# Supply chain management in the oil industry: The Angolan case

Arne Wiig

**WP 2001: 6**

# Supply chain management in the oil industry: The Angolan case

Arne Wiig

**WP 2001: 6**

**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@cmi.no
Web/URL:http//www.cmi.no

Price: NOK 50 + postage

ISSN 0804-3639
ISBN 82-90584-86-5

## Indexing terms

Oil industry
Supply chain
Firm
Property rights
Economic theory
Angola

# 1. Introduction[1]

A supply chain consists of all activities and information associated with the transformation flow of goods and services from the raw material stage till the final product reaches the consumer. Since the transformation of individual products and services normally involve the interactions of independent firms, several organisations are typically involved in the supply chain. A key variable in the organisation of the chain is therefore the level of financial integration and the contractual obligations between the participating firms. Pending on the external business environment, the organisation of the supply chain varies across sectors and between firms in a given sector.

This paper focuses on the organisation of the supply chain in the offshore oil industry, primarily the relationships between upstream oil-companies and their main contractors. Upstream oil activities represent one part of a broader supply chain of fluids, but we will only look at the extraction and production phases in this chain. The oil company is thus our final consumer. From studies of the North Sea offshore industry, we know that there are close ties between the upstream oil industry and its suppliers. The Norwegian state owned oil company Statoil, for instance, tends to outsource goods and services to numerous independent suppliers. At the same time, Statoil provides several incentives and makes alliances with its suppliers in order to reduce life cycle costs. In new and promising markets in developing countries where technology and trust may differ from those of the North Sea, the organisation of the supply chain may differ from the above pattern. If so, we may expect the internationalisation strategies of these firm to differ from those applied in the North Sea.

Along the transaction costs traditions, we are particularly interested in how the organisation of the supply chain depends on the complexity of the technology applied (Williamson 1985, Coase 1960). In this analysis, we will bring in one new dimension by analysing how cultural aspects such as trust may influence the organisation of the supply chain (Sako 1992, Baker 1997).

Angola is currently considered the most promising market in the world, and the increased production will be from deepwater wells. While subsea and deepwater constitute approximately one third of the global market for offshore engineering and construction services in 2000, they will increase to nearly 50 per cent or approximately USD 30 billion in 2004.[2 3]

---

[1] I would like to thank Hildegunn Nordaas, Line Tøndel, Inge Tvedten, Øystein Kristiansen and Henri de Groot for helpful comments on this draft. Financial support from the Norwegian Research Council, 'Petropol' is greatfully appreciated.

[2] Estimate by Coflexip Stena Offshore. A smaller estimate of USD 20 billions is provided by *The World Deepwater Report 2000–2004* by Douglas-Westwood Limited (adapted from Alexander's Gas & Oil Connections Online; http://www.gasandoil.com/goc/company/). According to *The World Subsea Report 1999–2003* by Douglas-Westwood Limited, subsea expenditure will constitute around 50 per cent of deepwater expenditure.

The Angolan case is important for several reasons. First, it gives information on the organisation of the supply chain in a new technologically advanced segment of the oil market, namely deepwater exploration. Second, it sheds lights on how differences in cultural factors such as trust influences the structure of the supply chain. Finally, from a more strategic point of view, Angola represents a growth potential for the Norwegian supply industry and others. In subsea markets such as the Angolan, the growth potential for the supply industry is highest.[4]

In the following section, we give a brief overview of the oil industry in Angola and supply chain management in the Norwegian part of the North Sea. While the structure of the supply chain in the North Sea is presented in several publications (Heum 1999; Greve H, Haugland, and Walderhaug 1996; Nordaas 2000ab), one hardly finds any comprehensive analysis of supply chains in Angola. Based on transaction costs-inspired theories of supply chain management, section three generates some hypotheses regarding the organisation of the supply chain in Angola. By presenting two case studies, section four analyses this supply chain, particularly in terms of contracts awarded, ownership structure and informal network between the parties. The two case studies chosen, Kuito and Girassol, have either recently started production or are in the process of doing so. The main question addressed is whether technological and cultural differences may explain how and why these supply chains differ from the present North Sea structures. The concluding section emphasises the way in which the organisation of the supply chain influences main strategies for penetrating this type of market.

---

[3] West Africa is the most promising area in this field, and the expenditure on subsea drilling and completion will exceed that in North America (including Gulf of Mexico) in 2002. Cf. *The World Deepwater Report 2000–2004.* Douglas-Westwood Limited (adapted from Alexander's Gas & Oil Connections). According to Dick Matzke, vice chairman of Chevron, Angola is "one of the world's best areas for frontier oil exploration and production, especially in deep water areas." Press release from Chevron January 5 2000.

[4] Moreover, since deepwater activities are extremely skill-intensive, one should expect a high profit margin.

# 2. Supply chains in the oil industry

This section gives a general overview of the types of agents involved in the supply chain in the oil industry, their core activities and market segments. It starts with an overview of the oil industry in Angola and its growth potential. Supply chain management in the oil industry is then described with an emphasis on the role played by human and physical assets. As a benchmark for the subsequent analysis, an overview of supply chain management in the Norwegian part of the North Sea is presented. Section 2.3 demonstrates how creating partnerships plays a significant role in this market.

## 2.1. The oil industry in Angola

Angola started oil production already in 1957. Oil plays a significant role in the Angolan economy. Oil production constitutes 50 per cent of GDP and revenue from oil production constitutes half of Angolan tax income. In 1999, a Chevron-led consortium produced 420,000 bpd oil, or 58 per cent of the Angolan production of 720,000 bpd. Other companies, Elf, Texaco, Fina, Ranger, and the Angolan state oil company Sonangol, produced the rest. With the start-up of the Kuito Field, Chevron's total production per day has increased to 550,000 bpd.[5]

Since 1995, oil majors have started to encounter huge oil reservoirs in Angola's deep water, from depths of 300 meters to beyond 1200 meters. Reserves have been in proportions far exceeding anything onshore. In half a decade, some eight bn barrels have been discovered. If three-quarters of these are proven, Angola's reserves will more than double.[6] Since Girassol was discovered, ten other fields have been found in Elf's successful Block 17. Esso has made huge discoveries in various fields (nine founds) in block 15 and Chevron has made a number of significant discoveries in block 14.[7] All new fields are based on production sharing agreements (PSA) with Sonangol.

Angolan authorities expect yearly investments in the oil sector to be approximately four billions USD (www.angola.com ). Chevron and its partners alone plan to invest some six billion dollars in Angola over the next five years. In fact, Norwegian oil companies are poised to spend three billion dollars on offshore oil exploration in Angola during the next decade.[8] Angola therefore represents a growth potential for the supply industry.

---

[5] Press release from Chevron Oct. 4, 2000.

[6] *Alexander's Gas & Oil.*

[7] One of the reasons why these new discoveries have yet not been developed is that while the operators are seeking to develop different fields in concert Sonangol has put its foot down. For instance, as of November 2000 a dispute is ongoing between ExxonMobile and Sonangol regarding tenders for Kizomba field where Sonangol is seeking to reduce the speed of the process.

[8] Information from the Norwegian Ambassador Bjørg Leite (quoted in *Alexander's Gas and Oil*).

About 200 firms are registered in Angola, providing services and goods to the oil industry. There is no available information about the number of employees and turnover of these firms. Less than 20 per cent are Angolan companies and most of these has some relationship to Sonangol. The rest are local offshoots of multinationals put in place to service the Angolan market. Angola is not being used as a stepping stone to service other markets in Nigeria, Chad etc. Sonangol plays the leading role in the oil industry both as a concessionaire, a licence partner, a partner in the supply of goods and services and as a regulator and implementing agency of Angolan oil policy.

Several Norwegian companies are already established in Angola (e.g., Statoil, Norsk Hydro, Kvaerner, Stolt Offshore and Kongsberg Offshore), but as indicated above, the growth prospects makes Angola an even more interesting market in the future.

## 2.2. Market segment and supply chain

A firm which seeks to penetrate a new market needs first of all to clarify its core activities and which market it wants to compete in. Regarding upstream oil production, there are a number of different tasks or segments. Firms can be classified according to the task or market segments they work in.[9] Some firms specialise in a single task while others provide all or a combination. Firms specialising in more than one task are integrating or *bundling* its activities. Bundling means that the firm seeks to be an integrated provider of fluids (oil or gas). Table 1 classifies tasks or markets in the upstream oil sector. Halliburton is an example of a vertical multinational which has integrated all of the tasks listed in Table 1 (and is involved in downstream activities also). Halliburton can therefore serve as an example of a integrated oil service firm. The other extreme is a firm specialising in a single task (for instance in drilling). Normally the supply industry (the oil service firms) is dealing with tasks 1-5 in Table 1, while the core activity of the oil company is the production of oil (task 6 in table 1).

As with the oil majors, the supply industry consists of multinationals and we see a rising trend in acquisitions, particularly in terms of vertical activities.

**Table 1: Key Tasks in the Upstream Oil Sector**

1. Exploration (including seismic) and drilling (which in deepwater is undertaken by ships or SPAR platforms),
2. Engineering and project management,
3. Construction of production facilities e.g., platform,
4. Subsea construction, pipelay and fabrication of subsea equipment,
5. Installation (platform and subsea),
6. Operations (production of oil).[10]

[9] One may also classify markets geographically.

[10] There is also a separate market of well maintenance. The importance of this market increases during the on stream phase.

The key determining factor in the choice of market, is the *assets of the firm*, particularly its knowledge and capabilities. We distinguish between human and physical assets. There are two types of human assets, individual and firm-specific knowledge. A firm may acquire physical assets and firm-specific knowledge; individual knowledge, however, belongs to the individuals.

A particular aspect of the supply chain in the oil industry is the role played by producer services. Producer services such as research and development (R&D) and engineering act as intermediate goods at every step in the supply chain and play a significant role in the co-ordination of the whole process from field exploration to shipment of crude oil. In the deepwater sector, there are three types of know-how (engineering competence) of particular relevance: the engineering of a platform, the engineering of flowlines and sub-sea equipment and reservoir management and well design.

Efficient information flows between the agents involved in the different tasks are particularly important in the oil industry. The integration of tasks can increase the information flow between firms and thereby reduce the transaction costs in the supply chain. Oil companies prefer increasingly to deal with a limited number of suppliers, a factor which give additional supports to the integration of tasks. The other side of the coin is that integration may lead to inefficiencies. Normally, there is *a trade off between specialisation and integration*; *integration* reduces the transaction costs of using the market at the costs of scale economies and specialisation. *Supply chain management* deals with mechanisms for solving this trade-off.

The supply chain is mainly characterised by two *physical* assets: the production facilities (e.g., platform) and the fluid and reservoir characteristics (e.g., the oil); and one *human* asset, namely knowledge (producing engineering services). All assets are essential in order to produce oil.

In addition to the assets of the firm, the market potential in the different segments is also an important factor in the choice of market. In addition to engineering, *platforms (3, 3 refers to phase 3 in table 1)*, *subsea equipment*, *drilling* and *well completion* (1), (4) and (5) are the three markets which dominate deepwater expenditure.

The supply industry not only needs to decide which market segment in the supply chain it will penetrate, firms also need to assess how they will serve the market: through exports or investments? In order for multinationals to undertake FDI, three conditions need to be met (Dunning 1981): ownership advantage; internalisation advantage; and locational advantage.

The firm's *ownership advantage* refers to a situation where it has a product, technology or intangible assets (human capital) of such a nature that the firm enjoys some advantage in foreign markets to compensate for the disadvantages of entering new markets. *Internalisation advantage* relates to the fact that the firm must have a reason to exploit its ownership advantage internally, rather

than licence or sell its product/process to a foreign firm. Firms transfer knowledge internally in order to maintain the value of assets and prevent asset dissipation. When products are new, complex and have no prior commercial application, and are produced by R&D intensive firms, transfers tend to be internal (see (Markusen, Rutherford, and Hunter 1995) for an overview of the literature). As far as *locational advantage* is concerned, the firm must have a reason to locate production abroad rather than concentrate it in the home country, especially when there are scale economies at the plant level.

In Angola, local infrastructure is missing and the fact that oil companies make most of their important logistic decisions from their headquarters in Paris or Houston (confer section four), indicate that it is a locational disadvantage for the supply industry of locating in Angola. However, saying this, to the extent that local investments have been undertaken by the multinationals, they have played an important role in terms of being awarded contracts.

From the operator's point of view, there are different ways of organising the supply chain. Two extremes are the vertical integrated supply chain, in which all tasks are undertaken by one firm, and market transactions based on arm's length trade. There are also hybrid institutions (see the following section).

## 2.3. Forming partnerships - a hybrid example of integrated supply chain management

Since downstream competition is fierce, an oil company may increase its profits either by increasing the scale of its downstream production (to achieve economics of scale), differentiating its downstream products (through branding) or undertaking lifecycling cost savings in its upstream activities. Regarding the last option, the most important criteria are the success rate in exploration and the reduction in development or on-stream costs.

Since the oil companies tend to outsource or procure a substantial part of its goods and service from independent firms specialising in one or more of the tasks described in Table 1, they therefore need to provide the supply industry with incentives towards cost-reduction.

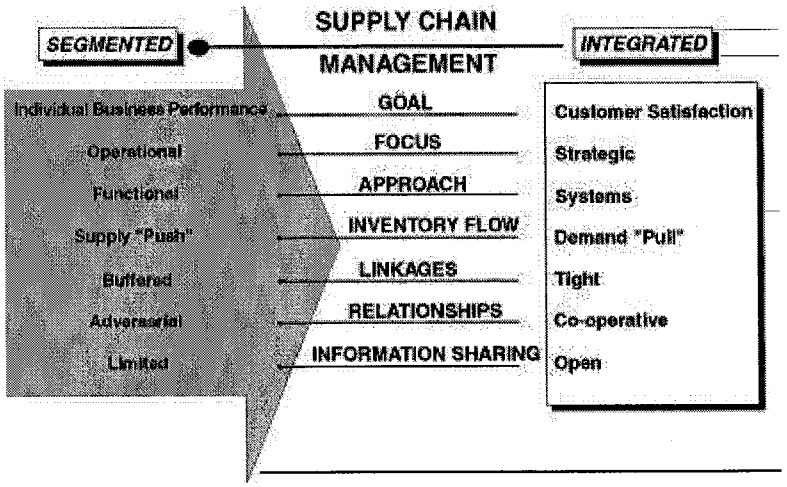
Procurement of goods and services constitutes more than 50 per cent of an oil company's cost.[11] For the oil company, this means that a considerable part of its gross output is created outside the company. Since even a small change in the organisation of the supply chain may lead to a significant change in profits for the oil company, providing the supply industry with incentives for cost reduction is important. Forming partnerships with *prequalified* suppliers is one mechanism for improving these incentives that is commonly applied in the Norwegian part of the North Sea. Forming partnerships based on interaction and mutuality with suppliers is a central Statoil strategy, and indicates that

[11] . Procurement of goods and services in 1996 constituted nearly three times as much as Statoil's profit before tax (www.statoil.com).

Statoil plays an important role in the organisation of the supply chain in the North Sea.[12]

According to Statoil's Director Trondslien (www.statoil.com), supply chain development in the oil industry is characterised by a focus on maximising the *chain's joint* profit. He is also conceptualising the competition arena as *between 'integrated chains'*(where a company is only one of many links in a supply chain) – not between disintegrated chains consisting of individual firms. It is no surprise that a downstream firm tries to give the impression that all firms in the chain have similar interests, although it has been difficult to find other oil companies emphasising this as clearly as Statoil, at least in Angola.[13] As we will return to in section 4, competition rather seem to be between *integrated oil service firms* (*excluding the oil company*).

**Figure 1:** ***Development trends through integrated supply chain management***




Source: Adapted from Trondslien, P. The Importance of the Procurement Process to Statoil, and the Development within Statoil´s Supply Chain. www. Statoil com.

The importance of creating partnerships (or relationships) is also underscored by other characteristics of procurement:

- The need for adjustment and bargaining. Parties need to bargain during the contract process because contracts are incomplete. Ex ante uncertainty related to technical specification leads the oil company in many cases to specify functional requirements to a product or technology. This gives the

[12] (Anna Duboi, statoil com ) distinguishes between a unilateral perspective and a bilateral perspective on partnerships.

[13] When deciding on contract partners, Shell seeks mutually beneficial relationships with their contractors. BP Amoco published a new "Supply Chain Management" philosophy in 1999 placing more emphasis on the supply chain management process in order to reduce costs and improve access to technology. We have not found similar explicit references to the importance of creation of relationships in the chain on the homepages of the other majors.

contractor some degree of flexibility in order to develop a particular piece of goods or services. At the same time, unforeseen contingencies frequently arise. Each parties' appraisal of such contingencies may differ, and, since contracts are incomplete, bargaining represents one way of solving such disputes.

- Technical solutions are specific to particular fields (depth and size) and may be tailored towards specific oil companies. Intermediate goods and services are therefore differentiated, and innovations are important in order to satisfy specific demands from the oil companies.
- Limited numbers of pre-qualified suppliers for the main contracts. At the same time, numerous contracts are awarded, implying that the oil company cannot create a relationship to all its suppliers (e.g., in the Gullfaks field in the North Sea more than 1,700 contracts were awarded (Nordaas 2000a).

Trondslien does not assess the supply chain in upstream oil market from the perspective of financial integration. By this measure, the chain, at least in the North Sea, is rather *fragmented.* The most common way of organising the supply chain in the North Sea is that of the independent and integrated supplier (contractor) that undertakes engineering (designing the platform), procurement, construction (build the platform), and installation (EPCI contract), and delivers the platform to the oil company. However, as the Gullfaks example showed there are a number of additional suppliers involved and the oil company plays an important co-ordination role towards these. Trondslien tends to look at the supply chain as a business group where the players create informal partnerships, networks and alliances. In such networks, long-term relationships, *trust and mutual dependence substitute for financial integration* and lead to an integrated supply chain where the oil company largely controls the value added outside the company.

### 2.3.1. NorSok - illustrating the role of trust

There are hybrid institutions in-between markets and hierarchies. *Business groups* vary not only by degree of *ownership*, but also according to *authority structure*, *trust* and *solidarity* (Granovetter 1995; Feenstra, Huang, and Hamilton 1996).

Trust is of particular importance when contracts are incomplete, and the environment is uncertain and under rapid technological change. Trust is therefore of particular importance in the oil industry, and a keyword in both the NorSok and the CRINE initiatives in the Norwegian and British parts of the North Sea respectively. Both initiatives were initiated by the oil industry and the governments in the respective countries in order to increase *co-operation* between contractors and operators. They focus on how the stakeholders in a supply chain through *informal* mechanisms and institutional *relationships* may enhance common goals of long-term cost minimisation.

Both initiatives try to build up new business groups independent of how the individual actors perceive ownership integration.[14]

According to (NorSok 1996:6) close co-operation between the customer and the contractors

> is a precondition if projects are to be completed in a faster and a less costly way.... Mutual trust between the parties is imperative to succeed. The need for formalities is replaced by a culture of work where the contractor and the customer are expected to implicitly know what is right and what is wrong based on agreed attitudes and objectives.

According to (Crabtree, Bower, and Keogh 1997), the outcome of the Crine initiative for the oil companies, are savings of 30 per cent on capital expenditure. The use of partnership and teamwork has played a significant role in this process. Similar reductions of costs have been achieved in Norway, even though this has led many suppliers into financial distress.[15]

Having said this, trust can vary across locations for a given sector. We know, for instance, that the sub-contracting system of parts to Japanese car manufacturers is based more on trust and long-term relationships than the corresponding American system, although the technology is the same (Helper 1991; Sako and Helper 1998).

NorSok does not address mechanisms that can create trust and how trust can influence the way agents deal with each other. It rather appeals to the moral obligations of the parties. Sako and Helper (1998) analysed such mechanisms in the automobile industry and found that trust increases with the *information flow* between the parties and by the level of *technical assistance* provided by the customer. The building of trust can be regarded as an investment. Trust between an oil company and the main supplier (or between the first and second-tier suppliers) represents a sort of 'relation-specific skill' (Asanuma 1989). This means that changing partners has switching costs, which ultimately strengthens the glue in the chain.

Except for the integration of suppliers in the decision-making process for technical solutions, Statoil is not explicit regarding what is meant by the creation of relationships and what partnerships mean for the (independent)

---

[14] One additional reason for the upbeat Norwegian attitude towards NORSOK is that it stimulates the development of a national supply industry (at least in its home market). Trusts between independent actors are probably easier to establish between firms from the same country since they share common cultural conceptions, at least a common language. The idea of an integrated supply chain based on trust, as described by Trondslien and base on the NorSok (and Crine) initiatives, represents a way of promoting a *national supplier industry in a legal context where national discrimination is not allowed.* Similar initiatives are not taken in Angola, partly because there are other available instruments which can be applied for the same objective.

[15] In Njord in the Norwegian part of the North Sea, a 40 per cent cost reduction was achieved due to changes in project organisation.

parties. A business partner can, for instance, be a buyer in one relationship and become a seller or a competitor in other relationships. So what is the 'glue' in the chain? This is the topic of the next section.

# 3. Theories of the firm

Our knowledge of the 'glue', both in terms of the type of factors holding the different firms in the chain together and the degree of integration in the chain are limited. In section 2.2 we discussed the trade-off between integration and specialisation, represented by an oil company undertaking most activities in-house, and a company basing its operations on arm's length trade with independent firms specialising in a particular task respectively. In section 2.3, the creation of relationships and trust between independent partners were pinpointed as a factor increasing the costs of switching partners in the chain, and thereby cementing the existing trading practice.

This section seeks to present hypotheses concerning the organisation of supply chains in Angola based on the property right perspective of the firm. The underlying question is: When will a firm choose a particular strategy regarding i) choice of market segment and ii) supply chain management (cf. section 2.2)? In section four, we present our results and discuss these in light of alternative theories.

The degree of vertical integration is one indicator of the strength of the glue in the supply chain. A measure of this is external procurement as a share of value added (or value added as a share of sales). If this share is low for a particular task (compared to other firms in the sector), it indicates that production is undertaken in-house. If it is low for all the tasks, the supply chain degenerates to a fully vertically integrated multinational energy provider (such as Halliburton or an oil company which undertakes all activities in-house). If the share is high, the supply chain consists of independent firms. Independent ownership structure, however, does not mean that transactions are based on arms' length trade:

- The contract partners are integrated oil service units. A contract partner may be involved in more than one task (cf. Table 1) at the same time, either through acquisition or through long-term relationships.
- There are close relationships between the contract partners and the oil company (as discussed in section 2.3).

## 3.1. Transaction costs

The property right approach is inspired by transaction costs analysis, and we will start by presenting some of that theory's main hypotheses. According to transaction cost analysis, governance structure is treated as a dependent variable (Klein, Crawford, and Alchian 1978; Williamson 1985). Between the polar extreme of arm's length trade and vertical integration, the degree of integration is assumed to be increasing with *asset specificity, uncertainty and the frequency* of transactions (the fixed costs of internal governance are spread

on more transactions).[16] *The degree of integration between companies in a supply chain can be analysed by a similar approach.*

When transactions are characterised by asset specificity, the value of the transactions has a higher value between the parties than outside the relationship. The extreme case is a transaction with no value outside the relationship, e.g., a technology development undertaken by an upstream firm which can only be applied by a particular oil company. Although such cases are rarely found in any industry, it is nonetheless a fact that different oil companies apply different types of technologies or standards. This implies that upstream firms may undertake relation-specific investments with a resulting risk of hold-ups, since it is costly to switch to a different buyer. The outcome is that the firm risks to underinvest in technology improvements.

There are three types of transaction-specific assets:[17]

- When assets are immobile once in place, we have *site specificity*. Site specificity is most relevant during the production phase. The extreme cases are pipelines, fixed installations or platforms and yards. The theory predicts that:
  - An increasing degree of site specificity increases the tendency of vertical integration. Since floating platforms are more mobile than fixed platforms, the tendency for oil companies to own them consequently is lower.[18]
  - The lower the number of suppliers of particular goods and services, the greater the frequency of internal production. If, for instance, goods and services have to be provided locally and few service providers are available, the oil company is unable to switch to other suppliers and it will tend to integrate production (catering and transport facilities are good examples).

- *Human asset specificity* describes transaction-specific knowledge or human capital achieved through specialised training or learning by doing (e.g. engineering competence). Transaction costs theory predicts accordingly that increasing engineering intensity of a task tends to favour integration. Engineering competence of particular relevance for an oil field or a particular operator (e.g. reservoir knowledge and the engineering of a platform) should accordingly be owned by the oil company. Nevertheless,

[16] Uncertainty by itself does not lead to integration without asset specificity. If there is no asset specificity and thus many potential suppliers of a component for which future demand is uncertain, it may be cheaper to buy it in the market than produce it yourself.

[17] There is a fourth type termed *dedicated assets* which refers to cases in which substantial general purpose investments would not have been made outside a particular transaction serving a large customer. Strategic delays or temporal asset specificity are used by (Masten 1986) as a fifth type of asset specificity. Particularly in the oil industry, delays can be used strategically by the upstream firms.

[18] At least in the Angolan case, most deepwater platforms are more or less mobile although ownership structure varies. Yards are mainly owned by the main contractors (jointly with Sonangol).

oil companies tend to employ engineers with reservoir competence and frequently hire in other type of engineers from independent contractors.

- When equipment and machinery are relation-specific, we have *physical asset specificity*. Masten (1984) uses component 'complexity' as a measure of asset specificity, but since most of the technology in the oil sector is complex, this measure does help explain the difference in the degree of vertical integration between different phases. For instance, refining technology is a general-purpose technology and similar across firms, while upstream technology is more complex. Despite this, one sees more integration downstream than upstream. What distinguishes the different upstream technologies is that they are tailored toward specific fields (the technology and complexity of the conditions (such as pressure) in deepwater fields differs from shallow water or onshore), contractors or oil companies. This means input is *differentiated* and the supplier may risk a hold-up. The theory gives similar predictions as above.

In sum: the transaction cost of using the intermediate product market is lower the more suppliers locate close to the oil companies in a given offshore province; the less consequential the oil company's costs of switching between suppliers; the more standardised the inputs; the more effectively technical change can be organised through the market; the stronger the long-term relationships between contractors; and the higher the internal relocation costs (Hallwood 1992). *According to this theory, we would therefore expect the supply chain in Angola to be more integrated than in the North Sea.*

One of the weaknesses with transaction cost analysis is that it mainly focuses on the costs (transaction costs) and benefits (economics of scale) of market transactions, not on the costs of vertical integration. One of the costs of vertical integration is that it may give *lower* incentives for an upstream firm to undertake product development and *innovation* since the downstream firm (as an owner) can refuse the upstream firm to apply the technology other places.[19] Such incentives are of particular importance when the upstream firm, by its actions, has a great influence on the downstream agent's value of the product, as was discussed in section 2.3 above.

## 3.2. A property right perspective

The central question, addressed by Grossman and Hart (1986), is *why do we have firms*? In a world of complete contracts (which can be verified by a third party), firms are to some extent unnecessary. Transactions can be handled by independent actors based on arm's length trade. However, when contracts are incomplete, ownership (firms) are necessary in order to give proper investment incentives. Based on the same approach, we might ask why we have a *group of firms* organised as a supply chain. *Similar to the tradition in transaction costs*

[19] But integration represents one way of acquiring firm-specific knowledge. The recent merger of Coflexip and Aker represents one example of this. One problem with such a strategy is that it gives few incentives for Aker for further improvement of its deepwater technology. Confer section 4.2.

*analysis, the degree of integration of the supply chain is the endogenous variable and the key issue is what type of hierarchical (governance) structure will most efficiently facilitate product innovation or quality improvement by the upstream firm.*

In Grossman and Hart's modelling approach, each agent owns his own human capital, but a firm is a set of non-human assets under common ownership. Ownership of assets is important because it gives the owner bargaining power under unforeseen contingencies (which require bargaining) and it confers ownership of goods. The ownership of *non-human assets* affects the ex ante incentives to invest in human capital and the boundary of the firm is determined by the agents needs to protect their *investments*. According to this theory, firms are only needed in order to deal with incomplete contracts and the focus in the analysis is therefore on the incomplete part of contracts.

As regards the oil industry, it is reasonable to assume that contracts are incomplete in the sense that not all contingencies are covered. Complex technologies and uncertainties require extensive applications of functional contracts and change orderss. The property right perspective is therefore an interesting point of departure for analysing the structure of the supply chain (see (Kvaløy 2000)for a discussion).

Grossman and Hart focus on formal structures (ownership) *between* firms, but do not analyse self-enforcing informal structures such as the parties' concern for their reputation. Baker, Gibbons and Murphy (1997) extend Grossman and Hart's model by analysing the interplay between formal structures and informal relationships (relational contracts), particularly how the former facilitates the feasibility of the latter. Trust and partnership, discussed in section 2.3, is one example of a relational contract. This interplay can be analysed both between firms and within a firm (for instance between different departments). In contrast to the transaction cost approach where 'relational contracts' are placed in a continuum along one dimension (degree of ownership), Baker and Gibbons distinguish between two dimensions and four prototypes of ownership/governance regimes (see Table 2).

**Table 2: Outsourcing versus integration**

| | Ownership Environment | |
|---|---|---|
| Governance Environment | Non Integrated (Upstream owns) | Integrated (Downstream owns) |
| Spot ('arm's length') | Spot Outsourcing (1) | Spot Employment (2) |
| Relational | Relational Outsourcing (3) | Relational Employment (4) |

There are two agents, an upstream firm and a downstream firm. The upstream party produces an item that can be used in a downstream party's production process. The upstream firm may undertake observable but unverifiable investments in the good such as technology improvement. Let us assume that