

Norway

Entrapped by the Refinement of Raw Materials

or

Saved by a Growing Periphery of Innovative Agents?

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1. Introduction: Norway – trapped by the resource curse or moving towards a knowledge-based society?

Norway is performing remarkably well. For several years in a row the United Nations has named Norway the best country in the world to live in (Human Development Reports). The population enjoys one of the highest levels of GDP per capita, an egalitarian distribution of wealth, and generous welfare state arrangements. Yet, Norway is trailing the other Nordic countries in terms of economic dynamism. On the World Economic Forum's ranking lists, Norway has been ranked lowest among the Nordic countries and has most recently dropped significantly behind. The country is ranked very low on international innovation scoreboards (cf. EIS), is blamed for investing too little in R&D, less than 1.7 per cent of GDP which is well below the OECD average, and is less integrated into the globalized economy than the other Nordic countries. Are these indicators symptoms of a nation about to be trapped by the paradox of plenty? Has Norway failed to sustain and develop a dynamic and competitive economy for future challenges?

There is no doubt that Norway owes her wealth to oil windfalls. The petroleum sector accounts for more than one fourth of GDP and for more than 60 per cent of the value of commodity exports. Norway's strong dependence on natural resources is unique in the group of advanced industrial economies. Nevertheless, the political awareness of this state of affairs is high, and the notion of being in control of the situation has allowed the unique resource dependency to develop. Within the system of economic governance a framework of institutional constraints has been constructed for preventing the abuse spending of oil money at home. Over all the economic governance regime sticks to a strict national budget policy: oil incomes are recycled into international finance markets, so linking Norway to the increasing flow of petro-dollars. The result is an oil fund that for the time being amounts to almost \$ 300 billion. Furthermore, a positive balance of trade, no state debt, and low levels of unemployment together with a high level of labour participation is legitimizing Norway's peculiar pathway.

Two sets of factors have helped Norway achieve her unique financial and economic position: in addition to macro-economic regulation, the refinement of core technologies for the exploitation and extension of natural resources. Still, the key issue is whether national

strategies have provided the economy with relevant skills and sufficient transformative power? Investigating this issue does not provide any obvious answer. On the one hand, Norway has abandoned developmental policies, and has been alone in experiencing an actual decline in total manufacturing output among advanced industrial economies. The effect is that the competence base has been narrowed down (Andersson et al. 2004:27, OECD 2007a). On the other hand, the economy is for the time being demonstrating surprising elements of renewal in terms of both productivity growth and the emergence of new science and technology based sectors. Recently, Norway presented the highest productivity level in the world in terms of GDP per hour worked (OECD 2007). Technologically, it has become a leader in offshore solutions, and emergent clusters in ICT and biotech are attracting international attention.

The case is that Norway presents a mixed picture of inertia and dynamism, and from the outside it is not obvious what sort of institutional reforms are triggering a renewal of the economy. Since the 1980s the public sector has recurrently been subject to reforms, although less radical than in the other Nordic countries. This chapter will explore different sub-systems and sectors of the national business system in search for institutional change that enable firms and individuals to initiate experimental activities and to redefine themselves. The point of departure for this search is the case study of a selection of innovative firms. These firms demonstrate both high flexibility and a global visibility, and the inferences drawn from the analysis serve as reference points as to what sort of institutional resources innovative driven firms make use of. How and to what extent do public reforms open for supply oriented services? To what extent have public institutions co-evolved with private partners? The degree of match between institutional resources and ongoing transformation in the international economy will be informative as to how far Norway has moved towards an enabling welfare state.

The next section sketches the traditional Norwegian business system for a review of historical structures and institutions supporting a natural resource based economy. The third section points out key reforms within the economic governance system and the public sector; the fourth section gives an account of the case studies; the fifth section compares institutional reforms in Norway with reforms in the other Nordic countries; and the last section summarizes the present state of the Norwegian business system.

2. The traditional Norwegian business system: the exploitation of natural resources

Through history the Norwegian economy has repeatedly been framed by the exploitation of natural resources: fish; timber; minerals; water power; and most recently oil and gas. For certain reasons business activities have largely been restricted to the export of raw materials and semi-finished products. Within the dual Danish-Norwegian monarchy this role was politically decided: Norway was to generate incomes through the export of natural resources whereas Denmark was given the privilege of developing trade and handicrafts. With the breakthrough of modern industrialization in late 19th century this industrial practice was reproduced. At the time this was not only related to organizational skills and routines, but also a resultant outcome of the then situational context. Since Norway for all practical purposes had been a colony for some hundred years, modern capitalist institutions such as a financial system were under-developed. For example, Hamburg was during the first part of 19th century a financial centre for Norwegian international business.

Lacking an effective finance system, an industrial firm was often constituted as a family owned enterprise, a few large companies except. Therefore, a dominant way of financing industrialization took place through reinvestments and/or inter-firm financing within networks of related families. In the Norwegian context family ownership meant a personalized and strong centralized control. The strong autonomy orientation inherent in this system gave few incentives for risk sharing. Traditional economic practice and the institutional setting for controlling and coordinating economic activities have framed firms' patterns of growth, the scope of business activities, and the nature of cooperative and competitive relations. To put it differently, the combination of bulk business and narrow spans of control has shaped a distinct national understanding of how to earn money: concentration on one single activity, i. e. the processing of raw materials. This practice has been reproduced at critical junctures. The narrow span of control favours organic growth and discourages diversification since external capital or new skills are to be avoided. In this way of understanding business competitiveness is achieved through cost reduction. Moreover, specialization restricts the development of cross-functional capabilities within firms, necessitating the externalization of complementary activities. This form of specialization debar firms from developing a customer orientation and from information about market trends. Lastly, the internalization of risks rules out risk sharing with suppliers, customers, and bankers. Typically, the majority of

Norwegian firms were and still are small and medium-sized enterprises and many of these are life-bread operations.¹

The way firms are constituted impacts on the nature of intra- and inter-organizational relationships as well. Coordination across organizational boundaries has in particular proven to be challenging when it conflicts with owners' prerogatives. For this reason autonomous firms in Norway have often demonstrated an unwillingness to merge and to integrate vertically and horizontally². The bank-based coordination system that evolved in both Sweden and Finland did not take place in Norway, nor the cooperative kind of inter-firm organization of production and distribution typical among small and medium-sized firms in Denmark. However, during the economic crises in the interwar period this governance system was modified to some extent through the construction of sector level coordination. For example in several manufacturing industries cartels were not only allowed but also to some degree encouraged as it was considered 'good governance' (Nordby 1994, Hanisch et al. 1999, Moen 1998). This practice remained unchanged during most of the postwar period.

In the postwar period the national business system was further modified: first by an active state, and secondly through the system of industrial relations. A majority government provided the Labour Party with strong political potential, and its ambition of regulating the economy was equally strong. Under the guidance of leading economists from the renowned Oslo School, leading Labour politicians were convinced that administrative systems for a scientific exploitation of resources could replace the market. As to planning, the Oslo economists took a stronger stance than Keynes. Subsequently, the Norwegian planning economy developed a comparatively high degree of state control, planning, and centralization. In this way the state not only shared risks with business, but took on major responsibility for developing the economy.

Labour's main tool for framing the economic development was politically governed credit rationing and low interest rates. Credits were allocated to politically prioritized projects that included the generation of hydro-electrical power, metal processing and ship building. Tools for allocating financial resources were private banks and over time an increasing number of

¹ By international standards Norwegian firms are rather small. In 1995, 80 per cent of all employees were employed in firms with less than five employees (Moen 2002:61).

² For example, a strong cost focus and lack of risk sharing has led to industrial decline as was the case of the pulp and paper industry (Moen 1998).

different state banks or funds that were to serve specific sectors and aims. In addition to this type of 'selective' industrial policies, the regulation regime developed a wide set of planning tools: ownership or owner stakes in manufacturing companies, the set-up of institutional and corporative arrangements let alone protective measures. Yet, the most prioritized sector in terms of direct financial support was agriculture. This formed part of regional or district policies, a 'sacred' policy area in Norway (Hanisch et al. 1999, Knutsen 1995).

In the aftermath of World War II Labour declared the overarching goal for the economy to be industrial diversification. Due to institutional inconsistencies this goal did not materialize. Labour's Fordist model of industrialization clashed with management's discretion and strong autonomy orientation. The coordination of large-scale operations conflicted with the existing structure of small and medium-sized enterprises. Moreover, Labour's strong ambition of controlling the economy exacerbated latent tensions with a conservative management that feared nationalization. Traditionally, there was weak capacity for strategic cooperation between the state and private business. This state of affairs is linked to a divide in the wider Norwegian society. Through the work of Rokkan (1967) this divide is generally known as the centre-periphery cleavage. This cleavage refers to a dominant centre with access to critical resources and a periphery partly excluded from the same resources.³

The weak capacity for cross-sectoral cooperation impacted on how industrialization processes unfolded. When Labour failed to develop a shared understanding with Norwegian management as to appropriate type of industrialization, the objective of diversifying the economy in cooperation with the private sector was largely abandoned. The pragmatic solution found was a strengthening of the exploitation of natural resources, principally in terms of hydro-electrical power. This strategy was realized by extending the supply of hydro-electrical power, and by either establishing state owned companies or by favouring private ones within the energy intensive sectors such as electro-metallurgy and electro-chemistry. Favoured companies were given both cheap loans and subsidies in the form of long-term contracts for the supply of cheap energy. This type of state-led industrialization was successful and was nick-named 'power socialism' and had strong support among large groups

³ Eckstein (1966:180-1) in his study of Norwegian democracy related the paradox between the salience of segmental cleavages and cultural divergences and an 'overarching attitude of solidarity' to three kinds of behaviour: 'noneconomic (primordial) definitions of human behaviour, non-competitiveness, and great organizability, i. e. the similarity of Norwegian authority patterns because it involves homogeneity in a realm of social experience related closely to political life.

within Labour. By 1970 Norway had become the largest exporter of ferro alloys and the second largest of magnesium in the world, and the second largest exporter of aluminium in Europe

This kind of production system was simple to manage. Typically, companies within the process industries were run with an emphasis on volume and cost reduction in up-stream operations. Production facilities were located in scattered and peripheral areas that gave rise to a large number of mono-industrial towns, a hallmark of Norwegian postwar industrialization. Since a large part of input factors – raw materials and machinery – were imported, state owned or state supported companies developed few ties to the rest of the economy and they functioned more or less as isolated enclaves. Price fluctuations on raw materials and semi-finished products had few socio-economic ramifications. The energy intensive industry employed only about five per cent of the work force, and economic volatility could easily be handled through stock and import management (Moen 2002).

For these reasons Norway developed less institutional arrangements for cross-sectoral coordination such as the bank based coordination system in Finland and Sweden. Instead Norway developed a strong system of intra-sectoral coordination (Hernes 1978), and links between the state and private business assumed rather a clientistic nature than strategic cooperation.

Yet, different mechanisms within the Norwegian political system function to mediate divides. One such mechanism is the Norwegian election system, which is based on a geographical seat allocation favouring peripheral and rural constituencies. Over time this system has created strong inter-dependencies between elites in the polity and the periphery. However, one effect of such inter-dependencies is a mix of different policy areas. Another effect is that competition between constituencies has triggered power games and horse-trading. Typically, these types of political games tend to provide sub-optimal performance outcomes. Another mediating mechanism is the system of centralized wage bargaining. In the Norwegian context this system developed an unusual capacity for cross-sectoral coordination and cooperation. The system of wage bargaining emerged after the turn of the last century, and a peak was reached in the mid-1930s when a general agreement was reached between the social partners centrally.

The strong capacity for cross-sectoral cooperation enabled the system of industrial relations to reform managerial practices and work organization in the postwar period. The institutionalization of co-determination and the principle of local union representation in boards have facilitated reforms in work practice and organization. In fact, Norway was a pioneer in work organization experimenting. In the early 1960s a joint project between the Norwegian Federations of Trade Unions, the Norwegian Employers Confederation, the government, and Norwegian and British researchers was launched as one of the first in Europe. The tripartite programme was called the Industrial Democracy Programme and implemented at the shop floor level. The objective of the programme was to develop new ideas for cooperation and work organization (Gustavsen et al. 2001). Through these trail blazing programmes the trade unions adopted a positive attitude to technological change. For increasing efficiency and process optimization these sorts of cooperative relations have been vital. But also for developing the welfare state the system of corporative industrial relations has been a driver.

At critical junctures work organization experimentation was initiated through programmes for technological development. A technology programme had been implemented after World War II, and it became particularly relevant after Norway joined the NATO in 1949. A minor, but influential, group within Labour wanted to use technology strategically in Norway's defence and security policies. When Norway joined NATO, the decision was made to develop a domestic weapon industry and to connect the development of this industry to NATO's military strategy. To achieve this goal several research institutions were set up and government funded technological research programmes established⁴. One resultant outcome is that a couple of state companies was upgraded, first and foremost Kongsberg Weapon Factory. Later the technology programme was extended to comprise telecommunication. Within this field participation in the pan-Nordic research collaboration, that spearheaded the Nordic countries to the frontier of mobile telecommunication, became of particular importance. However, by contrast to the other Nordic countries these investments did not materialize in any commercial success as was the case of Nokia in Finland and Ericsson in Sweden. Due to lack of institutional support – funding, the understanding of long-term

⁴ These institutions comprised a research council for science and technology, and sector based research institutes like the Norwegian Defence Research Establishment (FFI) and its spin-off the Institute of Nuclear Energy in addition to a large number of sector based research institutes.

industrial strategies – and cross-sectoral cooperation, Norway failed to capitalize on her technological achievements in mobile telecommunication technology.

When the Norwegian oil sector emerged in the 1970s, its structure, routines, and patterns of interaction were largely shaped in line with the planning tradition of the postwar period. There was a strong ambition for controlling the exploitation of oil, and the authorities decided not to confine their roles only to property rights management and tax collection, but to play an active part. Statoil, a Labour Party construction, was to be the state's most important tool. To get political consensus for an active policy, a National Project for developing the North Sea was constructed (Olsen 1989:34). In exchange for developing the North Sea, petroleum incomes were to be used as an instrument for regional development and for diversifying the Norwegian economy. The main objective of the National Project was to develop national competences for exploring and exploiting Norwegian resources. By transferring knowledge to other business sectors, research institutes, and universities, the rest of the economy was to be upgraded and diversified. The strategy was to learn from foreign oil companies, and different incentives schemes were introduced for encouraging oil companies to engage Norwegian suppliers (Hanisch et al 1999). One such incentive is a risk sharing arrangement with the state: costs connected with the searching for oil and related investments are eligible for tax reduction.

Thus, the state took on responsibility for developing the Norwegian shelf and in rhetoric also for diversifying the economy to counter-balance the impact of a petroleum economy. But so far diversification in relation to the exploitation of oil has not materialized, apart from one exception to be dealt with below. The Norwegian oil sector has been and is dominated by the production of crude oil. In a sort of 'taken-for-granted' manner, activities have mainly been restricted to process optimization and to increased recovery of existing oil fields.⁵

3. Change and continuity in the national business system: increased centralization and new social spaces

The redefinition of the economic governance regime

⁵ Vertical integration has taken place to the extent that Statoil has invested in down-stream activities; retailing. Attempts of diversifying into chemical activities were abandoned.

Failure to deal with the crises in the 1970s and to stabilize the volatility in the 1980s discredited the postwar planning economy. The fact that all state owned industrial companies for all practical purposes had been a commercial failure likewise destroyed confidence in the regime. Armed with new public management (NPM) templates the governance regime started to reform itself from within. In the first place this concerned the redefinition of the role of the state, and secondly the deregulation of most industrial sectors. The ideological shift underlying the reform processes was radical and was referred to as the ‘from plan to market’ (Løken and Trygstad 2006). Competition was to replace planning for improving quality, efficiency, and effectiveness. The financial system, the public sector, the system of higher education, and industrial sectors such as energy, telecommunication, parts of mass media, which all had been monopolies, were gradually subject to reforms. However, the transformation movement was less internally coherent than the ideological shift signalled.

The redefinition of the role of the state represented the most substantial action. From being the key player in the economy, it relegated itself to the background. First, the state deregulated the financial system; secondly it withdrew as an active player in industrialization. State companies were either closed down or sold. Thirdly, ‘selective’ industrial policies were abandoned. Instead market regulation was to secure a healthy industrial and business development, at least in rhetoric.⁶ Lastly, postwar technology programmes were dismantled. For all practical purposes these reforms meant the end of development policies. The economic governance regime to replace planning was solely to be based on macroeconomic regulation. The main regulatory tool was a fixed rate system introduced in 1986. With the dismantling of planning, the central wage bargaining system became of importance for a cross-sectoral coordination at the national level.

The state stepped down as an active player in business, but the fact is that its influence in the economy has not diminished. On the contrary, its economic capacity has grown and is stronger than ever. This is due to the fact that oil revenues have made the state rich. As a result of deregulation the state’s direct and indirect ownership in the domestic stock market has increased. Between 1985 and 1996 public ownership doubled. In this period the share of public ownership at Oslo Stock Exchange increased from 9 to 21 per cent. The state had

⁶ The primary sectors and related businesses such as the food industry were except from market governance as was the area of district policies.

ownership stakes in 29 out of the 100 largest companies in Norway (Moen 2002). This is partly a result of the part-privatization and listing of state companies, and partly a result of heavy state investments in the biggest banks in the early 1990s to alleviate a domestic bank crisis. Today the state controls as much as 45 per cent of the shares on Oslo Stock Exchange (Grünfeld and Jakobsen 2006). Consequently, the share of private investment is very low. In Norway private investments amount only to 15 per cent of GDP whereas in Sweden they amount to 80 per cent of GDP (OECD 2008a). At the same time Norway has the lowest share of market capitalization of GDP among the Nordic countries (Sinani et al. 2008:30-31).

Thus, in contrast to the postwar period the state is not playing an active role in business, but indirectly its economic position is stronger than ever. At the same time the recycling of oil incomes into global financial markets has de-coupled the state from interaction with the non-petroleum part of the economy. In fact, oil windfalls has made it almost independent vis-à-vis other societal spheres. It is likely to consider the dismantling of developmental policies and the end of a number of risk sharing arrangements in this perspective, likewise the reinforcement of a natural resource based economy. This political economy orientation is stronger than ever entrenched in the political and administrative leadership. The governance mechanisms linked with the centralized wage bargaining is further strengthening this orientation. The Norwegian model, which is based on the Rehn-Meider model of development, is in tune with an economy based on the refinement of natural resources and process optimization.⁷ Since there is a shared understanding between the tripartite partners, there is no forceful alternative to contest this type of political economy orientation. The configuration of actors are pulling resources in the same direction rather than constituting a mechanism of balance and check. The resultant outcome is an economic system with a high degree of centralized control and an asymmetrical distribution of power between sectors.

New Public Management reforms

The 'autonomy and de-coupled' perspective on the state can help explaining the inconsistent and contradictory nature of the Norwegian reform movement. The overarching goal of managing oil incomes has implication on reforms and policy-making across a wide set of

⁷ For example, when unemployment increased in the early 1990s, wage moderation was the most important weapon for counteracting the business cycle thus making employees taking on a large part of the responsibility for competitiveness.

policy areas. Due to political opposition reforms occur in bits and piecemeal. The movement of administrative reforms has been described as being the result of different forces and contingent events rather than a result of a general and comprehensive administrative policy derived from government's modernization programmes. Moreover, Norway has been described as a laggard in adopting NPM reforms and the Norwegian approach has also been described as focussing more on the managerial component than on the marketization component. Inconsistency in reform principles has produced a number of layering implying that reforms are rather complementing previous administrative systems than supplanting them. Currently, the public administrative system is characterized as being highly varied, diverse, and fragmented, and having to manage a more complex task portfolio (Christensen and Lægreid 2008, Lægreid et al. 2006, Bleiklie et al. 2003).

Various studies draw the same conclusion: the Norwegian governance system has become more centralized in spite of NPM inspired reforms aiming at increasing devolution, autonomy, and increased flexibility at local and regional levels. Under the guidance of management by objectives and results by introducing activity planning, budget and pay reforms, local government was to become more efficient and ease governmental tasks in an expanded state activity by undertaking different roles and by giving effective responses for local action. Different types of intervention, occasionally referred to as post-NPM reforms, have counteracted processes of devolution. One is the concern for assuring equal and uniform provision of public social services across the country. Another concern is the fear of rivalling interests inherent in the governmental sector principle. New tools and mechanisms such as standardization requirements, targeted allocation of resources, and different audit and assessment measures have over time been introduced to compensate for loss of direct sector control at the local level (Fimreite et al. 2004).

Allegedly, as a result of 'post-NPM' reforms Norway has developed greater central supervision and lower local empowerment than the other Nordic countries (Sellers and Lidström 2007:622). Local government in Norway has become more state dependent, a development trend that represents a break with the tradition of local government. The municipality act of 1837 secured a relatively strong local government. During the reform movement it appears as the central administration has lost trust in municipalities' capacity for carrying out governmental tasks. At the same time there is less belief in municipalities' capability for managing the nation's wealth. Recent studies also suggest that the state has

developed a strong belief in its own capacity for governing vis-à-vis the local level, and that the state has developed governance tools and resources for full control. Such an allegation might be justified since studies also evidence that NPM reforms have triggered power games between different social and professional groups at the local level. Increased professionalization of local administration and unwillingness to take on new roles has released tugs-of-war, tension and conflicts, and reduced local power for problem solving and carrying out tasks. Central actor groups agree that the oil wealth is a driver in centralization (Fimreite et al. 2004:106-7, Lægreid and Christensen 2008).

At the same time as the political and administrative governance system has become more centralized, it has also become more complex and fragmented. This sort of inconsistency has weakened the capacity for problem solving. But occasionally devolution has open up new social spaces which has produced new configuration of actor groups with a problem solving orientation. An illustrative example is the oil sector where a neo-corporatist configuration of actor groups jointly opened up for experimentalist operations.

The Case of the Offshore Sector

Around 1990 the government changed its oil policy: the Norwegian shelf was to be opened for free competition. The national oil company was to be freed from socio-political objectives such as securing regional development. Statoil, the state owned company, was to be operated purely on the basis of profit criteria. At the same time the decision was made to internationalize operations. There were a set of different external and internal factors that trigger the shift in policies: the oil price shock, less activity on the Norwegian shelf, lack of new discoveries, and Norway's negotiations for EU membership. Thus, the oil sector was to be liberated from the political system and instead to be 'governed by the market'.

Over the years operations on the Norwegian shelf had become increasingly marked by heavy bureaucratic routines, organizational ineffectiveness, expensive and rigid technological solutions. Statoil's administrative and organizational procedures constituted an emulation of the practices of the state administration. This is marked by a sharp division of labour (Olsen 1989:112-13), and bureaucratic procedures applied proved to be particularly costly when used for development projects. Statoil provided the specifications of assigned projects. To control suppliers and to secure transfer of knowledge a system of dual management – in the shape of

'shadow organizations' - was established, since various suppliers had to build their own administration. For a middle-sized project the flow of documents could amount to 30 to 40 000 only in the engineering phase. It is estimated that costs linked to administration and organizational routines were about three times higher than in the Mexico Gulf (Lerøen 2002, Ryggvik 2000:263).

Improving profits also implied a change of technology. The style applied on the Norwegian shelf was characterized by large concrete platforms that over time had assumed monstrous proportions. They were constructed to master extreme weather conditions in the North Sea. By the end of the 1980s the concrete platforms were becoming too expensive. They also proved to be less manageable in smaller oil fields that constituted an increasing part of the activities. But changing the technological style was as much an issue of changing mind-sets. Within the petroleum sector it was taken that 'we were the best in the world'. 'That we did it at a price that was 50 per cent too high or 100 per cent too high did not worry people ...' (Engen 2002:155).

In rhetoric the market was to solve challenges facing the Norwegian oil sector. In reality political initiative was taken to remedy the situation. In 1991, the Minister of Oil and Energy launched a cooperative programme called NORSOK (The competitiveness of the Norwegian shelf). The aim of this coordinated action was to encourage search for technical and organizational solutions that could attain acceptance by all relevant groups, and to develop interactive patterns that could induce efficient and mutually beneficial routines and procedures (Engen 2002:292, 302).

An underlying idea of NORSOK was to render suppliers a more independent role. It was taken that a change in the contractual relationship between oil companies and suppliers would open up for greater risk sharing. Institutionalizing risk sharing would in turn create incentives for more efficient technological solutions. For the oil companies this meant that they would have to pay lower prices for commissioned products. For the suppliers it would involve the possibility of developing more efficient organizational procedures and cost reductions. Three main areas were targeted: 1) simplifying and standardizing procedures 2) reducing documentation and bureaucratic procedures, and 3) involving the suppliers earlier in the development projects. A more liberate contractual relation was to lead to a win-win situation for both parties (Engen 2002:182-3, 187).

NORSOK did not proceed as planned. Developing technical standards that everybody could agree on proved to be futile, among other things because it conflicted with emerging internationalization. Later reports also criticized the programme for having created a win-loser situation for the supplier industry in the race-to-the-bottom initiated by oil companies. Reports maintained that suppliers had insufficient organizational capability and experience to be network entrepreneurs with the responsibility of maintaining national and regional competence. However, the situation following 'the liberalization' was less homogenous as depicted. Capacity suppliers for example, that produce standardised components and that possess few technical and organizational capabilities, were more negatively affected than system suppliers (Engen 2002).

Over all, the NORSOK initiative failed to provide practical solutions such as technical standardization. But the coming together of various actor groups opened up for new solutions. These actor groups consisted of oil companies, supplier and services firms, industrial federations, employers' and employees' organizations, and Norwegian oil authorities, in fact a typical neo-corporatist arrangement. Within the framework of NORSOK, these formally organized groupings developed a more open culture to the extent that actors' mind-set changed. Realizing that they had common interests, and that they were all part of a 'we', paved the way for a new kind of interaction between oil companies and suppliers.

An outcome of new relational ties was a new contract form called EPI (Engineering, Procurement, Construction). This type of contract is characterized as efficient incentive contracts: open specifications open up for innovation. They are also known as relational contracts because they contain elements, so-called functional requirements, which are difficult to treat legally. For a third party it is difficult to assess an engineering service. Its nature is therefore seen to be self-enforcing, and reputational motivation an integral part. Mutual trust facilitates these kinds of contracts and partnerships, and they will consequently contain a high degree of 'soft governance'. Another decisive outcome was a shared understanding that development projects should be delegated to only four large system suppliers instead of oil companies controlling and coordinating the activities of a large bundle of suppliers. The Norwegian shelf is supposed to be unique in this sort of decentralized coordination.

New contractual forms and new, decentralized ways of organizing and coordinating activities opened social spaces for entrepreneurial players. The following narrative gives one example of how a representative of the supplier industry made use of this institutional change in this contingent situation to co-create new rules of the game in the Norwegian oil sector.

The player in question used to be a division of Kongsberg Weapon Factory, Kongsberg Offshore (KOS), specialized in systems and equipment to subsea operations. In the early 1990s, then a subsidiary of a US based multinational, it was a comparatively small organization, employing less than 100 people. Due to its small size a problem arose when it was offered two projects simultaneously, one for Statoil and one for Shell. Typically, both oil companies required quite different technology for their subsea operations (KOS Annual Report 1991). KOS' first thought was 'we have to choose one of them'. The next was, 'why don't we develop a common technology base that both can use?' KOS went for the latter option, and managed to persuade both companies to accept their technical solution without either of them knowing about the other.

The option chosen had two important implications. First, KOS as a supplier took on full responsibility for designing the project. Secondly, their design involved a standardized solution based on a modular approach. Standardization was a controversial issue in the oil industry since oil companies' identity and reputation was based on discrete technology. However, an accidental situation made Statoil change their mind about a standardized solution. On 23rd of August 1991 one of its platforms, Sleipner, disintegrated and sank. Statoil got a dilemma since they already had sold the gas from Sleipner. The need to solve the problem instantly was imperative. Normally it would have taken two years to replace the installations, two subsea templates. KOS delivered both within nine months after being assigned the job. 'That gave Statoil a good taste of the advantages of standardization' was the observation made (KOS Annual Report 1992).

For the oil industry this sort of flexible specialization proved to be ideal for meeting new requirements in terms of cost reduction and flexibility in relation to variation in the nature of oil fields. Standardization or modularization allowed increased flexibility, reduced costs, and shorter installation and project cycle time. Standardization in subsea systems implies modules

that can be re-configured to suit every application in use on subsea oil fields. It also implies the redeployment of tools, technical, and management resources. The effects were visible right from the start. The learning curve of the dual project surpassed expectations. One of the offers the subsidiary submitted was estimated to cost around NOK 480 million. This figure was some 300 million lower than the second lowest offer. It was considered craziness. However, between 1991 and 1997 KOS managed to half costs twice. KOS' stroke of genius can be described as tailored solutions for standard prices. Generally, project-based operations tend to be idiosyncratic and cross-project learning consequently low (cf. Whitley 2006). Modularization made it possible to capitalize on learning from one project to the next.

The Sleipner project represented the start of a technology development that revolutionized the subsea business. Moreover, risk sharing between customer and supplier in solving increasingly complicated tasks lifted Norwegian offshore technology to the forefront. The cooperative mode that evolved allowed the Norwegian shelf to become a sort of experimental laboratory. Not least was experimentation sustained by the fact that customer-supplier interaction was extended to also include to R&D projects. This kind of collaborative projects is in the offshore sector referred to as framework contracts. It started with the introduction of the first Technology Development Agreement between KOS and Statoil in 1994. A year later Mobil, Elf, and Shell joined the agreement. The aim of such joint projects is not to produce a specific product or delivery, but to further develop inventions and technological solutions for perceived future challenges. In this respect, companies and suppliers have benefitted from interaction with the wider business and innovation system in Norway. The competitive aspect involved in the informal rule of using four different system suppliers in projects is considered to add extra dynamism in the sector.

Changing relationship between customer and supplier has at the same time changed the power balance within the supply chain. System suppliers have taken over the driver's seat as to the technological development. This role shift has several implications. Complex projects require knowledge and competence from a variety of internal and external sources at the same time as complexity has triggered the outsourcing of tasks and manufacturing operation. To the extent that cooperation takes place across organizational boundaries, more players have been drawn into experimentation and are benefitting from knowledge transfer and sharing within the supply chain.

Over the years several types of institutions have co-evolved with players within this sector: research funding (targeted research programmes within the Research Council of Norway), counselling, educational services, internationalization support (Intsok) and so forth. In 1999 the temporary NORSOK organization was replaced by a permanent one. A forum consisting of representatives of oil companies, suppliers, the public research system, employers and employees, and Norwegian ministries and authorities presides over the new organization. The forum is headed by the Minister of Oil and Energy and has 37 participants.

The result of this co-evolutionary process is that Norwegian players have become leaders in offshore technology. Three of the four largest subsea companies in the world are Norwegian or Norway based. For players that have become global the Norwegian shelf has served as a platform. In 2005 Norwegian players had a market share of 48 per cent in subsea systems (Quest Offshore Resources, Inc. Jan 2006). In the national economy the offshore sector has become the third largest export sector after petroleum products and metals. Between 2003 and 2005 foreign sales accounted for 75 per cent of its growth, and from 2005 to 2008 foreign sales almost doubled. Depending on how the boundaries of this sector are defined, whether firms are entirely or partly offshore suppliers, the number of entities varies between 1500 and 2800. It is a complex sector and it is not classified as a sector in its own right, key areas comprise seismic, reservoir analyses, drilling, well services, engineering, subsea installations etc. In several regions of southern Norway offshore has become an engine of growth. The so-called subsea-corridor in the wider capital area of Oslo is even about to become a global hub within subsea technologies (Heum et al. 2006:12, Vatne 2007).

An assumption one can draw from the offshore experience, is firms have to adapt to the experimental orientation for benefitting from the cooperative mode of operation. The case study of the Kongsberg companies is in this respect revealing about organizational changes within Norwegian business.

4. Creating global competitiveness: the case of the Kongsberg companies

The state owned company Kongsberg Weapon Factory (KV) was split and divested in 1987. Some of the successors are strong examples of Norwegian business that have achieved global visibility. In the Norwegian context they stand out as to integration with the global economy.

About 80 per cent of their production is exported and they have operations/or are owned by enterprises that operate globally. This state of affairs together with the fact that they have a relative peripheral location made them appropriate as case studies for the Translearn project. The following gives a presentation of five of the successor units and an account of how these units have reinvented themselves after the state divested the company. Information is based on interviews, annual reports, and different types of literature.⁸

KV used to be a traditional manufacturing enterprise based on mechanical engineering, but through the postwar technology programme its business model changed. In the technology programme KV was designated to be a national locomotive for the development of high tech industries: to develop new civilian products based on new defence technology. For this reason KV evolved into a conglomerate of partly related and partly unrelated production lines. The technological capabilities underlying its diversification were accumulated skills in cybernetics, computing and electronics. The diverse production lines included: missiles; components for satellites; maritime steering systems; CNC tool machines; gas turbines; jet engine components; subsea systems; and components for the car industry to mention some of the most important products.

Failure to produce profits for years concurrently with the change in the economic policy regime prompted the state to either sell or close down parts of the traditional state company, which had been established in 1814.⁹ However, the decision reached in 1987 was to split and sell KV into eight major and 14 minor separate units. Five of these have grown to become large by Norwegian standards and/or have achieved global visibility. The enterprises Kongsberg and Kongsberg Automotive have become multinational companies in their own right. The former subsea, gas turbine and jet engine component divisions are subsidiaries of foreign multinational companies. These are the USA based FMC Technologies, the USA based Dresser-Rand, and the Sweden based Volvo Aero respectively. These units are still co-located in the small town of Kongsberg situated in the interior of southern Norway. But since they target different markets and customers, co-location implies that they only share a common geographic space. These firms do not constitute a local production system or cluster

⁸ The sketchy presentation of these units is far from providing justice to the richness of these stories.

⁹ As a state owned company KV was highly irregularly governed. Whereas it formally was registered as a corporation with limited liability, in practice the board run it as a research and development institution. This inconsistency impacted on its commercial results. With the change in the economic governance regime, this state of affairs was found unsatisfactory. The employees fought hard to avoid the closure of units.

in the sense that they are cooperating in business activities. But it is a common feature that they have performed remarkably well after privatization.

First and foremost their achievement is linked with their integration with the global economy. By tapping into global value and supply chains these units have been able to expand their business, to improve their position in value constellations and markets, and to increase returns substantially. For the five units in question the current situation¹⁰ is as follows: Kongsberg employs about 4400 people, which is a doubling since its start in the late 1980s, and it has operations in some 25 countries. The concern targets the offshore, merchant marine and defence markets, and it is organized in two business areas, Kongsberg Maritime and Kongsberg Defence and Aerospace.¹¹ In some niches within these markets Kongsberg is global leader. Among its customers are leading organizations and institutions world-wide such as the US Armed Forces, NATO, and the European Space Agency and the Ariane project. It has had a long-term partnership with world-class companies such as Raytheon and Lockheed Martin in the United States, Aerospatiale and Thomson in France, and Hyundai in South Korea. The company has earned a good reputation, and has, for example, been named Raytheon's Four Star Quality Supplier and the Australian Defence best supplier ever (Annual Reports).

The second multinational company, Kongsberg Automotive (KA), has more than 50 facilities in 20 countries and over 11 000 employees.¹² The company presents itself as a global provider of systems solutions to vehicle makers world-wide.¹³ When the new company was incorporated in 1987 it started with 315 employees mainly producing components for Volvo. At the time of incorporation its goal was to become world leader within its market segment. After completing a major acquisition in early 2008, KA became part of the top 100 automotive suppliers in the world. For some time it has been a market leader within some of

¹⁰ That is before the financial crisis broke out.

¹¹ 1.1.2009 Kongsberg Defence and Aerospace was split into two units: Kongsberg Defence and Kongsberg Protector System.

¹² The acquisition of the US-based Global Motion Systems (GMS), a diversified industrial company listed on the New York Stock Exchange, was completed at the beginning 2008. As a result of this acquisition KA has made its most significant expansion. GMS has a global presence with about 8000 employees working in 16 production facilities in North and South America, 13 factories in Europe and 5 factories in Asia, and is a long-term supplier to blue chip customers like Mercedes Benz, Toyota, Ford, GM, Renault, Peugeot, Lear Corporation, Caterpillar and Scania.

¹³ A more detailed description is a global provider of engineering, design and manufacturing for seat comfort, driver and motion control systems, fluid assemblies, and industrial driver interface products (www.kongsbergautomotive.no)

its core areas, gear and clutch actuation. It is a supplier to all the major car makers world-wide, and has been able to cope with constantly decreasing costs in the automotive industry at the same time as it has managed to increase returns (Annual Reports).

KV's former subsea division (KOS) is today owned by the US-based FMC Technologies. In total, FMC Technologies employs approximately 13 000 people and operates 33 manufacturing facilities in 19 countries. KOS makes up the largest part of its business area Energy Systems and Services which accounts for about $\frac{3}{4}$ of FMC's total revenues.¹⁴ Today FMC is the world leading supplier of subsea systems to the oil and gas industry with a market share of 40 per cent. FMC has met the expectations of the finance markets. In the five years period since incorporation in 2001 the company doubled its total turnover, and in 2006 its return on investment was some 20 per cent. Since 2000/01 the energy business and in particular the subsea part, which is largely operated from Norway, has been the main driver of growth of the entire MNC. In this development KOS has played a key role. Fortune Magazine has named FMC three times (2005, 2006, 2008) America's most admired oil and gas equipment and service company ahead of renown companies like Schlumberger and Smith International. The evaluations are based on factors like innovation, management, and financial strength (Annual Report 2007, www.dn.no 17.3.2008).

The former gas turbine division belongs to the US based multinational company Dresser-Rand. Dresser-Rand is one of the largest suppliers of rotating equipment solutions to the energy industry in the world. The former gas turbine division employs about 100 people on a permanent basis, manufacturing is outsourced, but this unit has an annual turnover of more than one billion NOK (Annual Reports). Its gas turbines packages are delivered world-wide and after internal competition the Kongsberg division is the only unit within the multinational company that are delivering gas turbine packages. The Kongsberg unit proved not only to be more cost efficient than the English, French and American units within Dresser-Rand, but it had also developed a better industrial concept based on a systemic approach. Although the North Sea has constituted an important market, in which the Kongsberg unit is the dominant supplier of gas turbine packages, it has delivered and is increasingly delivering packages world-wide (Annual Reports, interview evidence).

¹⁴ The other two business areas comprise Foodtech and Airport Systems

The Jet Engine Component Division (JET) is an independent company jointly owned by the Sweden-based Volvo Aero Corporation, a wholly owned subsidiary of AB Volvo, and the US-based Pratt & Whitney and it is named Volvo Aero Norway (VAN). VAN was started on the basis of offset work within the framework of the F-16 programme in 1976 and employs about 400 people. Due to the nature of business virtually all of its production is exported. Within this sector competitiveness is highly reputational and based on technological excellence. Within shaft design VAN has achieved world class reputation. Internationally it is known as a proven supplier for both military and commercial players, and is the main supplier of turbine shafts for Pratt & Whitney and General Electrics (Company accounts, interview evidence, US Department of Defense 2003).

Internationalization

For all these business units internationalization has been a pro-active strategy for benefitting from new opportunities. After a consolidation period the intensity of internationalization has increased markedly in the past 10 years: from being the state's technology developer they have reinvented themselves to becoming global players. However, their way of internationalization varies.

Today Kongsberg has operations in more than 20 countries. Access to markets and following-the-customer orientation has been an important driver in its foreign direct investments (FDI) implying that most of these facilities are to support local marketing and service activities. The customer orientation has largely determined the geographical distribution of FDI, and main operations abroad are located in the UK (oil and gas), South Korea, Singapore, and China (maritime), the United States, and Canada (defence and maritime). Assembly departments are established in China, India, South-Korea, and Singapore. But also local conditions have impacted on the mode of internationalization. For example, nationalistic industrial policies in countries like South Korea and China prompted Kongsberg to enter on joint ventures with local partners. In 1999 Kongsberg together with Hyundai Information Technology founded Hyundai Kongsberg Maritime (HMK) in South Korea, the leading country in ship-building. In 2003 HMK merged with a South-Korean service company and the name was shifted to Kongsberg Maritime Korea (KMK). Its goal of becoming the preferred supplier of maritime electronics in South Korea has been reached. KMK is by far the largest supplier of maritime automation. Currently it has a market share of about 50 per cent. Representatives of

Kongsberg point to the company's reputation for explaining its achievement. The company is known for delivering and for being highly reliable. 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. Also in these countries the aim is to become the preferred local supplier (Annual Report 2003 and 2004). More recently, the search for complementary knowledge and competence has impacted on FDI strategies. The acquisition of Gallium in Canada and GlobalSim in the USA are cases in point (Annual Report 2006). Kongsberg has only a few manufacturing facilities outside Norway. These are located in Scotland, Canada, and the USA close to customers. But due to recruitment problems Kongsberg's international activities have been stepped up. To ease recruitment Kongsberg has established engineering companies in Poland and India, and extended service operations in St. Petersburg, Singapore, China and South Korea to also include engineering.

For KA it was clear early on that growth had to take place abroad. Internationalization is perceived as a strategy for securing and improving its market position. As a start this concerned particularly the position KA had achieved with clutch and gear actuation. Acquisitions abroad were judged imperative to consolidate its position. However, this strategy has been guided by a meticulous assessment of appropriate acquisition targets. It took almost ten years before KA made its first acquisitions abroad. In 1996 KA acquired two companies in Sweden and one in England to strengthen the market position of its core products. These acquisitions also involved a new production line, seat comfort. But instead of selling this line, KA further developed it to the extent that the company has a strong position globally also within this market niche. The following year it acquired a company in the USA. By 2000 the company was a world leader in clutch actuation. But realizing that customers' requirements and expectations were constantly changing, KA saw the need of global presence, and picked up on a follow-the-customer strategy. From 1999 it has pursued an aggressive internationalization strategy by establishing new production facilities in Mexico, Poland, and South Korea. Further FDI include activities in China, the acquisition of a factory in Norway and another one in England. In addition sales offices have been established in Germany and France. But being part of the highly competitive automotive component market means that cost pressure is increasingly influencing localization issues. As a representative of company phrased it: 'the rule of thumb is set by the cost structure'. 'If wage costs surpass 10 per cent of the sales price, off-shoring is considered.'

The fact that KA is a commercial success has facilitated the financing of its expansion. From 2001 to 2005 its EBITA increased from 5 to 12 per cent. KA's long-term relation with a Norway based Private Equity fund, which ended in 2008, has been instrumental for its growth. Early 2008 a preliminary peak in its globalization strategies was attained when KA could conclude the buy of the automotive activities, named Global Motion Systems (GMS), of the US based Teleflex. GMS had been on KA's target list for ten years. GMS was more than twice as large as KA in terms of production facilities and three times as large as to the number of employees. An exceptionally strong industrial fit between KA and GSM was the reason given. The two units complement each other in terms of product platforms and customer base, i. e. gear shift, seat comfort and fluid systems.

Like KA, KOS early on developed a vision of becoming a global player¹⁵, but it chose a different internationalization strategy. Rather than constituting itself as an independent unit, the division preferred to achieve this goal by becoming part of a multinational company. Facing the situation of getting new owners, both management and employees engaged themselves actively in finding one. The US-based FMC, head-quartered in Houston, was preferred since it had complementary technologies and product portfolios. Jointly FMC and KOS would be able to deliver total subsea system solutions. As important was the fact that the American company possessed a global marketing organization that KOS needed in order to become a global player. However, during contract preparations it turned out that the head quarter wanted to restrict KOS' market access to the North Sea. This was in direct opposite with KOS' aspiration of becoming a global player. The clash over KOS' mandate took place at several levels, and was spearheaded by the employees' representatives. The Kongsberg people won through, and the head quarter accepted that subsea engineering and production should take place in Norway and that the subsidiary should keep its intellectual property rights, expertise and patents. KOS was given the responsibility for supplying subsea systems world-wide apart from North America, which was awarded to the mother company. Moreover, the head quarter made the obligation to develop KOS internationally: its marketing organization should assist the subsidiary in internationalization. Lastly, KOS was denominated a Centre of Excellence (Dahling and Erlandsen 1999).

¹⁵ After successfully finishing a breakthrough project in the North Sea in the mid-1980s, the employees then knew 'what they would be when growing up: a leading subsea supplier globally'. 'What was dim was then clarified'.

Why KOS won trough must be understood in terms of a reflexive learning process. FMC used to be a traditional manufacturing company. In its inherent logic assets were tangible. By visiting Kongsberg the head quarter's executive officers had the opportunity to observe a different world and a different logic. Instead of tools they saw that 'the main value went out of the door at four o'clock in the afternoon'. As the representative of the parent company expressed it 'KOS has helped us to see the big picture in subsea systems, with the emphasis on *systems*'. In the make-over process from a low-tech product-oriented enterprise to a high-tech systems supplier the head quarter recognized the fact that knowledge and competences are locally embedded and accepted the decentralization of technological excellence. Like Kongsberg other local sites were given the status of Centre of Excellence (Dahling and Erlandsen 1999). Recently the local manager was appointed senior vice president of the parent company, and most recently strategic responsibility for the subsea systems area for the eastern hemisphere was transferred to its Kongsberg premises.

The internationalization of the gas turbine division took place in a similar way as KOS, but pre-dates the privatization of KV in 1987. Lacking both competence and resources to develop a global marketing organization for gas turbines, which was considered too costly for only one production line, KV started actively looking for a partner in order to penetrate the US market. Dresser Industries expressed interests and purchased first 50 per cent of KV's shares in the Division in 1985. Dresser for its part wanted access to the North Sea oil and gas market. The remaining shares were purchased after KV was split in 1987. The organizational resources Dresser provided thus enabled the marketing of the Kongsberg gas turbine internationally. Since Dresser produced gas turbines of different sizes than Kongsberg, the company had the advantage of providing a wide range of products within this market segment. Dresser merged with Ingersoll Rand in 1987 and with the new name Dresser-Rand Company it was listed on the New York Stock Exchange in 1990.

VAN, which started on the basis of offset work within the framework of the F-16 programme, got a head start access as a component producer to the most exclusive part of the jet engine market. VAN made use of this opportunity by persuading Pratt and Whitney to adapt to VAN's production system solution as to shafts, vanes, and cases. By targeting the civilian market it was able to further develop expand business. Since the design of jet engines are extremely costly and technologically extremely demanding, development processes take place as a partnerships between jet engine manufacturers and component suppliers. Due to world

class reputation VAN has managed to conclude development contracts and deliveries to the foremost customers in this market. These connections have been crucial for this unit's existence since Norwegian authorities have failed to share risks in its technological development. Although risk sharing between customer and supplier is fundamental, the supplier's competitiveness is based on technological excellence in strategic areas. Today deliveries to the civilian market make up about 80 per cent of its sales.

Customer Orientation

The five Kongsberg units have pursued different modes of internationalization, but they share one common strategy: a strong customer orientation. In a recent survey enterprises at Kongsberg indicate that foreign customers constitute the most important group with whom they cooperate in innovative activities (Oxford Research 2006). They also indicated that this kind of relations had resulted in increased sales of products and services, and enabled them to enter new markets and gain new customers. This approach is consciously cultivated. Kongsberg maintains that it cooperates with customers more than most firms in their business areas. KOS states that close relationships with customers constitutes a cornerstone in their business strategy and it assumes that it has been able to form more types of cooperative arrangements than any other player in its sector (FMC Annual Report 2004).¹⁶ KOS began working in integrated teams with customers in 1994.

For the Kongsberg units a pro-active customer approach implies working closely together with the customer. Their orientation is experienced based and is found to be indispensable in improving competitiveness. Through assigned projects the workforce learned that knowledge sharing and exchange in team was instrumental for practical problem solving. Moreover, accumulated skills and knowledge in one project upgraded the organizational competence and prepared it for solving increasingly complex problems. The method developed implied new ways of involving the customer. When assigned a project the people in charge may not have any idea of what the result is going to look like, but 'technological solutions are found in the intimate cooperation with customers (Kongsberg Annual Report 2006). The point is to get an

¹⁶ This is how the business units present themselves: Dresser-Rand: Delivering systems and business practices that provide value to all participants (www.dresser-rand.com). VAN: To innovate customized partnership solutions and being the best partner. (www.volvo.com). Kongsberg: the best partner, the preferred supplier or the best alternative; FMC: customers most valued supplier; KA: the best alternative for our customers; Dresser-Rand: value for all participants.

in-depth understanding of the customer's most critical needs. In their own words the Kongsberg people say that the first step 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.

Cooperation with customers started way back in the KV period and has over time changed its nature. In the first stage it took place as licence production. In the 1950s KV started licence production for automotive components for the Swedish company Volvo that needed to expand its production capacity. KV's experience of repetitive production facilitated the establishment of this sort of scale production. KA's present leadership in clutch servo and hydraulic gearshift started as a licence production for Volvo in the 1970s. In the 1950s KV started production of air defence cannons for the Swedish Bofors company that introduced KV to number technique in manufacturing. Later on this competence formed the basis of KV's development of computers.

A next stage started around 1960 when KV was assigned a project that entailed the development of a 'tailor-made system' for the Norwegian Defence. The project, Terne, concerned an anti-submarine weapon system and KV was to develop and adapt the system for production and installation. Terne was a highly complex system and required the combination of knowledge from different disciplines that went far beyond in-house resources. Until that point of time KV had basically been a mechanical workshop. For transforming and upgrading activities KV started to recruit engineers from the USA and UK and to support relevant research projects. The Terne project impacted strongly on KV's future role, identity and on the organization of work both internally and externally. It induced processes of cooperative interaction with customers, both also with other types of partners due to the need of complementary technology (interview evidence). Thus, from being instructed by customers what to do, KV changed its role to take on responsibility for developing customized products and services.

To develop Terne, KV's project team collaborated with research teams at key technological institutes in Norway such as Sintef and Christian Michelsen's Institute in addition to the Norwegian Defence Research Establishment (FFI). Two companies, Simrad, a small Norwegian company and an American one, both with expertise on subsea acoustics, were also engaged. In the production process the developers interacted with skilled workers thus pioneering a type of simultaneous engineering. Installation work was sub-contracted to

suppliers of sub-systems. Sub-systems were partly acquired abroad, from the USA, the UK and the Netherlands. Activities within the framework of NATO facilitated the search for complementary cutting-edge technology. The transnational community related to NATO provided Norwegian research and industrial communities with a good overview of where to find relevant expertise internationally. The NATO framework was also important for gaining new customers and markets and providing a search-network. For example large projects such as the F-16 necessitated interaction with about one hundred different US based companies. Equally important was the fact that this framework also made it possible to be connected with 'world class' customers and partners. It became a rule of the game in the Kongsberg community of practice¹⁷ not to cooperate with the next best only the best (interview evidence). For example, through the Norwegian Defence KV was able to establish links with leading defence contractors in the USA like Hughes and Raytheon. These relationships have persisted for decades and have facilitated access to new customers and markets.

The customer orientation has not taken place as a sequential process, but has over time been repeated from business area to business area. For example the subsea division started as a licence producer of well heads for Cameron Iron Works. Gradually this cooperation expanded to include first sales and in the next stage product development. On the basis of this cooperative interaction, the assignment of pre-projects and engineering tasks for oil companies the subsea division systematically assembled knowledge of subsea oil and gas production systems. This systematic search period lasted for about ten years. The work for Shell and Statoil in the North Sea in 1984-87 represented a breakthrough for the division's role as a system supplier, particularly the Gullfaks project. The project comprised the first diverless subsea solution that covered even unforeseen underwater difficulties. To solve the assigned project KV formed a joint venture with the UK based TRW Ferranti and the two companies established a subsidiary, Kongsberg Subsea Controls. Thus, through active interaction with customers and business partners KOS developed from being a licence producer to becoming a system supplier i. e. having the responsibility for designing and delivering subsea control systems.¹⁸

¹⁷ Community of practice refers to socio-cultural practices that emerge and evolve when people who have common goals interact as they strive towards those goals.

¹⁸ Subsea systems comprise subsea wells for the production of oil (the extraction) and the further processing of it, including oil, gas and water separation. This takes place in so-called subsea trees and manifolds. The inner part of the physical outfit is filled with complicated electronic control systems.

By deliberately seeking more demanding customers, the Kongsberg units have been able to upgrade skills and knowledge. Today the customer approach is a strategy for continuous improvements and innovation.¹⁹ Products or systems produced are not restricted to the value of themselves, but products and services developed for one customer can be used in such a way ‘that (it) leads to innovations that are applicable throughout the industry’. This can be secured in the contractual agreement where the supplier retains the right to commercialize new technology against paying a royalty to the customer that has paid for the development (Kongsberg Annual Report 2005). In this way distinct projects form part of a long-term process of technological development in which competence is accumulated at the organizational level. Through close interaction with customers the Kongsberg units have been able to change their roles, identities and tasks. From being a licence producer they are today capable of solving problems ‘the customer does not know of himself, and to present the customer with a vision of future change’. Based on excellence in some core technologies the units can deliver a wide set of customized products and services. The flexibility linked with this type of production system has proven capable of taking advantage of new possibilities – ‘to be prepared for the unknown’.

System Suppliers

To a large extent the Kongsberg units also share the same business model: the supply of integrated systems. The system approach implies creating unique products by combining different knowledge and providing services related to unique products. The understanding of systems originates in KV’s work on developing weapon steering systems, but the system template also evolved from practice. For example, KOS lost an important contract due to opposing interests and strained relations with a partner. This experience taught employees a lesson about the importance of owning and controlling the technology. In their own words they started methodically to amassing knowledge about ‘how things work’, product group after product group. In this perspective system engineering is also a method for reducing risks in inter-firm relationships that are becoming increasingly fluid in global supply chains. Being

¹⁹ Co-creating products and services with customers can be fraught with challenges and a central theme in collaborative activities is ambiguity and their provisional nature (cf. Sabel et al. 2000). Collaboration can be hampered by struggles for influence, provisions relating to property games. Large companies might pass on innovation costs to their suppliers, but firms may also appropriate innovative concepts or product ideas. One solution found among the Kongsberg units is to secure further use in the contractual agreement. The supplier can retain the right to commercialize new technology against paying a royalty to the customer that has paid for the development (Kongsberg Annual Report 2005).

able to control the design and construction of integrated systems has reduced uncertainty in the relationship with customers and partners. In highly costly projects such as the production of subsea projects, or gas turbine packages, costs may amount to billions. The Kongsberg units themselves maintain that system engineering has been instrumental for reducing risk substantially in innovation.

Yet, system engineering does not preclude fluidity in the division of labour in inter-firm relationships. In searching for new opportunities and for reducing costs, the Kongsberg players are continuously changing their business concept. As the CEO of Kongsberg phrased it ‘the more complex packages we can deliver, the more our share of value added will increase’. ‘It was a truism in the 90s that it paid to move as high up in the value chain as possible. But since ‘everybody’ now is engaged in system integration the margins have fallen, and we are instead focusing on ‘in-sourcing’, i.e. creating products with high competence.’ KA is also emphasizing in-sourcing in describing the nature of their system solutions, and pointing to the general trend from producing components to designing and manufacturing systems. Changing points of reference are prompting the adaptation and re-composition of relational interaction whether to be collaborative, arms-length, in-house activities or the subcontracting of volume of standard components. However, there seems to be a general trend that intensified collaboration in global value chains increases the need of in-house R&D activities.

Investments in R&D

All the Kongsberg units invest above the national average in R&D. Moreover, survey data indicate that in-house sources of ideas are almost as important as ideas from customers (Oxford Research 2006). On top is VAN that has invested some 20 per cent of its turnover in recent years. This high share reflects the buy of partnerships shares in the development of jet engines. Kongsberg invests about 10 per cent operating revenues for the development of new products. This amount is considered necessary for sustaining a sufficient, modern and cost effective product portfolio (Annual Report 2006). For KA long-term in-house development is considered a vital part of its business strategy. In-house product development has been a key strategy for accessing new customers and markets and for meeting customers’ changing demands. By systematically developing unique products the company has been able to produce products, as they say, that ‘impress our customers through innovative solutions that

create customer value'. Today 90 per cent of what the company is manufacturing are own products. One such unique product is the use of a highly flexible hydraulic technology in gear change systems. KA is the only supplier of this system in the world. Typically, investment in in-house R&D is mainly done by the business units themselves. Public R&D makes up only a minor part of the R&D work carried out. However, the public research system has been of importance for the supply of competent workforce and research institutes as partners in commissioned projects.

External Partners

Collaboration with R&D institutions dates back to the seminal Terne project. The Norwegian Defence Research Establishment (FFI) designed the Terne prototype in the late 1950s. Particularly FFI has been important for KV and its successor companies, but early on other research institutions such as Sintef and Norway's Institute of Technology (today Norwegian University of Science and Technology) were also of importance for the transfer of technological knowledge. Cooperation and knowledge sharing between KV and these institutions have been crucial for technological achievements. For example, in 1967 KV was among the first companies in the world to launch a CNC tool machine for the mechanical workshop industry. Successively, KV's core competence in control systems has been adapted to several markets and customers: in navigation, in systems for dynamic positioning; and in maritime control systems and so forth. Based on the same core competence KV managed to develop a gas turbine, which later enabled KV to produce components to jet engines components for the F-16 programme. The CNC tool machine project was linked to a large technology programme, the Numerical Control System Project, that involved the most important technology and science communities in Norway (Sødahl og Brataas 2005). Thus, despite the dismantling of the technology programme in the 1980s these network contacts have been maintained. For example VAN states that its cooperation with Norway's Institute of Technology and Sintef has been crucial for the development of the jet engine components.

Cooperative R&D activities have not taken place exclusively with research institutions. In fact, a substantial part of R&D work is carried out as partnership projects with customers and other business partners. As indicated above, on the Norwegian shelf the pro-active interaction with customers was expanded to also include development projects. This form of cooperation was institutionalized as framework contracts, an institutional arrangement and risk sharing

system that has helped Norwegian offshore technology to its current leadership. It started with the introduction of the first Technology Development Agreement between KOS and Statoil in 1994. A year later Mobil, Elf, and Shell joined the agreement. In 1996 Dresser-Rand concluded a framework contract with Statoil. The aim of such joint projects is to further develop inventions and technological solutions for perceived future challenges. Much of Kongsberg development work occurs in this form, and roughly about a half of investments is customer-funded. One 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 vehicle developed in the mid-eighties. Today the Hugin concept is a leader within this market niche (Kongsberg Annual Reports).

Over time KV's number of collaborative partners increased and comprised a growing number of partners abroad. For example the cooperation with Germany and Siemens in the mid-1970s introduced KV to the micro-processing technology which resulted in the Supervisory Control System. Foreign collaboration included also the funding of projects. The jet engine division benefitted greatly from two US Air Force funded projects in the late 1970s: ICAMIC (Integrated Computer Aided Machining in Cells), and RAMIGO (Robotics and Measurement in Grinding Operations). Both projects targeted work practices and organization in the manufacturing of components. Today the Kongsberg units cooperate with research institutions world wide; they form part of transnational consortia participating in the EU's research programmes; Kongsberg has established a centre of expertise in software in Bulgaria and is about to establish a similar one in India.

The American connection has been crucial for the development of the defence business, but it has been helpful also for accessing civilian markets. 1979 the Norwegian Armed Forces (NF) commissioned Hughes Aircraft Corporation to develop the specifications for a new command and control weapon system. The implication of KV's participation in this project was continuous cooperation with Hughes and other key contractors in the American defence industry like the Raytheon corporation with whom KV/Kongsberg have cooperated since 1984. In 2005 this cooperation was renewed with the signing of a 10-years contract. Since Kongsberg itself is having insufficient marketing and sales resources these relations have been crucial for increasing its market shares and obtaining information about opportunities of changing markets and technologies. One recent opportunity, following 9-11, is to develop a

system of defence of civilian airports in the United States (Kongsberg Annual Report 2006). The fact that 25 per cent of Kongsberg's export incomes derive from the US market indicate the importance of these relations (Kongsberg Annual Report 2005).

Cooperative interaction is also taking place at the local level. Project-based operations imply the outsourcing of a number of activities, for example Kongsberg's manufacturing workforce has been reduced by one half in the past decade, and standard products and components are increasingly sourced externally. Kongsberg is purchasing all sorts of different items and devices from more than 2000 local firms: machines, automation systems, computers, cables, software and so forth. But there is no definite answer to the 'make-and-buy' dilemma (Kongsberg Annual Report 2006), and most purchases occur as arms length type of transactions.

Whether assignments involve collaborative interaction depends both on the type of delivery and the sub-supplier. Many supplier firms are small and medium-sized and spin-offs of former industrial enterprises, including Kongsberg itself. Some are willing and able to take part in processes of co-design, others are not. The nature of customer-supplier relations can be an issue of resources, but can also be an issue of small- and medium sized firms' orientation. In general it is taken that sub-suppliers' early stage participation in projects can have a positive impact on both quality and costs. But the fact that sub-suppliers lack relevant competence hampers the effectiveness of disintegrated supply chains. To some extent such bottle-necks are sought resolved in inter-firm relationships. VAN, for example, has provided both financial resources and competence to sub-suppliers (Fraas 1999). KOS has made some of their contract manufacturers partners to spur upgrading, and is encouraging sub-suppliers to take part in processes of co-design. KOS has about 185 qualified sub-suppliers in Norway. Examples of firms benefitting from close cooperation can be found. At least one of KOS' partners has become system supplier and a global player in its own right. There are also examples indicating that local interaction can be highly beneficial for both partners. The idea for Kongsberg's most recent success, Protector²⁰, derived from a local partner, a small

²⁰ Protector is a remote weapon station developed to protect troops in armoured personnel carriers. The idea developed by the small firm intrigued a couple of 'front-liners' within the Kongsberg company. They got the CEO's permission to try to sell it to the US Army. When they returned with the prospect of contracts worth billions, everybody was surprised. The idea was then further developed and in 2007 Kongsberg concluded a NOK 8 billion framework agreement with the US Army for the Protector. The weapon station proved to be highly advantageous in the US' warfare in Iraq. The weapon station is now sold worldwide and the growth of

company specializing in defence equipment. The extent and quality of such inter-firm activities is unknown.

Decentralization and flexible work organization

The system of disintegration global supply chains rewards quick responses and the capability to adapt to varying situations. When explaining achievements, representatives of the Kongsberg units themselves point to organizational effectiveness: ‘we are quicker, more flexible, faster in making decisions, and we communicate fast in an informal way. It is the way we communicate’. Such statements reflect key managerial and organizational challenges in global supply chains: the capability of coordinating decentralized activities world-wide. The globalized economy’s exigencies of constant innovation and cost reduction, competitiveness depends utterly on co-workers’ creativity and dedication to solve problems.

KV used to be a hierarchical industrial company, and all the successor units have a hierarchical organization, although a relatively flat one. Work practices and organizations have been and are subject to recurrent reforms and improvement. A common trend has been the decentralization of resources and responsibility, the team level constituting the most decentralized entity. Project operations imply that work is organized in teams, and the team level constitutes a key organizational principle: the interface between all sort of activities and levels internal as well as external. During the KV period multi-tasking operations made centralized decision-making ineffective, and teams and individuals were delegated a high degree of decision-making. Until recently, all the CEOs used to belong to the same community of practice linked with KV. This sensitized them to the importance of responsibility, openness and trust, and it appears as decentralization processes have been taken for granted as it is indispensable for creativity and problem solving.

The composition and size of teams vary within and across firms depending on markets and tasks. In Kongsberg, KOS, and Dresser-Rand most operations are project-based and teams are continuously recomposed. In Kongsberg, KA and VAN, that are also running manufacturing facilities, teams are mainly divided either in production teams or development teams, but can also be formed ad hoc. The size of teams can vary depending on complexity and size, ranging

this product has prompted the division of the Defence and Aerospace business area. The small firm that developed the idea has become rich thanks to royalties.

from NOK 10 000 to one billion. In Kongsberg it is the task of the team manager to pick people with relevant expertise. This has been possible in a situation where ‘everybody knows everybody’. Kongsberg has a reputation for successfully combining teams, and management has dedicated attention and resources to secure their functioning. The company has initiated its own education in project organization. KA, on the other hand, tends to maintain teams on a more permanent basis. This is also the case with Dresser-Rand, but it has started experimenting with rotating people in order to provide employees with a better overview of the totality of tasks. This is taken to enable the organization with a more flexible use of its people.

All the Kongsberg units are stressing the importance of collaboration within teams. In Kongsberg project work starts with team building in which people as a start get to know each other, and although the team manager has a key role, the principle of shared responsibility and collectivistic behaviour is considered fundamental. As a project co-worker put it: ‘we are supposed to enrich and upgrade one another and to pull one another forward’. In Dresser-Rand it is stated that everybody is to participate, to give one another collegial support and pull together. ‘Together we achieve things, and there is very little of this is not my job.’ VAN is also pursuing a policy of involving everybody and refers to the ‘spirit of dugnad’ (teaming-up) in teams. In KOS the sense of all-for-one and one-for-all is deliberately cherished. Teams are made collectively responsible for their work, meaning that nobody is hanged in case of failure.²¹

The collectivistic orientation is understood as fundamental for processes of problem solving: the practice of knowledge sharing has formed an essential part in the development of technologies and new products. Knowledge sharing takes place both formally and informally. In 1997 Kongsberg established a new organizational principle: the decentralization of decision-making and functions. The different business units and product groups were given responsibility for various tasks. However, decentralization was given on one condition: the units were to allow ‘technology to flow freely’ (Hattestad 1998:42). Two factors have been

²¹ Norwegian workers discovered the advantages of risk sharing when encountering American work culture in the North Sea. ‘The Americans, and particularly the Texans, were obviously prisoners of their own system’. The personal consequences involved with failure in American corporations induced a behaviour that was basically preoccupied with protecting themselves and their jobs, in other words defending established practices. The resultant outcome was, in the eyes of the Norwegians, an archconservative approach to innovation.

crucial for the Kongsberg units' capacity for knowledge sharing: experimenting in work organization and systematic training and education of employees.

The Kongsberg units can draw on a protracted tradition in work organization experimenting. For example, production cells were pioneered in Norway in the jet engine division in the late 1970s. New organizational principles were to improve efficiency. But as important were the norms and values that informally evolved within the community of practice. The implication of this culture together with project operations represented a break with a rigid understanding of roles and routines. Projects normally involved the cooperation across professional divides, across divisions and with extra-firm expertise. 'At the time there were open doors throughout the whole company, so we could simply walk into any workshop and get a problem solved. The foreigners couldn't believe their eyes' (Dahling and Erlandsen 1999). Simultaneous engineering was practiced already in the Terne project in the early 1960s (interview evidence), and today operators and engineers are encouraged to cooperate. All sorts of employee groups are invited to participate in improvement work and particularly in pilot projects. Most employees find such challenges rewarding and only a small minority prefer to stick to routine tasks. The principle of 'broad participation' has also been facilitated through formal organization changes by removing the social division of the work force. For example Kongsberg has institutionalized the same working hours and the same sort of employment contract all sorts of employees.

Thus, a forceful factor underlying the Kongsberg units' achievements is the set of informal norms and values that evolved within the community of practice linked with KV. This culture has been instrumental in several respects. A key principle has been/is 'there isn't anything we cannot solve'. Today representatives of this community will tell that 'we solve anything from the seabed to the moon'. This sort of adventurous spirit – well embedded in the national tradition of explorers - has been cherished in KV's managerial practice. Employees were pushed to develop new projects and business opportunities, and 'people went to the task with a pioneering spirit and enthusiasm'. Management's response to challenging projects and even 'wild' ideas was 'go ahead'. Given responsibility of projects provided employees' with self-confidence. In the words of one of the CEOs: 'No one can become a world champion without feeling secure'. Such orientations helped creating a work organization that offered unique challenges and opportunities for talented young engineers world wide before the era of globalization. In the 1970s KV was the most internationalized company in Norway. The

resultant outcome of the community of practice that evolved was a work culture and organization that in itself is driving improvements and innovation. For the successor units' achievement this legacy has been essential. A driver underlying employees' effort is their pride in solving problems and working in a positive and encouraging atmosphere.

Sustaining this type of work organization in an 'everybody knows everybody' situation is one thing. With increased interaction together with the creation of virtual work organizations world wide, the issue of team building and communicating has intensified. When most activities were co-located, the socialization of employees into the existing culture and work practices could function. Transmitting tacit knowledge and informal rules in spatially dispersed locations represent a different challenge. Typically, all the units are continuously experimenting with organizational principles and work methods to cope with exigencies of the globalized economy. Practices in project work are subject to alteration and new tools are introduced to improve efficiency and quality such as bench-marking and 'best practice'. KA has over time been consistent in adopting lean principles such as Kanban, Kaizen Events, and Six Sigma. To ease information and interaction across divisional divides for increasing efficiency, different 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 Kongsberg has introduced the Capability Maturity Model (CMM), the world most used tool for process improvements. Through the cooperation with Raytheon Kongsberg has been introduced to lean methods. 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).

Kongsberg is also 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. 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 on 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 (Kongsberg Annul Report 2006).

Education and Training

To sustain a learning organization all the Kongsberg units are making considerable investments in the further training and education of employees. Education and training include all sort of employees in a 'lifelong learning' perspective. Constant role shifts require the upgrading of employees' skills and knowledge, but internal training also represents an institutional arrangement for transmitting 'the Kongsberg way' of operating. Furthermore, in a highly competitive labour market at the national level, company level education is a strategy for retaining the work force. To a varying degree the units have been facing increased turnover. The units' educational systems have over time evolved as responses to situational challenges.

In 1998 Kongsberg established the Kongsberg School to manage all education and training activities. The School's mission is to organize and coordinate training and educational courses for employees. All new employees receive at the start a six months training programme. Engineers are trained at Kongsberg whereas operators receive on-the-job training. The company has a programme for active searching management talents and run tailor-made management development programmes.

KA introduced a trainee programme in 1994 targeted at tertiary educated engineers. This programme was institutionalized in such a way that all trainees receive two years' education and training in all functional areas as well as international practice. In 1995 management started systematically to map all employees' competence. At the same time they started compiling expertise requirements for different positions and comparing them with the employees' profile. In case of disparities, these are rectified with training measures. Employees' competence profile is also used for evaluating future need of competence. On the basis on such evaluations the company construct development programmes, which are partly obligatory partly facultative. Training is also linked with remuneration in order to encourage employees to develop their skills and creativity. This is a measurement to support KA's belief in principles of delegation and personal responsibility. KA sets individual targets and

standards for all employees and in return provides support for employees to master their job and for reaching personal career goals.

FMC/KOS is operating an Annual Performance Appraisal which is used both to evaluate and map the company's competence and to develop career development plans for the employees. Employees are offered further education support and scholarship schemes. To promote competence upgrading the company is practicing job rotation, trainee schemes and buddy/mentor schemes. Dresser-Rand is also encouraging employees to use the firm's fully paid tuition reimbursement programme for continuing formal education. It offers internal training provided by external experts as well as the attendance of professional development programmes world-wide.

Typically, company level education systems have evolved unilaterally. This development pattern deviates from what is the case in the other Nordic countries and particularly in Denmark where local organizations and institutions jointly reform curricula and educational courses. To the extent that the units are using external providers, international providers appear to be favoured to Norwegian ones suggesting a gap between the public educational system in Norway and the needs of knowledge-intensive globalized companies. However, this gap appears to be valid for different types of professions. As KA puts it 'knowledge acquired at school is considered to have a 'shelf life'. It is indicative that VAN has to train operators themselves. As will be explicated below, there are some signs that this situation may change.

The construction of social structures

The Kongsberg units are integrated into different global value chains and processes of business renewal have taken place unilaterally. Yet, a pre-requisite for achieving global visibility from a peripheral location is the existence of decentralized social structures. The existence of social networks and a critical mass of firms have been crucial for creating a local labour market (cf. Casper 2008). Today more than 100 firms are co-located at Kongsberg. The educational level of the local labour market is unique. More than sixty per cent of employed people have an education above the bachelor level which is exceptionally high for a small town of approximately 23 000 inhabitants situated in the 'middle of nowhere'. Kongsberg can not benefit from proximity to a university (Kongsberg Chamber of Commerce and Industry Project 2006). But the critical mass of firms provides a variation in job

opportunities that facilitates the recruitment of competent labour, at the same time as fluctuations in the need of labour can be offset between companies.

The existence of social networks has an important function as to informal information sharing across firms. The inherited social ties from KV have been vital for the creation of social networks, and these ties have formed the basis for action taken to engineer social structures and orchestrate the development of the Technology Town. After KV was dismantled the different successor units co-created Kongsberg Chamber of Commerce and Industry. One of its first tasks was to support business activities internationally. Over the years this institution functions as a sort of organizational framework for joint action to solve common problems locally: to improve and extend social services and to improve the attractiveness of the town by supporting infrastructural and cultural arrangements. Understanding the needs of globalized businesses appears to be a challenge for players at the municipality level. Social services initiated within this framework are to support people working in globalized businesses: an international school for the children of foreign employees, a day-and-night kinder garden, and tailor-made programmes for expatriates and their families to make the transition to Norway as smooth as possible. The expatriate programme includes all sorts of practical counselling such as dual career support and language classes. Activities for developing the Technology Town also include initiatives for creating an attractive and innovative business environment in order to attract new firms and support start-ups. The Chamber of Commerce organize networking between large and small firms and provides cross-sectoral meeting place, organize annual conferences, courses and study trips.

Recently, the major Kongsberg units together with the Chamber of Commerce and the local college were designated one of six National Centres of Expertise. Within the framework of this programme the units and the college has jointly developed a Master Programme in system engineering with the aim of developing it into a doctoral programme. To quality assure the education the local college is cooperating with Stevens Institute in the USA. The business units' cooperation with the local college represents a new development trend. This action appears to be part of a trend taking place across the country. Until the late 1990s the recruitment of labour locally could be done without problems. Recruiting and retaining labour has become increasingly challenging, and has prompted various initiatives such as cooperating with and supporting activities within the public educational system. However, pro-active local or regional support of globalized businesses is hard to detect, and reforms in

the multilevel governance structure have partly impeded a shared understanding of the situation to the extent that potential public-private partnership projects have failed.

5. Comparing Institutional Reforms in Norway with Reforms in the other Nordic Countries

The account of the Kongsberg units indicates that business renewal is largely taking place without strong links to the economic governance regime apart from some activities linked with the extraction of oil in the North Sea. This suggests that public and private resources are not pulled in the same direction and that innovative firms in Norway to a lesser degree than innovative firms in the other Nordic countries can share risks with the public. The way research, education, and active labour market policies are managed and organized, supports such a view.

The public research system

When Sweden and Finland stepped up their investments in R&D in the 1990s, Norway's research policy went in the opposite direction. Government even cut back investments in industrial R&D. As mentioned 'the market' was to govern economic development. This reorientation was the result of an ideological clash between neo-liberal inspired groups within the administrative and political elite and the group of 'technologists'. The latter lost with the consequence that economic policies narrowed down. Despite recurrent policy statements of increasing investments in R&D, Norway's investment rate is less than 1.7 per cent of GDP, the rate has remained low in spite of Norway's unique financial situation.

Low spending on R&D is often explained by low investments in the private sector. It is true that R&D spending in the private sector is lower than can be explained by Norway's peculiar industrial structure (OECD 2008). In comparison with the other Nordic countries, the private sector's share is low in Norway, it accounts for about half of total spending in contrast to for example the one in Finland that rose to more than 70 per cent already by the end of the 1990s. Nevertheless, it remains a fact that Norway spends less on total R & D per capita than the other Nordic countries although government spending is almost levelling the other Nordic countries in terms of amounts invested.

Moreover, both international and national reports point to low efficiency in the management of public R&D spending: too low coordination and too detailed control by the central administration. But OECD also criticizes the public research system for having developed symbiotic ties between the public research agencies and the large state owned companies, thus locking research into established trajectory. Moreover, recent reports conclude that less than half of money allocated through a governmental body went to innovation projects. OECD also finds that R&D carried out by the large companies is too less integrated into international networks (OECD 2008). In Norwegian research communities there is fear that key business players may off-shore research tasks, which also has happened.

Norway also prioritizes her R&D investments differently than the other Nordic countries. Norway spends far more on university research, mainly social sciences, and on welfare research than on science and industrial research. Since the early 1990s the system of higher education has increased its share of public spending at the expense of industrial research (OECD 2007:129, Kallerud 2006:15). Yet, only exceptionally are Norwegian research communities ranked among excellent communities internationally. In a recent European scoreboard only biology at the University of Oslo obtained the status of excellence (www.che.de).

As to prioritization the public research system in Norway plays a different role than in particular Finland and Sweden. In both these countries, research policies have made up an essential part of national innovation policies. Particularly in Finland was the research policy instrumental in transforming the economy in the 1990s.

The educational system

Norway's prioritizing of education has made it one of the top spenders among the OECD-countries. Norway invested 6.2 per cent of GDP in 2006 against the OECD average of 5.7 per cent (OECD 2007). Spending is particularly high as to primary and secondary education.²² Although spending relatively less on tertiary education, Norway has a higher share of the

²² Particularly, primary and secondary education has been prioritized in Norwegian politics. It has been instrumental both in the processes of nation formation and in the process of constructing a social-democratic society. For this reason the Norwegian educational system has had a special focus on equalization, social solidarity, democracy, and personal development (Teige 2007:104).

population with tertiary education than almost all the other OECD-countries (Salvenes et al. 2008:8). The public education system has provided the Norwegian economy with a workforce with a high level of basic education enabling people to navigate in a changing world. By international standards this highly educated workforce is also 'cheap', thus constituting a competitive advantage for knowledge-intensive enterprises. It is likely to argue that a highly qualified workforce is a driver in ongoing transformation of business in Norway.

Nevertheless, there are reasons to question the appropriateness of the public educational system. An increasing number of studies indicate that the Norwegian education system is not as fit as has long been assumed. The PISA comparative studies have served as an eye opener as to primary and secondary education. The first study, published in 2002, showed that the achievements of Norwegian students were below average. The second PISA study showed that the performance of Norwegian students had even deteriorated since the first one. Nor has the education system fulfilled objectives as to social equalization as there still is a correlation between school performance and family background (www.udir.no/skoleporten).

Thus, despite generous spending on education, and despite recurrent reforms to improve the system, only during the 1990s as much as three major reform programmes were implemented, Norway has failed to secure the quality of education of all social groups, just like many other western industrialized countries. An important challenge is an increasing number of drop-outs from the secondary level. Most of these are boys later found to receive disability benefits at a young age. Young people, and in particularly young men with low education, fail to be integrated into the labour market. Instead they are becoming members of an increasing group receiving social benefits. In 2001 this group numbered 700 000 and by 2006 it had grown to 800 000 despite attempts to stop it from growing.²³ The problem can also be related to the organizing of the vocational education and training system (VET).

The Norwegian VET system is considered to have low efficiency. Vocational schools and apprenticeships were regulated by different sets of legislation until 1980, but as a general principle skill training used to be the employers' responsibility. This state of affairs was

²³ To secure a better coordination between health, social and labour market services in order to provide better and more 'taylorized' services for the people, the parliament decided in 2006 to merge the states bodies managing these activities. This major institutional reform is to be implemented within a three years period from 2007 to 2009.

understood to make the system unstable, to be subject to market fluctuations and employers' discretion. Trade union officials claimed that skill training was for the few and not for the many: since employers decided who should receive skills training or not, 'it was the face-factor that counted'. For example, in 1953 only 30 workers in the metal industry were receiving formal vocational training. But despite the fact that workers got a legal right to vocational training in the 1950s, not many workers were formally educated at the level of VET in the succeeding decades. Still in the early 1990s the majority of Norwegian workers were not holding formal trade certificates. At that time it was stated that especially young people had difficulties in gaining appropriate education and training that was attractive at the labour market.

In the early 1990s the VET system was radically reformed. Reform 94 was to transform VET from being a recruitment system to becoming an education system. The strategy was to forge tighter links between the apprenticeship system and upper secondary education. The structure was adapted to the new school system in which 16-19 years olds were given a statutory right to three years of upper secondary education. Although the number of apprenticeship contracts increased from less than 300 at the beginning of the 1970s to 13500 in 2007, an investigation of the system could not identify any positive link between Reform 94 and the growth in contracts. The current situation is that approximately 30 per cent of yearly cohorts complete an apprenticeship as a part of their upper secondary education. Moreover, only half enter into apprenticeship contracts at the normal age (Høst ed. 2008, OECD 2008). This situation forms a sharp contrast to the situation in Denmark where 60 per cent of young people between 17 and 19 years of age are enrolled in VET programmes.

Why Norway has failed to develop an efficient VET system is a complicated issue. But a comparison with the organization of the VET system in Denmark gives some clues as to the failure of the Norwegian system. In Denmark the trade unions have traditionally a strong voice in vocational in education and training. Representatives of employers and employees have majority seating on the boards of local secondary schools that provide vocational training programmes. In Norway the social partners were entrusted with a high level of authority for the administration and control of the system until 1980 when a new act transferred the responsibility of VET to the level of county municipalities. In 1990 the new Local Government Act released conflicts between the county municipality education administration and the VET administration. Subsequently, the secretariat for the national VET

board was formally integrated into the Ministry of Education in 1992. This transfer of authority has provided the state full control of VET. The argument for centralizing the VET system was the need for the educational authorities to evaluate more flexibly the ability of the trade structure to meet the labour market's demands. Critics of the centralization link it to the hegemony of school interests in the Norwegian educational administration (Høst ed. 2008). Whatever the reason, it remains a fact that the VET system has become de-coupled from the labour market and real-time work practices. This de-coupling has made employers losing their interest in the public VET system. Instead the social partners prefer an experienced based Trade Certification as a system of certification.

Active labour market policies

Educational reforms affected the system of further education and training as well. As pointed to in the Introduction, Norway curtailed the proportion of occupational training in active labour market policies from 1990 onwards. In the other Nordic countries, particularly in Denmark, the opposite happened. As indicated in Table 1 in the Introduction, Norway still spends far less on vocational training and unemployment than the other Nordic countries. This outcome is yet an example of inconsistencies and paradoxes characterizing Norwegian policies. Throughout the 1990s the Confederation of Trade Unions campaigned for Lifelong Learning. For almost a decade Lifelong Learning topped the political agenda. In 1999 a pact on further education and training, the Competence Reform Programme, between the state and the social partners was eventually achieved²⁴. This pact secured employees a statutory right to further training. However, the funding of the reform remains unsolved. The money the government allocated was mostly spent on bureaucratic arrangement, and consequently the whole initiative disintegrated in the early 2000s²⁵.

The claim is made that Lifelong Learning only was used as an 'exchange commodity' for controlling wage formation. It is a fact that none of the tripartite members showed any genuine interest in developing the programme. It has been a strong point of view among the polity and the bureaucracy that further training and education is firms' responsibility. But also

²⁴ When the Competence Reform Programme was evaluated, it turned out that among the 80 000 employees that had participated, most of these had a tertiary education and was employed in the public sector (Døving et al. 2006).

²⁵ This initiative earned Norway the reputation of being a frontrunner in educational policies, particularly in vocational education and training (Teige 2007, OECD 2002, 2000).

the Trade Union centrally failed to gain support for Lifelong Learning. One reason was that Lifelong Learning was not embedded among the rank and file. When asked, trade unions locally would rather have money than skill training. It is also claimed that the Trade Union centrally was afraid that workers should gain so much competence that they would migrate to other and rivalling unions. It remains a fact that none of the social partners were genuinely committed to an active labour market policy similar to 'learnfare' in Denmark beyond its symbolic significance (Teige 2007, Døving et al. 2006, Nyen and Skule 2005).

Still, Norway scores high on international scoreboards of further education and training, particularly as to learning 'on the job'. Employees' participation rate is about the same level as in the other Nordic countries, but scores lower when the total population is counted. The reason for Norway's high scores is that adult training and education is largely paid for by employers. In fact, Norwegian employers' share of further training and education is the highest within the OECD area, but Denmark, Finland and the UK come close to the Norwegian level (Nyen and Skule 2005, OECD 2004). Typically, further training and education takes mostly place within companies, and rather than making use of public providers other companies, customers and suppliers constitute the most important external providers (Nyen and Skule 2005). When provided for by the public, training and educational activities are mostly restricted to employees with higher education in the public sector. This means that important social services are restricted to a small and privileged part of the labour market.

Thus, in comparison with Denmark, Norway constitutes a direct opposite as to active labour market policies (ALMP). The role ALMP plays in sustaining dynamism in the Danish economy is informative as to the importance of a system of further education and training in the new economy.

Emergent local initiatives

There is an increasing criticism of the different parts of the public education system in Norway. As many other western industrialized countries the Norwegian education system has problems in recruiting students to science and technology. But this challenge is greater for Norway since its share of students in these areas is lower than in comparable countries. The relative low return to education, related to the system of central wage bargaining, is seen as a

challenge to develop and sustain a competitive knowledge economy. Another emergent issue is that students' basic qualifications match badly the need of companies. Claims are made that too few Norwegian students graduate with qualities that are relevant to innovative methods in companies (Andersson et al. 2004:37). To a large extent the higher education system in Norway is structured to provide a workforce for the public sector. Sixty per cent of academics are employed in the public sector.

Several sectors – engineering, ICT, biotech, pharmaceutical – have for a long time had problems in recruiting a qualified work force, and despite increasing unemployment, companies are struggling with recruiting people with adequate qualifications. Against this background several interest organizations are claiming the existence of a gap between the Norwegian educational system and the labour market's need of basic competence. Recently, the Confederation of Norwegian enterprises identified the competence gap as the biggest future challenge. This challenge does not only affect basic education but involves also the upgrading of employees' skills (NHO 2008)²⁶.

To recruit needed competent workers Norwegian companies are launching different strategies. One is to recruit workers abroad.²⁷ However, in certain labour markets, such as ICT, Norway does not appear to be an attractive location. Alternatively, some companies have established centre of expertise abroad and have tasks carried out in countries where workers come from such as Poland and India.

A third strategy is to cooperate with a local education provider. For example to secure a competent work force, the Kongsberg companies have started a master programme in system engineering in cooperation with the regional college. The aim is to expand this master programme to also include a doctor programme. To assure the quality of the educational programme the local college is cooperating with Stevens Institute in the USA. Typically, until recently the Kongsberg companies considered the local education provider incapable of providing the students with a relevant and qualitative acceptable education. This sort of local interaction can increasingly be witnessed across the country. For example, in Rogaland local

²⁶ This point of view represents a radical break in the strategic thinking of the Federation. Traditionally, cost cuts, mostly with reference to wages, has been considered the appropriate competitive strategy.

²⁷ To attract people to come to Norway some companies are offering extra money, and some companies have established own recruitment offices in India and some are actively calling on educational institutions to recruit students (TU 24/07, www.nrk.no 9.8.07).

interest groups – politicians, business, academics - have cooperated for a long time on a more general level in order to boost business and to create new jobs. The regional interest groups rallied around the objective of establishing a university in the region (Gammelsæter 2002).

This sort of actions can be termed rebellion from the periphery. Local initiatives are seen as counter-action to central authorities' failure to adapt key macro-institutions to exigencies of the globalized economy (Sellers and Lindstrøm 2007). Such initiatives can also be witnessed at the sectoral level. Within the maritime cluster several firms have joined forces with the intent of funding ten professorships within or related to maritime disciplines. This is the biggest private investment ever made in basic research.

To sum up, this review of relevant social services supports the view that there is less risk sharing between the private and the public sector in Norway. In several areas there appears to be a mismatch between institutional resources and ongoing transformation internationally. One impediment for creating more experimental processes seems to be increased centralization in the system of governance. Within the framework of Norwegian authority pattern centralization can imply less capacity for cross-sectoral coordination and delegation. When this is the case, there is risk of developing lock-in situations.

A silent revolution in routines complementing business renewal

A contrary trend to centralization is found within the national system of industrial relations. As part of a broader movement within the Nordic countries, the trade unions have for a long time been engaged in workplace reforms. Within the broader movement it is taken that the decentralization of industrial relations and the emphasis on the articulation of local interests within the centralized structure of decision-making will impact on the advance of a new production concept. Increased reflexivity in working life is seen to have an internal restructuring effect. The ability to monitor one's own work from the perspective of the competitiveness of the company or the business unit have generated a new concept of production, in which the workers themselves are supposed to be able to reflect the needs of the customer. In this new concept new roles and identities, new working careers and professional identities are seen to have the potential of creating new possibilities of development (Kettunen 1998).

In Norway the tripartite programmes that were initiated within the framework of this movement were designed to include areas of productivity and adaptability, and to encourage the participation of all sorts of employees. Recent programmes explicitly stressed the participatory principle for innovation: to make cooperation instrumental for development, change, and innovation (Gustavsen et al. 2001). However, the effect of these experimental programmes on organizational change in Norway has been unclear, whether new forms of work organization had disseminated beyond the number of firms involved or not. National and Nordic level studies carried out in the mid- and late 1990s indicated low effect, that Norway was even trailing the other Nordic countries as to organizational flexibility (NUTEK 1999, Gustavsen et al. 2001). However, the last European Working Conditions Survey (2007) indicates that this state of affairs has changed (cf. Introduction). Norwegian employees, as the other Nordic ones, have the highest scores as to learning and work autonomy. These figures imply that Norwegian working life has been transformed in the past decade. This change process has occurred simultaneously with an intensified globalization. But paradoxically, this reform process has taken place with decreasing activity of trade unions locally particularly in knowledge-intensive companies.

Yet, it is likely to argue that the trade union's focus on broad participation – making cooperation instrumental for development, change and innovation - have facilitated new management templates and internalizing the interests of employees in how they are managed and organized when exposed to new challenges. The Trade Union centrally has a positive attitude to change and can in this way facilitate innovation at the firm level. This pertains particularly to the redefinition of work tasks in which representatives locally have a high degree of co-determination. The pro-innovation attitude counter-balances possible negative effects of employee co-determination. Instead of blocking change and the redefinition of tasks, trade unions can have a positive influence on firms' capacity for innovation. For example when Terotech, a small engineering service company at Kongsberg, wanted to introduce an incentive based wage system this was accepted by the Union centrally. The incitement for changing the remuneration system stemmed from the firm's changing role vis-à-vis customers. Solving customers' problems in interaction with customers themselves required new and different competences from employees beyond standardized routines and technical tasks. Moreover, problem solving for customers involved the participation of all employee groups. To further cooperation between groups – to transfer the shop floor collective to also include engineers – the company wanted to introduce one single tariff

system for all sorts of employee groups. This was accepted by the Union centrally. This orientation from the employees' side has undoubtedly facilitated firms' need for responsibility and functional flexibility.

6. A Summary: Can Dynamic Complementarities replace Contradictory Institutional Orders?

As a country to live in, Norway offers her population a good life: a high degree of social security and social services in terms of free education, maternity leave, child care, and high gender equality²⁸. As to institutional adaptation to ongoing transformation in the international economy, Norway demonstrates less malleability. To a lesser degree than the other Nordic countries has Norway evolved a welfare state that enables localities, firms, and citizens to master the exigencies of the new economy.

Yet, given the strength of the natural resource based economy, this study has revealed surprising ongoing dynamism in parts of the Norwegian economy. Norway's economic success relates to skills in the refinement of natural resources. By refining core technologies, Norwegian companies and public research institutions have jointly developed increasingly efficient manufacturing processes and at the same time extended the supply of resources. Well-known examples are fish farming and increased exploitation of oil resources in the North Sea. More recently, new application of a traditional product has emerged: the refinement of silicium wafers for use in solar cells. To what extent this new industry will be devoted to explorative activities as well as exploitation remains to be seen. The remarkable growth this industry has experienced is politically induced, and future growth is uncertain since the industry is still struggling with unresolved problems as to commercial viability.¹

More surprising is the dynamism that marks the offshore sector. The emergence of an open and decentralized innovation system in which customers and subcontractors collaborate closely has turned the Norwegian shelf into an experimental laboratory. The concurrent restructuring of institutional arrangements – by turning lobby coalitions into a sort of communicative corporatist body – has facilitated transformation. Through joint efforts the

²⁸ The statutory requirement of 40 per cent representation of women in corporate boards led to Norway being ranked as number one (www.weforum.org).

offshore sector has redefined itself to the extent that it has become a global leader. The fact that growth has taken place mainly on international markets is clearly signalling that the sector has passed the 'market test'. Leading players have reinvented themselves from being local suppliers to becoming global players.

The emergence of this competitive sector is triggered by public policies' concern of extending the supply of raw materials. An unexpected outcome is that a number of firms have changed from process optimization to experimenting and continuous adaptation. Peripheral players have been the frontrunners in the creation of this new pathway. Our case studies have disclosed that experimentation is not restricted to players within the offshore sector, but players within the automotive industry and jet engine component industry have demonstrated remarkable achievements. Across the country there are occasionally similar surprising outcomes. One example is the emergent biotech cluster in Oslo. In 2008 this cluster was denominated one of the twenty most emergent dynamic biotech clusters in the world, and the only one in Europe by the international journal *Genome Technology*. Given generally weak university-business links in Norway and biotech businesses' dependence on academic research, this cluster represents a novelty in the national business system.

These achievements are the resultant outcome of players' capability of integrating into global value chains and constellations, and by their capability to construct social networks locally. Network building locally and transnationally has compensated for lack of risk sharing arrangements at the national level, and it has helped avoiding narrow role definitions and strong functional boundaries characteristics typical of the traditional Norwegian business system. There was a weak tradition of inter-firm interaction let alone cross-sectoral interaction. Beside the horizontal collaboration that evolved in relation to the technology programme in the postwar period, a few exceptions like the maritime cluster in the north-western part of the country, Møre (Andersen 1997), and the automation/robot cluster in the south-western part, Jæren, can be counted.

A key issue is to what extent experimental businesses can sustain and expand without the help of public social services. The situation is for the time being that public policies are mainly geared towards sustaining a natural resource based economy and to balance activities and spending, not developing. Institutions are aligned to support ground rent seeking activities and process optimization. To a large extent there is a mismatch between institutional

arrangements and the exigencies of the globalized economy, let alone the fact that resources spent for social services in Norway rather push individuals into passivity than enabling them to master challenges. In fact, social services are creating social problems instead of solving them.

For future competitiveness and welfare much depends on to what extent institutional change can co-evolve with the needs of and share risks with localities, firms and citizens. Local initiatives for bridging gaps in research and education are strong signals of needed reforms. But reforms need to be decentralized for the tailoring of policies to local needs: for stimulating and sustaining local dynamism. To give weight to an open and decentralized innovation system, incentives must include broad participation and stimulate cross-sectoral experimentation and collaboration. A flexible labour market is now considered to provide better conditions for experimenting than mere technology programmes, and although labour turnover in Norway is high - over half a million workers change jobs each year out of a total workforce of 2.5 million – the extent of cross-sectoral crossings have been limited (OECD 2007:73). Recent reforms such as the system of national centres of expertise and regional research funds represent steps towards decentralization. The question is whether these activities suffice to counteract post-NPM centralization trends.

¹ In the early 1990s a small industrial community close to the polar circle was searching for new industrial activities to replace operations at one of the local plants. By chance the community formed an alliance with a researcher entrepreneur looking for a production site and the financing of the production of a new product: silicium wafers to the solar energy industry. The project got started through financing from the district development fund and local banks. In addition public money was granted for further training of the local workforce in order to support the survival of the community (Hansson 2008). This was the start of a company that today is world leader in this business and of a new industry sector in Norway. By profiting on a highly qualified work force and new forms of work organization the newly established company REC managed to achieve top quality wafers.