

The Snorre Field and the Rise and Fall of Saga Petroleum

Hildegunn Kyvik Nordås

WP 2000: 16

The Snorre Field Development and the Rise and Fall of Saga Petroleum

Hildegunn Kyvik Nordås

WP 2000: 16



Chr. Michelsen Institute *Development Studies and Human Rights*

CMI Working Papers

This series can be ordered from:

Chr. Michelsen Institute

P.O. Box 6033 Postterminalen,

N-5892 Bergen, Norway

Tel: + 47 55 57 40 00

Fax: + 47 55 57 41 66

E-mail: cmi@amadeus.cmi.no

Web/URL: <http://www.cmi.no>

Price: NOK 50 + postage

ISSN 0804-3639

ISBN 82-90584-76.8

Indexing terms

Oil industry

The petroleum sector

The offshore sector

Norway

JEL L7, L8, Q4

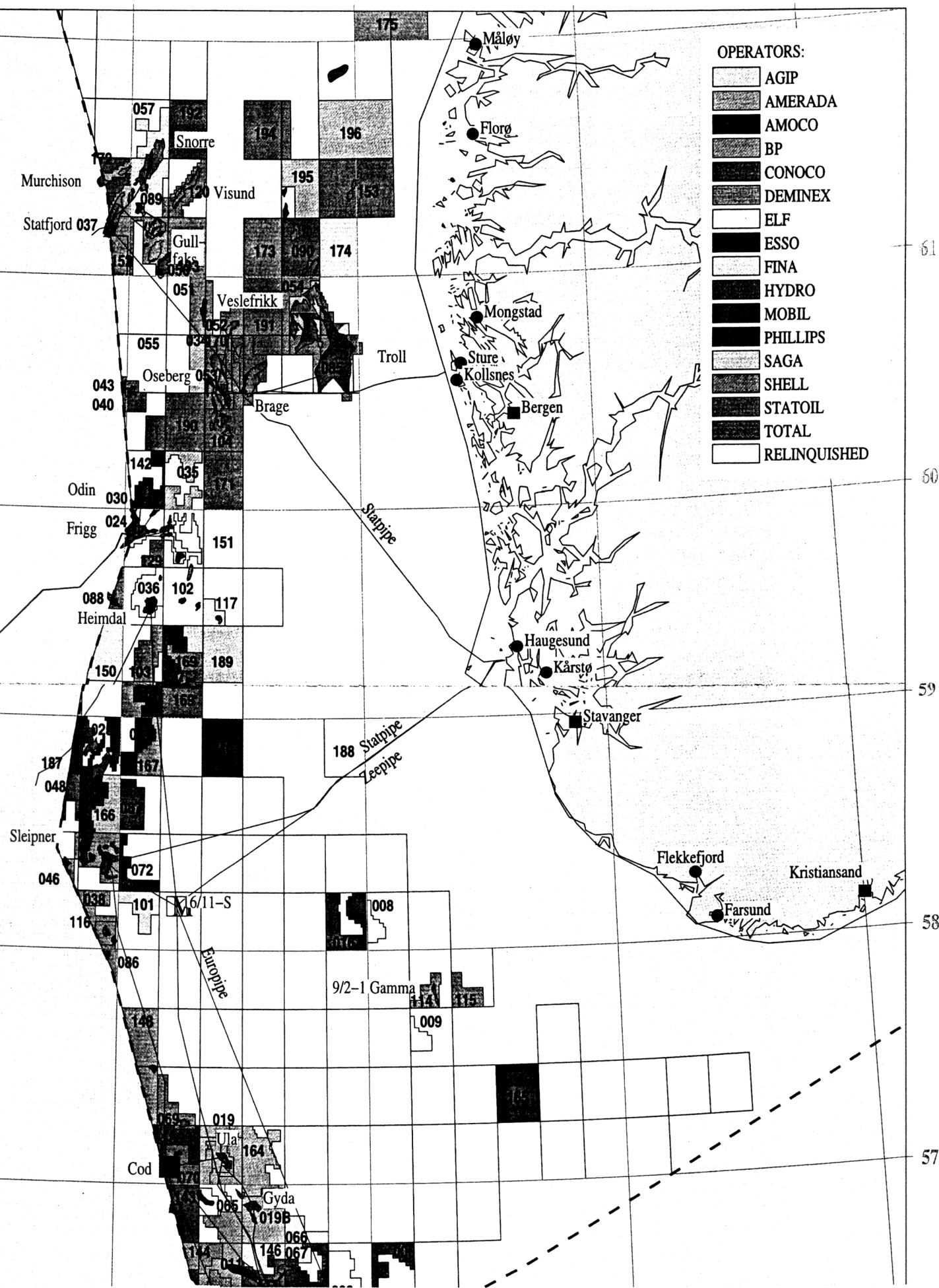
North sea

2°

4°

6°

8°



- OPERATORS:**
- AGIP
 - AMERADA
 - AMOCO
 - BP
 - CONOCO
 - DEMINEX
 - ELF
 - ESSO
 - FINA
 - HYDRO
 - MOBIL
 - PHILLIPS
 - SAGA
 - SHELL
 - STATOIL
 - TOTAL
 - RELINQUISHED

61

50

59

58

57

1 Introduction^{1,2}

This paper analyzes the role of producer services in the categories engineering, maritime services and non-maritime services in the exploration, development and operation of the Snorre oil field. The purpose of the paper is to study the market structure of the Norwegian offshore market for oil-related services during the Snorre project. We focus on the extent of competition in the various segments of the market, the Norwegian market share and the nature of vertical linkages between oil companies and the offshore industry, focusing on oil-related services. We finally discuss how the producer service sectors have contributed to technological developments during the Snorre development.

The Snorre field development represented a milestone in Norway's development as an oil producer. It was the first field for which the Norwegian private oil company, Saga Petroleum, established in 1972, was the operator. The Snorre project was a milestone also in the sense that it represented a further step into deeper waters and the introduction of new, floating technology on the Norwegian shelf. Saga had estimated the investment cost of conventional technology to \$10 per barrel of oil produced, which was not seen as economically viable (Lappegård et. al. 1991a).³ An alternative technology had to be found and Saga chose the so-called tension leg platform (TLP) solution. This is a floating solution and the first of its kind installed in Norwegian waters. Moreover, it was the third TLP ever to be installed and the largest in the world at the time. The Snorre platform is still the largest floating production system in the world after upgrading and installation of additional capacity in the late 1990s.

Since Snorre was the first Norwegian field for which Saga was the operator, the company lacked experience, and therefore entered a contract of technical support with Esso, one of the major multinational oil companies. Technical support from an experienced oil company was furthermore one of the conditions that the Norwegian authorities attached to the license and the role as an operator in order to ensure quality and safety. The license is shared among the following participants:

Saga Petroleum 11.26 percent (taken over by Norsk Hydro in 1999);
Statoil 41.4 percent, including the state's direct financial interest;
Esso 10.33 percent;
Deminex Norway 10.03 percent;
Idemitsu Petroleum Norway 9.6 percent;
Norsk Hydro 8.27 percent;
Elf Petroleum Norway 5.51 percent;
Amerada Hess Norway 1.46 percent;
Enterprise Oil Norway 1.46 percent;
DNO Olje 0.69 percent.

All licensees participate in decisions related to the field development and operations and thus contribute with their expertise and technology.

¹ I am grateful to Ola Kvaløy for research assistance; the Norwegian Research Council, under the program "Næring Finans og Marked" for financial assistance and Aker Maritime for useful information.

² If not otherwise stated the source of information in this section is the Ministry of Oil and Energy's Fact Sheet, Norwegian Petroleum Activity.

³ The investment cost in earlier Norwegian fields varied between \$3.5 and \$8 per barrel.

The Snorre field is located 150 km west of the village Florø and 210 km from Bergen. It stretches over block 34/4 and 34/7, an area of about 75 km². The first block (34/4) was discovered in 1979 and the second in 1984. Total recoverable reserves were initially estimated to 169 MSm³ of oil, 5 billion Sm³ of gas and 2.3 million tones of NGL. It has later been upgraded to 225.3 MSm³ of oil, 9.2 billion Sm³ of gas and 6 million tones of NGL. Because of the vast area of the field and the nature of the reservoir, reserves per well (1.3MSm³) are significantly smaller on the Snorre field than the other major fields that had been developed so far.⁴

The Snorre field was developed in two phases. The first development was approved in May 1988 and contains a steel TLP and a subsea production system located some 6 km from the platform. The platform consists of a four column floating hull made of steel and an integrated deck which is anchored to the seabed with 16 strings of steel pipes or tension legs. The TLP is constructed and anchored in such a way that heaving is prevented, but limited sideways movement of the platform is allowed for. The steel deck of the platform contains production and drilling equipment and a living quarter. It is thus an integrated platform, similar to the Gullfaks platforms, but with a simpler production system. The Snorre platform's production capacity is estimated at 190 000 barrels of oil per day, while the subsea system has a production capacity of 60 000 barrels a day. The field came on stream in 1992. Later additional capacity has been installed in order to process oil from smaller neighboring fields such that the combined capacity of the Snorre TLP and the subsea systems is 360 000 barrels of oil a day.

Water injection in order to maintain the pressure in the reservoir was introduced from the start. In addition, a pilot project testing the feasibility of gas injection was initiated, resulting in a water alternating gas injector (WAG). Oil and gas are separated in the platform's processing facility and piped to the Statfjord A platform for final processing and loading into shuttle tankers. Some of the gas is injected into the Statfjord formation in order to increase the recovery rate at this field. Remaining gas is transported through the Statpipe trunkline to Kårstø for removal of natural gas liquids before lean gas is piped to continental Europe.

The second development of the Snorre field was approved in June 1998 and contains a semi-submersible platform (Snorre B) with drilling, processing and accommodation facilities and a subsea production system. We concentrate on the development of the first phase in this study. The rest of the paper is organized as follows: Section 2 gives a broad overview of the market structure of the offshore and oil-related services sector for supply to the Snorre field development. The data is broken down to three phases of the project, the exploration phase, the development phase and the operational phase. Section 3 analyzes the market for producer services in more detail. Four categories, engineering, maritime services, non-maritime services and other services are examined. The data is taken from a database compiled by the Ministry of Oil and Energy, the PI-base. These data are supplemented by the annual reports of the companies involved, interviews and other sources of information. Section 4 discusses vertical relations between the operator, contractors and subcontractors. Section 5

⁴ Reserves per well were estimated at 4.9 MSm³ at Statfjord and 3.9 MSm³ at Gullfaks.

presents findings on technological developments during the Snorre field development, while section 6 summarizes and concludes.

2 The structure of the offshore market

Saga Petroleum entered a contract with Esso in 1984 for technical support for the development of the Snorre field. The cooperation was of vital importance during the project preparation phase in order to secure quality and appropriate technology choice. Saga and experts from Esso formed a team to carry out exploration appraisal, reservoir description, development planning, economic screening, cost and schedule planning, technical screening and concept safety evaluations (Lappegård et. al. 1991a). This team's work laid the foundation for the tendering and procurement process during which 80 percent of the Snorre contract values were open to international competitive bidding.

Saga purchased the Gullfaks project systems and process specifications from Statoil and used it as a starting point for the Snorre project. Since this was Saga's first project, it was seen as very important to have a well-established project system, which the personnel and the contractors were familiar with (Lappegård et. al. 1991a). The Saga/Esso project team worked closely with the major engineering contractor, sharing engineering, procurement and project databases. Therefore, it was seen as important that engineering was based in Norway and the contract was subject to Norwegian competitive bidding only. The topsides fabrication contract was also limited to Norwegian competitive bidding in order to avoid open ocean towing of the complete deck (Lappegård et.al. 1991a).

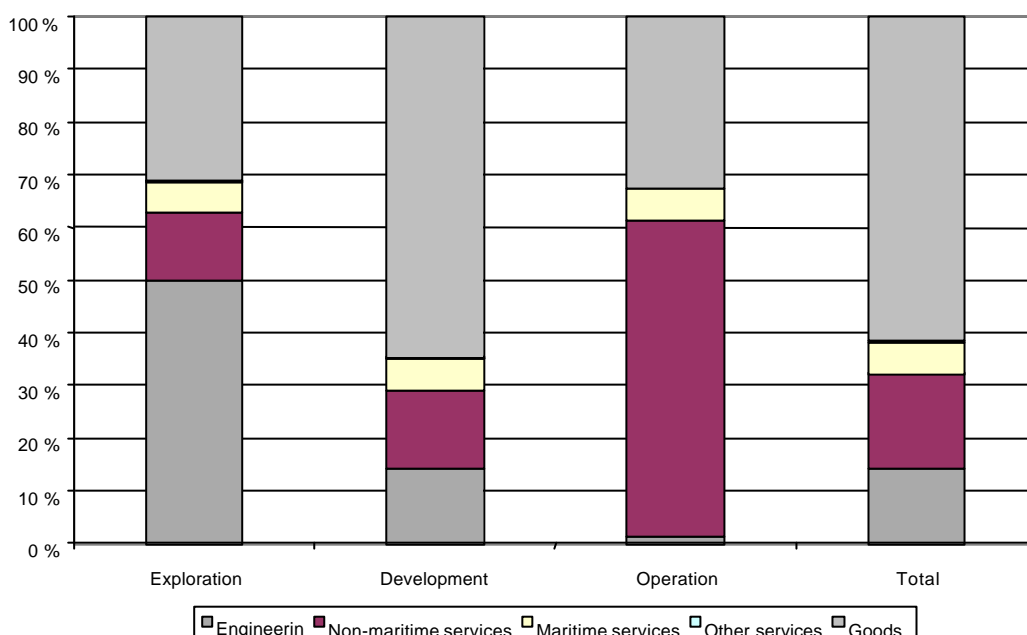
The total value of contracts registered in the PI base is NOK 15 billion of which 442 million for the exploration phase, 13.7 billion for the development phase and 1 billion for the operation phase.⁵ This compares to total accumulated investments during the development phase of 21.5 billion by the end of 1994, reported in the Ministry of Oil and Energy's fact sheet (1995). The fact sheet figure is measured at constant 1994 prices. The difference between the two sources of data is partly due to inflation during the period, partly due to the oil companies' own expenditure which is registered in the fact sheet, while the PI base only covers external purchases, and there could also be omissions in the PI base. Esso's contribution to the development of the field through the agreement of cooperation, for example, is not included in the PI base. Finally, only contracts exceeding NOK 1 million are included in the PI base. The PI base is, however, the most comprehensive detailed record of purchases and contracts for the individual oil fields and it is our major source of data for the analysis presented in this section.

The actual cost of phase one of the Snorre field development turned out to be NOK 1.5 billion below the initial budget from 1987 (Saga Petroleum 1992). To some extent this can be explained by the difficult times in the offshore industry at the time when tenders for Snorre were announced. The offshore industry had substantial spare capacity and there was fierce competition for the contracts in spite of the limited number of bidders for the contracts.

⁵ The PI database has been prepared on the basis of the compulsory reports the oil companies had to submit to the Ministry of Oil and Energy in order to monitor the market share of the Norwegian offshore industry.

Figure 1 shows the composition of inputs during the three phases of the Snorre project. Maritime services are defined as services provided from vessels and aircraft. They include personnel transport, supply vessels, standby vessels, drilling vessels, diving services, cranebarges, flotels, seismic services, soil sampling and survey positioning, pipelaying barges and installations of platforms and other structures. Non-maritime services are defined as services provided from rigs or onshore. They include drilling, mud engineering, cementing, testing, well services, catering, maintenance and hook-up.

Figure 1: Cost shares by phase



Source: The PI base

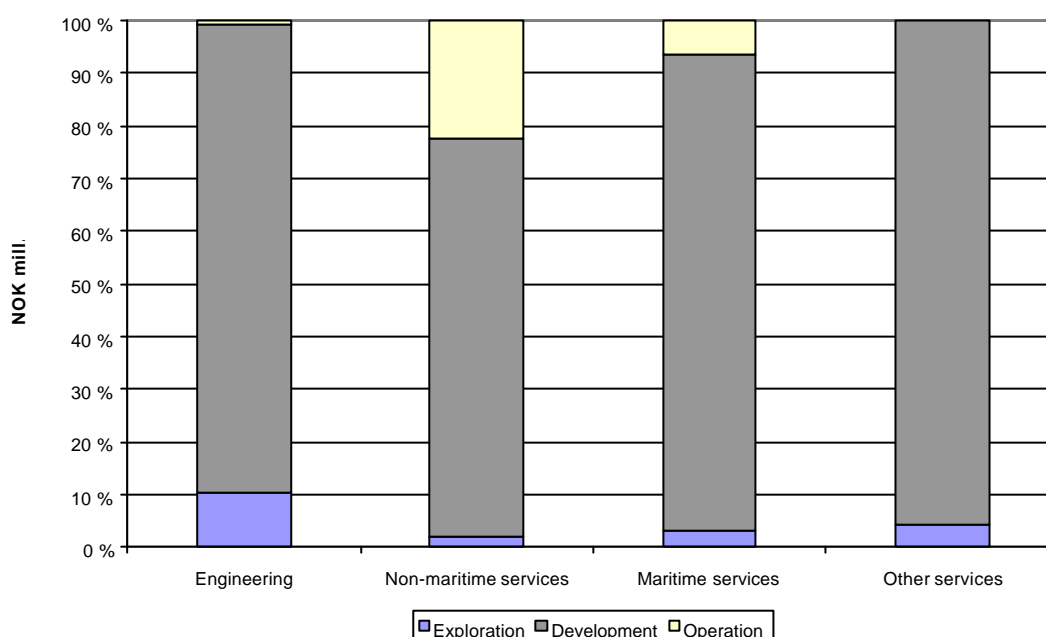
The exploration phase is the most service-intensive with about 70 percent of total procurements falling on services, closely followed by the operation phase. Among services, non-maritime services and engineering are the two most important measured by expenditure shares for the project as a whole. The large share of engineering during the exploration phase is worth noticing. This is much higher than in previous field developments. Furthermore, the exploration phase constitute a larger share of total costs than previous field developments.⁶ It can be explained by two factors; first, the exploration phase in the database contains the entire period from the license is awarded to the approval by the Norwegian parliament to develop the field. For Snorre the license for block 34/4 was awarded in 1979 and for block 34/7 in 1984, while the approval to develop the field came in 1988, 9 years after the first license was awarded. The long exploration phase implied that a large amount of concept evaluations took place during this phase and a well-founded base for the design of the TLP was established during the period 1985-87 (Lappegård et. al. 1991b). Second, due to the fact that the Snorre field development represented one further step into deeper waters, technologies hitherto untried at the Norwegian continental shelf had to be considered. Indeed, 14 structural concepts and a number of processing and

⁶ See for example Nordås (2000) for a case study of the Gullfaks field.

transportation alternatives were assessed before the steel tension leg platform (TLP) combined with the subsea system was chosen (Lappegård et. al. 1991a). Furthermore, a disagreement with the Norwegian Petroleum Directorate (NPD) on technology choice required additional documentation of the chosen technology's advantages relative to a concrete TLP, which was the technology that the NPD preferred (Saga Petroleum 1998).⁷

Figure 2 below shows the relative importance of the service markets for exploration, development and operation for each service category.

Figure 2: Service expenditure by phase of field development



Source: The PI base

For all services the development phase is by far the most important market. The insignificance of the operation phase is of course largely because the database only covers the first two years of production. Figure 2 clearly shows that the exploration market is small for all supply categories with the possible exception of engineering.

The 5 largest contracts for the Snorre project recorded in the PI base are presented in table 1.

Table 1: the 5 largest contracts recorded on the Snorre project

Supplier	Item
Aker Stord	Fabrication of TLP topsides, tow and mating of TLP topsides to hull, inshore hook-up and commissioning of TLP topsides/hull, offshore hook-up and commissioning of TLP.
Moss Rosenberg Verft	Fabrication, assembly and outfitting of the hull for the Snorre TLP platform.
Norwegian Petroleum Consultants (NPC)	Project service contract
Aker Engineering	The main engineering contract
Saipem	Rental of drilling rig Scarabeo 5 for Snorre phase I subsea drilling.

⁷ A concrete hull would probably have generated more work for the Norwegian offshore industry.

The Norwegian offshore market was dominated by two firms, Aker and Kværner, which had both restructured from shipbuilding and other construction work to offshore companies. They both offered a wide range of products for the petroleum sector from a number of subsidiaries specializing in particular products or market segments. Moss Rosenberg Verft was a company within the Kværner group, while NPC merged with Aker Engineering in 1991. The only contract among the 5 largest in value terms not going to these two companies is the rental of a drilling rig from the Italian company Saipem. The two largest contracts for the Snorre field are construction contracts, while the other three contracts included in table 1 are all service contracts. Services account for almost half the value of the 5 largest contracts, and indicate the large-scale nature of the oil-related services industry. All the 5 largest contracts are for the development phase. The project service contract awarded to NPC is for support to the Saga project team in managing the Snorre development project. Such a large contract on project management indicates the formidable task of managing and coordinating such a large project.

Table 2 below presents the number of contracts awarded during the Snorre field development up to the end of 1994 for each expenditure category and phase of the project.

Table 2: Number of contracts

	Exploration	Development	Operation	Total
Engineering	58	42	5	105
Non-maritime services	10	62	23	95
Maritime services	7	31	2	40
Other services	1	11	0	12
Goods	10	278	35	323
Total	86	424	65	575

The number of contracts awarded during each phase and to each category largely reflects the relative level of expenditure during each phase and category as depicted in figures 1 and 2, although the average value of contracts varies as shown in table 3.

Table 3: Average value of contracts (NOK mill.)

	Exploration	Development	Operation	Total
Engineering	3.8	46.2	2.4	20.7
Non-maritime services	5.6	32.9	26.5	28.5
Maritime services	3.8	26.3	29.8	22.5
Other services	1.5	3.0	-	2.8
Goods	13.7	31.8	9.5	28.9
Total	5.1	32.2	15.6	26.3

These figures conceal large variations in the value of contracts. The value of the median contract in each of the most important service categories is NOK 2.1 millions for engineering, 4.9 million for non-maritime services and NOK 6 million for maritime services. A median value this much smaller than the average value reflects the fact that there are a few very large contracts complemented by many smaller contracts. A large number of the smaller contracts were for adjustments and supplementary work by firms awarded the major contracts, but there is also a significant number of contracts for specialized services awarded to niche firms. The number and average value of contracts therefore give a biased picture of the market

structure in the offshore sector. In order to get a more complete picture, we analyze measures of competition and market concentration below.

2.1 Market concentration and competition

In this section we take a closer look at competition in the service market for the Snorre field. The indicators chosen are:

- i) The market share of the 5 largest and the 2 largest companies respectively;
- ii) The Herfindahl index;
- iii) The number of bidders per contract;
- iv) The Norwegian market share.

The first two indicators measure the degree of concentration in the market. We present the indicators for the Snorre field as a whole and for each service category in table 4. Our estimates are based on the PI data base.

Table 4: Market share of 5 and 2 largest companies and the Herfindahl Index

	Exploration	Development	Operation	Total
Engineering	87, 61 0.23	96, 91 0.41	100, 63 0.25	92, 87 0.38
Non-maritime services	100, 94 0.78	83, 71 0.26	92, 72 0.37	78, 67 0.24
Maritime services	100, 69 0.37	75, 49 0.19	100, 100 0.60	73, 49 0.17

Market share (percentage) for the 5 and 2 largest companies is given in the upper row of each cell, The Herfindahl Index in the lower row.

We see that engineering is the most concentrated service sector, while the cell that represents the highest degree of concentration is non-maritime services in the exploration phase. Schlumberger totally dominates this market with a market share of 88 percent.⁸ The market share of the two largest companies is more than half in almost all markets and phases. Table 5 identifies the two largest companies in terms of market share by category and phase:

Table 5: Dominant companies by sector and phase⁹

	Exploration	Development	Operation	Total
Engineering	Aker, NPC	Aker, NPC	Veritec, British Gas	Aker, NPC
Non-maritime services	Schlumberger, Promud	Aker, Saipem	Aker, Chalk	Aker, Saipem
Maritime services	NGI, Coe Metcalf	Rockwater, Saipem	Saipem, Sonsub	Rockwater, Saipem

We note that Aker is the major contractor to the Snorre project. But the prominent role of multinational companies is also worth noticing.¹⁰ This is not reflected in the Norwegian market share presented in table 7 below, simply because the multinationals have established subsidiaries in Norway in order to service the offshore market. The Norwegian market share includes what is produced in Norway and does

⁸ E.g., the Schlumberger group which includes Anadrill, Flopetrol and Geco.

⁹ Recall that Aker Engineering and NPC merged in 1991. NGI is Norwegian Geotechnical Institute

¹⁰ The nationalities of the multinationals are: British Gas (UK), Schlumberger (USA), Coe Metcalf (UK), Rockwater (UK), Saipem (Italy).

not take ownership of the company into account. But before we take a closer look at the Norwegian market share, we include one final indicator of competition in the market for oil-related services. This is the number of bidders per contract, depicted in table 6.

Table 6: Average number of bidders per contract:

	Exploration	Development	Operation	Total
Engineering	1.5	1.8	1.4	1.6
Non-maritime services	4	2.8	2.7	2.9
Maritime services	2.3	3.4	4.0	3.2
Other services	1.0	2.3	-	2.2
Goods	2.8	3.7	2.5	3.5
Total	2	3.3	2.3	3.0

The table suggests that there is little competition on the Norwegian offshore market, particularly in engineering services, which have less than two bidders per contract on average. However, the number of bidders per contract may underestimate the extent of competition in the offshore market for at least three reasons. First, Saga Petroleum's contracts with some subcontractors are in the form of frame agreements. There may thus be little or no competition on single contracts covered by the frame agreement, while there may be fierce competition in order to get the frame agreement. Second, a number of contracts entail options for future deliveries such that absence of competition on a particular contract may be due to the fact that an option is executed. Third, a number of small contracts is supplementary to larger contracts and it is often most cost effective to place such orders with the same company who was awarded the main contract. Finally, it is worth mentioning that the average presented in table 6 conceals large variation. For example, out of the 575 contracts recorded, 206 had only one bidder. A number of these contracts were options exercised and continuation of existing contracts, indicating established operator-supplier relationships.

A factor that does limit competition is the cost of bidding on a contract. Not only are considerable resources spent on the bidding process, but the bidding cost for the potential supplier may depend on experience from previous deliveries to the oil company. Learning effects on the company level may thus over time have erected barriers to entry in segments of the market.

With these qualifications in mind, the engineering service sector appears to be the least competitive sector, while the supply of goods appears to be the most competitive sector/activity. The development phase appears to be the most competitive of the three phases, while maritime services appear to be the most competitive producer service sector.

The Norwegian Ministry of Oil and Energy emphasizes that international competitive bidding should be the guiding principle for awarding contracts, and Saga Petroleum has awarded 80 percent of all contracts for Snorre after international competitive bidding. However, out of a total of 105 engineering contracts only 18 had foreign bidders, or an average of 0.26 foreign bidders per contract. The corresponding figures for non-maritime services were that out of 95 contracts, there were foreign bidders on 29, and the average number of foreign bidders per contract was 0.64. Finally, for maritime services 23 out of 44 tenders had foreign bidders, and an average of 1.1 foreign bidders per contract. The figures suggest that foreign companies may have

perceived the Norwegian market as difficult to penetrate via exports and that direct investment is the preferred mode of servicing the market. The service sectors that appear to be most open to international trade are other services and maritime services. Other services include general services not specific to the oil industry.

Table 7: Norwegian market share percent of total purchases

	Exploration	Development	Operation	Total
Engineering	85.6	81.1	44.7	81.4
Non-maritime services	40.4	74.5	6.7	58.5
Maritime services	63	63.5	0	59.3
Other services	100	55.6	-	57.5
Goods	20.3	59.8	25.7	58
Total	58.4	65.3	13	61.5

At 61.5 percent, the Norwegian market share is not particularly high, bearing in mind that Norwegian subsidiaries of multinational companies are included. Engineering services are again the exception with a Norwegian market share above 80 percent, while goods and all other services have a Norwegian market share slightly below 60 percent. Engineering is not much traded because engineering services are undertaken in close relation to the construction and operation activity and often needs to be performed at the construction site or the operation site. Comparing tables 6 and 7 it seems like the Norwegian market share and the average number of bidders per contract are negatively correlated. We estimated the correlation coefficient to -0.74 , indicating, as should be expected, that the more traded is the service, the more competitive is the market.

3 Producer services

In this section we will analyze the market structure of inputs for each producer service category within each phase of the project in more detail. We use the information presented in tables 2-7, supplemented by information from the Annual Reports of the companies involved and other relevant literature. The analysis focuses on market structure and contractual relations between the oil company and the supply industry.

3.1 The exploration phase

As seen from figure 1, services account for a large share (about 70 percent) of total expenditure during the exploration phase. Among services, engineering clearly accounts for the largest expenditure share (about 50 percent), followed by non-maritime services.

Out of the 58 **engineering** contracts awarded, 39 were in the category concept evaluation studies and R&D, most of them related to the development of the Snorre TLP platform. Thus, this service category had little to do with exploratory activities as such. Among the 39 contracts in the category concept evaluation studies and R&D, 16 went to Aker Engineering, Aker Engineering/John Brown and Norwegian Contractors e.g., the Aker Group, while the remaining 13 contracts were awarded to 13 different companies of which 2 are foreign providing the services from abroad. These 13 were smaller contracts, most of them with a value of NOK 2-5 million. Reflecting the shortage of relevant skills in the Norwegian market, 5 contracts under the engineering category were for mobilization of key personnel.

Within **non-maritime services** we find the more specialized exploratory services, related to drilling and well services and the analysis of reservoir properties by means of testing and logging. No drilling contracts are reported, indicating that exploratory drilling was undertaken by Saga Petroleum itself, or its license partners. Testing and logging contracts were awarded to the major multinational oil service firms and their Norwegian subsidiaries or affiliates, with the Schlumberger group being the most prominent.

Only 7 contracts were awarded under the category **maritime services** during the exploration phase, all of them were on soil sampling and surveys. No seismic surveys were awarded, indicating a gap in the database or that seismic surveys were done in-house, or before 1980.

3.2 The development phase

The largest expenditure category during the development phase is goods. Nevertheless, this phase constitutes the largest market for producer services in terms of absolute value.

3.2.1 Engineering

Engineering services are divided into 7 subcategories:

1. Concept evaluation;
2. Project management services;
3. Pre and detailed engineering;
4. Project support functions;
5. Education and training;
6. Special studies;
7. Other.

As discussed above, most concept evaluation contracts were awarded during the exploration phase. Only two contracts, both relatively small were awarded in this category during the development phase.

One **project management** contract was awarded. This is the contract mentioned among the five largest for the entire Snorre project and it was awarded to NPC who was the only bidder for the contract. Through this contract, Saga partly outsourced management and coordination of the project, although NPC worked closely with the Saga/Esso project management team. This way of organizing the project management was adopted from the Gullfaks project system that Saga bought from Statoil.¹¹ The project management contract accounted for about 6 percent of total development costs.

Five contracts were awarded within the group of **pre and detailed engineering**. Among them are the major engineering contract for the Snorre platform included in table 1, two other large contracts, and two small contracts. For all five contracts there

¹¹ See Nordås (2000) for a case study of the Gullfaks field.

were only one bidder and all were Norwegian, although foreign subcontractors were used reducing the overall Norwegian market share to 79 percent.

The market for **project support engineering** services is more diversified with less market concentration. 18 contracts were awarded to 15 different firms, and most contracts were relatively small (below NOK 10 million). Nevertheless, 13 out of the 18 contracts had only one bidder, indicating that there was little competition in each market segment.

The market for **special studies** is similar to the market for project support engineering. 12 contracts were awarded to 11 different firms in this category. All contracts had a value of less than NOK 6 million. This is the most competitive category under engineering services in terms of number of bidders per contract. The average number of bidders was 2.4 while 5 contracts had only one bidder.

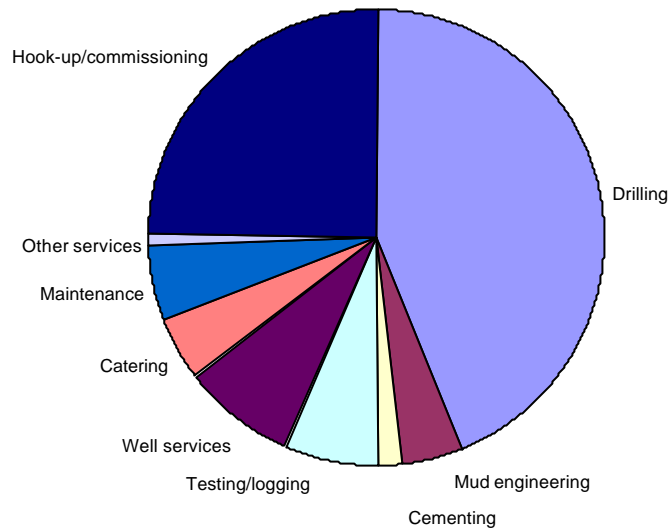
To summarize, the engineering service category during the Snorre development phase was a highly concentrated market with Aker and NPC obtaining a market share of 45 and 41.5 percent respectively. The remaining 13.5 percent were shared between a large number of firms, all except 2 were Norwegian or Norwegian subsidiaries or affiliates of multinational oil service or engineering firms.¹² The Norwegian market share is, however, somewhat exaggerated in the data. It was a widespread practice in the sector to employ foreign experts within the Norwegian engineering firms' own organizations. Thus, about half the work Aker Engineering did on the Snorre development was done by Aker's own employees, while the other half was done by subcontractors, mainly British and American.

3.2.2 Non-maritime services

Non-maritime services account for the largest expenditure category of producer services during the Snorre development phase, slightly higher than expenditure on engineering services. The sector appears to be more competitive than the engineering service sector with a higher number of bidders per contract and a slightly lower Norwegian market share, and a significantly lower Herfindahl index as illustrated in tables 2-7. Figure 3 shows the composition of non-maritime services on subcategories by total value of contracts.

¹² The two foreign firms were both British and were awarded relatively small contracts.

Figure 3: Composition of non-maritime services during the development phase



Clearly, drilling services account for the largest share of total expenditure on non-maritime services. There are three large contracts on drilling, one of them is included in table 1. The market for drilling and drilling services appears to be competitive with 5-6 bidders on each of the contracts. The largest contract was, however, given to Saipem as the only bidder after Saipem had won an earlier contract on drilling in competition with 4 Norwegian and one British rig company.

The second largest subcategory is hook-up. There is one contract for inshore hook-up, and one for offshore hook-up, both awarded to Aker Stord who also did the fabrication of the TLP topside. Both contracts represented execution of options.

The subcategories with the largest number of contracts are well services (17) and testing/logging (16). The latter involved 11 different firms and appears to be a competitive market with a relatively high number of bidders per contract. The few contracts that had only one bidder were extensions of existing contracts.

To summarize, the market for non-maritime services contains a number of niche firms along with large-scale drilling and offshore companies. Drilling is a global business and involves a large number of bidders on each contract even in the relatively small Norwegian market. We also note that services are often related to sales or rental of equipment. It is commonly cited in the PI base that the company that is awarded a contract already has installed its equipment on the Snorre platform or on the drilling rig Treasure Saga. This probably reflects that services are complementary to deliveries of equipment and that there are switching costs related to such services since the supplier of equipment has superior knowledge of the equipment and exclusive access to spare parts.

3.2.3 Maritime services

The contacts on maritime services were divided among subcategories as follows: 1 on personnel transport, 9 on diving and remotely operated vehicle (ROV) services, 2 on flotels, 5 on barges, 1 on seismic services, 4 on soil sampling and surveying related to the installation of the platform and laying of the pipelines, and 9 installation contracts. The Norwegian market share varies from 51 percent in the installation category to 100 percent in personnel transport and the seismic survey. The Norwegian share of supplies is smaller than the Norwegian companies' share of total contracts awarded because Norwegian companies typically award sub-contracts to foreign suppliers, including foreign partner companies.

Twenty different companies were awarded contracts during the development phase in the maritime services category. The most successful bidder was Rockwater, a British firm, which gained a market share of 38 percent distributed on 6 contracts. Rockwater provided a wide range of services from diving to barges, flotels and installation of the platform.

3.3 The operation/ production phase

The operation phase started in 1992, while the database runs up to the end of 1994. Our data is therefore limited to the first three years of operation. According to Saga Petroleum (1994), 180 persons worked on the Snorre platform every day. Of these 70 were employed in Saga Petroleum, the remaining 110 worked for other companies on drilling, maintenance and catering. These services were in other words outsourced to independent service firms. Engineering and non-maritime services dominate as can be seen from figure 1. There are five contacts awarded in the engineering category, all of them are relatively small (less than NOK 5 million), 2 are on project support, while three are on special studies.

Non-maritime services are clearly the largest category both in terms of the number of contacts and the aggregate value of contracts. One long-term contract on production drilling awarded to Transocean accounts for more than half the total value of contracts.

We can not draw any firm conclusions on the basis of this short period of production from the Snorre field. Two observations are, however, worth noticing. First, the operating phase is characterized by long-term contracts and more relational contracts than the exploration and development phase. Out of 30 service contracts, 22 were either long-term contracts, most of them with options for further extensions, execution of options, or frame contracts. Second, the Norwegian market share is much smaller in this phase than in the two other phases. The implication of this as the Norwegian petroleum sector matures is discussed in section 6.

3.4 Producer services - summary

The findings of sections 2 and 3 can be summarized as follows:

- Oil-related services are a highly concentrated industry where a few firms dominate the market, but there is also a broad range of specialized niche suppliers;

- The engineering service category is the least traded service sector with the largest Norwegian dominance;
- Maritime services constitute the most competitive market;
- There is a strong negative correlation between Norwegian market share and competition measured as number of bidders per contract;
- The Norwegian offshore sector has concentrated on the development phase of the Snorre project. In general the development phase is characterized by large projects with peaks and slumps in the market, substantial economies of scale and a high degree of field-specific technology;
- The operation phase is characterized by long-term contracts and a smaller Norwegian market share.

4 Vertical relations between suppliers and the oil company

The first relation worth mentioning in this section is a horizontal relation between Saga Petroleum and Esso where Esso provided technical assistance to Saga. Esso had a share in the license and thus its own interest in a cost-effective and safe extraction technology. Esso seconded 35 experts to the project, and in all leader positions there were one person from Esso and one from Saga (Saga Petroleum 1998). The Snorre project was therefore in many ways a gigantic learning by doing exercise transferring technology and project management skills from an experienced multinational oil company to an infant Norwegian oil company. Esso furthermore brought its subsea technology into the project. The subsea production system chosen is a third-generation system based on the Shell/Esso Central Cormorant System and the Exxon Subsea Production System (Lappegård et. al. 1991a).

We now turn to vertical contractual relations between Saga Petroleum and the service suppliers in the categories engineering, non-maritime services, maritime services and other services. The PI database contains information about contractual forms and is our main source of information. The general picture from analyzing the database is that relations between the oil company and the service suppliers are characterized by arms-length trade and market transactions. Out of a total of 252 service contracts, 77 are relational contracts in one way or the other. The contractual forms we consider relational are frame agreements, options, long-term contracts with or without options for extensions, extensions of existing contracts and change orders. In addition there are a few contracts for which only one firm is invited to bid, because of previous experience with the firm, but these are not counted among the 77 relational contracts.

Relational contracts are most common in the operation phase where they constitute about 70 percent of the total number of contracts.¹³ Among sectors, relational contracts are most common in the non-maritime service sector where they account for 53 percent of the total number of contracts.¹⁴ The average value of relational contracts is somewhat higher than the average for total service contracts, at about

¹³ Relational contracts account for 15 percent of total number of contracts during the exploration phase and 29 percent during the development phase.

¹⁴ Relational contracts account for 19 percent of total contracts in the engineering sector, 12.5 percent in the maritime services sector and there are none relational contract in other services.

NOK 32.5 millions. The Norwegian market share of such contracts is about the average for total contracts at 58 percent.

After a sharp fall in the oil price in 1986, it was of crucial importance for the Norwegian petroleum sector to reduce costs. For this purpose, the oil companies, the supply industry and the Norwegian authorities established a joint project, the NORSOK project. One of the measures envisaged in the NORSOK reports is a more effective project organization during the development phase (NORSOK 1995, NOU 1999:11). This involved a more prominent role for the major contractors in project management and procurement, manifested in the engineering, procurement and construction/fabrication (EPC) contracts. Some times the contract also involved installation, the EPCI contracts. The organizational structure common before the NORSOK process, with a large number of contractors and subcontractors entering into contracts with the oil company independently, was seen as inefficient.

The Snorre project represents contractual relations somewhere in between the traditional way and the new way. There is a large number of contracts with a relatively low average value and some contractors are awarded many contracts, representing the old ways. In addition, we find 15 EPC contracts in the PI base, with a total value of NOK 2.3 billion, representing the new way. The EPC contracts were for modules of the TLP platform, parts of the subsea system and pipelines from the Snorre TLP to the Statfjord A platform. Awarding EPC contracts for *modules* of the TLP platform was possible only due to innovations in the design of the topside of the Snorre platform. Technological developments are further discussed in section 5 below. But before we turn to technology we note that project management was partly outsourced to a consultancy firm, NPC, which (until 1991) was different from the main contractor. The Gullfaks field development applied a similar project organization, but it was found to be expensive - accounting for 6 percent of development costs in the Snorre project - and replaced by the EPC contract in later projects.

5 Technological developments and technology transfers¹⁵

Saga Petroleum had been established for more than 10 years when it started developing its first major oil field, the Snorre field. During its first decade Saga had participated in several licenses on the Norwegian shelf. In addition, the company had its first operatorship in the US. Saga cooperated with Amoco, among others, in its international engagement which turned out to be a disappointment from a commercial point of view, but were valuable in terms of developing Saga's competence (Saga Petroleum 1998). Nevertheless, Sagas experience and competence did not entail development of deep-sea fields. The Snorre field development was therefore a tremendous technological, organizational and commercial challenge for the company and depended on successful technology transfer and adoption of technology to the circumstances of the Snorre field.

Saga saw itself as a user of technology rather than a producer, and emphasized the importance of using proven technology (Lappegård et. al. 1991a). The Snorre field is,

¹⁵ In addition to the cited sources, this section builds on information from Henrik Hannus, Aker Engineering during an interview 25 August 2000.

however, located at a depth where the hitherto proven technology on the Norwegian shelf, platforms fixed to the seabed, were seen as prohibitively expensive. Alternative solutions had to be sought and a tension leg platform (TLP) combined with a subsea production system were chosen.

The origin of the TLP concept appears to be US government studies on floating airfields (Conoco 2000). A small American engineering firm, Deep Offshore Technology (DOT), adopted the technology to the offshore petroleum sector where it was first used by Conoco on the Hutton field in the British sector of the North Sea, and on the Joliet field in the Gulf of Mexico. Aker Maritime fabricated the tenders for the latter TLP. The Snorre platform was the third TLP in the world. Aker acquired the technology through its own development work before and during the exploration phase of the Snorre development as described in sections 2 and 3, its contracts with Conoco, and finally Aker bought into DOT in 1995.

As already mentioned, the TLP installed at the Snorre field is the largest in the world. It adopted existing technology, but it was imperative to minimize weight and space given the large production capacity of the platform. Research and development (R&D) activities therefore largely centered around the task of minimizing weight and space. In most cases this involved choosing the most recent technology available and adopting it to the Snorre field. A characteristic of a TLP is that it has to be adopted to the particular field in which it is installed to a larger extent than production ships and semi-submersible platforms, also available at the time (Høgtun 1996). Such adoption requires considerable engineering work, which resulted in the following innovations:

- The design and construction of the deck is such that 17 of the deck sections could be prefabricated and outfitted at different sites and then transported and lifted into the main frame;
- Systems and equipment that functionally belonged together were grouped into the prefabricated sections;
- Living quarters and flare stack were made of lighter material than previously adopted;
- Vertically mounted pumps were designed in order to save weight and space;
- Application of recent drilling technology to take into account the sideways movement of the platform and relative movements of the drilling substructure and the drilling riser systems (Lappegård et. al., 1991b).

During the operational phase, continuous process R&D take place in order to reduce costs and improve recovery rates. Operating costs were reduced by more than 40 percent by the end of 1995 compared to the estimates included in the plan for development and production (Saga Petroleum Annual Report 1995).¹⁶ One of the most significant projects was a pilot project in order to test the method of alternating injection of water and gas (WAG) in the reservoir in order to improve the recovery rate. The project included two injection wells in the Snorre reservoir. The reservoir was originally thought unsuitable for gas injection, but the pilot project proved that it was possible and profitable to do so, when alternating with water.

¹⁶ Later reports do not contain information about operating costs at the field level.

In order to optimize the level of recovery of a reservoir, detailed knowledge of the hydrocarbon flows is necessary in order to position the production wells optimally. In order to increase Saga's reservoir expertise, a long-term cooperation with Rogaland Research and IKU petroleum research was entered (Saga Petroleum Annual Report 1992). The development cooperation has later entailed experiments with using gels and foam in the water and gas injection wells in order to improve the recovery rate. The first full-scale experiment with foam treatment of a reservoir is undertaken at the Snorre field. The foam reduces leaking of injected gas and is used in combination with the WAG technique. The foam used is purchased from the French shampoo industry (Anda 1999)!

The Snorre field is spread out over a relatively wide area. In order to minimize costs, the number of wells should be minimized without jeopardizing the recovery rate. A low number of wells requires efficient methods of transporting unprocessed oil and gas over relatively long distances. The subsea system at the Snorre field, is located 6 km from the Snorre platform. The distance to nearby fields for which oil and gas are processed at the Snorre platform is even longer. Saga, together with Esso, supported the development of pumps, the Kværner Booster Station, which improved the transport technology for unprocessed oil and gas significantly. The Booster Station was tested by SINTEF, a Norwegian research institution related to the University of Trondheim. Saga and Kværner have also cooperated on developing cost-effective subsea processing systems.

Effective application of large subsea systems requires advanced measurement systems for production supervision. Saga has conducted projects aimed at developing and testing multi-phase meters that can measure relative amounts of oil, gas and water being produced from each well, and at the same time can measure the production volumes.

During the period covered by the PI base, it appears that Saga has largely undertaken R&D in-house, in cooperation with the offshore industry. The total accumulated value of R&D contracts in the PI base is only about NOK 37 million, all contracts are awarded during the exploration phase, all are in the engineering category, and most are awarded to the main engineering service contractor. The R&D expenditure reported in Saga Petroleum's annual reports is much higher than what is registered in the PI base. Saga reports R&D expenditure of between NOK 60 and 70 million annually during the early 1990s, increasing to about NOK 100 million in 1998.¹⁷

To summarize this section, the origin of the extraction technology for the Snorre field can be traced back to the US government's research on floating airfields. The technology has been adopted and further developed to the offshore industry by US engineering and oil companies. The technology came to Norway via Norwegian offshore companies' cooperation with the multinational oil companies. However, since oil and gas reservoirs are different, and sea depth, weather conditions and other relevant circumstances vary from one field to the next, a considerable amount of engineering is necessary in order to adopt the technology to the field. Furthermore, continuous process improvements and innovations take place during the operation

¹⁷ R&D expenditure is given at current prices.

phase by adopting new technology to the installed production equipment in order to reduce operating costs.

5.1 Technology diffusion from the Snorre project

By the year 2000, nine TLPs have been installed worldwide, and Aker Maritime has been involved in all but the first one. The company together with Saga Petroleum on the Snorre field and later together with Conoco on the Heidrun field on the Norwegian continental shelf, has developed the TLP into a more cost-effective solution at depths down to about 1000-1200 meters. These are the depths of the fields under development in the Gulf of Mexico. However, in spite of commanding state of the art TLP technology, Aker has not been involved in the *design* of TLP platforms in the Gulf of Mexico.

R&D in the offshore sector typically focuses on finding novel ways of *applying* and combining existing technology such as materials technology and information technology in new designs. R&D is much less focused on *developing* new materials technology or information technology. The offshore industry is a global business with a large number of oil service, consulting and engineering firms providing services to all the major oil companies in all the major offshore oil producing regions. Non-proprietary technology, including new developments of the TLP solution, diffuses from project to project through the movement of these service providers.

The TLP solution competes with Spar platforms, semi-submersible solutions and Floating Production Storage and Offloading vessels (FPSOs). Until recently the Spar solution has been considered superior in very deep waters. The disadvantage with TLPs on very deep waters has hitherto been related to the tendons. They should ideally be weightless in the water in order to limit the size and weight of the hull. This requires a certain ratio of the tendon diameter compared to the walls. At very deep water the walls have to be thick in order to withstand the high external pressure. The deep-water TLP with conventional tendons therefore needs a large hull in order to carry the tendons. This makes the conventional TLP less cost effective than the Spar solution at deep waters. However, Aker Maritime has recently developed a new design of the tendon string, which allows smaller and lighter hulls in very deep waters. The solution to the problem is the stepped diameter tendon, with a small diameter pipe with thick wall at the bottom and a large diameter thin wall pipe closer to the surface and intermediate combinations in between (Hannus et. al. 2000). The concept has not yet been tried out at an oil field, but it demonstrates interesting possibilities for deepwater technology developed from the experience with TLPs in the the North Sea, of which the Snorre platform was the first.

Other technological developments involving Saga Petroleum and the supply industry following the Snorre field development are a joint project between Saga and Aker Engineering developing the concept for a three column steel TLP which is a cost-effective solution for deep waters. Saga Petroleum and ABB offshore entered an agreement of technology cooperation in 1995 for the development of the next generation of subsea systems. We have not been able to identify technology developments that have had applications outside the offshore sector.

6 Summary and conclusions

This paper has analyzed the extensive quantity and variety of inputs required to develop a technologically challenging oil field, focusing on service inputs. We have seen that the field development task was undertaken by a young and inexperienced petroleum company, supported by more experienced license and technology partners. One of our main observations are that in spite of the fact that 80 percent of contracts were subject to international competitive bidding, the Norwegian market share on the project as a whole was more than 60 percent. This reflects both the fact that some of the largest contracts were open to Norwegian companies only, and the fact that the extraction technology chosen is relatively field-specific and some of the inputs can not be easily traded. This applies to engineering services in particular, where the Norwegian market share is more than 80 percent. We have, however, noted that the presence of the multinational petroleum and offshore industry is more prominent than a first glance at the data suggests. First, Norwegian subsidiaries of multinational firms are included in the Norwegian market share; second, the Norwegian contractors used foreign subcontractors, entered into agreements of technological cooperation with foreign companies or engaged skilled foreign staff on a contractual basis within their own organizations. The latter was quite common in the engineering sector.

Producer services have the largest relative share of the market during the exploration and operational phase, while the absolute level of expenditure on services hitherto has been largest during the development/investment phase. Due to the size of the market and the factors determining the Norwegian market share discussed above, the Norwegian industry, including oil-related services, has largely focused on the development phase. As the Norwegian sector matures, the operational phase will increase in relative importance, while the absolute size of the market will probably stagnate. Internationalization is therefore important for future development of the sector.

We have noted in our study that while the development phase is characterized by arms-length trade and market transactions, relational contracts are much more common during the operation phase. Furthermore, relational contracts, whether implicit or explicit, are more important in trading with American oil companies than European ones in all phases of the development of an oil field.¹⁸ Established relations with the operating oil companies may therefore be of critical importance for successful internationalization. Aker, for example, states in their annual report that the relations built to the oil companies on the Norwegian continental shelf, together with competitive local partners (in export destination countries) are crucial for international success (Aker 1994).

The Snorre field development was a first step into deeper waters using the TLP solution. Norwegian companies, particularly Aker Maritime, have been world leaders in the development of this solution to a competitive technology for increasingly deeper waters. As the Norwegian sector matures and new fields are on increasingly deep waters, deepwater technology is seen as an era for internationalization of the Norwegian offshore industry. The most promising and dynamic area for deep-water technology is probably West Africa, particularly Angola. American oil companies are the most prominent in this area. We have just argued that relational contracts are

¹⁸ Information given by Henrik Hannus, Aker Maritime during interview 25 August 2000.

important in trading with American oil companies. We also note that Houston, Texas is seen as the center of excellence for deepwater technology. It is probably necessary to be present in this market for the offshore industry both in order to stay at the technology frontier and in order to develop relations to the American oil companies. Aker, Kværner and ABB, the three most prominent companies based in the Norwegian offshore sector are all present in the Gulf of Mexico, but their activities are mostly focused on fabrication rather than design. Only ABB Vetco Gray has significant service production in the Gulf of Mexico. An alternative or additional way of establishing links and relational contracts with the major multinational oil companies is to award more licenses to the multinational oil companies in Norwegian waters.¹⁹

Saga Petroleum was the most international Norwegian oil company early in its history, and it was the only significant privately owned oil company. During its first years of operation, its activity outside Norway was much higher than the Norwegian activity. The company “came home” with the development of the Snorre field. Paradoxically, as the harvesting phase of the Snorre field started and the debate on internationalization of the Norwegian petroleum and offshore sectors as well as privatization of the state-owned oil companies gathered momentum, Saga Petroleum was bought by Norsk Hydro, and its assets split between Norsk Hydro and Statoil.

¹⁹ See also Heum and Vatne (1999).

References:

- Anda, I., 1999, "Renslig sorti for Saga," Søkelspeilet, no 2 1999.
- Conoco, 2000, "125 years of energy", www.conoco.com/about/history/index.html
- Hannus, H., K. Engebretsen, R. Borresen and P. Schamaun, 2000, "Achieving a step change in ultra-deepwater TLP capital costs with the innovative step-diameter tendon system," paper presented at the 2000 Offshore Technology Conference held in Houston, Texas 1-4 May.
- Heum, P. and E. Vatne, 1999, "Hjemlandseffekter av direkte utenlandsinvesteringer I norsk oljeindustri," Foundation for Research in Economics and Business Administration, Report 25/99.
- Høgtun, K.G., 1996, "En offshore-industri I endring – betydningen av flytende produksjonsløsninger," in Aker Maritime Annual Report 1996 pp. 36-39.
- Lappegård, O.T., B. Solheim, F.B. Plummer, 1991a, "Snorre project strategies and status," in "The Snorre field development project, Six papers presented at the Offshore Technology Conference in Houston, Texas, 6-9 May 1991.
- Lappegård, O.T., G. Brusted Nilsen, I. Skjørshammer, O. Graff and I Gabrielsen, 1991b, "Snorre TLP topside design," in "The Snorre field development project, Six papers presented at the Offshore Technology Conference in Houston, Texas, 6-9 May 1991.
- Ministry of Oil and Energy, the PI database.
- NORSOK, 1995, "Kostnadsanalyse og måltall," Delrapport no. 1.
- NORSOK, 1995, "Samarbeid operatør og leverandør," delrapport no. 3.
- Nordås, H.K., "Gullfaks – the first Norwegian oil field developed and operated by Norwegian companies," WP 2000:13, Chr. Michelsen Institute.
- Nordås, H.K. and O. Kvaløy, 2000, "Oil related producer services and productivity – the case of Norway," WP 2000:6, Chr. Michelsen Institute.
- Saga Petroleum, Annual Report, various issues.
- Saga Petroleum, 1994, "Snorre a workplace far out at sea," Saga Petroleum.
- Saga Petroleum, 1998, *Sagaen om Saga*, Saga Petroleum.

Recent Working Papers

- WP 1999: 8 BØE, Turid
Access regimes and institutions: The economic organisation of the migrant Popo fishermen of Pointe-Noire, Congo. Bergen, 1999, 36 pp.
- WP 2000: 1 NORDÅS, Hildegunn Kyvik
Liberalization of trade in services and choice of technology in the Norwegian petroleum sector. Bergen, 2000, 22 pp.
- WP 2000: 2 GRANBERG, Per
Monetary variables in Macmod. A note concerning the introduction of monetary variables in the Tanzanian macro economic model: Macmod. Bergen, 2000, 32 pp.
- WP 2000: 3 RAKNER, Lise
The pluralist paradox: The decline of economic interest groups in Zambia in the 1990s. Bergen, 2000, 21 pp.
- WP 2000: 4 FJELDSTAD, Odd-Helge and Ole Therkildsen with Lise Rakner and Joseph Semboja
Taxation, aid and democracy. An agenda for research in African countries. Bergen, 2000, 11 pp.
- WP 2000: 5 NORDÅS, Hildegunn Kyvik
Patterns of foreign direct investment in poor countries. Bergen, 2000, 22 pp.
- WP 2000: 6 NORDÅS, Hildegunn Kyvik, and Ola Kvaløy
Oil-related producer services and productivity - the case of Norway. Bergen, 2000, 30 pp.
- WP 2000: 7 FJELDSTAD, Odd-Helge
Taxation, coercion and donors. Local government tax enforcement in Tanzania. Bergen, 2000, 19 pp.
- WP 2000: 8 HYDEN, Göran
Post-war reconciliation and democratisation: Concepts, goals and lessons learnt. Bergen, 2000, 21 pp.
- WP 2000: 9 JONES Bruce D.
The UN and post-crisis aid: Towards a more political economy. Bergen, 2000, 22 pp.
- WP 2000: 10 NORDÅS, Hildegunn Kyvik with Leon Pretorius
Mozambique - a sub-Saharan African NIC? Bergen, 2000, 26 pp.
- WP 2000: 11 OFSTAD, Arve
Economic growth, employment, and decentralised development in Sri Lanka. Bergen, 2000, 16 pp.
- WP 2000: 12 NATY, Alexander
Environment, society and the state in southwestern Eritrea. Bergen, 2000, 40 pp.
- WP 2000: 13 NORDÅS, Hildegunn Kyvik
Gullfaks - the first Norwegian oil field developed and operated by Norwegian companies. Bergen, 2000, 23 pp.
- WP 2000: 14 KVALØY, Ola
The economic organisation of specific assets. Bergen, 2000, 25 pp.
- WP 2000: 15 HELLAND, Johan
Pastoralists in the Horn of Africa: The Continued Threat of Famine. Bergen, 2000, 22 pp.
- WP 2000: 16 NORDÅS, Hildegunn Kyvik
The Snorre Field and the Rise and Fall of Saga Petroleum. Bergen, 2000, 21 pp.

Summary

This paper presents a case study of the Snorre field development focusing on the market for oil-related services related to the development of the oil field. The Snorre field was the first field developed by Saga Petroleum and it was also a step into deeper waters using floating technology in Norway. The Norwegian supply industry became world leaders in the TLP floating technology applied for the Snorre field. We find that the market for oil-related services is highly concentrated, the Norwegian market share is extensive, and foreign companies service the Norwegian market mainly from their Norwegian subsidiaries. We also find a strong negative correlation between Norwegian market share and competition measured by the number of bidders per contract. Relational contracts between the oil company and the service suppliers are most common during the operation/production phase and in the non-maritime services sector. Turning to sources of technology, we find that producer services have played a crucial role in the transfer of technology from multinational oil and offshore industries to the Norwegian petroleum sector. The TLP technology was first developed in the US for floating airfields and came to Norway through cooperation with multinational oil companies and local R&D work. Other channels of technology diffusion appear to have been agreements of technical assistance, joint ventures, foreign direct investments and employment of foreign professional staff on a contractual basis. It is, however, more difficult to identify technology diffusion from the Snorre field to the economy at large.