

Working paper in progress

**Kongsberg – A Small Player in Global Super Games:
How peripheral actors can gain competitive leverage**

‘TRANSLEARN’

**Transnational learning through local experimenting: the creation of dynamic
complementarities between economy and society**

EU’s Sixth Framework Programme Citizens and governance

Case Studies Norway:

Local outcomes and dynamics

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Human contact and constructive cooperation generate innovation and can release unpredictable opportunities (Kongsberg 2001).

Introduction

Currently a new perspective is emerging about how Norway is adapting to the globalized economy. In opposition to the OECD's (2007) latest country report on Norway, characterizing the country as a technological laggard, the New History will tell a story about a highly innovative and dynamic economy. Criticism but also the fact that OECD declares Norway to represent an economic puzzle has triggered the creation of a New History. The alleged puzzle stems from the combination of low investment in R&D and low innovativeness on the one hand, and high productivity growth rates on the other. An argument against the OECD account is that it lacks methods for capturing the dynamism of the Norwegian economy and is therefore failing to give an accurate account of the state of affairs. However, the OECD is sharing this failure with both Norwegian authorities and research communities.

We are thus facing two related issues, what is the nature of the dynamism in the Norwegian economy and how to uncover it? To approach these issues this paper will make use of a neglected fact in the OECD report, namely the phenomenon that certain Norwegian sectors and firms are global leaders in their respective fields. Through a case study the aim is to explore how a rather peripheral located high tech company has attained global competitiveness. For this purpose Kongsberg is a case-in-point. It is a multinational company, although by international standards a rather small one.¹ In 2006 its number of employees totalled 3 650 (Annual Report). Today the company presents itself as a knowledge enterprise that delivers high-technology systems for offshore oil and gas production, the merchant marine, defence and aerospace. Within these sectors it is global leader in several market niches. There are two distinct features about its global presence: it is delivering to leading organizations and institutions world wide such as the US Armed Forces, NATO, and the European Space Agency; and it has long-term partnerships with world-class companies such as Raytheon and Lockheed Martin in the United States, Areospace and Thomson in France, and Hyundai in South Korea. Kongsberg is thus an illustrative example of the fact that globalization games are not only for big players, and that peripheral companies can build global businesses – even in the most sophisticated industrial sectors such as defence and aerospace. Uncovering the Group's strategies and organizational resources as well as institutional arrangements that enable it to achieve a global standing should give us insight into the dynamism of this surprising outcome.

Much research literature and public discourse stress the importance of healthy corporate governance in building competitiveness and profitable businesses. Kongsberg was listed on the Oslo Stock Exchange in 1993, and has over time adopted and adapted to the rules of the financial game: increased its business focus, introduced 'best practice' methods, and increased

¹ Kongsberg represents the continuation of a former state-owned company that was established as a weapon factory in the early 19th century. In 1987 the company, by then an industrial conglomerate, was dismantled. Only the defence division was kept as a state-owned company that eventually adopted the name Kongsberg (Kongsberg Gruppen). Among the spin-offs from the previous state-company Kongsberg is the biggest in terms of employees and turnover.

transparency.² It fully complies with the 'Norwegian Recommendation for Corporate Governance' introduced in 2004 by the Board of Directors and the Norwegian state. This recommendation provides principles for state ownership (the Norwegian state has a 50 per cent ownership share in Kongsberg), and was based on the OECD's guidelines for state ownership. But the point of this paper is that the system of corporate governance cannot give an adequate explanation of the company's achievements.

Rather the argument is to create a space for thinking about alternative kinds of governance by making actors and the dynamic interaction of roles and rules the centre of analysis. What roles and rules do actors enact to cope with challenges and opportunities, and how do they adapt to other actors' rules for practical problem solving? The argument starts with the changing relational dynamics in industrial markets that will provide a framework for analyzing local actors' practical problem solving. In the globalized economy there is a constant pressure to innovate, improve and create new products, and a constant pressure to reduce costs. At the same time new systems of innovation have emerged in which innovation is taking place as interactive processes in open distributed value chains worldwide rather than as closed and separated in-house activities. To denote these new patterns, concepts such as open innovation, networked innovation, distributed and interactive innovation, user-centred innovation, and so on are currently used (von Hippel 2005, Chesbrough 2003, Powell et al. 1996). The new open system is seen to 'attack' the traditional system in which large central industrial laboratories played a key role and were strongly embedded in a fixed structure of the social division of labour. Changing this social division of labour is considered difficult for many firms and industries, but also for governments and policy-makers. In order to adapt firms have to change their business model and we accordingly see the need of a new theory of the firm.

Because innovation has become open and global, new relational ties have emerged between users and producers. One perspective is that these changes have created ambiguity in the roles actors play in the innovation and production system (Herrigel 2007). Consequently firms' ability to constantly redefine itself, to re-interpret its role and routines is seen essential for tackling this ambiguity and for learning. This implies that firms no longer can resign to solely operate within established routines as a condition for efficient action. Rather they have to systematically questioning routines to achieve efficiency. Firms that rely on collaborative development and experimental strategies are, according to Sabel et al., incompatible with the standard theory of the firm. They claim that what they call the non-standard firm is rooted in a new understanding of *cognitive* possibilities. In contrast to the standard approach routines become accessible to deliberate evaluation without undermining them as guides to normal activity (Sabel et al. 2000:465).

Given Kongsberg's achievements we should expect to find the source of its competitive strength within the dimensions of this analytical framework and, in fact, the empirical evidences are largely consistent with it. The explanatory model developed in this paper is supported both by the new perspective on innovation and by the new theory of the firm. Case study findings as well as broader statistical evidence indicate that multilevel cooperation provides competitive leverage, and that it takes place at both the global and local level. However, the question remains to what extent Kongsberg is representative of the general dynamism of the Norwegian economy? Since Norway has failed to come up with strong developmental policies, as for example is the case in Sweden and Finland, a relevant question is to explore whether the company has been able to strategize with and made use of other

² In 2005 Kongsberg divested its Yachting and Fishing division in order to solely to concentrate on business-to-business activities.

kinds of local and national institutional resources? A dynamic complementarity is found in inter-firm relations and in the nature of these relations in the way they assist in meeting customers' need. Finally, this pattern of inter-firm relations is supported by initiatives both within the system of industrial relations and at the sector level.

The New Economy – a heterogeneous and volatile world

To capture characteristic features of the New Economy it is contrasted with what is called Fordism in the postwar period. Fordism denotes mass production and mass consumption, a production system in which the division of labour, roles and routines were fixed and stable. In this system new products were taken to result from researchers' routine work in large central industrial laboratories, representing the advances of several scientific fields. Patenting and other protective strategies were an intrinsic part of this system. This in turn impacted on the division of labour to the extent that research labs and other activities were separated from other activities. In this system scale was all that mattered, and competition tended to become monopolistic or oligarchic, since only firms able to afford development costs could participate.

New Relational Ties and Modes of Innovation

From the 1970s on the relevance of this system was questioned. Contrary to the then conventional wisdom small and medium-sized firms co-located in industrial districts proved to be more innovative and able to organize production in more flexible ways, as evidenced in the Third Italy, and in areas such as Silicon Valley in the United States. Parallel to these development trends what has become known as the 'Japanese' production system in car making spread from Japan to other parts of the world. Japanese-inspired 'lean' firms were successfully challenging the dominance of mass producers in the automobile and other industries. One dimension of this system implied outsourcing and basing the products on networks of suppliers. The system allowed increased product differentiation and shorter product-cycles, and in this capacity represented a definite threat to the static Fordistic system. Another threat was an increasing fluid labour market that for example emerged in Silicon Valley where high tech start-ups developed and commercialized whole new technologies, and where employees moved between various projects and thus opened new ways of organizing innovation activities, and also speeding up innovation processes. When also suppliers to car makers became engaged in innovating on parts and subsystems of the car, 'the continuous improvement of products was on its way' (Kristensen 2007b).

The trend towards continuous improvement and innovation has been speeded up by parallel processes: technological change and vertical disintegration. Technological change has created an increasingly complex environment for organizations: higher propensity for change, higher speed and efficiency of task accomplishment, and greater risk taking. At the same time it has become increasingly difficult for any single firm to hold all the knowledge necessary for innovation and other complex tasks. The mechanism to solve these challenges is seen to bring together, combine, and coordinate the unique knowledge of individual firms and institutions to jointly innovate new products and services. Today it is generally agreed that companies that want to attain a leading position in its field have to develop strong global networks because innovation is too expensive and too complex to be handled within the boundaries of a single firm.

The financial communities' imperative of focusing has led firms to constantly consider what activities to embed in their own organization and what to outsource – the make-or-buy decision - to reconsider and redefine their own roles and their division of labour in relation with other firms in a value chain. Waves of mergers and acquisitions in order to regroup conglomerates to become more focused have together with outsourcing speeded up the process of vertical disintegration. In this process 'in which parts and pieces for integrated products and systems incessantly turn up', innovation has become continuous. This drive for innovation in combination with the imperative to reduce costs has propelled firms to constantly redefine their roles in global value chains. The paradoxical outcome of these structural changes is that vertical disintegration is requiring more collaboration across organizational and national boundaries. This means that firms have to open their boundaries and find new ways of organizing work. How to coordinate activities across boundaries and how to organize worldwide flows of local learning and innovation have become critical issues for globalized firms. Thus, being competitive means to develop strong global networks (Kristensen et al 2006).

A new template for innovation is called simultaneous engineering or simultaneous innovation. The idea is to bring together people across specialties and disciplines in order to explore possibilities and solve problems. Design takes place as a disciplined and decentralized process. Group discussion allows the interplay of diverse disciplines and projects, and creates a pool of diversified knowledge. Consequently, outcomes cannot be anticipated. The constant change of roles and rules in such processes represents a challenge to established social division of labour. One is the role of universities and other research institutions that traditionally used to be the providers of open communication and search-networks. Now these changes take place closer to the boundaries of firms. This 'revolution' also affects the internal organization of firms. Ongoing decentralization has come to break down the division of labour to the extent that one can now observe all levels of employees participating in innovative activities, and that improvements, product and process innovative work occur simultaneously. This trend has partly been seen as a solution to dilemmas that firms have to solve: to divert resources from routine production activities into research and development areas.

A New Type of Firm – Pragmatic Collaboration

Collaborating with others has become the new imperative for organizations intent to develop knowledge and technology. Knowledge required for innovating has become more dispersed and is rapidly changing, and products are requiring a broader range of technologies. Consequently, external sources of innovation are becoming more important for leveraging operations, for getting access to rare expertise, and learn about scientific, technological, and commercial developments. However, a central theme in collaborative activities is ambiguity and their provisional nature (Sabel et al. 2000). Collaboration can be turned into to learning and mutual benefit for both parties, but learning also undermines the stability of relations and increases the complexity of contracts. There can also be trade-offs through hold-ups and waiting games. Collaboration can be hampered by struggles for influence, provisions relating to property claims. Large companies might pass on innovation costs to their suppliers, but firms may also appropriate innovative concepts or product ideas from users. This ambiguity is aggravated by the territorial dimension of contemporary value chains. Customers and suppliers seek to achieve their goals wherever they can, and it involves supplementing local

capabilities with those of other places (Herrigel 2007). Subsequently, the pressure for innovation and cost reduction generates highly volatile and heterogeneous relations. Kongsberg has captured this situation in its own wording: 'If you don't know where you're going, any port in the storm will do' (Annual Report 2006:13).

To shun ambiguity in collaborative activities Sabel et al. (2000) propose a novel organizational form, the non-standard firm. In short, their proposal implies that the transacting partners jointly determine the gains from learning to be distributed according to the standards agreed between them, as interpreted by each (Sabel 1994). The ability to monitor is the capacity of each party to assess whether it is getting enough of a fair deal to continue dealing. According to Sabel et al. this can be achieved through what they call 'pragmatic mechanisms' that are disciplines that reveal the ambiguities of product designs, production processes, and organizational boundaries. Joint inquiries are orchestrated, and in the process of inquiry each collaborator can continuously monitor the performance of the others. Because these mechanisms advance knowledge, they increase pay-off of cooperation. The result, which Sabel calls learning by monitoring, forms the basis for pragmatic collaboration. Sabel et al argue that these practices, which share several commonalities with the Japanese model, are not dependent on certain institutional conditions (Sabel et al 2000:445).

Pragmatic is understood as participants routinely having to question the suitability of their current routines and continuously readjust their ends and means to one another in light of the results of such questioning. This coordination method can only be achieved when the participants mutually recognize each other. Bringing in interactive dimensions and pragmatic action at the same time presupposes actors' reflexivity. Reflexivity is basically understood as interactive processes, and consequently roles and practices can only be changed through interaction and negotiation with others. Such organizations are characterized by continuous experimentation; work autonomy is fostered; innovation and improvements are co-designed processes; and the organization is open for unlikely innovation and the 'unexpected to happen and gain organizational space' (Kristensen et al 2006, Mead 1967).

The novel type of organization differs outwardly from the standard firm that it advances learning and innovation. It is federated, not centralized: decisions of higher level entities are shaped by the decisions of their constituent units. The organization is open, not vertically integrated: components or services can be provided externally. The fundamental unit is the team, which has the responsibility to achieve goals mutually agreed with its collaborators, 'by means that are determined through group deliberation'. Teams are the key coordinating mechanism and coordination within and across teams makes use of a method of iterated goal setting. This method casts pragmatic doubt on the suitability of current methods and sets the stage for exploring unveiled possibilities. The outcome of the search is to be sufficiently unfamiliar and disconcerting to force re-evaluation of habitual responses. The distinctive mark of such firms is the routines they use for interrogating and altering their routines. This is what makes them pragmatic.

Thus, the design work follows a disciplined, decentralized process known as simultaneous engineering. 'Each subunit responsible for a constituent component proposes modifications of the initial plan, while also considering the implication of like proposals from the other subunits for its own activities. Provisional designs are thus evaluated and redefined and the cost of each attribute is compared with its contribution to functionality using the techniques of value analysis/value engineering. Once production begins, systems of error detection and correction use breakdowns in the new routines to trigger searches for weaknesses of the

design or production process that escaped earlier examination (Sabel et al 2000:466). Current research sees in this normative description a template for a new system of innovation (Kristensen 2007).

It is reasonable to argue that collaborative development today is central to the activity and organization of firms, and it has potential to account for the institutionalization of ongoing improvements and innovation. A large variety of literature reports that more and more companies are pooling their resources in common research and development projects, and using teams as the fundamental unit and coordination mechanism. Current research emphasizes that successful teams require, as a foundation, a more fundamental shift from coordination-based structural organizational designs to human-interaction-based designs. As Sabel et al argue (2000:469) 'It is group discussion of problems that renders the resulting flood of alternatives tractable. Group discussion meets an immediate objection to problem solving through extensive collaboration rather than hierarchical decomposition of tasks. For example Nokia is considered to be highly advanced in creating such a structure. Nokia itself considers its key R&D advantage to be the efficient operation of multicultural project teams, which is based on the Nokia corporate culture and the commitment and successful rotation of personnel (Ali-Yrkkö et al. 2004, Moen and Lilja 2005).

It is also reasonable to argue that pragmatic collaboration is a source of efficiency and effectiveness: it renders faster lead times and fewer total engineering hours, higher quality, lower inventory and more efficient design. Because these mechanisms also advance knowledge, they increase the pay-off of cooperation. However, this way of innovating and producing requires a different kind of work organization since pragmatic collaboration presupposes that the boundaries of professional groupings are transcended. To enable constant external redefinitions firms must incessantly adapt their internal organization and division of labour. Decentralizing to teams the responsibilities for continuous improvement is one example of such redefinition. Furthermore, this sort of decentralization demands more skills.

New Types of Work Organization

The nature of work and organizations has been changing, but the research interest in the nature of these changes and their wider implications is only about to emerge. Consequently, the theorization and conceptualization are still poorly developed, despite the use of more catching words such as the flexible firm, the networked firm, and the extended firm. Concepts developed in bureaucratic organizations are little applicable for new types of firms. The argument of the research community is that organizational theory is now facing several challenges similar to those when the foundation of this subject was made (www.egosnet.org). Not to mention that the emergence of new kinds of relations in industry has generated tremendous pressure for change on all the institutions that constitutes a national business system - in industrial relations, vocational training, finance, welfare provision, regional industrial policy (cf. Herrigel 2007).

What statistical analyses can tell us is that new organizational forms have been widely dispersed. An analysis based on the EU's Third Survey of Working Conditions documents both the sectoral and geographical diffusion of different types of work organizations within this geographic area (Arundel et al 2006). According to the given set of variables the analysis identifies four basic categories of work organizations: traditional, taylorist, lean, and discretionary. The traditional form is marked by informal and non-codified methods, the

taylorist category is typically characterized by task specialization and a clear distinction between the work of conception and execution, the lean type distinguishes itself with a high degree of quality norms, characteristic of the ‘Japanese’ or ‘lean production’ model, and finally the discretionary form is distinctive for its combination of high levels of autonomy, high levels of learning, problem-solving, and task complexity. The use of team work is above the average level. There are wide differences in the importance of these four basic forms of organization across European nations. The latter, the discretionary form, is most widely diffused in the Netherlands and the Nordic countries³, whereas it is little diffused in the southern European countries. The lean form is found mostly in the UK, Ireland, and had diffused only to a low degree in the Nordic countries, Germany, Austria, and the Netherlands.

Table 1 National Differences in Forms of Work Organisation⁴

	Percent of employees by country in each organisational class				
	Discretionary learning	Lean production	Taylorist organisation	Traditional organisation	Total
Belgium	38.9	25.1	13.9	22.1	100.0
Denmark	60.0	21.9	6.8	11.3	100.0
Germany	44.3	19.6	14.3	21.9	100.0
Greece	18.7	25.6	28.0	27.7	100.0
Italy	30.0	23.6	20.9	25.4	100.0
Spain	20.1	38.8	18.5	22.5	100.0
France	38.0	33.3	11.1	17.7	100.0
Ireland	24.0	37.8	20.7	17.6	100.0
Luxembourg	42.8	25.4	11.9	20.0	100.0
Netherlands	64.0	17.2	5.3	13.5	100.0
Portugal	26.1	28.1	23.0	22.8	100.0
United Kingdom	34.8	40.6	10.9	13.7	100.0
Finland	47.8	27.6	12.5	12.1	100.0
Sweden	52.6	18.5	7.1	21.7	100.0
Austria	47.5	21.5	13.1	18.0	100.0
EU-15	39.1	28.2	13.6	19.1	100.0

Source: Third Working Condition Survey. European Foundation for the Improvement of Living and Working Conditions, Lorenz et al. 2006.

For our purpose an interesting finding from the statistical evidence is that the Nordic countries score high as to work autonomy and learning. Yet, studies from Denmark indicate a varied development pattern in the Nordic countries as to increased functional flexibility in organizations. It is assumed that higher flexibility here is achieved primarily through an extensive delegation of autonomy to employees. This suggests that flexibility is gained through the skills, role-sets and interaction among employees. It is also assumed that the other Nordic countries instead have made use of a number of modern managerial techniques to

³ Unfortunately Norway did not participate in this survey.

⁴ Norway did not participate in this study, but has participated in the Fourth Working Condition Survey, as will be referred to later in the paper.

achieve similar outcomes (Kristensen et al. 2006). What the actual situation in Norway is remains to be seen. What we know is that work autonomy, participation, and the upgrading of skills have been on the top of the agenda of the trade union for long period of time. In a way its represents the continuation of the experiment tradition introduced in Norwegian working life in the 1960s (Gustavsen et al. 2001). However, after Norway's pioneering role in work organizational experimenting, activities slowed down after the 1970s and Norway has until now been considered a laggard in the Nordic context. Governmental policies have been lacking, yet in a bottom-up way the social partners have agreed on strategies to reform Norwegian working life. Government has supported these cooperative initiatives through different cost-sharing programs⁵. The outcomes of these initiatives and firms' individual initiatives have not been widely explored.

The Kongsberg Way

Customer interface innovation

The paper set out by asking how Kongsberg has gained global competitiveness. In constructing an explanatory model the findings confirm the relevance of the novel ways of innovating and novel ways of organizing firms. Today, the Group has organised its activities in two different business areas, Kongsberg Maritime (KM) and Kongsberg Defence and Areospace (KDA). Both areas have their core competences in signal processing, engineering cybernetics, software development services and systems integration. Yet, its product portfolio spans over a wide and diversified range of products. The Maritime area is the biggest one both in terms of turnover and the number of employees. But despite their diversified nature both business areas dispose of several leading products in their respective niches. One example is dynamic positioning systems (DP) within the Maritime area. It is the company's so-called best seller, and has been so for a long period of time. The origin of this system is telling as to the company's mode of innovation. Basically DP is the result of a customer-supplier relationship, and in this capacity it represents a clue to untangle what can be called the Kongsberg way: customer interface innovation.

The Group itself highlights the significance of customer proximity and cooperation as a key factor in its business model. But the notion customer interface innovation needs to be elaborated in order to provide a better conceptualization of what we can term the Kongsberg way. Customization is a well-known marketing strategy, but it can also entail processes for co-creating value. Developing new products in this manner reduces risks dramatically. To what extent and what kind of role customization plays is unknown. If we stick to Kongsberg, there is no doubt that the Group's main strategy for learning, improvement, and innovation takes place as co-designed processes with customers, and that these processes follows a regular pattern. When assigned a project the Group might have no idea of what the result is going to look like, but 'technological solutions are found in the intimate cooperation with customers' (Annual Report 2006). The first step, in their own wordings, is to get to know the customer as well as possible and 'at the end to have a deeper understanding of the customer's situation than the customer itself'. New products that stem from assigned projects reduces both market and technology risks. As part of the contractual agreement Kongsberg retains the right to commercialize new technology against paying a royalty to the customer that has paid

⁵ An initiative took the form of a programme in co-operation with the Research Council of Norway and Innovation Norway under the heading "Enterprise Development 2000"; later to be replaced by the programme "Value Creation 2010"

for the development (Annual Report 2005). However, in developing a new product or system Kongsberg will often involve a partner with complementary knowledge, research institutes, and occasionally sub-suppliers, first and foremost within the areas of electronics and design.

This pattern of learning and innovation has a strong resemblance with what above is described as an open innovation or networked innovation system typical of the globalized economy. Learning and innovation take place across different levels and across national boundaries. Within the Maritime area what can be termed an innovation pipeline might involve an oil company, a ship-owner, a ship-building company, and Kongsberg on the one hand, and Kongsberg's sub-suppliers on the other. In this pattern of innovation engineering companies like Kongsberg play a mediating role between the global and local in the transfer and upgrading of knowledge.

Origins of customer-supplier relations

A distinct feature about the Kongsberg case is that it entered on a cooperative mode early on. Actually, its open approach predates the globalization period. In the following two event histories will account for how the cooperative mode was brought about. The first concerns the development of dynamic positioning that took place in a Norwegian context. The second concerns the development of a command and weapon control system that occurred in a cross-national setting. This event history is also illustrative as to the importance of mutual recognition, and how the partner accepted Kongsberg's rules of the game.

The development of dynamic positioning systems took place during the state period. In fact, dynamic positioning was one of the first projects the KV's Oil Division carried out when it was established in the 1970s, and it is currently characterized as a text book example of cybernetics. In short, it deals with seagoing vessels and rig automation, and is crucial for deep sea oil and gas production. Dynamic positioning allows vessels to remain in a stable position and is critical for offshore oil and gas production. The system is based on forward coupling, which is the use of direct wind measurements and mathematical models to simulate a variety of forces acting on a vessel, and constituted the innovative element when the project only existed as an idea developed by a professor at Norway's Institute of Technology. A computer digests all information and steers the propellers to counteract drift. The first system was commissioned by a Norwegian ship-owner. At that point of time Norwegian ship-owners had just entered the market for rig activities in the North Sea, and faced unprecedented challenges in the shape of extreme weather conditions and sea depths.

When the first system was ordered, there existed no solution as to how such a system should be, only a group to develop the professor's idea consisting of representatives from KV, Sintef, an independent research organization and Simrad, a firm that originally produced radios to the fishing fleet and had specialized in sonar technology. Since nobody knew how the system was going to look like, the ship-owner was considered 'mad'.⁶ When the deal was made and the customer entered the group, the constellation of cooperation changed. It was turned into a customer-supplier relationship. However, the successful achievement of the project can be ascribed to the organization of the task as a sort of co-designed project. KV bought the positioning system, the subsea part, and had two researchers from Sintef to do development work. Typically, the project could also benefit from KV's previously own developed products

⁶ It was in fact one of the ship-owner's co-worker that persuaded the ship-owner to order the system. This co-worker had previously worked at KV.

and technology through the cooperation with its own Computer Division and Defence Division (Bjørnstad 2007, Velvin et al. 2002:54).

By combining sonar and data technology the DP system is also an example of a successful outcome of large governmental science programs typical of the postwar period, and how these investments played an important role in developing technological competence in Norwegian engineering companies. The data technology developed at Kongsberg was linked to a large R&D research programme that ran from the mid-1950s until the beginning of the 1980s. In the 1960s Kongsberg's role formed part of the Numerical Control system project (NC), later to be known as Computer Numerical Control (CNC), and its task was to develop industrial application. Kongsberg recruited key researchers within this technology field to assist in achieving this goal. The NC project involved the most important Norwegian technology and science communities and leading Norwegian engineering firms (Sødahl and Brataas 2005).

The sonar technology was developed by the Norwegian Defence Research Establishment (FFI) and commercialized by Simrad. The link between user and producer was also salient in the sonar case. In developing the sonar Simrad benefited from the cooperation with users, first and foremost the Institute of Marine Research, which was testing the sonar in practice. Simrad's own development work was facilitated through its recruitment of FFI researchers. The effect of the cooperation project was a substantial lever to Simrad's technological knowledge and competence (Onsager 2005:82).

By 1980 KV's dynamic positioning had knocked out its main competitors the US-based Honeywell and the France-based Alcatel. KV became the global leader in this niche market, and its successor company Kongsberg still maintains this position. It is argued that DP did not represent a superior technology to start with, and after the system was delivered, improvements went on for a long period of time. A reason why it won through in markets has been found in the establishment of a highly creative marketing unit and a strong service-mindedness towards customers (Bjørnstad 2007:139). However, due to a long learning curve and strong market presence an oligarchic structure of this niche market in which Kongsberg holds a share of approximately 80 per cent has been preserved. This experience was significant as to future possibilities. In summing up the KV's history a couple of decades later dynamic positioning was considered a proof of the fact Norwegian technology and an intrepid attitude could conquer the world (Dahling and Erlandsen 1999:24).

In KDA command and weapon control systems form one the business area's three important product areas (Annual Report 2006). Both the origin and successfully international marketing of this sort of system are based on the cooperation with leading defence contractors in the United States. In 1979 the Norwegian Armed Forces (NF) commissioned Hughes Aircraft Corporation, one of the then big contractors in the American defence industry, to develop the specifications for a new command and control weapon system. At that point of time it was the possible biggest single contract the NF would commission, and as part of established practice in national defence spending internationally, it required an offset agreement. Part of the negotiated agreement was that KV should participate in the development of the specifications in order to advance knowledge and competence in this field nationally. The outcome of the development project was that the NF decided to make a call for tender for a new command and weapon control system. Hughes and KV teamed up to compete for the contract, which they won.

The point in this story is that KV's representatives managed to persuade the American partner to accepting their way of cooperating and learning. The crew KV sent over to California was small, consisting of only two – three engineers. However, these engineers did not exactly receive a warm welcome, they felt like flies in the ointment, and was given an office in a remote place of the building. They were explicitly told to respect the corporate hierarchy. This implied that they had to turn to the project leader for all kinds of decisions to be made or issues to be discussed. Since the project leader was placed three – four steps up the hierarchical ladder and had several jobs, it would last at least a month before they got an answer. The KV engineers were also told to make a request three weeks afore hand before having a meeting with the customer. This procedure was to be followed although the customer, in this context meaning representatives of the Norwegian Armed Forces, was located in the same building, only a few meters away from the engineers. Two factors were important for the successful breakthrough of the KV way in this system.

First, one of the KV engineers understood that they had to 'short circuit' the American system in order to realize the project. Being accustomed to a high degree of delegation, he immediately saw the short-comings of the hierarchical system. At KV management had come to recognize its own limitation as to technological development, and delegated decision-making to those directly involved in the respective development projects. This meant that rather young engineers travelling the world could make decisions. The engineer therefore addressed the representatives on location in California directly. The customer understood the situation and met the KV engineers with a positive approach. The relationship was facilitated through the creation of informal social interaction typical in Norway, but a decisive factor was the KV engineers' way of interacting with the customer. The definition of their own role, implying a careful dialogue in order to acquire application knowledge, set the rules of the game. Unknown with this kind of customer relationships the Americans to start with condescendingly stated that the Norwegian Armed Forces did not understand what was best for them.

The second factor that opened the doorway for KV was the Americans' lack of technological knowledge in developing the software for the control system. The customer realized this early on, and when Hughes also did, the KV team was eventually warmly welcomed. The two partners agreed on a division of labour. The Americans were to develop the basic technology such as electronics and computer screens, whereas the Norwegians were to specify applications and develop the software. However, as a part of the contract the Norwegian team included a clause about improvements. Hughes was to pay for extra costs in connection with improvements. Since Hughes did not have a system for monitoring the work process and thereby being able to verify changes, the Norwegian team developed one that was accepted by Hughes. By decomposing the project in its various elements, and computerizing these, they could produce graphs that showed the progress of the whole project. When change occurred they were consequently able to trace them back to their beginning and in that way calculate the extra costs.

Knowledge of the US defence industry at that time suggests that this situation was not surprising. Gansler (1989:9, 89) points out that the American industry was marked by substantial inefficiency, high costs and low quality despite its world leadership. A report published in April 1986 stated that 'too many of our weapon systems cost too much, take too long to develop, and by the time they are fielded incorporate obsolete technology'. To remedy this situation the Congress passed the so-called Competition in Contracting Act (CICA) the same year releasing a competition for defence procurements. Nonetheless, the US defence

industry became increasingly dependent on sales abroad and on supplies of critical components and material from other countries. The US Air Force created in particular a market for numerically controlled machines. However, in these fields the US manufacturer failed to make the cross-over from military to commercial uses. It was on the contrary German and Japanese tool makers that profited from the new technology and came to dominate this market (Gansler 1989:89, 242).

It was precisely within this technology field KV made its initial success in the American Defence Industry. In developing the software for the control system it could benefit from previous projects and the dual use of this technology. The competence in software originated with the Penguin missile in the 1970s, still one of the world's leading anti-ship missiles. The question was raised whether it could also be developed for civilian use in firms in transaction systems, production, order system etc. In cooperation with Sintef KV developed a product that was sold to the major engineering companies in Norway. Knowledge and competence developed in these projects thus formed the basis of KV's cooperation with Hughes. They earned respect for their technological competence. The mutual recognition of each other's technological competence provided a platform for a good relationship and the formation of integrated teams between Hughes, KV and other partners involved in the project that lasted until after the turn of this century.

Hughes' recognition and later cooperation with KV was paramount for the cooperation with other contractors in the American defence industry. Its cooperation with American contractors also in marketing has been of big importance for their present standing in international defence markets, since Kongsberg itself is lacking strong marketing and sales resources. The fact that 25 per cent of its export incomes derive from the US market evidences the importance of these relations (cf. Annual Report 2006). The cooperation with Raytheon has been of particular importance for KV/Kongsberg. Raytheon is among the leading American defence contractors. It has an impressive track record in this respect including World War II projects and the Apollo project. Raytheon has also been successful in converting defence technology for use in commercial markets, one example being the invention of microwave cooking. In the 1990s it aggressively participated in the US Defense Reinvestment and Conversion Initiative, a set of programs in the Departments of Defense, Energy, Commerce, and Labor to stimulate commercial-military integration. As an outcome of these government programs participating firms became more entrepreneurial internally, creating new groups to facilitate cross-over of expertise. Today Raytheon comprises companies such as Texas Instruments and Hughes Aircraft among others (www.raytheon.com, Markussen et al. 2003).

In 2005 Kongsberg signed a 10-years contract with Raytheon. The strategic cooperation agreement concerns the production, marketing and after-sales services of a mobile air defence system known as NASAMS (Norwegian Advanced Surface to Air Missile System). The system is a resultant outcome of cooperation between the Norwegian Air Force, Raytheon and Kongsberg. Kongsberg supplies the system with decision-support tools and command and control systems, while Raytheon supplies missiles, radars and other equipment. Another important aspect of the strategic agreement is that it opens for several opportunities, one being to develop a system for the defence of civilian airports in the US (Annual Report 2006). This has in fact been the situation since Kongsberg started the cooperation with Raytheon in 1984. An interesting aspect of this cooperative relationship is that it over time has come to include other dimensions than the pure technical one. Kongsberg has also participated in Raytheon's internal programs for continuous improvement activities based on lean principles. At the same

time such educational programs have provided Kongsberg with more in-depth knowledge of the American partner's culture (Annual Report 2004).

A collaborative and reflexive community

The upshot of these event histories is that multilevel collaboration has long been a constitutive part of Kongsberg's strategies and mode of operation. Yet, there is still the question why customer interface innovation has such relevance in the Kongsberg case? The Group itself stresses that it cooperates more than most other firms in their area. If the intensity of collaboration matters, literature supports the relevance of this dimension. Sabel et al (2000:451) state in a study of American automobile industry that collaboration appears to be especially marked among a group of diversified, award winning designers, the so-called *super suppliers* and their customers. The point to be taken is that they *learn more* from their customers without the reliance on vertical integration or elaborate contracts. At this point it is relevant to mention that Kongsberg can show a large number of national and international awards particularly as to best quality and supplier awards, naming Raytheon's Four Star Quality Supplier and the Australian Defence best supplier ever.

For constructing an explanatory model these findings indicate in the first place the relevance of pragmatic learning theory for understanding the nature of global value and knowledge chains. Secondly, the findings relate to the questions whether the formation of reflexive communities constitute a key element in certain forms of learning organizations as referred to and defined as a non-standard firm above (Kristensen et al. 2006), and in this context we could add: what does it take to become a super supplier? A relevant question is then how self-reflexion is created in groups and at the firm level? A key argument of the explanatory model in this paper is that Kongsberg constitutes such a collaborative and reflexive community in the sense that it has internalized an understanding of cognitive possibilities. To substantiate the claim, it will below first sketch how it has changed its identity and mode of governance since its incorporation in 1987, and secondly the role the KV legacy has played in this context.

After the restructuring in 1987 a main exercise has been to change its identity from being an industrial to becoming a technology company. In their own wordings they were increasingly replacing 'iron and steel' with high tech products. A contingent event, the end of the Cold War, kicked-off a decision that has had wide ramifications.⁷ Due to the new international situation investments in defence technology were to be strongly reduced. The company subsequently decided to enter on a strategy that would make it less dependent on the defence market. In addition to defence it decided to include the development and sales of civilian products, first and foremost products within space and maritime information technology. The expansion was realized through acquisitions. These new areas represented an unrelated diversification, but since the former state company had been into both earlier, Kongsberg could somehow draw on this experience.

Deliveries to defence institutions mean negotiations with political authorities to a large extent. Deliveries to civilian markets imply that a company has to pay more attention to profits. By being publicly listed on the Oslo Stock Exchange the Group at the same time aimed at internalizing a new dynamism and thereby changing the corporate culture to become more

⁷ The following account of events is to some extent based on Lågendalsposten 22.11.1991 and Jubileumsavis for Kongsberg 1987-1997.

profit oriented.⁸ The Group used this institutional arrangement to introduce a share and option programme for employees. This was an instrument intended to increase employees' sensitiveness to the principles of shareholder value. Regularly employees are offered to purchase shares at a 20 per cent discount, and options corresponding to half the number of shares purchased is allocated to all those taking part in the programme (Annual Report 2006).

The change of identity entailed a change in its business model and logics, and the Group started to name itself a customer and market based concern. This in turn involved a change in the internal skill and role matrices leading partly to layoffs and partly to hiring new workers in order to recombine employees. Layoffs and recombination have also been driven by the 'make-or-buy' dilemma. Kongsberg started to outsource activities, and to buy standard products and components when possible. Within ten years the number of employees directly engaged in production processes was halved, and by 1998, 59 per cent of the work force consisted of engineers/technicians with a secondary or tertiary education. The trend towards focusing on design and engineering as core activities has persisted. In 2006 engineers and technicians' share had increased to 72 per cent of the work force whereas operators accounted for only eleven per cent (Annual Report 2006).

Yet, a further alteration took place with the change of identity and acquisition of a new business area. In 1997 a new main organizational principle was established: the decentralization of decision-making and functions. The acquired subsidiaries like Simrad and Norcontrol, which make up a substantial part of Kongsberg Maritime, were rendered a relatively free mandate to develop their own products. They were also given the responsibility for own purchases. However, the head office put forward one condition: cooperation between the Groups' various units in order to allow 'technology to flow freely' (Hattestad 1998:42). R&D activities were likewise decentralized. Previously, this kind of activities took place in one central department. With the new concept R&D activities were transferred to so-called product groups that were organized around a sort of core technology. These product groups, or teams, consist of members who are respectively responsible for marketing, project calculation, securing quality etc. However, a part of the centralized department of R&D was kept. This was responsible for the development of new products, and in this endeavour interacts with the various product teams (Fraas 1999:58).

The role of the central R&D unit at the same time demonstrates the Group's commitment to long-term technology development, and also how cross-project knowledge is safeguarded over time. Typically, successful breakthroughs are often based on applying technology in new ways. During the investigated period the Group has devoted about 10 per cent of operating revenues for the development of new products, an investment level it considers necessary for achieving a sufficient, modern and cost effective product portfolio (Annual Report 2006). However, also as to long-term development the Group is able to profit from cooperation with customers. Roughly about a half of investments are customer-funded. But although a central R&D unit is responsible for developing new products, development projects are carried out in cooperation with research institutes and involves researcher training, among other things. Long-term development work also takes place with customers. One such example is the development of the autonomous underwater vehicle Hugin. This started as a collaborative project with the Norwegian Defence Research Establishment (FFI), Norwegian Underwater Intervention, and Statoil in 1995. The project represented a continuation of a small underwater

⁸ The main motivation for the public listing on the Oslo Stock Exchange was to get access to external capital. Through the public listing the state ownership was reduced to comprise just above 50 per cent of its shares. Hydro was used as a model when the company was restructured.

vehicle developed in the mid- eighties. Today the Hugin concept is a leader within this market niche (Annual Reports).

Through various strategic decisions the Group has transformed itself to the extent that it can be defined as non-standard firm: it is an open and decentralized organization with a high degree of delegation of decision-making in which the team constitutes the fundamental unit. Typically, the organizational structure is subject to constant alteration, but over time changes have been directed towards creating a less formal structure and at the same time gearing the organization more towards problem-solving. The dismantling of a bureaucratic structure is also evidenced through the shrinking share of employees with bureaucratic functions. Since the mid-1990s this share has shrunk from about one quarter of the total work force to 17 per cent today (Annual Reports). Reflections on organizational structure stem from overall strategic considerations that the Group is constantly exercising: How to make its way up the value chain, and increase its share of the value added? What are we really good at? Currently, one way is to develop products and systems that are interrelated and indispensable for the end user. This is a slight trend away from the logic of supplying only sub-systems, and implies somehow a redirection towards proprietary products containing a high degree of complex knowledge. It is marketing the sales of taylorized products, but is at the same time pursuing a policy of using a basic product that is adapted. However, this orientation does not imply less collaboration. On the contrary, complexity increases the dependency on external knowledge sources. The firm takes that access to further and more varied technology milieus internationally will become more significant in the future. Such a direction still demands increased flexibility within the organization. As a step to cope with these challenges the Group, among other things, is focusing on a better exploitation of cross-divisional resources and technology (Annual Report 2006, interviews). These steps also involve changes in the organization of work, which will be dealt with after tracing the sources of a reflexive and collaborative community.

The KV legacy

It is worth while noting that the Group itself also highlights this dimension in its self-presentation: 'Transformative power is one of our competitive advantages', 'Facing challenges, breaking new paths and cracking conventional wisdom allows us to keep on' (Annual Report 2003, Annual Report 2000). A key issue is how reflexivity is fostered? How to develop organizations that are open for the unlikely innovation and the unexpected to happen? To account for this dimension in the present case, we have to turn to the KV legacy. In that period the design of governmental research programmes kicked-off a distinct pattern of innovation, as described above. An important point of departure was the division of labour between participating actors. Research institutes were to provide knowledge and new technology whereas KV was commissioned the task of finding practical application of new technologies. In these cooperative relationships KV managed to identify its own shortcomings, and from this action of self-reflection defined its own role and tasks. Being a player in cooperative game has certainly facilitated reflexivity, but the corporate culture that evolved within KV itself has strongly supported this dimension. There is a magnitude of accounts telling about its creative and 'mad' culture. In development projects new ideas were highly welcomed. The CEO could give his blessing to even 'crazy ideas'. At the same time employees were told only to cooperate with the best, never the next best, and never to underestimate themselves. In fact, it was KV's overall strategy to systematically search for new areas to make use of acquired knowledge and skills, and through new projects stepwise

upgrade knowledge and skills. Collaborative projects was a strategy in which KV started as the underdog and came out as the super dog, as a former CEO phrased it (Dahling and Erlandsen 1999:18, Fraas 1999:58, interviews).

Another factor that has sustained and reproduced the reflexive dimension relates to the type of firm it was and is. It is a project based type firm, prevailing in sectors such as engineering. Today, this kind of organization is by some seen to heralding the development of a new 'logic of organizing' (cf. Whitley 2006). The fact is that this type of organization has been around for a long time, as we also know from the present case. Nevertheless, project based organizations are seen to provide firms with a higher degree of innovativeness and effectiveness in dealing with complex tasks due to their greater creativity and experimentation, higher propensity to change, higher speed and efficiency of task accomplishment and greater risk taking. In other words, they come close to what above is described as a non-standard firm. What we at least can deduce is that frequent job shifts lead to the mastering of an increasing number of roles and skills. This mastering can occasion deliberative role-taking and the construction of new role-matrices. The interactive social character involved in frequent job shifts better enables organization for searching and reflecting on their own role.

A flexible work organization

There is no well-established definition of a flexible organization, but in a comparative study of flexible enterprises in the Nordic countries at the end of the 1990s, four indicators were listed to identity flexibility: the use of teams, organized job rotation, wage flexibility in addition to the most important features, namely delegation of responsibility and the presence of organized human capital development (Nutek 1999). These indicators fit well with the more recent definition of discretionary or learning organizations in which task complexity and problem-solving is listed in addition to autonomy, learning, and teams. Kongsberg fits well into both categories. Work has always been team based and the company as well as its predecessor have delegated responsibility to a large extent. Even young engineers travelling the world were rendered wide ranging responsibility in decision-making. For the engineers it appeared as a matter of fact, 'something like we just do it without thinking about'. However, in this way both decision-making and implementation could take place at a speedy rate. The tradition of team work and delegation does not imply that the internal organization has not changed or adapted to changes in overall strategies and corporate identity. Competition and increased pressure to reduce costs and increase margins have put pressure on the organization.

This has been particularly felt in manufacturing. In addition to considerable layoffs, the work organization has gone through considerable changes. A fundamental change involved the cross-over from universal production to production cells and to data-based steering-systems. In fact, KV had been a front-runner in this respect when cells were introduced in the jet engine division in the late 1970s. At the same time as operators had to adjust to new technology they were faced with continuous and increased pressure to improve productivity in order to be more cost efficient. The local trade union described the transformation to have been tough, but, in line with the overall policy of the Trade Union centrally, participated and cooperated in changes. The transformation as well as the technological development led to training and further education becoming an important item on the agenda in industrial relations (Dahling 1996).

In 1998 the company established the Kongsberg School, an initiative to map and develop the company's knowledge and competence. The School's task is to organize and coordinate courses and education for employees, to systematically upgrade the company's knowledge and competence (Annual Report 1998). The Kongsberg School is an important policy instrument for facilitating, streamlining and co-ordinating courses and training activities throughout the corporation. The company carries out an active search for qualified management talents throughout the Group, and run tailor-made management development programmes. When hired new engineers receive a six months training programme at Kongsberg whereas operators get an equal on-the-job training.

Practices in project work have likewise been subject to alteration and new tools have been introduced to improve efficiency and quality such as bench-marking and 'best practice'. To ease cooperation several types of data systems are used, one being to increase the visibility of co-workers knowledge and experience across the entire organization. To improve software development the company has introduced the Capability Maturity Model (CMM), the world most used tool for process improvements. Through the cooperation with Raytheon the Group has been introduced to lean methods, as mentioned above. In project work iterative development is employed which allow the teams in a pragmatic way to monitor and assess each phase of a project as well as its totality (Annual Reports, interviews).

Currently the Group is experimenting with creating improvements with 'agile' methods. This experimentation is linked to a national project, and is tested in Kongsberg Spacotec to improve software development. The method is based on employees working in 30-days cycles with 15 minutes project meeting every day, and a four-hour meeting every month that is also attended by the customer. The system allows swift responding to any changes ordered and to deliver accordingly rather than in accordance with contract specifications. Currently, this method is used in two pilot projects, one being the modernization of NASA's ground stations, and the other an in-house product development project. The method increases the visibility of participants and facilitates communication. It focuses more on results rather than methods, and is based individuals' action and the interaction between them. Another important dimension is the principle that change are normal and that participants can make changes into a useful process (Annul Report 2006).

Changes in the work organization have been supplemented by a break down of the social division of the work force. All employees are enjoying the same working hours, and the same sort of employment contract. Moreover, operators and engineers are encouraged to work together, particularly in pilot projects. Such efforts have been met with enthusiasm, and operators are contributing to improvements and innovative alterations. However, increased collaboration across all sorts of boundaries represents a challenge despite the company's long track record in this respect. At the same time the Group and its employees realize cooperation increased importance, and the company has initiated its own education in project organization. The team leader picks the co-workers he wants to join the project, and project work starts with team building where people as a start get to know each other. Group discussion is used to solve problems, and team members are supposed to encourage each other. Project teams may be composed of employees from all the sub-units worldwide. Shared knowledge, shared responsibility and shared reporting constitute important dimensions of project work.

With increased interaction issues such as how to talk to others and to work and function with others are moving to the centre stage as a future challenge. In 2002 and 2003 the Group

devoted a lot of work to understand conditions underlying collaboration in projects. A method of story telling was used to identify relevant experience. The lessons from these exercises were codified and taken back to the organization. A method for monitoring cooperation and learning in projects was subsequently developed. The Group considers the potential for learning in cross-divisional projects and in customer-supplier relations still to be high. It is an issue how to systematically learn across units (Annual Report 2004). The last initiative to improve collaborative challenges is the introduction of a master degree in system engineering at the local college. This initiative has been launched in cooperation with other former KV firms and local institutions, and form an important part of their common Centre of Expertise project co-financed by the government. System engineering is about the ability to use different technologies to create a unique product. But it is also about how people can work together.

Globalization strategies

Kongsberg's path abroad reflects the main stages of its development. A first step in its internationalization process was exports. In 1995 exports accounted for approximately 40 per cent of total turnover. In 2006 the export share has increased to more than 70 per cent, and it is taken to increase. With increased sales abroad Kongsberg's customer approach has become pertinent. Follow-the-customer strategy has led to increasing foreign direct investments. The customer strategy has also been determinant as to the geographical distribution of investments. Its main foreign operations are in the UK (gas and oil), South Korea, Singapore and China (maritime), the United States and Canada (defence and maritime).

In setting up new operations abroad Kongsberg is making use of its collaborative approach both vis-à-vis local partners and in their own work organizations. Design is based on team work and the system for project based work developed in Kongsberg. Start-ups in foreign units are led by a Norwegian, and all employees are given an education in its system for project based work, and the team are composed of employees from all parts of the world. In this way engineers acquires work experience from all parts of the world, and learn how to adapt to and deal with a large variety of cultures and institutional settings.

Due to nationalistic industry policies in certain countries such as South Korea and China, Kongsberg has joined forces with local partners and established legally independent companies. Together with Hyundai Information Technology it founded Hyundai Kongsberg Maritime (HMK) in South Korea in 1999. In 2003 HMK merged with a South-Korean service company and Kongsberg Maritime Korea (KMK) was established in stead. Its goal is to become the preferred supplier of maritime electronics in South Korea, the leading country in ship-building. Currently KMK has a market share of about 50 per cent. The same strategy is pursued in China and Singapore. In China Kongsberg has established a new company, Kongsberg Maritime China, together with a local player, Hoi Tung Marine Equipment. In all these countries the aim is to become the preferred local supplier (Annual Report 2003 and 2004).

Currently, a change in its globalization strategies is about to take place. Foreign engagement is now also directed towards the acquisition of complementary knowledge and what is found to be necessary expertise. A second dimension concerns access to qualified work force due to a tight labour market in Norway. An increasing part of new employees are recruited abroad. In 2006 45 per cent of new employees came from outside Norway. In this respect India has

become of importance. Kongsberg has already established itself in India, which also has an emergent maritime sector, and as the Group phrase it ‘to be present in new markets, represents market power’. India is important because of a highly qualified work force, and Kongsberg runs software development there. .

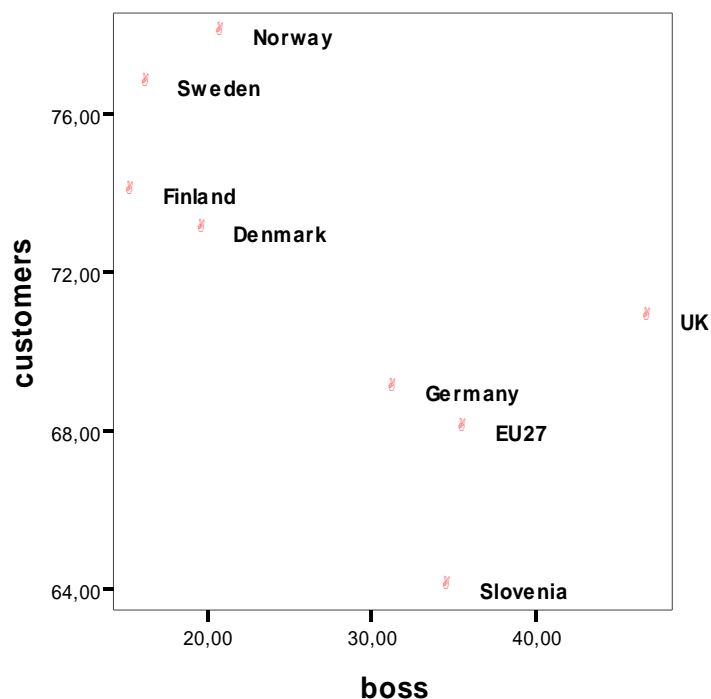
National institutional arrangements

Institutional conversion and layering

Considering Kongsberg’s institutional context, it clearly differs from the ones in Finland and Sweden. Typical of both the Swedish and Finnish patterns is that national policies have facilitated a strong interaction between business, research and politics, the so-called Triple Helix model. As graph 2 below evidences, the university sector plays a minor role in firms’ R&D activities. Lacking this sort of institutional support it has been a puzzle what sort of institutional arrangements have enabled Norwegian actors to tackle global challenges. As the

**Nordic countries, Slovenia, EU27, UK
and Germany:
Pace of work depends on
direct demands from customers..
monitoring of boss**

Fourth European Working Conditions Survey



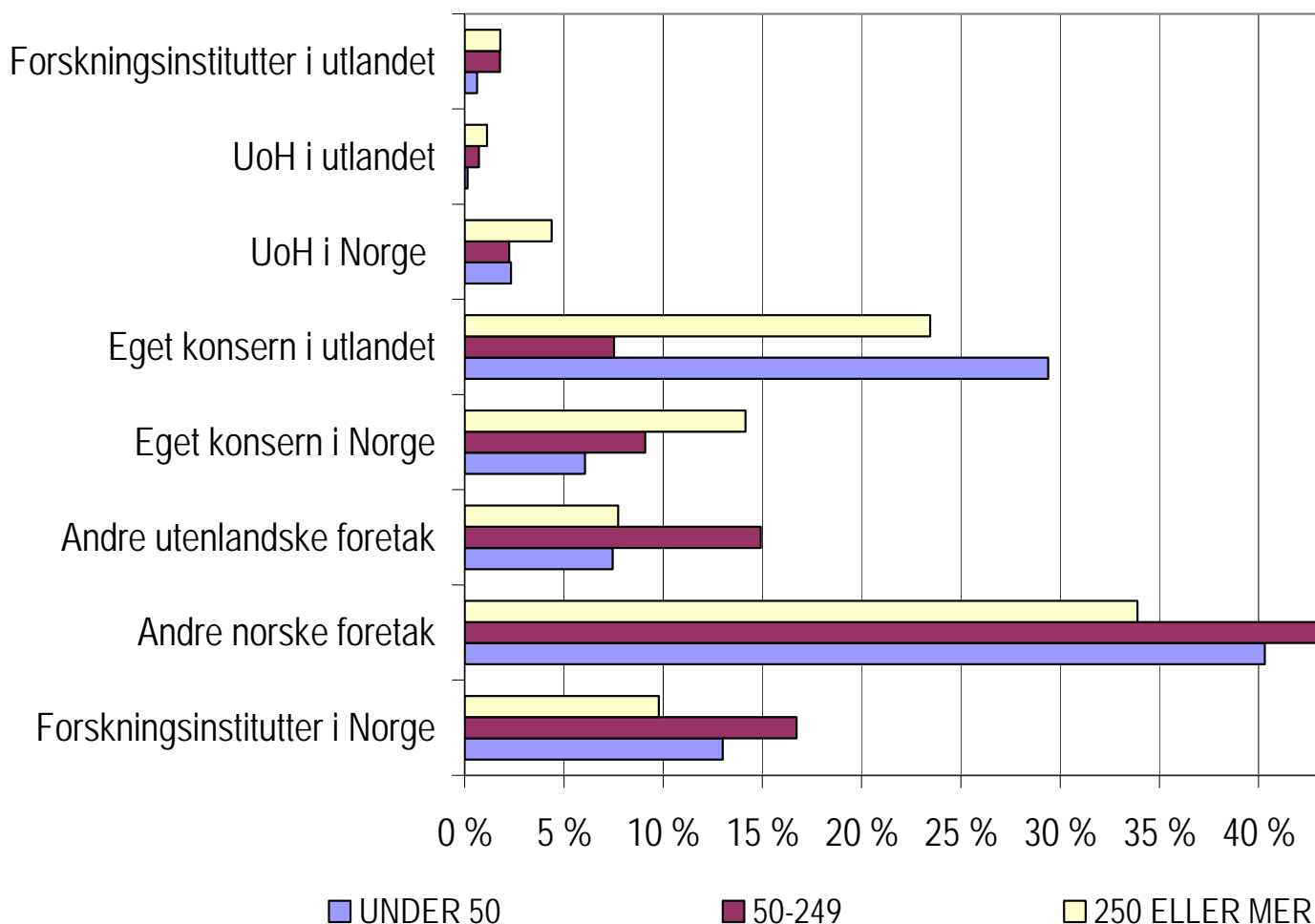
Graph 1

Kongsberg case shows an important dynamism is found in customer-supplier relationships. Through collaboration with ‘world-class’ partners Kongsberg has been able to upgrade knowledge not only to a state-of-art level, but also to become a frontrunner in certain

technologies. EU's latest survey on working conditions confirms this finding. Customer-supplier relationships have a special relevance in the Nordic countries, see graph 1. In this respect they perform far above the EU average, and among the Nordic countries it is also interesting to note that Norway has the highest score as to customization, a position indicating a Norwegian distinctness. The EU's survey figures thus support the relevance of the Kongsberg case, and its customer interface innovation approach.

What should be stressed is that inter-firm relationships are not restricted to customer-supplier relations, but they include also supplier-sub-supplier relations. National figures show that inter-firm relations mostly take place at the national level, see graph 2. This is most likely a result of the increasing use of sub-suppliers. For example, Kongsberg's external division of

Graph 2. Norwegian Firms' R&D Purchases, 2001



Source: Nifustep 2006.

labour has led to an impressive amount of sub-suppliers. With its increasing focus on engineering and designing, production and other tasks have been increasingly outsourced. Today Kongsberg interacts with 3000 sub-suppliers, of which three-quarters are located in

Norway (Annual Report 2006). The extent of this type of division of labour is well illustrated by the new contract for the production of Naval Strike Missile (NSM) for the Norwegian Navy's new frigates and missile torpedo boats. Production will run until 2014, and will ensure employment for 200 to 250 individuals in Kongsberg and nearly 120 sub-contractors will get assignments as a direct result of this contract. In addition to subcontractors in Buskerud County, the contract will generate considerable activity in Akershus and Oppland counties (www.kongsberg.com).

Moreover, considering Kongsberg frontrunner role in global value chains and the fact that it interacts with 2 to 3000 firms at the national level as a part of its production system suggests that Kongsberg is playing a facilitating role in the national innovation system. Being a sub-supplier to a knowledge intensive firm means the constant upgrading of knowledge in order to meet specification requirements. This trend can be quite salient in certain regions where sub-suppliers based on similar technologies co-locate, as figure 1 is demonstrating. Over 70 per cent of Kongsberg's sub-suppliers are located in the wider Oslo-region, and along the eastern part of the south coast. Many of these firms are spin-offs of former industrial enterprises, including Kongsberg itself. The implication of this division of labour is that one also has to take the transnational level into consideration in order to catch the dynamism of current innovation patterns. Super suppliers in global value chains can boost development of a whole sector at the national level.

The point to be made is that this emergent pattern represents a rupture with the national business system in Norway. A feature characterizing the traditional system was a low degree of strategic inter-action across boundaries, i. e. both cross-sectorally and in inter-firm relations. This was a salient feature in the previous pulp and paper industry. Rather than joining forces for modernizing the production system, firms preferred to maintain the control and coordination of resources within the boundaries of their own unit. Failure to coordinate across independent units prevented modernization with the resultant outcome that most firms succumbed (Moen 1998). Other studies also support the lack of inter-firm cooperation in Norway (Rynning 1993). The low inter-action between business and universities also demonstrates the compartmentalized nature of the national business system as is the case also between the public and the private sector. However, there are regions where compartmentalization has been broken. One such example is the shipbuilding industry at the north-west coast of Norway where structural changes in the 1960s led to a new division of labour between the various shipyards. Interestingly, the new regional production system here was facilitated through the cooperation with research institutes linked with the Technical University in nearby Trondheim (Andersen 1997).

From an institutional perspective the intriguing question is how the emergent pattern of inter-firm relations has been brought about? In this respect the sector factor is decisive. Kongsberg is supplier to two of Norway's most important sectors: maritime and gas and oil. Particularly gas and oil stands out. In offshore technology Norwegian actors are leaders. There is also a high degree of intra-sectoral activities in gas and oil, and to external observers the Norwegian oil and gas sector stands out for being a community that collaborates well. This cooperation is facilitated through several institutional arrangements of a corporatist nature. But it is not a sort of corporatist arrangements connected with what was termed the nationalistic project initiated with the discovery of oil in the North Sea. The nationalistic project was dominated by distribution games and was dismantled around 1990.

By contrast the new institutional arrangements are characterized by both collaboration and competition, and they evolved from various situational contexts in which both top-down and bottom-up initiatives converged. The oil price collapse in 1986 and the changing nature of the oil fields in the North Sea induced a new understanding of the future prospects of Norwegian oil and gas production: a viable future was to be based on technological development. This has since been the state's policy and the Norwegian oil companies have been sensitive to their owners' point of view. This understanding together with the introduction of co-designed projects between the oil companies and their suppliers turned the North Sea into an experimental laboratory for technological development. The fact that Norwegian oil companies and large Norwegian suppliers converged on the idea that development projects should be delegated to only four large system suppliers instead of the oil companies controlling and coordinating the activities of a large bundle of suppliers, was imperative to the co-designed pattern that evolved on the Norwegian shelf. The Norwegian shelf is unique in coordinating technological development in this way. On other oil fields the oil companies still carry out detailed control and coordination (Tore Halvorsen 2007, Harald Norvik 2007).

However, the sectoral interaction does not involve direct financial support, and the extent of tripartite risk sharing that has taken place up till now, could said to be more of a symbolic value. To support technological development at an early stage the government through the Research Council runs a programme targeted at pilot and demonstration projects. It is based on a model in which risks are shared between the government, the oil companies, and the supplier firms. An important goal is to increase the visibility of Norwegian firms and technological solutions abroad. To assist internationalization a new organization, Intsok, was created in 1997. It is a partnership between the oil authorities, industrial federations, oil companies and supplier firms.

Another key instrument in the new institutional set-ups is KonKraft that is headed by a so-called top leader forum. Members are the Minister of Oil and Energy, several representatives from the Ministry of Oil as well as from other Ministries' bureaucracy, the CEO of the Oil Directorate and other state agencies linked with the oil sector, representatives of the Federation of Norwegian Industries, the Federation for the Oil Industry, the Norwegian Ship-owners' Association, the Trade Union centrally and other relevant trade unions, the Research Council of Norway, research institutes as well as CEOs from oil companies and supplier and service firms. Through regular meetings, seminars, conferences both at the national and international level representatives from these organizations and institutions keep up a strong and dense communicative activity. Moreover, this sector represents the first one to be based on high tech products and services.

What could be termed both a technological and a business revolution can be characterized as the result of a co-constructed process. This co-constructed process has led to a new export growth industry based on high tech, and at the same time has brought Norwegian technology to the forefront globally. Norway's offshore sector has become a node in the global offshore industry's innovation system. As spelled out above innovation occurs as a co-designed process and risks are shared between customer and supplier. Yet, the communicative corporatist arrangements play an instrumental role in these processes through the dissemination of information and through creating visibility. Their core function is nevertheless that they connect multilevel actors, create a common understanding of the situation, and make the various actors mutually recognize each other. 'The fighting cocks are brought together and have to come to terms with one another', as a member of the Forum phrased it. In other words, the various social arenas developed within the gas and oil

sector have paved the way for inter-firm relationships. The importance of this sort of multilevel interaction for improving their own standing is recognized by Kongsberg, and the Group actively participates in various fora, programmes and interest organizations (Annual Report 2005).

Kongsberg has also profited from being a supplier to the Norwegian Armed Forces. This kind of public investments makes it possible to develop products that would not have been possible through self-funding. About 45 per cent of defence contract investments are allocated to Norwegian contractors. The Naval Strike Missile (NSM) project is a case-in-point. It is one of Norway's most advanced development projects and has lasted for more than ten years. Kongsberg Defence and Areospace concluded the contract in 1996 with the Norwegian Navy, and the development work, which has produced the most advanced missile of its kind and represents a radical innovation, has taken place in collaboration with the Norwegian Defence Research Establishment (FFI) in addition to the Navy. The first contract for serial production was made in 2007, and is the largest contract Kongsberg ever has landed (Annual Report 2006, www.kongsberg.com).

The system of industrial relations and labour market policies

Firms in Norway are also profiting from other sorts of risk sharing. More generally it is taken that the universalistic welfare state arrangements with certain rights create a sort of security for employees. Education is free, and one can experiment and move relatively freely between places of work without jeopardizing one's own pensions, health insurance etc (Dobbin and Boychuck 1999). In cases of layoffs firms can make use of an early retirement system or assistance from the local Labour and Welfare Organization to solve unemployment. As in the case of Kongsberg firms may also use their network contacts to explore employment opportunities (Annual Report 2004). Thus, the welfare system facilitates the restructuring of firms, which often is required in order to adapt to globalization challenges, as we also have seen taken place in the case of Kongsberg.

However, equally important is the way political-ideological interests of the trade unions have co-evolved with changes in working life. How to create a new understanding of the New Economy? It is taken that what happens at each separate workplace is interwoven with similar processes among a large number of actors and organizations (Gustavsen et al. 2001). The question is, how is a supportive context created? In this respect Nordic trade unions are seen to have sought an active role, and it is claimed that Nordic industrial relations institutions contribute to competitive innovation. Technological and organizational change has strong legitimacy and is seen to secure places of work in the long-term perspective.⁹ In the tripartite programme initiated around 1990 in Norway, the so-called Enterprise Development 2000 (ED 2000), the main purpose was to link research resources to cooperation between the parties in the labour market in order to make cooperation instrumental for development, change and innovation. The focal point was on involving all concerned, generally referred to as broad participation (Gustavsen et al. 2001).

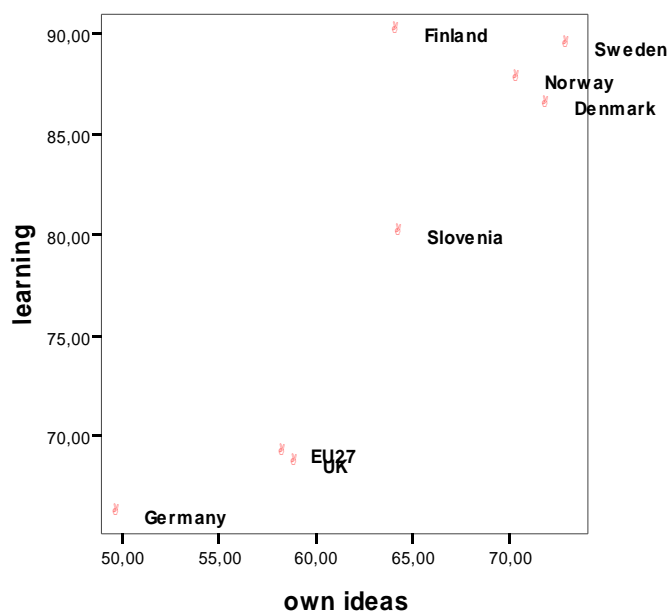
⁹ Another aspect of the trade unions' positive attitude to change is that they represent a balance-and-check to the Norwegian Labour Law, which renders employees a high degree of co-determination as to changes in the definition of work tasks. In comparison with the other Nordic countries Norway is seen to have a high degree of co-determination in this respect.

In summing the ED programme, which included about 3 – 4 per cent of the employees in Norwegian industry, the authors could find no evidence that the experiences had disseminated to any significant degree to other parts of Norwegian industry. The conclusion was therefore: 'still much to be done' (Gustavsen et al. 2001:47). The finding of a low degree of workplace changes was consistent with the comparative study of flexible enterprises in the Nordic countries commissioned by the Swedish National Board for Industrial and Technical Development in the late 1990s. The comparative study showed that Norway was lagging behind the other Nordic countries as to flexibility (Nutek 1999). Findings from the last European Working Conditions Survey indicate that this state of affairs has changed.

Graph 3

**Nordic countries, Slovenia, EU27, UK
and Germany:
Generally, does your main paid job involve
learning new things ..
You are able to apply your own ideas at work**

Fourth European Working Conditions Survey



The EU's Fourth Working Condition Survey published in 2007 shows that all the Nordic countries, including Norway, score highest as to learning and work autonomy, i. e. being able to use one own ideas, see graph 3. The graph also shows that the Nordic countries in this respect form a group of their own in the EU context. Moreover, the recent survey indicates that Norway has caught up as to workplace changes. Other data also indicate processes of change in Norwegian work organizations and that Norwegian working life has become more flexible, and likely also more innovative. An OECD study (2004) shows that 46 per cent of all employees in Norway are receiving training or further education. These costs are paid by the employer. This share is the highest among the OECD countries, but Denmark, Finland and the UK come close to the Norwegian figures. How, why and to what extent these changes have

taken place is still unresearched. Are they a result of benchmarking, increased reflexivity or other initiatives? The decentralization of industrial relations and the emphasis on the articulation of local interests within the nationally centralized structure of decision-making is taken to have been of importance in advancing a new production concept. Generally, increased reflexivity in working life is seen to have an internal restructuring effect in addition to transnational benchmarking. The ability to monitor one's own work from the perspective of the competitiveness of the company or production unit is giving rise to a new concept of production, in which the production processes and the workers themselves are supposed to be able to reflect the needs of the customer. In this new concept we can discern new roles and identities, new working careers and professional identities, creating new possibilities of development. The losing significance of separate organization of professional employees also contributes to a new conceptualization (Kettunen 1998).

Conclusions

Viewed against traditional variables such as investments in R&D, innovation scores, and patenting the Norwegian economy appears as lacking dynamism and the characteristic features of being knowledge based. An in-depth study of a global competitive Norway based MNC contradicts the sticky image. The findings from the present case study together with other relevant statistics and information make it possible to sketch a different picture. Key parts of Norwegian business demonstrate a high degree of dynamism and a high degree of adaptability vis-à-vis the globalized economy. A first salient finding is that the pattern of Norwegian dynamism differs from the one in Finland and Sweden where science and business relations, the so-called Triple-Helix model, form an important part in firms' innovative activities. What could be called a gap in the Norwegian system is compensated for by the fact that innovation and learning takes place in close collaboration with competent customers and business partners. National figures support the relevance of this case study finding. Inter-firm cooperation at the national level constitutes an important element in firms' upgrading processes. However, in this respect the Kongsberg Group slightly deviates from the overall Norwegian pattern. As to innovation and learning the global level matters more than the national one and this dimension makes Kongsberg highly relevant to inform us about ongoing dynamics in Norwegian business and how parts of the Norwegian economy are directly confronting the global economy.

The paper reveals that Kongsberg's global horizon of action predates the globalization period. This mode of operating is stemming from Kongsberg's predecessor company, the state-owned weapon factory, and its assigned role in the government's technology policy strategies in the 1960s and 1970s. Its prime task in this respect was to develop practical application of new technologies. To solve this task the then state company entered on a strategy of intimate cooperation with customers since it lacked application competence. At the same time offset agreements made in relation with defence investments and the fact that Norway was a member of NATO represented a gateway for the state enterprise to establish cooperation with world class partners abroad. Through various projects knowledge and skills were stepwise upgraded. Thus, there is a direct link between the technology policies of the 1960s and the 1970s and the global visibility of Norwegian companies today. After the privatization process the highly specialized labour market created in relation to the state company's innovative role has been a driver in the globalization of the successor companies.

But to understand what Kongsberg has achieved at the global level, we need a model where globalization is conceptualized as a game of constant redefinition of mutual roles. This has been done in this paper. Kongsberg has in its own wordings described its transformation as a process of moving its core activities to the higher end of the value chain. But characteristically the transformation of its business model has taken place as a co-evolved process with customers: Kongsberg has transformed itself from supplying customers in accordance with given specifications, to learn from the customer, to finally teach the customer. In this perspective it appears as globalization has provided windows of opportunities for a company that could profit from an early start in developing capabilities for multi-level cooperation. By being linked to 'world class' customers and partners small Norwegian MNCs and Norwegian subsidiaries of foreign MNCs have through pragmatic collaboration been able to become global leaders in several market niches.

The second important finding is thus that Kongsberg's achievement is linked to the type of firm it has developed into and that this type of firms appears to thrive in the changing context of the globalized economy. By being able to adapt to changing external rules, it has reshaped its own internal organization. In the process of changing roles and identity Kongsberg has developed into a highly flexible and a learning form of organization. Its organization can be described as open and decentralized, decision-making is delegated to a high degree, and teams form the key coordinating unit. In addition the social division of labour has been broken down to a large degree. This type of work organization in which co-workers are capable of fast role shifts provides a high degree of agility, and its capacity for quickly re-combing skills and knowledge makes it highly adaptable to customers' varying needs. Another characteristic feature is a systematized educational program for employees. On the one hand, these extended programs represent an internal dynamic complementarity for supporting improvements and innovation in this type of firms. On the other hand, they represent a substitute for a weakly developed Triple Helix model in the Norwegian system. The paper has also stressed that the latest European Working Conditions Survey (2007) supports in a way the relevance of this type of work organization in Norway as for the rest of the Nordic countries. According to this survey learning types of organizations are most widespread in the Nordic countries and the Netherlands. More significantly for the relevance of the Kongsberg case and corollary for explaining the nature of the dynamism of the Norwegian economy is that a recent study demonstrates co-relation between the degree of innovativeness and the learning type of organization (Arundel et al 2006).

A further dimension in this paper is the question whether Kongsberg has been able to strategize with and made use of other local and national resources, and the study shows that different institutional arrangements has facilitated processes of learning and innovation. During the transformation of its business model Kongsberg's need of acquiring expertise, products and services externally has increased. This new division of labour has had implications: it has induced a stronger inter-action with sub-suppliers. To the extent these sub-suppliers also participate in developing and designing projects for customers, they can be said to constitute a dynamic complementarity in meeting customers' complex needs. In this sense Kongsberg and similar types of flagship firms represent a mediating mechanism between the global and the local. Moreover, in a national business system perspective this sort of inter-firm activity represents a novelty. Traditionally, strategic cooperation between autonomous units has proved to be a hardship. But the strength of this dynamic complementarity and its present and future potential for developing globally competitive innovation by combing knowledge at the national level remains to be seen.

Although more indirectly, a facilitating factor for both internal change processes and inter-firm activities is also found within the system of industrial relations. Tripartite funded programmes initiated by the social partners have as an objective to make cooperation instrumental for development, change and innovation in firms and between firms. Thus, these institutional arrangements are one factor found that support firms' upgrading. Yet, another type of supporting institutional arrangement is the reinvention of a corporatist arrangement within the oil and gas sector. Different institutions in this field have clearly smoothed the progress of multilevel collaboration. At the national level what is here termed communicative corporatism has created a common understanding of the involved partners' situation, and made them mutually recognize each other. This mutual recognition provided the basis for changing the technology and turning the Norwegian Shelf into an 'experimental laboratory'.

An important reason why traditional macro-statistics have failed to capture how learning and innovation is actually taking place in the Norwegian economy is linked with how these processes are organized and coordinated. Current statistics are based on the behaviour of the Chandlerian type of firm in which innovation processes are conceived as being linear and closed. In recent accounts of the globalized economy innovation is on the contrary described as open. Open innovation takes place as collaborative processes across all sorts of boundaries: professions, intra-firm, inter-firm, and nations. It takes place as continuous and simultaneous processes. Operation, improvement, product and process innovative work occur simultaneously. One issue is how to separate and distinguish one task from another and in this way identifying and quantifying innovation. Another issue is that actors themselves do not readily realize that everyday operations represent improvement and innovative work. Thus, to explore and explain learning and innovation in the globalized economy we at this stage have to make use of qualitative, in-depth case studies. For further research two issues appear relevant: a further investigation of learning processes at the global level and as multi-company relations, and potentials and limitations of complementarities at the national level in the shape of system supplier – sub-supplier relationships.

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