultative Office for Inventors.

²⁸ For an overview of the innovation policy institutions see the working report to the MONIT-project: Remøe, Røste and Aanstad 2004

²⁹ see Kjellberg and Reitan 1995:24 for a policy-typology.

3.1 The innovation policy institutions and the innovation process of Think

3.1.1 The innovation policy institutions supporting Think

The innovation process of Think received support from several of the Norwegian innovation policy institutions. NTNF, Industrifondet and SND helped Ringdal with counselling, to get in touch with potential partners, with public funding etc. But did the implementation of the existing policy in these innovation policy institutions support the innovation process of Think as a green innovation?

In the case of Think the implementation of existing innovation policy was handed over to the institutions' own judgement. Moreover, the judgement was passed on to one or a few public officials in the institutions. Thus, whether the innovation process of Think received support was decided by how these few public officials presented the innovation project for their superiors, steering groups and the directors of the institutions. Their judgements were leading in the treatment process. Furthermore, the decisions of the officials to support, or not to support, the innovation process of Think seem to have been based on their own opinion of the idea and its potential for becoming a profitable product.

Ringdal contacted NTNF in 1989. During several meetings with a specific official his idea was examined. The official spoke of himself as the only one, except his direct superior, that was interested in supporting Ringdal's idea. Others in NTNF found the idea interesting, but were sceptical towards producing cars in Norway. The managing director of NTNF was also sceptical, but the official and his superior managed to persuade him to give them time and capital to help Ringdal to develop the idea.

Industrifondet refused PIVCO's application for an OFU-contract in 1992. The official that handled the application found the idea interesting, but considered it to be a too high-risk project. However, Think did receive this OFU-contract because the Ministry of Industry reversed the refusal. Here, it is important to keep in mind that what happened was not a "standard" implementation process as defined in this paper. Industrifondet refused the application, but the cabinet minister of the Ministry of Industry reversed the refusal in a general assembly. The Ministry of Industry had the superior authority in cases where it was applied for financial support over 5 million Norwegian kroner, but it was not common practice that the Ministry changed the decisions of the Industrifondet. Why this happened will be further discussed in section 3.2.

SND was the central financial contributor to the innovation process of Think, funding almost fifty percent of the development costs from 1993 until PIVCO went bankrupt in 1998. In fact, the involvement in the innovation process of Think was the largest investment SND has ever made.

Another finding was that the opinion the officials had of the idea of Think seemed to be based on their own contact with Ringdal and their own view of Ringdal's personal and entrepreneurial qualities and competence.

Ringdal had experience from his position as CEO of Bakelittfabrikken, he had competence on thermoplastics that was one of the central components of the idea, he had equity and he was described as a pleasant person. Some of my informants said that entrepreneurs might be hard to work with, because entrepreneurs often are so full of their own idea that they are blinded in

the belief that everybody is waiting for the idea to be developed. In addition, they have often tried to sell the idea on their own and only when they are broke they find it necessary to bring in the innovation policy apparatus. This makes it hard for the innovation policy institutions to help entrepreneurs to develop the ideas into successful innovations because the idea is already known in the market, and the industry and financial investors have therefore often formed an opinion of the entrepreneur and the innovation project. The fact that the entrepreneur needs more money might often be because the image is negative, and a negative opinion is often hard to change for the innovation policy institutions.

Summarized, in the case of Think the implementation of the existing innovation policy seemed to be a version of the garbage can model, where a “decision is the outcome or interpretation of several relatively independent ‘streams’ within an organization”³⁰. These “streams” are the coming and going of participants and their attributes, the problems concerned, the solutions that exist and the choice opportunities the organization is expected to produce.

3.1.2 On the environmental issues in particular

However, environmental issues did not seem to have a central part in the streams represented by the innovation policy institutions that supported the innovation process of Think. None of the institutions put environmental issues forward as *the* triggering factor that made them support the innovation process of Think.

NTNF found the idea interesting because it represented a totally new technology construction; i.e. the mix of plastic in the chassis and aluminium in the frame. These components had not been combined before, and are in principle two products that are hard to mix. For example, aluminium and plastics have different levels of tolerance for temperature and are materials that can not be glued or nailed together.

At the same time no emphasis was given to the new and environmentally friendly technology concept of the chassis of thermoplastics coloured with natural pigments. And, on the subject of electric cars as a “new” and environmentally friendly alternative of transport to traditional cars, it is rather interesting that it was made a point of not to focus on Ringdal’s idea as an idea of a new car. Earlier efforts to develop cars in Norway had failed³¹, and the impression had been established that it would never be possible to develop cars in Norway. Therefore, it was a better strategy to focus on the technology development in this early phase of the innovation process.

The environmental aspect of the idea first appeared as an issue in connection with the EUREKA-project in 1992. The project description says: “Today’s ‘normal cars’ do not adequately fulfil most transportation needs when environmental aspects such as energy consumption and usage of natural resources and space are taken into account. There is therefore a need to develop small, lightweight vehicles which will serve as an addition or replacement for ‘normal cars’, particularly in urban areas or which lend themselves for use as a link to public transportation systems”³².

³⁰ March and Olsen 1976:26

³¹ In particular the development of the car called Troll in the 1950s, but also other failed efforts, see for example Kvamme 1999.

³² Eureka Project Form 2000

At the same time Oslo Energi was involved as a financial contributor through the OFU-contract. Oslo Energi got involved because they were interested in electric cars as a new way to use energy, and because support to the development of the electric car Think would give the company a good image. In general, Oslo Energi has been involved in several energy technology development processes and has tried to be an initiator for the use of electric cars by providing financial support, letting out electric cars on hire, building depots for battery charge in the centre of Oslo etc.

The environmental aspect of Think first and foremost became an issue in the implementation of the existing innovation policy instruments at SND. SND found it interesting to develop an environmentally friendly vehicle especially fitted for driving in towns: a product that offered individual environmental friendly transport in addition to the public transport system, a small vehicle that was unproblematic to drive around and to park in packed and busy cities, and a vehicle that does not pollute or make any noise when driving.

SND found that it was no market for electric cars at the moment, but that the market would change in the future. Transport would be considered by other criteria than status, image, acceleration and horsepower – and electric cars would be an ordinary means of transport in Norway as well as in other countries. They found that the lack of the market was an advantage for the innovation process of Think. Now it was possible to develop a market with the growing demand for electric cars. Hence, it was possible to keep the innovation costs low by first producing a low volume of Think and creating a niche market, and thereafter increase the production little by little.

However, even though SND found the environmental aspect interesting, environmental policy was not central in their support to Think. Their support was purely economic in granting subsidies and loans to the development of Think. Although SFT was involved in an OFU-contract in 1996, it was merely as an economic contributor.

It is reasonable to conclude that the existing innovation policy institutions supported the innovation process of Think, but also that they restrained the development of a competitive green innovation. The involvement of NTNF seemed to bring credibility to the project and was in that way a good start for the development of a network of companies, policy institutions and financial investors, whereas the funding from SND seems to have been crucial for the idea to develop. At the same time these innovation policy institutions did not support the development of the idea up to a product ready to be put into mass-production, but let PIVCO go bankrupt even though the public support had been enormous up to that point.

In general, the central roles of the officials in these institutions might be said to support competitive innovations as the officials have experience with what criteria must be filled for an idea to be competitive. However, the fact that this was a green technological innovation did not seem to have any special relevance for the involvement of these innovation policy institutions. Rather, the support from these institutions seems to have been triggered by different “streams” within the respective institutions. In addition, it was no coordination between the different innovation policy institutions. Among the institutions it was no discussion of why to support Think, and of how to coordinate the support to give the best result for the innovation process and for society as a whole.

3.2 The specific company-directed innovation policy at Think

3.2.1 The specific company-directed decisions by Ministries and regional policy actors in the case of Think

We might expect the specific company-directed innovation policy at Think to support the innovation process. At the same time it is not obvious that the decisions contributed to the development of the new technology, of a green product and to a competitive start-up of Think. These are three other aspects of the innovation process of Think. However, in a broader perspective we clearly see that these different aspects can not be treated separately. Moreover, when we here discuss the coordination of innovation policy and environmental policy these aspects are obvious elements of the one question: Did the specific company-directed innovation policy in the case of Think support the innovation process of Think as a green innovation?

Several specific company-directed innovation policy decisions were made in order to support the innovation process of Think. Ringdal got financial support from the Ministry of Transport and from the Ministry of Petroleum and Energy to develop the first prototype of this electric car in 1992. Later the same year the Ministry of Industry decided to reverse Industrifondet's refusal of the OFU-contract PIVCO had applied for. The local authorities at Aurskog-Høland contributed with a package of specific company-directed innovation policy to get PIVCO to establish their factory at Bjørkelangen in the municipality of Aurskog-Høland. Finally, the Norwegian Parliament decided upon a number of new framework conditions in order to enhance the use of electric cars in Norway.

The financial support from the Ministry of Transport and the Ministry of Petroleum and Energy to the development of the first prototype is described by the informants as decisions made by the Cabinet Ministers, and not as a result of ordinary ministerial decision-making processes. Ringdal made contact with these two Ministers through an experienced politician he knew personally. This politician made the Ministers aware of Ringdal's idea and managed to arrange a meeting where Ringdal presented the idea. The Ministers found the idea interesting and decided to support the development with one million Norwegian kroner each.

An interesting question is whether the decision processes of the Ministers followed the same garbage can logic as found in the support from NTNF, Industrifondet and SND³³. We might say that the support followed the same garbage can logic because the Ministers found Ringdal's idea interesting in contrast to the other "streams" at that time. Furthermore, Cabinet Ministers are expected to hold and produce more choice opportunities and solutions than the public officials in the above mentioned institutions, and they are also exposed to more problems and participants. At the same time the Ministers are in general supposed to produce overall policy rather than specific company-directed innovation policy. They are only expected to make specific company-directed innovation policy when it is believed to be of fundamental importance. Besides, they are politicians and not specialists on innovation policy. The decision structure is more hierarchic and not that specialized, but at the same time the access and attention structure is more open and un-segmented. Therefore it might be concluded that the decision processes in the Ministries even more follow the logic of garbage can than in the innovation policy institutions.

³³ see section 3.1.1

However, it was an important difference in how these decisions were made compared to the implementation processes of the innovation policy institutions. The two Ministers were introduced to the specific decision situation by an experienced politician. Hence, the “stream” of Ringdal’s idea of the electric car did not go through the hierarchic systems of these Ministries, but became directly a decision situation when the politician contacted the Ministers.

According to the Actor Network approach³⁴ society is made up of un-numerable actor networks. Actor networks are “seamless webs” that consist in constructions of individuals, institutions and technology. In this approach, innovations, and society, are studied through the identification and understanding of the actor networks: how they come into being, how they evolve and how they persist. In understanding the phenomenon of innovation it is important to study the tactical operations actors do to make other actors interested in participating in or providing financial support to the innovation process. The actor or a group of actors tries to convince others that their scenario is the best to give oneself up to and to enrol in at the moment. A scenario is a wished image of the future and of what must be done to make this image a reality.

The decisions of the Cabinet Ministers might be understood as an enrolment into the actor network of the innovation process of Think. The Cabinet Ministers might have been convinced that the scenario of the electric car Think was the best image for how the future should be and that they must contribute to make it happen. In addition, Ringdal’s use of the experienced politician as a spokesperson might have been a good tactical operation. In general it is difficult to get the attention of a Minister. Furthermore, the spokesperson might have “strengthened” the scenario, the Ministers might have found the involvement of this experienced politician some kind of guarantee that this was a good project to support financially.

We might expect to find similar interpretations for why the Cabinet Minister of the Ministry of Industry reversed the refusal of the OFU-contract later the same year. However, the Cabinet Minister was already enrolled in the actor network of the innovation process of Think. The Minister was the same person who had supported the innovation process in his role as the Minister of Petroleum and Energy. The previous Minister of Industry had resigned in September 1992 and the Government decided that the Ministry of Industry and the Ministry of Petroleum and Energy were to be reorganized into one new Ministry: the Ministry of Industry and Energy from the 1st of January 1993. Therefore, the existing Minister of the Petroleum and Energy took over the tasks from the Minister of Industry till the end of 1992

The local and regional authorities contributed with a package of specific company-directed innovation policy to arrange for the factory of mass-production of Think to be located at Bjørkelangen. The Mayor of the municipality of Aurskog-Høland was particularly active, but the county authority of Akershus, some neighbouring municipalities and some private companies in the area were also involved. These actors established an estate company, arranged for the building of a factory hall that suited PIVCO’s needs and offered the building for a cheap rent to PIVCO. Infrastructure, like water, energy and roads were also arranged for, and necessary workforce capabilities were built up through courses at the office of employment exchange and at the secondary school at Bjørkelangen.

³⁴ see for example Latour and Woolgar 1979; Callon 1980; Latour 1987; Callon 1992, 1995

Of course, the specific company-directed innovation policy supported the innovation process of Think. However, the support did not come into being as support for Think as a green innovation. Rather, the decision to support Think was motivated by a wish to boost the regional development of the area of Bjørkelangen. The support arose because Ringdal's existing factory Bakelittfabrikken was located at Bjørkelangen and because this was where he had started the development of Think. Now the local and regional actors wanted to make sure that the activity, competence and workforce were situated there. Thus, the specific company-directed innovation policy was rather based on regional policy concerns than on innovation policy or on environmental policy concerns.

Like in the implementation of the existing innovation policy, environmental issues did not seem to play a central role in how the specific company-directed innovation policy came into being. At the same time *some* of the specific company-directed innovation policy seems to have been aimed at supporting the innovation process of Think as a green innovation. We will here study more closely how one of the new framework conditions came into being – more exactly the exemption from road tolls. We will discuss both whether this framework condition emerged as a specific company-directed innovation policy decision to support the innovation process of Think and whether it might be a part of a creation of the new innovation policy.

3.2.2 Exemption from road tolls, an example

On the 21st of June 1996 Lars Sponheim, a member of Parliament from the Liberal Party, put forward a so-called Document-8 proposal³⁵ where he asked Parliament to allow local authorities to make exemption on road tolls for electric cars. Sponheim emphasized that the Government should do everything they could to stimulate the use of electric cars as he regarded electric cars as an important contribution to reducing pollution, especially in the big cities³⁶.

The proposal was treated in Parliament by the Standing Committee on Transport and Communication. The Committee agreed upon the exemption on road tolls for electric cars, but not on the delegation to the local authorities³⁷. The unanimous Committee found that Parliament should request the Government to make exemptions from road tolls for electric cars in general, because of a need to stimulate increased use of environmentally friendly means of transport – especially in the big cities.³⁸

When the proposal was discussed in Parliament, the Committee emphasized the need to stimulate increased use of electric cars and that the Norwegian company PIVCO was to start production at Aurskog in 1998 and that it would be interesting to follow this development. The proposal from the Standing Committee on Transport and Communication was unanimously agreed upon in Parliament on the 13th of December 1996.³⁹

The fact that PIVCO was mentioned by some members of the Committee when the proposal was handled in Parliament indicates that the innovation process of Think probably had been

³⁵ A Document-8 is a proposal of a political decision put forward by one member of Parliament as his or hers own personal proposal.

³⁶ Dok.nr.8:107 (1995-1996)

³⁷ The reason they gave for this was that the authority was already delegated, to the Ministry of Transport and to the Directorate for Transport.

³⁸ Innst.S.nr.74 (1996-1997)

³⁹ Stortinget, 13.12.1996

discussed in the Committee's handling of the Document-8 proposal. At this time, PIVCO had just decided to localize the production line at Bjørkelangen and was frequently mentioned in the media. We might therefore assume that the innovation process of Think influenced the discussion of this proposal and the voting patterns in Parliament. We might even assume that the innovation process of Think was *the* triggering factor that made Sponheim put forward the Document-8 proposal in the first place.

In any case it might be concluded that the innovation process of Think had a role in how this new act came into being – whether it was the triggering factor or an influencing mechanism. At the same time it might be stated that this act is an example of how the two policy areas of innovation and environmental policy might interact. This new act both supported the innovation process of Think in stimulating the use of electric cars and enhanced the market for the product Think. Furthermore, the stimulation of the use of electric cars might contribute to less use of traditional cars resulting in less pollution.

However, how these two policy areas might interact and result in a win-win situation – both for the environment and for the innovation process of Think – was not discussed in the handling of the proposal in the Committee on Transport and Communication or in the Parliament session. The reason may be that the proposal was treated in this particular committee and not in the Standing Committee on Energy and the Environment or in the Standing Committee on Business and Industry, where policy issues of environment and industry are treated respectively. At the same time the proposal held a transport policy issue – concerning the road toll – an issue that might be said to have a negative consequence for the transport area in reduced tolls. Financial effects of new acts are however issues for the Standing Committee on Finance and Economic Affairs.

Thus, we see that this one proposal actually touched upon the policy areas of four Standing Committees of the Norwegian Parliament, and that only one Committee was directly involved in its treatment. The proposal may have been this extensive because it was a Document-8 proposal and not a proposal from a Committee for a specialized policy area. However, when the proposal was handled in the meeting of Parliament in December 1996 the statements of the members of the Committee indicated that they had discussed some of these issues beyond the traditional concerns of transport policy. Environmental policy played a prominent role and the industrial development of the green technological product Think was also mentioned. However, the discussion of these policy issues in the policy forum for transport seem to have been more like garbage can processes and constructions of actor networks than coherent, planned and co-ordinated political strategies between different policy areas in Parliament.

It might be concluded that none of the specific company-directed innovation policy in the case of Think came into being to support the innovation process as a green innovation. Rather, the specific company-directed decisions seem to have been the results of more random policy processes, where regional policy and transport policy were of equal importance as innovation policy and environmental policy. Still, in none of these decision situations the correspondence between these different policy issues seems to have been discussed, nor what could have been gained – both for the innovation process of Think and for the innovation, environmental, regional and transport situation – if the different policy issues had been better coordinated.

4. What can be learned from the case of Think?

The previous section discussed how the “two” policy areas of innovation policy and environmental policy interacted or failed to interact in the case of Think. Here, it will be further reflected on what can be learned from the case of Think when it comes to the innovation policy system in Norway and the co-ordination between innovation policy and environmental policy.

The case of the innovation process of Think can be considered a good example of how environmental policy may contain innovation policy options and how the innovation policy system failed to utilize these possibilities.

The innovation process of Think received support from both the traditional innovation policy apparatus and from other policy institutions and actors. However, Think did not receive much support from policy institutions directed at environmental policy issues. Ringdal contacted the Ministry of Environment in the very beginning of the innovation process. The Ministry found the idea interesting but had no funds available to support the development of the idea. Later in the innovation process, in 1996, Ringdal received an OFU-contract from SND where SFT was the public institutional partner. SFT was involved because the idea of an electric car was an innovation that would contribute to a reduction of CO₂-emissions. However, beyond the financial support SFT was not involved in the innovation process.

We may for example envisage SFT as an important consultant for Ringdal on sustainable development and how to sell the idea and product as a green innovation: for example on argumentation strategies, potential business partners and how policy institutions could contribute to the development of an idea of sustainable development.

Furthermore, in the project called “Green Government”⁴⁰ no policy institutions involved Think as a part of their environmental strategy. The project was intended to show that significant economic and environmental benefits could be achieved by integrating environmental considerations in the day-to-day operations of public institutions. Ten public institutions participated in the project. Some had as an objective in their action plans to use electric cars in Government services, like for example SFT and the Ministry of Petroleum and Energy. However, this objective was directed at electric cars in general and not at Think in particular.

Certainly, the eventual favouring of Think might have been considered an issue subjected to the Competition Act and the Public Procurement Act – if public sector had given preference to one particular product. At the same time buying qualitatively good innovative Norwegian products and services could have been a part of the innovation policy. The public sector as first-buyer of products might have made the market aware of the new product, and hence also have served as some kind of guarantee for the quality of the new product.⁴¹

However, this discussion leads into the question of the quality of Think as a green technological innovation. It is outside the scope of this paper to assess the concrete quality of the product, it is the process that is of analytical interest. At the same time the presumption of

⁴⁰ the project lasted from 1998-2001, see: <http://odin.dep.no/md/gronnstat/pilotprosjekt/index-b-n-a.html>. For the continuance of the project “Green Government” 2002-2005 see for example information in English: <http://odin.dep.no/archive/mdvedlegg/01/20/Infob064.pdf>

⁴¹ on public procurement see for example Hauknes, Broch and Smith 2000 and Staude, Bugge and Monsen 2000.

the quality of the product was important for the course of the innovation process. There have been two central objections in the market. First, the limitation of the mileage range due to the limited capacity of the battery, and secondly, that Think is too expensive compared to other small traditional cars.

The first objection is a general problem for electric cars, and was partly also the reason Ford withdrew from the project – even Think is a lightweight model that uses less energy when driving compared to other electric cars on the market. Research has however not brought forward a better battery-technology. Some find this limitation a paradox compared to the development of battery-technology in other industrial fields like for example mobile telephones, and question whether there is a lack of interest in developing better batteries to be used in electric cars. In addition, the motor industry is dominated by huge industrial corporations and oil companies, and few initiatives to develop environmental friendly means of transport have come from the motor industry.

Interesting here is the Zero Emission Vehicle Mandate that was introduced as a public program in California in 1990. The aim of the programme was to pull environmental innovation in the motor industry by requiring that a certain percentage of the cars sold each year by the car companies must be zero emission vehicles. The percentage was set to be at least 2 % in 1998 and to increase to 5% in 2000 and to 10% in 2003. What has happened however is that the Mandate has been revised and the required percentages have dropped.⁴²

The second objection on the high price might however be easier to influence by policy decisions. The framework conditions passed in the Norwegian Parliament: the exemption from one-off state tax when buying an electric car in Norway, from annual owner tax, from road tolls and parking charge on public grounds are examples of policy decisions that made it cheaper to buy and drive electric cars in Norway. Hence, Parliament indirectly and maybe also directly supported the market for Think. At the same time more could have been done to enhance the market for electric cars in general and for Think in particular, especially within the project of “Green Government”. This could have been the beginning of the creation of a new innovation policy for green innovations.

The high price on Think compared to other small cars is also a problem regarding public procurement and the conditions of tender. The public sector is to choose the best bid to the best price, and Think therefore loses the competition on the purchase price. However, it has been possible to rent Think for lower costs, and Think has lower running expenses than traditional cars. Think only needs a small amount of electricity and the maintenance cost is low due to the chassis being made of plastics. Moreover, electric cars have another advantage that should be included in the calculation. To drive an electric car does not result in any direct harm on the local environment in contrast to the exhaust gases of traditional cars. Thus, electric cars represent another situation of public procurement than ordinary cars, with other costs and rewards for the public sector and for society as a whole. Surprisingly this essential characteristic did not appear as central in the support Think received from the policy actors and institutions.

Green innovations like the innovation process of Think might have an extra challenge compared to other innovation processes in Norway. In Norway the innovation policy system is divided into several policy institutions that are all to have an effect on both start-ups and

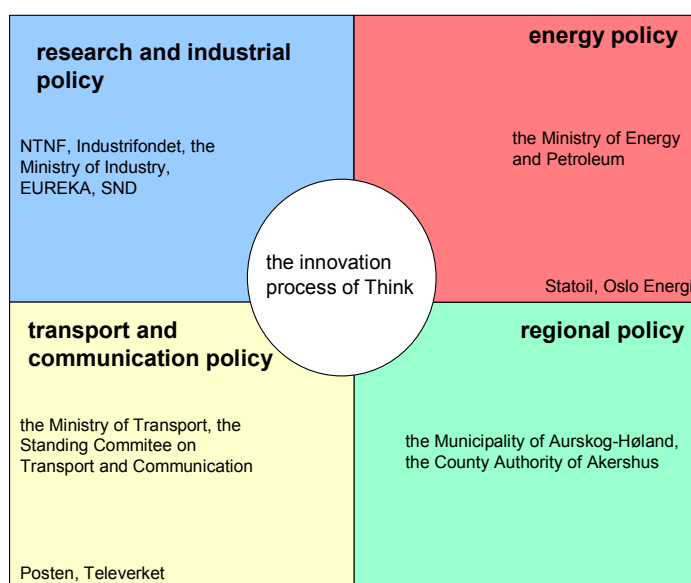
⁴² see for example Kémp 2002

new developments of products, processes, services and methods in existing business⁴³. At the governance level no institutions are directed at innovation policy, but several committees in Parliament and many ministries are involved in framing innovation policy. Innovation policy is to be “sector encompassing”. The challenge is that these governance institutions are also directed at framing policy in other sector policy areas and that the policy of these areas might conflict with issues of innovation and of attempts to develop one overall strategy for a successful national innovation policy.

Green innovations have an extra challenge in that the area of sustainable development is also a policy area with unclear limits of authority. The Ministry of Environment has superior power of environmental policy, but the policy issues of sustainable development are also to be “sector encompassing” bringing sustainable development issues into all aspects of societal planning and sector policy areas.⁴⁴

For example the plan for a new “holistic” Norwegian innovation policy is an interesting initiative in trying to coordinate innovation policy, and it is interesting to note that the Ministry of Environment has not been involved in this process.⁴⁵

Figure 2: Illustration of the policy areas involved in the innovation process of Think



The case of Think shows how different policy areas influenced the innovation process and how policy actors and institutions from different policy areas supported the innovation process. Figure 2 is an illustration of the different policy areas that were represented by one or

⁴³ For an overview and discussion of the current innovation system and the key actors in Norway see section 3 in the working-report to the MONIT project: Remøe, Røste and Aanstad (2004): *Governance of the science, technology and innovation system in Norway: an overview*.

⁴⁴ see White Paper 46 1988-89; White Paper 58 1996-97. For further reading see Ruud and Larsen (2004)

⁴⁵ see <http://odin.dep.no/odinarkiv/norsk/dep/nhd/2003/annet/024071-990018/index-dok000-b-n-a.html> for further information on the plan for the “holistic” Norwegian innovation policy. For a discussion see the MONIT-reports: Remøe, Kaloudis, Røste, Ørstavik and Aanstad 2004 and Ruud and Larsen 2004.

more policy actors and institutions supporting the innovation process. In addition, the companies that at the time were public are showed in the figure, although the effect of their special situation as public companies for their involvement in the innovation process is not discussed here. However, most of the companies that supported the innovation process of Think were public companies and it could be interesting to study the role these companies had and now have in the innovation policy system in Norway.

The areas that seem to have been the most central are: *the research and industrial innovation policy area* with NTNF, Industrifondet, the Ministry of Industry and SND; *the area of energy policy* represented by the Ministry of Energy and Petroleum, the public petroleum company Statoil and the municipal energy company Oslo Energi; *the area of transport and communication* with the Ministry of Transport, the Standing Committee on Transport and Communication plus two large public companies on communication services in Norway; and *the regional policy area* represented by the Municipality of Aurskog-Høland and the Municipality and County Authority.

Figure 2 does not have any box for environmental policy. SFT was involved as a public supporter, but had, as mentioned, a very indirect role. No other environmental actor or institution was involved. However, this does not imply that environmental policy issues did not play a role in the innovation process of Think – the strategy of SND and the decision-process of the exemption from road tolls imply that they did. Surely, sustainable development issues are to be “sector encompassing” and do not have to imply that environmental policy institutions must be involved. Hence, the issue of sustainable development faces the same challenges as innovation policy – the policy institutions are directed at policy in other sector policy areas and the policy of these areas might conflict with the issues of sustainable development.

However, the case of Think first and foremost shows that the course of the innovation process can not be predicted, but is like the innovation journey described by the Minnesota Innovation Research Programme⁴⁶: as an uncertain and dynamic exploration into the unknown where the novelty emerges. Figure 1 reflects this point, illustrating the innovation cycle as a process of highs and falls, success and failure. Moreover, the figure illustrates that the highs and falls of the innovation process are not happening in isolation within one company but that the success and failure of the process is clearly dependent on the support from other companies, policy actors, public institutions and financial investors.

The unpredictability of innovation processes makes it hard to develop one overall strategy for a successful innovation policy. The MONIT-project is not to find “universal policy instructions to be used directly in various economic systems, but more a framework in which to organise policy and guide policy learning and co-ordination”⁴⁷.

The Minnesota Innovation Research Programme⁴⁸ finds that there are some basic conditions and general patterns that often occur in innovation journeys that might function as a “road map” of how innovation processes typically unfold. Efforts to initiate innovations are for example often triggered by “shocks” in the market, innovation is a network-building effort in the development of transactions and relationships among persons and organizations and the transactions and relationships may also lock the innovation process in unintended

⁴⁶ Van de Ven et. al. 1999

⁴⁷ MONIT proposal description 2003

⁴⁸ Van de Ven et.al. 1999

consequences. Mistakes and setbacks occur frequently in the development process and the criteria for success and failure often change, as do human emotions among the innovation personnel from euphoria in the beginning to frustration and pain in the middle period and closure at the end of the process.

Several of these general patterns correspond with the observations from the history of Think. The study of Think might thus contribute to an understanding of innovation processes as neither stable and predictable nor stochastic and random. Rather the history of Think is an example of both successful network-building efforts and changed human emotions; and it shows that the market changes, that mistakes and setbacks occur in the development process, and that the views of success and failures also change throughout the process.

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