

Quest for frugality and sustainability in a crisis-stricken industry: a case study of the Norwegian petroleum-related supply companies

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Abstract

The downfall of oil prices since mid-2014 has greatly affected the Norwegian oil and gas industry, particularly its supply chain. To compensate for low prices and loss of revenues the supply companies within the petroleum-related supply industry in Norway are facing a new type of demand: cost-effective products and services that match the high technological and quality expectations but are also only “good enough”. This paper takes an exploratory approach to study the change that the supply companies are going through and aims at answering the following research question: *How are the companies responding to a situation where the demand is for solutions with same quality as before but at a much lower price which are also environmentally friendly?* The paper is based on data from a comparative case study of supply companies. The preliminary results show that a first reaction from the supply companies has been streamlining. They have also engaged in internal R&D for frugal innovation. However, frugal innovation seems to be difficult to achieve. To overcome the tension between technological complexity and the necessity for low costs the companies are looking for other ways to achieve frugality, mainly by collaborating with other actors in the industry. From the first round of interviews it is not clear whether the companies are taking into consideration environmental impact reduction, the lowering of the costs seems to be more important.

Introduction

The Norwegian oil and gas industry has been dealing with acute crisis due to persisting low oil prices since mid-2014. The industry is structured as a supply chain of specialised companies that support the exploration, extraction and production of oil and gas. It has been characterised by high costs, overengineering and goldplating of technological solutions. In the current situation of downturn it has called for more cost-effective products and services that match the high technological and quality expectations but are also only “good enough”. Additionally, the government has adopted an agenda for environmental impact reduction. Suddenly cost-effectiveness and sustainability have become a norm throughout the entire supply chain in the oil and gas industry in Norway.

This paper takes an exploratory approach to study the change that the supply companies are going through and aims at answering the following research question: How are the companies responding to a situation where the demand is for solutions with same quality as before but at a much lower price which are also environmentally friendly? To do so it is based on data from a comparative case study of companies within the petroleum-related supply industry in Norway. The primary method is semi-structured interview with R&D and management staff. The preliminary results are based on 10 interviews in the first round.

The paper combines the literatures on innovation under constraints and frugal innovation in order to assess how the supply companies are managing the change to R&D activities for frugal innovations in a context of a developed economy when a crisis shakes up a previously resource-abundant industry/market and creates a sudden need for cost-effective and

sustainable solutions.

The structure of the paper is as follows: the first part presents the theoretical framework and the methods and data used; the second part consists of the background of the study and the analysis. Finally the paper concludes with the presentation of the preliminary results and their discussion.

Theoretical framework

The literature on crises, innovation and technological change (Dosi, 1982; Freeman, Clark, & Soete, 1982; Schumpeter, 1912/1934) has been fruitful in explaining how the interrelations between technology, the economic system and the society change over time and how crises and challenging conditions can also be a source of innovation. This paper focuses on what exactly happens within companies and how they manage the R&D activities in a situation of a crisis and necessity to change. The mechanics of how firms react to this kind of situations and why they do so are many times unclear.

The literature on innovation under constraints (Caniëls & Rietzschel, 2015; Gibbert, Hoegl, & Valikangas, 2014; Gibbert & Scranton, 2009; Hoegl, Gibbert, & Mazursky, 2008) has shown that companies can innovate even though they experience constraints. Some firms ingeniously take advantage of constraints to explore novel trajectories (new products, new markets) (Keupp & Gassmann, 2013) or creatively use the resources that they have at hand to improve their competitive advantage (Garud & Karnøe, 2003). According to this literature the mere presence of constrained resources is not enough to stimulate innovation but rather innovation in turmoil is shaped by the way how firms respond to the constraints. But how exactly, why and under what conditions firms transform constrained resources into innovation performance is unclear (cf. Gibbert et al., 2014; Hoegl et al., 2008).

The literature on frugal innovation similarly studies how companies take advantage of the limitations in resources and turn them into opportunities (Bound & Thornton, 2012). Frugal innovations are low cost, match customer aspirations for quality and are adapted to the local context (Tiwari & Herstatt, 2012a, 2012b). The literature shows that achieving such frugal innovation means conducting an innovation process that is not focused only on lower costs, but is about completely rethinking the concepts and turning the constrained or scarce resources into an opportunity by sustainably using and shaping them by taking into account the broader local context (Tiwari & Herstatt, 2012a, p. 98). Even though the literature has almost exclusively focused on emerging economies (e.g. Zeschky, Widenmayer, & Gassmann, 2011) it can help understanding how the supply firms are managing the change to a new type of demand for frugality in the oil and gas industry.

The concept of frugal innovation is related to sustainability and sustainable development. Recent literature on sustainable innovation shows that the shift towards sustainability is not only about the sustainable end products or services, but also about changing the way how firms come up with the solutions and make money off of them (Jørgensen & Tynes Pedersen, 2015). In sustainable innovation field the firms are understood as black boxes and particularly so when it comes to decisions for undergoing more sustainable practices and venturing on paths for more sustainable products and services (cf. Boons & Lüdeke-Freund, 2013).

The paper builds on the different literatures to assess how the supply companies are managing the change to R&D activities for frugal innovations in a context of a developed economy when a crisis shakes up a previously resource-abundant industry/market and creates a sudden need for cost-effective and sustainable solutions.

Methods and data

The paper is based on data from a comparative case study of companies within the petroleum-related supply industry in Norway. The preliminary results are based on 10 interviews in the first round. The companies selected for the interviews belong to different parts of the supply value chain (See Table 1). The interest is to understand how companies in different parts of the chain are dealing with the downturn and whether there are similarities or differences in the management of the situation. There will be further rounds of interviews as the downturn is expected to persist.

The primary method of collecting data is semi-structured interview with R&D and management staff. Due to the contractual nature of the relations between the actors in the supply chain in the oil and gas industry, the commercial and technological side of doing business are many times intertwined. Therefore the respondents from management and R&D departments are expected to be familiar with the current situation in depth. The data from the interviews helps understanding how the companies are dealing with the challenges for innovation in the current situation, specifically how they are responding to the calls from the customers to provide lower-cost products and services and the calls from the government for lower CO₂ emissions and more sustainability.

The interviews were recorded, transcribed verbatim and anonymised. The analysis is conducted with NVIVO software. The unit of analysis are the responses measures adopted by the supply companies to the downturn in the oil and gas industry.

Table 1: Overview of the interviews

Company	Segment of the supply value chain	Position of respondent	Date
Company A	Engineering, fabrication and installation	CEO	11.11.2015
Company B	Engineering, fabrication and installation	Product Development Manager Subsea Products Manager	11.11.2015 11.11.2015
Company C	Operation	CEO	12.11.2015
Company D	Exploration and production drilling & Engineering, fabrication and installation	Business acquisitions manager	12.11.2015
Company E	Engineering, fabrication and installation & Operation	CEO	17.11.2015
Company F	Operation	Technical Manager	11.12.2015
Company G	Engineering, fabrication and installation & Operation	Engineering manager office 1 Engineering manager office 2	15.01.2016 21.01.2016
Company H	Operation	Sales and Marketing Director	20.01.2016

Background

The petroleum-related supply industry in Norway

The oil and gas industry is structured as a supply chain of companies that support the exploration, extraction and production of oil and gas. The supply chain is diversified: it consists of several specialised companies that support the activities of the oil companies that belong to a variety of industries.

The oil and gas industry is highly volatile and cyclical. It is tied to the fluctuation of the oil price and the investments. The industry experiences downturns with low activity which eventually turns up when the price of the oil rises. In periods of low oil price the oil companies tend to reduce the costs in order to keep the productivity and profitability of the oil wells. In periods of high oil prices the companies tend to invest in the activities in the

industry. The investments give prospects of activity for the supply chain in the oil and gas industry as the oil companies outsource services. The outsourcing is based on contracts made with different supply companies down the supply chain. The cyclical nature of the oil industry gives relative certainty to the supply chain that there will be a next upturn.

The technological innovation in the supply chain is oriented towards providing solutions and solving specific problems related to the activities. The innovation happens as interaction with the customers and other supply service companies which provide a solution according to those. The nature of the relationship between the supply chain actors is contractual and tied to the level of profits and investments. When the revenues and investments in the industry fall then the innovation in the supply chain is in great manner affected.

The Norwegian petroleum-related supply industry has developed into a world-leading cluster in the last decades. It is distinguished by high competence especially in subsea technology and services (Ryggvik, 2013). The supply chain had been characterised by increasingly high costs and margins, lavish R&D and gold-plating of technological solutions driven by high oil prices and big investments in the years before the oil price collapse in 2014.

Current downturn in the industry

The price of the Brent oil started falling in July 2014 and has fallen from 111,80 US\$ per barrel to under 30 US\$ mid-January 2016 with the current price of 41,20 US\$ as of 19 March 2016. The fall has been especially steep in the first period from July to December 2014. The geo-political situation, the behaviour of the actors in the market and the appearance of unconventional energy resources have set a scenario of persisting low oil prices into 2018 (EIA, 2016).

The new situation in the industry due to low oil prices means that the activities of the oil companies have become less profitable and the revenues have fallen. The persistence of the low oil prices is affecting not only the profitability of the oil wells, but also the attraction of investments to the industry. This means that many projects and contracts in the industry are being postponed or cancelled. Consequently the supply chain in the industry is affected by less demand for their products and services. Moreover, the new situation affects also the R&D and innovation activities in the supply chain. The supply chain has been pressed to lower the costs drastically and to provide the solutions that are cost-effective.

The situation coincides with increasing pressures towards environmental sustainability. The government has adopted an agenda for environmental impact reduction (Norwegian Ministry of Climate and Environment, 2015). At the same time the latest concession round for the Arctic region, namely Barents Sea, created a future demand for solutions for harsh but vulnerable environment. The situation has led to a double pressure on the supply chain: halted revenues and investments, but at the same time the pressure to become greener and to innovate for greener, cost-effective and technologically advanced solutions.

Analysis

Streamlining

The collapse and the persistence of low oil prices since the second half of 2014 have had a strong impact on the activities in the oil and gas industry in Norway. A first reaction of firms was to streamline in order to compensate for lower revenues. This means that they tried to reduce costs by making overhead employees redundant and redesigning their working processes for more internal efficiency. For example, some of the respondents were hired to streamline the company or their departments (Companies G&H). The redundancies were not

made among the positions that are related to the core competences of the companies, but rather positions “*which were nice to have but weren't necessary to have*” (Engineering manager office 1, Company G).

The intermittent down and upturns are a characteristic of the oil and gas industry. But the nature of the current downturn is different as the low prices are persisting at a very low level and the forecast is grim. Even for the supply companies, like Company B that have been around in the industry for many years the situation and have previous experiences with periods of low oil prices this one is different.

“Right now it’s been special, too, because there have been so many layoffs around in the industry. And it is also affecting our company. Now we’re into a stage where some really good people are having to leave and has been in the company... Some of them have been for more than ten years. Technology people. So, it’s a real loss... for everyone actually.” (Subsea Products Manager, Company B)

So, the specialty is that the situation is forcing the companies that are technologically intensive not only to reduce the costs associated with the work processes but to let go engineers that constitute to the core technological competences of the firms.

The companies redesigned the working processes to guarantee as efficient working processes as possible. For example, Company E adopted a “lean” approach to organise the bottlenecks and barriers within the organisation. The streamlining of work processes affected not only day-to-day activities but also R&D activities. The biggest change, for example, for Company G was to strip down the unnecessary activities. The result for the engineering department within the company was that two years into the downturn they halved the use of the engineering hours for a specific job. They did so by making a selection about “*which activities can we stop doing and still be /.../ safe and be within requirements*” and to increase routinisation by basing themselves on “*what we have done before so we don't have to reinvent the wheel every time we do a new project.*” (Engineering manager office 1, Company G).

Even though the downturn is characterised by constrained resources, the companies experienced also a slack of resources. As there are fewer or no projects now, many engineers can dedicate more time on their day-to-day activities or even spend time on activities that were earlier never prioritised because there was no time.

For Company B the experience has been that the engineers in bidding processes can spend time on improving their proposals. The customers for their solutions are taking their time to consider them and coming back asking for price reductions. In order to win the projects, their engineers are spending time in improving the proposals to offer cheaper subsea solutions. Before the company had neither time nor incentives to spend time on thinking of how they could come up with and supply more cost efficient ways. But now, as the engineer in (Subsea Products Manager, Company B) mentioned, “*we have time to do it as part of the bidding process. Our proposal engineers are involved in innovation in many aspects.*”

The persisting low costs put pressure on the companies to reduce costs of what they deliver in the current contracts, but also to think about how to deliver future cost-effective solutions for the next contracts. According to the engineering manager in Company G (office 1) this is a more demanding process “*if you just need to reorganise and be very objective and say, ok, I need to move this organisation from with all these people and these managers to being something smaller and simpler. That's pretty easy to do when you are sort of, you know... But actually, what's more interesting, but also harder, is to look at, ok, we used to design things in this way, but now we need to use our knowledge and understanding to simplify it. That's a bit harder. It requires lots of engineering know-how and experience. But that is also the way of actually reaching our goal of being more cost-efficient and competitive.*”

Changing the mindset for frugality

The new situation demands to spend less time for engineering, solutions that have the same functionality as before, but are not goldplated, rather just fit for purpose. When approaching this situation, the Company G had to ask themselves “*how can we design things so that they are cheaper and cost less*” but at the same time also “*how can we do this more efficiently by spending less engineering hours completing a job basically*” (Engineering manager office 1, Company G).

The engineering department organised workshops for the engineers to come up with new ideas for new solutions from scratch. The workshops resulted not successful as expected. The engineers ended up with the same solutions as they would have before. The engineering manager (office 1, Company G) emphasised that this has been frustrating for the company since the pressures for change towards more frugality started. In his perspective this is something inherently difficult because “*if you incentivise these guys and you beat them with the stick and say - be efficient and execute clearly /.../, get stuff designed and use a coat, oh and, by the way, think differently and be innovative - you are kind of asking people to use two different sides of the brain and change their behaviours. And that's really tough.*”

His colleague, also an engineering manager but at a different office, added that the engineers are used to thinking in a certain way and they only know solving problems the way they have always solved them. “*Within the industry a lot of the people who we put in specialist lead roles, they are there because they know how to apply the common rules set and they can work within a common paradigm really efficiently. They land on a solution, this is how we've done it, this is all we've done before, this is the efficient solution within this paradigm.*” But in the current challenging situation when the need is for different types of solutions, namely frugal innovation, problem solving by selecting from the set of previous ones is not enough. “*So, to innovate in a company, /.../ you need to find a way around that. Idea generation, making people thinking differently... and in a larger company that's tough.*” (Engineering manager office 2, Company G)

According to the engineering manager engineering in itself is not enough, to come to frugal solutions, but rather “*there's all sorts of stuff that you need to start changing in the organisation to make it happen.*” The organisation needs to adapt, but “*what does a process look like? What system's need in place? There's a cultural element there and there's a behavioural element, there's all sorts of stuff that you need to start changing in the organisation to make it happen.*” (Engineering manager office 2, Company G)

On the other hand the experience for Company A, a start-up company, is different. Being a smaller company they are able to be more flexible about helping out and responding to more customised cost-effective solutions for the customers.

A new demand

The overall need for cost saving of the customers is leading the supply companies to cut the unnecessary expenses of the current solutions, but also to think about the future projects.

The owners of the production licenses are looking for ways to cut costs on the developments in the oil fields. The slack of time in Company G allows the company to help them: “*of course, we have spare resources at the moment as well and we can do study work. Concept work, how to adapt our technology to their solutions, help them understand in a collaborative way how we can contribute to them reducing their costs. So, that's the story right now.*” (Engineering manager office 2, Company G).

This concept work, as defined by the engineering manager (office 2, Company G), comprises of looking into the current needs of the oil companies and developing possible solutions for those. The overall need of the oil companies is cost-effectiveness in all the activities.

But even though the oil companies and other actors in the supply chain say that what they need is new cost-effective solutions, this, according to the CEO in Company C is not the case in practice.

Their experience is that the adoption and implementation of new technologies, even though cost-saving, has been halted. A first reason is to reduce the costs and save money. But, the second one is that implementation of new technologies is costly in the downturn and “*people*” as, the CEO illustrated “*do not want to sign off and put their name on – yes, we will try this - if it fails, at least in these times, they are really putting their neck out there and risking their reputation.*” (CEO, Company C)

To reduce the risk and prove that the technologies are working, the strategy has been to implement them outside of the oil and gas industry, for example, maritime or energy industry. With a track record these can be more easily adopted in the oil and gas industry. But even so, “*it’s very much harder to come up with new technologies now even if you can document that this will be a cost effective, and you will save money, it is very much harder now to get someone to sign up for the use of different or new equipment.*”

The clients encourage Company C in this situation to “*push for implementation of new technologies at an earlier stage, but it’s very hard for a supplier to spend much time and effort to push for a new technology when you don’t have a specific projects aiming it against. Because that is the first thing they will ask – where do you plan to use this? – You can say – Well you can use it on all offshore installations – Yeah, which project? – But you don’t know the project because the project isn’t been presented to you yet. It’s an uphill battle and if you are in a busy day-to-day work situation, this is not something you really... you don’t gain any advantage by doing this.*” (CEO, Company C)

External collaboration

A way around the tension between risk-aversion and the need for new cost-effective solutions seems to be collaborating with customers and other actors in the industry in order to try to change the way activities in the industry are done rather than just trying to change one specific element of the chain.

The position of Company G has been to affect the life cost of the fields. This is where they have lost most revenues due to downturn. In order to do so the company decided to increase interactions and collaboration to understand what their customers need in order to create more value and to “*develop oil fields where they couldn’t be developed before or develop them in a more efficient and cost-effective way.*” (Engineering manager office 1, Company G)

The argument of the subsea companies is that with their knowledge they can genuinely help to build up life cost-effective solutions. The truly cost-effective subsea solutions can only be achieved by redesigning the development of the field in order to affect the life cost. This means that, the way the field is planned will affect all other costs in the development, operation costs and modification and maintenance costs. The only way to do it is “*with collaboration with our partners because they know, they have some parameters and some quotes to follow and they design their structures, but then we can work with them from an installation point of view, from a maintenance point of view and then we can get the best of two worlds. And that’s what we’re trying to do with the alliances.*” (Engineering manager office 1, Company G)

A year after the crisis had begun Company G decided to go into two separate alliances with two different companies from related parts of the value chain. Together they cover a wider range of complementing engineering competences, have a broader base of customers and achieve economies of scale when bidding for projects. But the most important aspect, according to the engineering manager, is the impact on the life costs of the oil fields they can achieve by expanding the set of competences: *“we are doing partnerships now with the suppliers of these structures so that we can sort of optimise how other companies are designing their structures so that they become cheaper and to install and operate. So we’re trying to have this holistic approach where we team up with other players in the market.”* (Engineering manager office 1, Company G). The idea is to influence earlier in the planning and development of fields so that they can actually use own competences and resources to deliver lower cost technology and solutions aimed at *“winning tomorrow’s work.”*

The pattern of collaboration for technological development and innovation has been that the supply chain has been quite specialised, this seems to be changing now. It is also changing in direction of earlier involvement of the companies. If the alliance or the individual company is to affect the development fields, it needs to be involved earlier. According to the engineering manager in Company G this is important because like this they can *“help them understand the technology that is coming down our pipelines and how they can use it. So, by the time they’re ready to start committing to different solutions, they know what we’re working on and they have the confidence that it’ll be ready when they need it.”* (Engineering manager office 1, Company G)

The non-involvement of the suppliers at an early stage has been a problem in the industry already before the downturn. Not involving the subsupplier enough and not asking them how things can be improved is *“often why a new technology will not be used”* because *“when they invite us, and when they encourage us to come with new technologies, it’s already too late.”* (CEO, Company C)

Standardisation

The level of customisation of technological solutions in the industry has been high and the call for more unified use of technology to achieve more mass production and consequently lower costs has been a clear call from the supply chain. But it is difficult for the oil companies to agree on standards: *“One of the problems that stood up at the UTC¹ in Bergen last year was that we need standardisation. And then someone from the audience said: Ok, Mr Statoil, Mr Total, I think it was, when are you going to agree on a standard? And they said: Never!”* (Engineering manager office 2, Company G). The standardisation pressures and movement means that one type of standard will be chosen.

Uncertainty and risk

The reaction of the companies to the new needs seems to be twofold: adapting the existing technologies to the new needs or creating new technological solutions for the new needs. But the future is uncertain. As the engineering manager in Company G expressed, *“hopefully when the oil price comes up again a little bit and the times have become a bit better, we will be a much stronger company than what we used to be because we will have been forced to develop new technologies and forced to simplify how we design conventional structures and equipment.”* (Engineering manager office 1, Company G). The expectation is thus to sell the adapted or novel technology when there is an upturn in the industry. There is no insurance

¹ Underwater Technology Conference in Bergen, Norway.

that their technology will be taken up. The majority of the R&D seems to be conducted backstage and the effort is to test it outside of the oil and gas industry. It is unclear if these new paths developed are going into the same direction and which one will be chosen during the next upturn.

Such is the case also for the particular future need for the technological solutions for the Arctic environment. The latest concession round has been in the Arctic Barents Sea, which is a harsher environment than the North Sea and the Norwegian Sea, and the technology needs to be adapted to that. Also, there is no existing oil and gas infrastructure there, which means that, for example, the pipelines for transporting the produced liquids will have to be longer and insulated to keep it flowing. There is currently no actual demand for such technology, but the concession round means that there is going to be a future demand.

Preliminary findings and discussion

The lack of projects for the supply companies has on one hand resulted in constrained financial resources and consequent adoption of cost-cutting strategies. The persisting low oil prices have halted projects and contracts in the industry. On the other hand it has resulted in slack of highly specialised human capital resources: the engineers have less day-to-day tasks so companies are engaging them in conceptual engineering for rethinking the existing technologies. The goal is to come up with solutions that respond to the call for more cost-effectiveness.

The constrained financial resources seem to have kicked off the search for frugal solutions but the slack of highly qualified human resources has enabled the actual R&D activities. Nevertheless, as the case of Company G shows, shifting the mindset from overengineering to frugal engineering in order to come up with a completely new idea is difficult as it entails making changes in the organisation as a whole.

To overcome the difficulty to change, particularly the tension between complexity and the necessity for low costs, the companies are searching for additional knowledge in other parts of the supply chain by going into alliances, and trying to collaborate with the customers. This secures on one hand a broader knowledge and competence base for the development and implementation of technology, but also reduces uncertainty around what a future frugal solution might be.

There is currently little implementation. Even though everyone is trying to come up with new solutions, companies report that these are not welcomed in the situation of downturn because the risk for anyone adopting a completely new solution is too high.

The call for standardisation can be seen as a way to contribute to the lowering of the costs, but at the same time it seems to be also creating uncertainty for the companies, especially the technology-intensive ones. There is no guarantee that their solution will be chosen as a standard or be compatible with the standardised solution. When the whole industry is developing frugal solutions in the backstage the uncertainty of which ones will be eventually chosen is high and the companies do not want to take any risks.

The supply companies seem to have reacted to the new situation by streamlining. They do not report any big frugal outcomes from the situation, but many measures towards cost-effectiveness, whether by using the resources they have for other ends (concept work) or giving new purpose (bidding processes). This goes along the lines of what the literature on innovation under constraint points out: creatively taking advantage of the situation. The way they are doing it currently is by making small changes for cutting the costs rather than radical innovations.

Frugal innovation seems to be desired, but difficult to achieve. It is difficult to change the mindset of the engineers, but it is also difficult because a company is dependant on others in the supply chain. It seems that the companies have to collaborate to come up with radically new solutions. The literature on frugal innovation emphasises taking into account local context, the results here point that in a context of a developed market to transition towards frugal innovation it is necessary not only to change the internal ways of doing R&D, but also to change the environment in order to prepare it for something completely new.

When it comes to environmentally friendly innovation, from the first round of interviews it is not clear whether the companies are adopting greener technologies, the lowering of the costs seems to be more important.

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