

# Risk and benefit sharing schemes in oil exploration and production

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## Abstract

The volatile environment of oil exploration and production sets new challenges to market players prompting them to explore new business models. In this paper, we analyze a novel type of partnering in oil and gas operations, i.e. the risk and benefit sharing schemes, that enable a field operator to bring third parties into the field development process. We develop a valuation method to assess the feasibility of the risk and benefit sharing schemes based on the real options approach and identify the optimal contract policy from the perspective of both the oil company and the contractor.

We analyze two application cases where an oil company collaborates with a drilling contractor and a FPSO leasing company to share risks and benefits resulting from the oil field development. We incorporate an “exit” clause in the contract as an instrument to provide flexibility for the parties to withdraw from the partnership as uncertainty unfolds.

Our results show that the risk and benefit sharing schemes with embedded flexibility have a potential to become an alternative form of contracting in oil and gas industry.

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One of the main drivers of uncertainty for the investment in petroleum activities is the maturation of the main exploration and production (E&P) areas in the world. New discoveries in mature production regions are characterized by smaller sizes and challenging technical conditions for development. Following another serious oil price downturn in 2020 amid the COVID-19 pandemic, a wide range of oil companies announced a reduction in their investment in new E&P projects. Many production licenses that were awaiting a final investment decision were put on hold.

Petroleum activities are expected to be exposed to even more risks in the future, which stem from, among other things, public pressure considering the environmental impact, increasing emissions taxes and peak in global demand for fossil fuels. As Tidd & Bessant (2020) argue, a volatile environment creates new challenges, which must be identified and understood as opportunities. In particular they state that in such conditions, decision makers can benefit from strategic flexibility, which includes “modification capability, options-keeping capability and the ability to innovate a business model”.

Among the solutions that can help oil companies and especially smaller ones to ensure profitability of the hydrocarbon production in the future might be various novel engineering, economic and contractual solutions. In this paper, we will focus on the contracts that allow oil companies to share risks and benefits with their contractors. Among these contractors are financial institutions, service and drilling companies, license partners and other oil companies and suppliers. Through the risk and benefit sharing schemes, they can get involved in the field development process with a possibility to share costs, operational risks and future revenues with the operator.

Within a risk and benefit sharing agreement that we propose in this paper, the oil company is responsible for a portion of capital costs only, while the rest is covered by a contract partner. In return, the partner receives an incentive in the form of share in future profit associated with oil production being sold in the market. We introduce a method that allows to design a risk and benefit sharing scheme between an oil field operator and its contractors. We analyze two different cases involving the risk and benefit sharing scheme between different actors: 1) an oil company (field operator) and a drilling contractor 2) an oil company (field operator) and a FPSO leasing contractor. In both cases, we identify if there exists a fair (i.e. transparent and balanced) contract that would be attractive for both the oil company and the contractor. We also consider the regulator/government as the third party that must ensure that establishing the risk and benefit sharing scheme does not lead to the reduction of tax revenues. We introduce an "exit" clause in the risk and benefit sharing agreement that allows both the operator and the contractor to withdraw from a partnership. This clause introduces flexibility in the contract, that can be used to avoid sub-optimal outcomes. We use an algorithm based on the real options approach that allows to optimize the contract policies for both the operator and the contractor in order to ensure a fair risk distribution and proper incentives to participate in the contract. We assess quantitatively the impact of various parameters (costs, the hydrocarbon reservoir and the oil price) on the project value (and value of the contract) and calculate the exact value of incentives that are necessary to balance the contractual risks.

The real world applications of risk and benefit sharing contracts vary from large infrastructure projects (Alonso-Conde et al. 2007) to movie rental studios (Cachon & Lariviere 2005). In these cases, using the risk and benefit sharing schemes allows to distribute project risks connected with uncertain demand and provide certain guarantees for participants against unexpected variations (Alonso-Conde et al. 2007). Cachon & Lariviere (2005) and Yao et al. (2008) also demonstrate that such contracts might improve supply chain performance by increasing the total profit of the participants. In oil and gas industry, however, such contractual forms are not widely used due to several reasons.

Firstly, the market has been dominated by large oil companies, who have well diversified portfolios, rich experience and extensive personnel and tend to encapsulate most of the operations within a company, contracting out a relatively small range of tasks in order to reduce costs. They have not had incentives to share risks by attracting third parties to the field development process as they can cover losses in unsuccessful projects by cash flow generated by profitable assets and access to cheap debt (Osmundsen et al. 2010). The state of the art in the petroleum industry has been that

oil companies (principals) hire contractors (agents) fully covering costs to perform a well defined and limited sort of tasks under relatively short-term agreements. Such contractors as drilling and service companies, rig providers have been responsible for the respective tasks with very limited involvement in overall operations of E&P projects. Smaller companies that are emerging in the market, typically focus on assets, that major companies refer as marginal fields (OG21 2021). Such players normally have much less abilities to preserve their activities in case of an unfavourable outcome of uncertain conditions. Scarce portfolios, smaller balance sheets, lower reserves, higher cost of capital and lower debt capacity makes the small oil companies more exposed to the market and technical risks. Cooperation with partners to develop a field can become beneficial for such companies due the lack of technical knowledge in operations that involve advanced technologies (Osmundsen et al. 2010). Involving other parties would be, therefore, motivated not only by costs reduction incentives, but rather by a potential to have access to external resources and expertise and ability to share risks. In this study, we show that risk and benefit sharing has a potential to become an important instrument in oil and gas industry to handle additional risks amid changing market conditions, where new incentives and opportunities to increase efficiency emerge. We demonstrate that the novel form of cooperation has a potential to decrease the cost of capital for smaller oil companies in the presence of capital market imperfections. These imperfections arise from the inability of financial institutions to adequately assess risks related to field development, which in turn may result in high interest rates on loans that are offered for small companies (Magri (2009) and Czarnitzki & Hottenrott (2011)). In addition, we show that risk and benefit sharing can be attractive for those contractors that are ready to take and manage additional unsystematic risk and are interested in diversification of their core businesses.

Secondly, the risk and benefit sharing scheme would require much more commitment both from field operators and contractors and more extensive information sharing from the principal. Oil companies often treat such data as reservoir properties and fluid characteristics as confidential information. Osmundsen et al. (2010), who analyze incentive schemes for drilling operations, argue that oil companies remain reluctant to disclose comprehensive data on the reservoir due to the fact that the number of contractors that exists in the industry is scarce and most of them work with several oil companies. This leads to the fact that contractors often have to work under conditions of information asymmetry, knowing only the piece of information that is directly connected with their part of work. This asymmetry might cause an agency problem (Norrman 2008) leading to superior efficiency of the operations in question. In order to introduce more flexibilities and incentives for contractors within risk and benefit sharing contracts, which would require the contractor's involvement in the whole process of the field development in cooperation with an oil company, both parties must be ready to share the information that has been traditionally considered as sensitive. In this paper, we demonstrate that adopting risk and benefit sharing can contribute to the establishment of long-term relationship between field operators and their contractors due to the contractor's involvement into the oil production phase. Intuitively, smaller oil companies that typically do not have a mind-set of oil giants and are more open for collaboration can become early adopters of the risk and benefit sharing agreements.

Thirdly, Osmundsen (2011) argues that for many contractors, accepting the reservoir and oil price risk is too costly as their strategy is to be industrial enterprises, not oil companies. In order to realistically assess the potential of the risk and benefit sharing schemes, contractors must significantly improve their competence in reservoir engineering and risk management as well as have opportunities for follow-up and control during the production phase. In this work, we demonstrate how this issue can be resolved by building a flexible agreement, where risk and benefits are distributed fairly. Our results allow to estimate the range of uncertainty and value at risk for all parties involved, making the agreement transparent.

Lastly, the legal base for risk and benefit sharing has not been developed yet. This is why we put a particular emphasis of the role of regulator in establishing the framework for such a cooperation in the oil and gas industry. We demonstrate how the risk and benefit sharing contract terms can be designed such that the collaboration ensures at least the same level of tax revenues for the regulator as the state of the art business models.

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