HØGSKOLEN I OSLO
OG AKERSHUS

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NCE Subsea in the Brazilian Subsea Sector

A Study of Norwegian-based Subsea Suppliers' Contribution to R&D in the Brazilian Subsea Sector

Master Thesis in Finance and Financial Management
Oslo and Akershus University College, Faculty of Social Science

Sammendrag

Denne oppgaven baseres på en kvalitativ studie av hvordan NCE Subsea, nærmere bestemt klyngens medlemmer samt den norske klyngemodellen, kan bidra til forskning og utvikling i den brasilianske leverandørkjeden av undervannsteknologi. Dunnings eklektiske paradigme er anvendt for å vurdere hvilken form for deltakelse som er mest hensiktsmessig for medlemmene av NCE Subsea.

Den betydelige etterspørselen av utstyr og tjenester knyttet opp mot undervannsløsninger i Brasil har resultert i en bølge av nyetableringer i Rio de Janeiro. Disse selskapene bringer verdifull kunnskap og teknologi sårt trengt i den voksende klyngen. I den sammenheng vil fokus på DUI sannsynligvis være mer hensiktsmessig enn STI for å gradvis kunne løse flaskehalsene som preger den brasilianske virkeligheten, bl.a. som følge av en umoden leverandørkjede.

Det er et klart bevis på selvseleksjon når bedriftene konfronteres med den "Brasilianske kostnaden". De mest krevende utfordringene er knyttet til mangel på kvalifisert arbeidskraft, logistikk, og det kompliserte skatteregimet. Studien konkluderer med at medlemmer av NCE Subsea bidra til å redusere gapet på etterspurt lokal kompetanse, spesielt ved å kvalifisere sjøfolk. Kvaliteten på lokalt produserte varer er fremdeles relativt dårlig, til tross for en helhetlig satsning på flere statlige nivåer for å oppnå lokalt innhold. Det er derfor grunn til bekymring for om den lokale kompetansen er tilstrekkelig til å absorbere mer avanserte innovasjonene som i økende grad vil utvikles i Rio de Janeiro i forbindelse med ulike samarbeidsavtaler.

Triple Helix er et fornuftig verktøy for å utvikle den lokale subsea-industrien, og bygger på prinsipper som passer det brasilianske landskapet i større grad enn klyngemodellen som NCE Subsea representerer. Likevel kan visse karakteristika ved den norske klyngemodellen være gunstig for Rio Subsea Cluster. Funn tyder på at samarbeid mellom industri-akademia kan knyttes tettere dersom Rio Subsea Cluster trekker på norske erfaringer rundt gjennomføring av anvendte forsknings prosjekter .

Oslo, Mai 2014
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Abstract

The thesis undertakes a qualitative study of how NCE Subsea - the cluster members and the Norwegian NCE cluster model – can contribute to R&D in the Brazilian subsea supply chain. Dunning's Eclectic Paradigm is applied to determine the means of participation in the Brazilian subsea sector most beneficial to members of the NCE Subsea cluster.

First of all, the great demand of subsea supplies and services has resulted in a surge of companies bringing much-needed technology to the emerging subsea hotspot, Rio de Janeiro. In this sense, DUI will perhaps prove more valuable than STI to gradually solve the many bottlenecks in the Brazilian subsea sector, partly caused by the immature supply chain.

There is clear evidence of a self-selection process when confronted with the "Brazilian cost". The most highlighted challenges relates to lack of qualified workers, logistics, and a complicated tax regime. The project concludes that members of NCE Subsea contribute to closing the gap of local competence, especially among qualified seafarers. The quality of local manufacturing is relatively poor, despite a holistic devotion to improve LC on several governmental levels. One is therefore entitled to question, as Rio de Janeiro is becoming a hotspot for subsea technology, whether the local capabilities are sufficient to absorb more advanced innovations that increasingly will be developed in Rio de Janeiro in connection with various cooperation agreements.

Triple Helix is a reasonable tool to develop the local subsea industry as it "fits" the landscape to a greater extent than the NCE subsea cluster model does. However, certain features characteristic for the Norwegian cluster model might prove beneficial for the Rio Subsea Cluster. Findings indicate that the industry-academia linkage may become stronger if Rio Subsea Cluster draws on the Norwegian experiences of conducting applied science projects.

Oslo, May 2014
Oslo and Akershus University College, Faculty of Social Science

Preface

In October 2013, I attended a seminar at Mariott Hotel on Copacabana. The seminar was arranged by the General Consulate in collaboration with Innovation Norway, INTSOK and the Brazilian-Norwegian Chamber of Commerce. The topic of interest was "How to achieve Local Content in Brazil". Not only was I intrigued to learn about the subject, but I was also impressed to see participation from the audience. The meeting hall was filled with representatives from the Norwegian Oil industry, equally frustrated with practical challenges related to the demanding business landscape in Brazil. It led me to think; how did Rio de Janeiro become such a hotspot for Norwegian-based companies when such discontent is expressed?

I want to express my gratitude to the Administration at HiOA. First of all for letting me pursue my somewhat untraditional choice of exchange destination, Rio. Secondly, that I was able to use my experiences as a starting point for choosing a theme for my thesis. Without the flexibility and cooperation from the Faculty Management, I would not be where I am today.

As suggested by a friend, my motto throughout this process has been "pretend to be writing to someone who is exceptionally intelligent, but have no knowledge of the subject". Little did I know how useful this advice would become. An especial thanks to my supervisor, Helge Nordahl, for agreeing that we might as well "learn together" while I was exploring my field of study. Your sound advice, inputs and ability to give feedbacks on short notice, has proved very valuable for my work.

Innovation Norway, inviting me to use your facilities while writing my thesis may seem like a small gesture from your side, but it proved crucial for my progress. Being surrounded by so many talented, helpful and welcoming people was truly an amazing experience. Flávia Ambrosano, and the rest of the team at the incubator office, it was a pleasure getting to know you all. I honestly cannot thank you enough. (Even the BodyTech-mafia for dragging me to the gym - there is nothing like a workout to clear the mind!)

To all my interviewees, Johanna Fiksdahl, Therese Fuglerud, Anders Kapstad, Kjetil Solbrække, Gulbrand Wangen, Denise Medina, Leonardo Melo, Jose Marcio Vasconcellos, Rune Andersen, Erik Hannisdal and Helge N. Austbø. Thank you for sharing your experiences, thoughts, knowledge, advise, opinions and time. In case you should wonder, your observations were remarkably tuned.

I am thankful for all the support from friends and family, especially for keeping your thoughts to yourself when I said I was returning to Rio to write my thesis – just in time to catch Carnaval. I must admit I am very fortunate to have parents willing to spend the Constitutional day proofreading.

Samordna Opptak deserves a roaring applause for selecting the best, first-graduating MSc class in Economics and Business Administration at HiOA one could ever ask. I appreciate that we collectively managed to keep the spirit up while being stuck in the same boat that occasionally felt sinking. I am honored, yet very sentimental, that our journey together terminates for now.

And last, but not least, my beloved Rio. The view from the office overlooking the Sugar Loaf and Botafogo bay helped me sustain my motivation from dusk until dawn and reinforced the desire to understand what lay before me. Muito obrigada!

Oslo, May 30th 2014

Anna Ringstad Lundgård

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Abbreviations

ANP - The national Petroleum agency, the regulator of activities related to oil, natural gas, its byproducts, and biofuels in Brazil

BN21 - Brazil-Norway in the 21st century

BNDES – The Brazilian development bank

BRICS – Brazil, Russia, India, China, Singapore, the ”Emerging Economies”

CENPES – Centro de Pesquisas Leopoldo Americo Miguez de Mello, Petrobras' research center

DUI - Doing – Using – Interaction (Experience-based innovation)

E&P - Exploration and Production

FDI - Foreign Direct Investment

FPSO – Floating Production System and Offloading

FINEP – The Brazilian Funding Authority for Studies and Projects

GCE – Global centre of Expertise

GIEK – The Norwegian Guarantee Institute for export credit

INTSOK - The Norwegian Oil and Gas Partners

LC – Local Content

MCDI – Ministry of science and Techology, main Brazilian deferral body for that encourages national research policies

NSES – Network of suppliers of equipment and services

NIS - National Innovation System

NCE - Norwegian Centre of Expertise

MNC – Multinational Corporations

OED - The Royal Norwegian Ministry of Petroleum and Energy (Olje- og Energidepartementet)

OECD - The Organisation for Economic Cooperation and Development, 34 developed economies

O&G – Oil and gas

ONIP - The National organization of the Petroleum industry (private, non-profit organization)

R&D - Research and Development

SEDEIS - Brazilian Ministry of Science, Technology and Innovation

SME - Small and Medium sized Enterprises (0-100 employees)

STI - Science – Technology – Innovation (Research-based innovation)

UFRJ – Federal University of Rio de Janeiro

Chapter 1: Introduction

1.1 Introduction to Research Topic

Brazil is anticipated to become the largest offshore market in the world for Norwegian vendors within this year, and until 2017. Norway is tagging closely behind as the second largest. Together, the markets will have a value exceeding USD 400 billions. The bilateral relationship between Brazil and Norway is particularly relevant in this context. In fact, Brazil is the third largest absorber of Norwegian Foreign Direct Investment (FDI), only surpassed by EU and the USA. The majority of the investments are by far inflows to the oil and gas sector with a strong focus on the rig and drilling services, subsea equipment and installation, and various types of offshore vessels. Statistics show a clear trend of accelerated activity after Petrobras discovered the first Pre-salt oil field in 2006, later named "Lula". The Pre-salt basins, or "beneath the salt", represents the Western Hemisphere's biggest oil discovery in 30 years. It extends 800 kilometers along the Brazilian coast, is up to 200 kilometers wide, and estimated resources range from 50 to 90 billion barrels of hydrocarbons (oil plus natural gas). This alone makes Brazil one of the worlds most promising oil frontiers in its size and a key "laboratory" for developing Norwegian petroleum technology.

Parallel to the development of the Brazilian oil sector, the bilateral collaboration between Brazil and Norway on a comprehensive plan has intensified. The Norwegian government's Brazil-strategy outlines several areas in which a strategic partnership would prove mutually enriching and contribute to growth and development in both nations (Departementene, 2011). The collaborative program for R&D and human resources Brazil-Norway in the 21st century (BN21), was signed by the Brazilian Ministry of Science, Technology and Innovation (SEDEIS) and The Royal Norwegian Ministry of Petroleum and Energy (OED) in 2013. Through an explicable action plan, the parties gather effort in the development of jointly needed technologies within exploration, development and production of oil and gas. Such areas high on the agenda include subsea technology, enhanced oil recovery and drilling technology.

Recently, the State Government of Rio de Janeiro turned to NCE Subsea, a leading subsea cluster supported by the program Norwegian Centers of Expertise, for input and support in the formation of a local subsea cluster. A memorandum agreement was signed between the parties in 2013 with the object to facilitate new partnerships, encourage innovation and develop cutting-edge subsea technology in the region.

Brazil and Norway have long ties of trade; ever since the *bachalao norueges* was unloaded at the docs of Rio de Janeiro around 170 years ago in return for sugar and coffee. Bearing this is mind, the industry has naturally initiated various agreements across business participants. As an example, Aker Solutions started its activities in mining, paper and cellulose in Brazil back in the 70s. In the mid 90s, they opened their subsea unit in Curitiba, in the south of Brazil. Within the first ten years, Aker Solutions received orders for "Christmas trees", subsea installments used to monitor the flow of oil out of the well, with a value of USD 500 million. Today, they are established in Rio das Ostras, Rio de Janeiro and have a facility is under construction in Macaé - making Brazil the single market where Aker Solutions is investing the most (Inventure Management, 2013). Statoil and the Brazilian national oil company, Petrobras, also serve as good examples. Statoil is now the second largest operator in the Brazilian offshore market after Petrobras (although it only accounts for 3% of total production). A general agreement on strategic technological cooperation has been in vigor since October 2003, and several agreements for technological research and technology transfer are in force (Statoil, 2011). The companies have achieved synergy effects through information sharing and a common commitment to technology projects. Translated from Portuguese on the Statoil Brazil website one is informed, "The strategy of the Rio Research Center is based on the business needs of Statoil and technological opportunities in Brazil."

"The Norwegian model of R&D" in creating a national innovation system around the development on the Norwegian continental shelf, has been the basis for comparison used by policy makers and practitioners in many countries, and serves as a playground for strategists. Brazil is no exception. Norway's success is partly due to the highly integrated R&D System of petroleum education and research that was introduced on several levels. Local content (LC) policies were strategically used as an instrument both for job creation and economic policy (Engen, 2007). Under the

"good-will" agreements introduced in 1979, international petroleum companies were rewarded by contracting with Norwegian firms, universities and research institutes for oil and gas related research and by developing Norwegian research centres. The operators' contributions to domestic capacity building (financial support for R&D and transfer of know-how) were reflected in their standing in the next concession rounds. Tax deductions implied that the state covered up to 78% of the cost related to R&D. This led to a gradual learning process that supported expansion of Norwegian participation in the petroleum business parallel to an increasing ability to solve bottlenecks on the way. As a result, clusters around the regional universities and research centers were created in collaboration with the national and foreign companies operating in Norway, primarily along the coast of Norway (Engen, 2007:11). Much credit is given to these policies for creating the valuable petroleum industry clusters present in Norway today. The question is if in two decades, Brazilians are able to look back and say the same. Discontent is expressed by the industry concerning the demanding LC levels claiming the requirements are numbing, rather than developing the local supply industry.

The Brazilian government is finally shifting policies in favor of R&D investments by the private industry, realizing that heavy investments are needed to induce the network of equipment and service suppliers of the Brazilian oil and gas industry and in connection with extraction of the pre-salt oil. A recent presentation held by Luiz Antonio Elias, Deputy minister of SEDEIS, concludes that "Innovation is a permanent agenda for government and for the business sector. Innovation policies are top priority" (Elias, 2013). Traditionally, funding of research has been provided by federal means, and often channeled through public research institutions with limited connection to the industry. Statistics show a clear trend of increased R&D governmental expenditures, however contributions from the private sector are significantly lower compared to the OECD countries and the BRICS. As of 2005, licensee operators are legally bound to invest minimum 1% of gross revenues from the fields with special participation in R&D. Out of this amount, a minimum of 50% is contracted universities and institutes approved by the National Petroleum Agency (ANP). Instituto Sintef do Brasil – henceforth referred to as Sintef - was recently accredited access to this "Special Participation Fund", which implies that Sintef may

be appointed to conduct projects funded through the "1%-rule" (Tønseth, 2013). The remaining half may be spent in facilities owned by the concessionaire in Brazil (or contracted with national companies). This might contribute to narrowing the gap between research and appliance in the market due to Sintef's ability to deliver innovations relevant for the company.

A domestic technology push is led by Petrobras through an interactive process with its suppliers and cooperative efforts with research centers. Petrobras is claimed to induce innovative behavior among its suppliers (Oliveira, 2012). However, due to its dominant position in the market, the R&D is based on their needs of equipment and services rather than radical innovations that can largely be used by other companies and in other sectors of the economy. Petrobras earmark heavy investments to its research centre, CENPES. The commitment to R&D has led to a leading edge in deepwater technology, but it lacks the necessary supply chain around it. The benefit is mutual; international companies can gain knowledge and serve Petrobras, and Petrobras need oil service suppliers to meet their ambitious plans. It is established that developing the Pre-salt fields will demand R&D. Local authorities and Petrobras are lobbying Ilha do Fundão, an island north of Rio de Janeiro where the Federal University of Rio de Janeiro (UFRJ) is situated, as the prime spot to conduct it. In addition to their gigantic research centre CENPES, one will also be impressed to find R&D centres of multinationals such as General Electrics (GE), Siemens, FMC Technologies, Baker Huges and Schlumberger on the island as well.

1.2 Research Question

Summarized, three aspects in which the potential for strengthening the relationship between Norway and Brazil within the subsea sector could prove complementary and beneficial are identified. These highlighted environments are;

a) Financially – by attracting Norwegian firms to invest in the Brazilian subsea sector
b) Technologically – by cooperation across and within universities, research centres, and research institutions in both countries, and

c) Institutionally – by drawing on the successful cluster experiences in developing a sustainable subsea supply industry in Norway (Guimarães, 2012:66).

Drawing on the above this paper seek to answer:

"How can NCE Subsea contribute to research and development in the Brazilian subsea supply chain?"

NCE Subsea will in this sense embody two aspects;

1) The members of NCE Subsea
2) The NCE Subsea cluster model

1.3 Aim and Structure of the Paper

The aim in this thesis is to present an admittedly crude model of the process that lead to two main outcomes in terms of R&D in the Brazilian subsea supply chain; Applied technology and Qualified workforce. There are also some indications that lead to a third element, transfer of technology, being amongst the contributions. The obvious starting point to resolve the research question would have been to analyze the scenario with, versus without, the members of the NCE Subsea present in the Rio de Janeiro area. Conducting such research would however be beyond my ability and the scope of this paper. It is therefore crucial to highlight that the findings in this thesis are neither to be understood as an isolated process, nor as direct effects of the other.

This thesis is organized as follows. The next section will give an introduction to the subsea segment in its industry context and a definition of how NCE Subsea will be used as a generic term for what it embraces, its members individually and the cluster model it represents, rather than the actual organization as it is presented. Chapter three will outline some important framework backing up who, why and how Norwegian subsea suppliers could benefit from participation in the Brazilian subsea sector. These ideas are investigated by conducting semi-structural in-debt interviews with

representatives from relevant areas, enabling me to explore a broad picture of the overall perceived reality. The respective interview subjects and the methodological procedure are outlined in chapter four.

The Analysis of Findings in Chapter five is divided into the three highlighted environments as identified above, namely Financially, Technologically and Institutionally. In Part A, the Brazilian reality is discussed in light of financial aspects, if and how participation is profitable. The scenario is briefly viewed from both perspectives; Brazilian incentives to attract and Norwegian incentives to participate. What becomes evident is that the decision to participate in R&D in Brazil is based on a time-quality-risk analysis. In Part B, we find that two core distinctions of the Norwegian Model of R&D – applied science and private contributions to R&D – are in fact two of the core shortcomings in the Brazilian. The cooperation and interaction is envisioned in a model designed by the author, inspired by the Triple Helix. The intention by doing this is to better present the possible movements in current overlaps caused mainly by "top down" formalizations enacted by the Brazilian government. The research cooperation described in Part B will be will be continued in Part C, allowing for exposure to the NCE Subsea cluster model. It has been claimed that the Norwegian model of cluster structure is not transferable as the Rio Subsea Cluster is in a different stage of development, however the author suspects that cultural aspects to a greater extent than structural, hinder the transferability.

The final sector summarizes the arguments in the paper and presents, in accordance with the findings presented in the analysis, a simple model and its implications. The model is to be viewed as a conclusion of how NCE Subsea – its members and the underlying cluster model – can contribute to R&D in the Brazilian Subsea Supply Sector.

Chapter 2: The Subsea Service Sector

2.1 Oil Service Companies

Within the offshore petroleum sector, one distinguishes oil companies from the supply industry. Oil companies provide project management models related to oil production, and the supply industry that provides technical solutions for exploration and production activities. In this thesis, all these suppliers are referred to as oil service companies, defined as a company that provides oil and gas related products or services to the upstream oil and gas industry (Rystad, 2012). They may deliver directly to the oil company or indirectly to other suppliers in the upstream petroleum sector. The market for oil service is very complex and it is important to understand the value chain in order to forecast the demand of the respective services. It is highly driven by the stage in which the region or field is undergoing. Figure 1 below is helpful to comprehend which type of oil service provider is requested during the exploration, development and production phase.

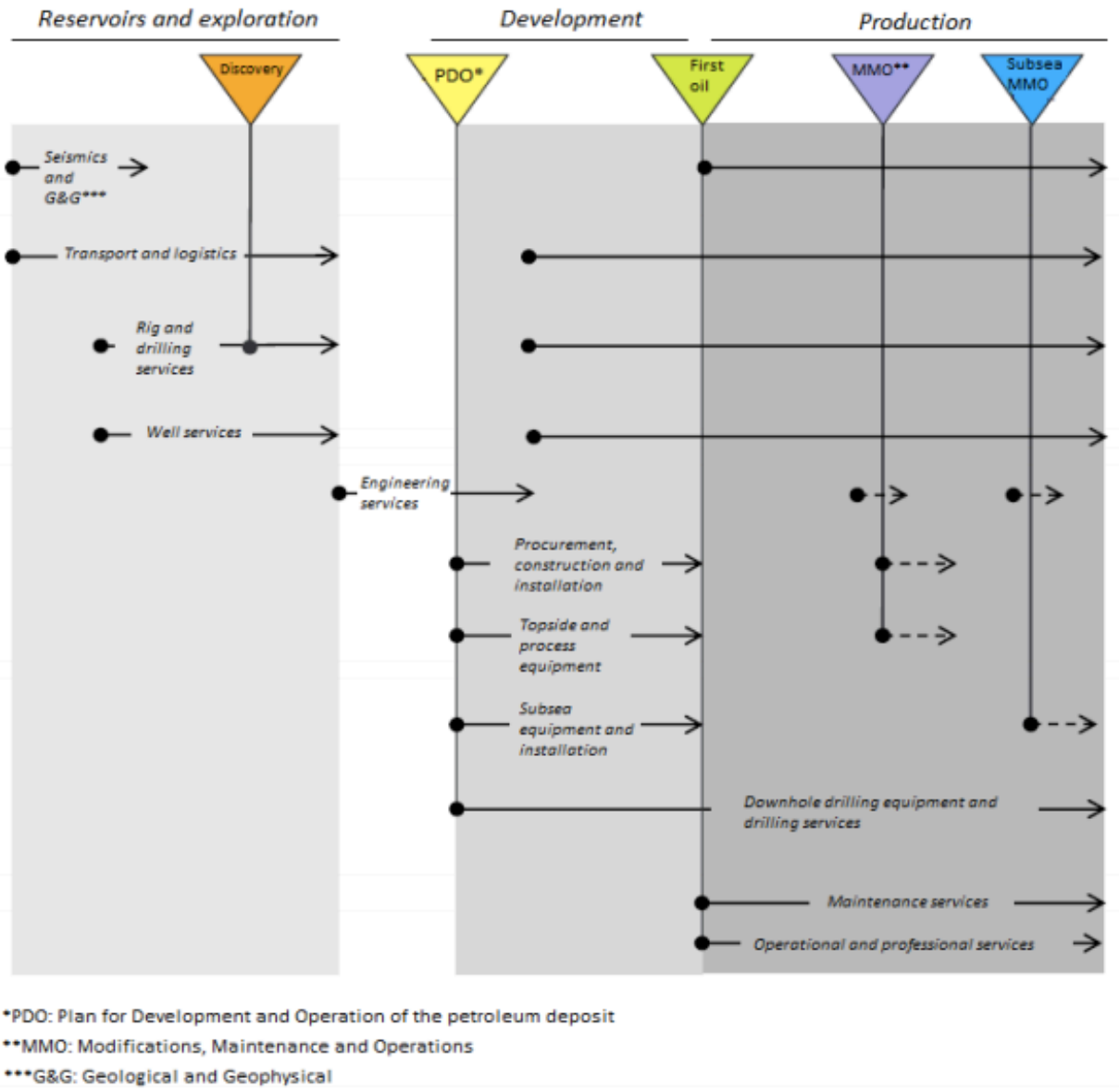


Figure 1: The oil service segments' position in the value chain. (Source: Rystad, 2012)

For instance, Brazil is in the early stages of exploration the gigantic Santos Basin. Estimates for the total pre-salt resources vary (some say up to 90 billion barrels of oil, 30 billion barrels more than the reserves found in the North Sea for comparison), but it is reasonable to predict that the extraction will require vast capital investments by the oil companies. Petrobras' aggressive five-year Business and Management plan announce an exploration program with estimated investment of USD 220,6 billion (Petrobras, 2014). In this phase, one will naturally experience a huge demand for companies in seismic and geology, rigging and drilling services and well services. As a consequence, Rystad asserts that Brazil is the most important market for rigs and drilling services. Additionally, companies involved in the transportation and logistics

must be present to support the activities above. Brazil is currently experiencing an increasingly pressing lack of engineers to provide engineering services to the design and development of the fields. The deficit may cause a sincere obstacle at this current point in the value chain in-between exploration and development. As the companies offering engineer services present the project, companies providing procurement and fabrication, installation of platforms, topsides and process equipment (drilling rig equipment) and subsea equipment and installations are demanded. In this picture, there is no coincidence that subsea suppliers are strategically positioned in the Rio de Janeiro area to meet the demands related to the pre-salt development.

Exploration and production in deep- and ultradeep waters spur the demand for rigs, which in turn leads to demand in topside and processing-equipment. When a field is in operation, it is mainly downhole drilling equipment and drilling services that is needed. It is important to note that the companies offering their services in an exploration phase is important throughout the entire value chain by providing maintenance.

2.1.1 Five Highlighted Areas

"Pre-salt area constraints are not financial, technological or administrative. The restrictions are in the pace that the supply chain needs to deliver everything the pre-salt requires"

José Sergio Gabrielli, Former Director of Petrobras[1]

Keeping the phase of the Brazilian oil market and the oil service segments' position in the value chain in mind, it probably makes sense to shortly describe the relationship between Brazilian and Norwegian oil service industry on a more firm-specific level, *to get an idea to what extent it affects R&D in Brazil*. According to CEO of INTSOK, Gulbrand Wangen, five technological areas should be highlighted in which the Norwegian oil service suppliers are heavily involved in the Brazil. These segments

[1] Valor Econômico. São Paulo, 10 September 2009.

[2] As defined by ANP, an operator is the company legally appointed the rights and responsibilities to

are Floating Production System and Offloading (FPSO), Maritime sector, Drilling rigs construction, Drillship operation and Subsea technology (Wangen interview).

Wangen report that 25% of all offshore vessels in the Brazilian **Maritime sector** are Norwegian controlled. Within the scope of supplies, Dynamic Positioning (DP) is one example of Norwegian expertise in operating offshore vessels, highly relevant in Brazil. By applying DP systems, vessels (or drilling rigs) are kept within specified position and heading limits. These motor systems are designed to minimize fuel consumption and wear and tear on the propulsion equipment (Kongsberg, 2014). Kongsberg Maritime employ substantial expertise and experience in developing and delivering cutting-edge DP systems and was this year appointed by Petrobras to deliver full range technology packages for ten new pipe laying vessels. The contract is reportedly worth USD 19.85 million and represents purely a ”sale of technology” from a Norwegian firm to Brazil.

Substantial potential for cooperation lay within the segment of **Drilling rigs construction**. As quoted by Jørgen P. Rasmussen, chairman of Seadrill, “Norway is the oil industry's equivalent of Silicon Valley. Nowhere else has there been developed so much advanced technology for use in wells” (Steensen, 2010). LMG Marin, headquartered in Bergen, won in 2012 a substantial contract worth over NOK 200 million to design 14 (out of 28) drill ships for Petrobras in the world’s largest construction program of its kind named Sete Brasil. Other Norwegian suppliers are also involved in the Sete program. Transpetro has designated two companies as "preferred suppliers" of drilling packages; Aker Solutions and the Norwegian branch of the U.S. National Oilwell Varco. Consequently, as highlighted by Wangen, the two Kristiansand-based providers have been awarded contracts for six and seven drill packages respectively.

Drillship operation is mentioned as the fourth area. Norwegian-based operator Odfjell Drilling will operate six of the 14 ships, and Seadrill will be responsible for three. Odfjell Drilling has since 2006 been involved in designing, planning and constructing four drilling units for ultra deep water, including Deepsea Metro II for

Petrobras in 2011. Its future involvement is settled, as it will be operating 20% of three rigs constructed in the Sete project[2].

FPSO is a floating vessel used for the processing of hydrocarbons and for storage of oil. FPSOs have been used by Petrobras since the 70s for the exploration of the oil reserves in Campos Basin and is a concept very familiar to Norwegian firms such as Aker Solutions and One Subsea. The vessels are particularly useful in remote or deep-water locations, and are used and demanded in a large scale nowadays. In terms of control and field operators as shown in Figure 4, Petrobras is dominating, with 15 operative and 12 in order, according to the International Maritime Associates (2014). The projects planned, such as the Libra FPSO charter, represents a great opportunity for Norwegian oil service operators to not only win the contracts, but also to influence the specifications for the future vessels ordered by Petrobras (Interview Wangen). At a workshop arranged by INTSOK in March 2014, their members were invited to present their products. If Petrobras agrees to set their specifications for the FPSOs according to the Norwegian proposals, it would clearly represent a technological transfer from Norwegian-based companies to Brazil, adjusted to operate offshore Brazil.

Brazil and Norway set the benchmark within **Subsea technology** worldwide. The major Norwegian-linked firms such as DOF Subsea, Aker Solutions and FMC Technology, are all established in Rio de Janeiro with a long-term commitment. The figure below briefly presents two main points; that Brazil is already a significant player, with sensational expected growth. As mentioned in the introduction, Brazil is a key market for Aker Solution's subsea technology and is heavily involved with a strategy to deliver high levels of LC. Just this April, Aker Solutions announced though its website that Petrobras awarded the company a USD 300 million worth subsea contract for manifolds in the pre-salt field with the first delivery scheduled in 2016. Local manufacturing facilities cover a certain part of the company's product

[2] As defined by ANP, an operator is the company legally appointed the rights and responsibilities to execute all operations of an oil field, while the contractor is delivering products or services to the operator. Brazil currently has a mixed regulatory framework of Concession contracts and Production-Sharing Contracts (PSCs).

line, and are currently expanding to include more equipment to reduce import, to exemplify subsea control systems will soon be produced locally (Dunaeva, 2013). FMC Technology is headquartered in Huston, but have strong ties to Norway after the acquisition of Kongsberg Offshore (Kongsberg Groups underwater technology division) from Siemens in 1993. They have already received four orders for subsea manifolds in the Pre-salt field (FMC, 2013). According to information on their website, approximately 50% of all oil and gas produced offshore Brazil passes through FMC Technologies' equipment. They have local employees throughout two manufacturing facilities in Rio de Janeiro and their subsea services base in Macaé. Both Aker Solutions and FMC Technology have established research centers in Rio de Janeiro. Bergen-based DOF Subsea holds substantial contracts with partners such as Technip and Chevron. The company is, together with its sister company Norskan, positioned to deliver high-standard vessels with advanced technology and the latest subsea equipment. The operator's core activities are project management and other ongoing services. Consequently, DOF Subsea is highly dependent on a competent workforce and there fore contributes actively to develop the local know-how. Subsea 7 (British) and Technip (French) hold significant contracts in the Brazilian market, and much of their subsea competence is located in Norway. However, their turnover in Brazil is not included in the reported international turnover as Headquarters are located outside of Norway.

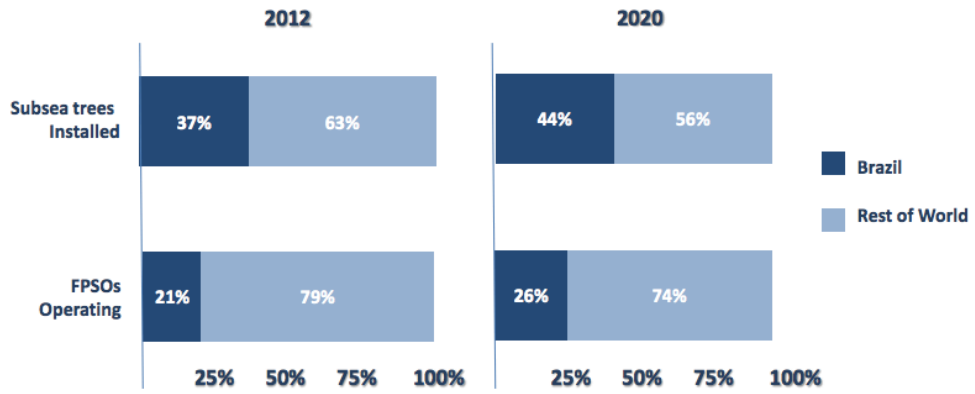


Figure 2: Brazil's share of installed Deepwater subsea equipment and FPSOs, 2012 and 2020. (Source: IEA)

2.2 The Subsea Service Segment

Figure 3 and 4 are INTSOK's overview of the Norwegian "world-class clusters", and the potential Brazilian "world-class clusters". To concentrate the thesis, it was natural to focus on the subsea service segment. It is reasonable due to several observations highlighting economic, technological and institutional relationship. Subsea technology encompasses everything between sea surface and seabed that is related to the extraction of oil and gas resources. First of all, the webpage Offshore.no proclaim that Petrobras is, and is expected to remain, one of the largest customers for subsea services. Of the total turnover for Norwegian oil service companies in Brazil in 2012, 23% came from subsea equipment and installation (Rystad Energy, 2013:18). The industry is fairly scattered consisting of a bundle of large companies, and a range of small and medium niche-like firms delivering essential technology to the oil companies or other oil service companies. It is important to note that Norwegian bound oil service companies in this thesis include Brazilian subsidiaries, although these account as *Brazilian companies* in practice (please see footnote 5 for details). Collectively, Norway provides world-leading solutions within the subsea segment with a global marked share of 73% (Fiksdahl interview). Extensive exploration and early development projects along Brazil's coastline will subsequently demand a significant amount of subsea-equipment and installations, implying large potential gains for Norwegian suppliers if positioned in the market. It is a highly technical field, and contracts are won by the best technology solutions to a greater extent than price. The competitiveness of the Norwegian subsea industry is claimed to be a consequence of targeted R&D policies involving universities, research milieus and incentives for industry participation. It is argued that the immaturity of such a network of equipment and service suppliers represent a bottleneck of the Brazilian oil and gas sector (Olivieira, 2012). The question is weather the Norwegian experiences and suppliers might enrich the current dynamics.

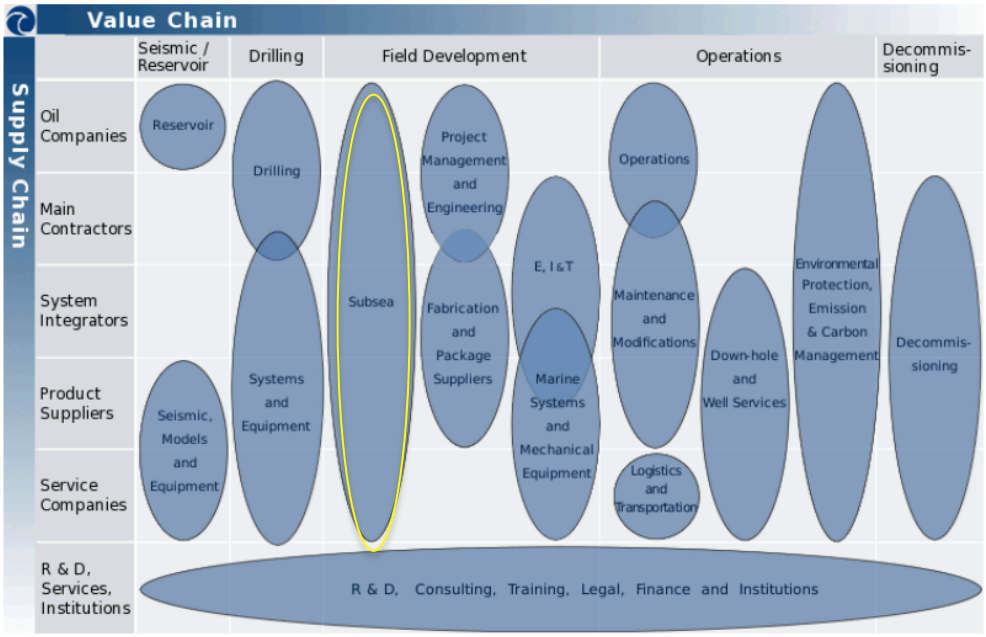


Figure 3: Norwegian «World-Class Clusters». (Source: INTSOK, 2013)

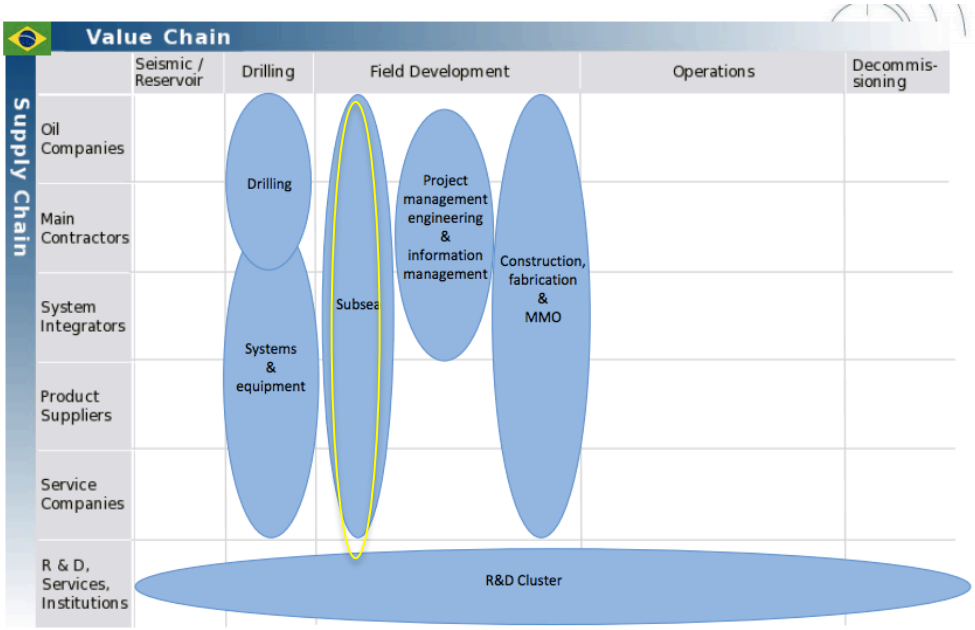


Figure 4: Potential Brazilian «World-Class Clusters». (Source: INTSOK, 2013).

A distinction is usually made between development of shallow- or deep-waters because different facilities and approaches for subsea technologies and production systems are required[3]. Recovery from offshore fields in general and deepwater fields in particular, is technologically very demanding. Deeper water and subsea technology go in pair, as the sector in its essence is always seeking new, innovative solutions for deeper waters and more demanding conditions. Hence, the two oil-nations face

[3] International Energy Agency define deepwater as water with a depth in excess of 400 meters

similar challenges on deep-water, but this also represent areas of possible synergies and cooperation. Petrobras has over the past decades developed leading technology capabilities in the area of deep-water exploration and production (E&P), an area in which Norwegian companies possesses technology, competence and experience from the northern sea. Over the past five years, 50% of new discoveries of oil worldwide were made in deep water areas. 63% of these discoveries is found on Brazilian shelf (Petrobras, 2012). It has therefore been stated that Brazil could become a "laboratory" for further development of offshore subsea technology.

The top three receivers of Norwegian subsea supplies are Great Britain, Brazil and USA, which can partly be understood by the similar geographic, and climatic challenges as faced in the North Sea. As the graph of the Brazilian subsea market below clearly illustrate, the growth in subsea spending has been tremendous, and the trend is expected to continue[4]. Large projects conducted by Petrobras drive the forecasted value of the subsea market to reach USD 12 billion by 2017. The market for subsea services are expected to grow from USD 900 million to USD 1.7 billion in the period 2013-2017 partly led by the need for subsea infrastructure to be connected to the FPSO installments. The sub-segments subsea equipment and SURF[5] are the most important segments for Norwegian actors and is described as services related to the installation of subsea equipment.

[4] Please note that international revenue from Norwegian subsea service firms can mainly come from one of two sources: Directly from Norway via exports, or sales through foreign subsidiaries. The sum of the two sources makes up the international sales. When the parent company is Norwegian, the sales come from either the Norwegian units' export, the Norwegian subsidiary established abroad, or subsidiaries that are acquired abroad. When the parent company is foreign, but the firm has a Norwegian subsidiary, will exports from the Norwegian subsidiary be included.

[5] Subsea Umbilicals, Risers and Flowlines.

6.3.2.3 Subsea

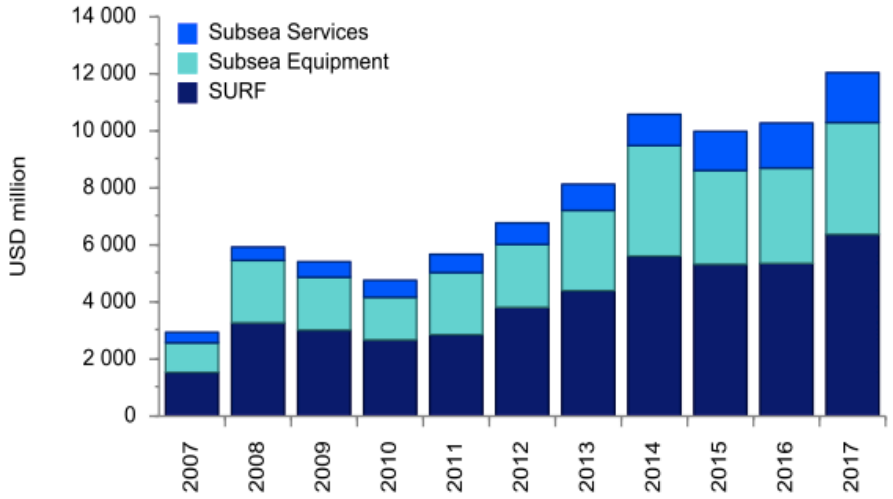


Figure 80: Subsea Market by Definition – Brazil

Table 74: Subsea Market by Definition – Brazil

USD million	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
SURF	1 536	3 273	3 017	2 674	2 857	3 818	4 400	5 612	5 323	5 357	6 371
Subsea Equipmen	1 038	2 188	1 856	1 496	2 176	2 205	2 815	3 874	3 291	3 342	3 924
Subsea Services	365	466	539	593	639	749	914	1 092	1 370	1 576	1 748
Total	**2 939**	**5 927**	**5 412**	**4 762**	**5 673**	**6 772**	**8 130**	**10 578**	**9 983**	**10 275**	**12 043**

Figure 5: Subsea market –Brazil. (Source: INTSOK Annual Market Report 2012).

2.3 Local Content in the Brazilian Oil Service Sector

It is expected that the role of the Norwegian based companies for R&D in Brazil is affected by LC requirements and thus relevant to give a short introduction to the topic. The term *local content* refers to the use of domestic goods and services and the Brazilian law requires a minimum amount of local content and participation in all projects and operations. The policies deal with the following elements;

1. Purchase of material, equipment, machinery and domestic made consumer goods[6]
2. Contracting of local service providers
3. Transfer of technology
4. Restriction of the use of workers formed by expatriated to enhance local workforce[7] (BNDES, 2010; p. 30).

[6] The mandatory local content of equipment ranges from 37-59% (Rodrigues,Napolitano,Paduan, 2013)
[7] The Ship Owners' Association relate to requirements that dictate 2/3 of crew must be Brazilian within one year of operation, many reports up to 100% local crew. (DOF, Ship Owners' Association and Fiksdahl interview).

The current process could result in establishment of a local network of suppliers of equipment and services (Olivieira, 2012). One way of seizing this opportunity is through Prominp, a program that lay out the plan for maximization of participation of domestic industry in providing goods and services. Its motto is clear; "Everything that can be done in Brazil must and will be done in Brazil" (Prominp, 2013).

One can hardly disagree that LC can be a sustainable tool for local based job creation, knowledge and technology transfer and industry development, given that the local content is based on principles to enhance competitiveness (Paul, 2013 and Fiksdahl interview). The case of Norway can testimony the effects. In Brazil, the purpose of the policies is beyond building just an oil industry. It also aims at stimulating broad-based social and economic development, through measures such as upgrading of infrastructure and improved education.

Practically, it forces the multinational companies to produce locally and hire local workers. The aspiration is to achieve local ownership and participation in different parts of the value chain, known as the concept of local value-add (Paul, 2013). Norwegian companies are generally expressing devotion to deliver LC, and there are examples of projects surpassing the required percentage, as presented at the seminar "How to achieve LC" in 2013. This may also be strategically beneficial in terms of stronger positioning as fulfillment of LC gives preferential rights in the market.

2.4 NCE Subsea

NCE Subsea is one of the 12 Norwegian Centers of Expertise (NCE), which is a governmentally funded cluster program within various industries. This knowledge hub is geographically located in Bergen – "the subsea capital" - on the west coast of Norway (NCE, 2014a).

NCE Subsea was established as an industrial cluster in 2006 and consists today of around 130 businesses and organizations, employs approximately 8000 people, and

reports a yearly turnover of nearly NOK 20 billion[8], according to information on the their website. The central partners for the industry worth highlighting are FMC Technologies, Aker Solutions, Vetco Aibel, Cameron and Statoil's Tool Pool (Steensen, 2010). Additionally, several SMEs suppliers work to deliver to these companies. Researchers are also involved though links to Sintef and the University College in Bergen. The cluster shall contribute to innovation in the Bergen-region by providing financial and academic support in establishments of development projects within the subsea industry.

NCE is funded and administered in cooperation with Innovation Norway, The Industrial Development Corporation of Norway (SIVA) and the Research Council of Norway. The clusters, defined as "A geographic concentration of related enterprises and institutions within an industry, a technology or value chain", get technical and financial support for up to ten years. Hence, NCE aim to contribute to the development of clusters, as mature clusters by nature are self-sufficient.
The mantra of the Norwegian cluster model is to "cooperate when you can and compete when you must", and the basic idea is that the companies in a cluster identify their common problems and work together to solve them. In addition to structural qualities such as vertical and horizontal links as further explained in the theory section, Jacobsen (2008) argues that there are other important factors that enhance the cluster. The most important are external links, allocation of resources, education and research participants, cluster identity and reputation, and the role as facilitator.

NCE Subsea act in ways that benefit the group as a whole, and its role as a facilitator can be in four areas; as host, seller, connector and gardener (Jacobsen, 2008). It acts as a hostess in providing service needed for businesses in the group. The seller part is about actively promoting the geographical area to investors, companies and competent individuals. The connector organizes forums and actively creates a platform to connect the players in the community and with stakeholders outside the cluster. The final role, as a gardener, is to facilitate germination and emergence of other new, innovative businesses, for example in the form of an incubator office.

[8] 1 USD=5,935 Norwegian Krone as of May 18th 2014

NCE Subsea is an internationally leading competence and production environment and the cluster contributes to raise international commitment in the Norwegian subsea industry. External links with participants outside the business group, both in Norway and in the rest of the world, is a prerequisite for the business group's productivity and long-term development capability. The Norwegian government stimulates increased R&D cooperations between members, R&D cooperation between members and universities, and other research institutions, as well as strengthening competitiveness internationally. Especially for small companies that lack sufficient expertise and resources, the NCE Subsea membership will give these companies access to markets they might otherwise struggle to break into. This kind of facilitation and promotion to internationalization is of such importance that it is currently undergoing a transformation from NCE to "Global Centre of Expertise" (GCE).

Cooperation between the local suppliers was limited before the establishment in 2006, and the NCE program has created an identity and network that previously did not exist (Econ Pöyry, 2009). Resource sharing and transfer between companies is one way to obtain external economies of scale. On the Coast Center Base in Ågotnes shared test-facilities and workshops for subsea equipment are one example how to apply this idea.

Knowledge and innovation is at the core of theory on industry cluster. Naturally do R&D-milieus, universities, and research centers play a crucial role in fostering knowledge accumulation locally and through its international contacts in the global forefront of knowledge. NCE Subsea have close ties with education and research participants such as Sintef and the University College in Bergen (HiB). The industry in collaboration with HiB have established a Bachelor degree and two Master programs in underwater technology. These graduates can play an important role for cluster learning by adding new competencies and knowledge during their studies and as newly educated employees.

It is important to understand what NCE Subsea represents in this thesis. Two points must be clarified:

Firstly, NCE Subsea represents 130 large and SMB directly or indirectly connected to the subsea service industry. An actor valuable in the NCE Subsea is not necessarily needed in the supply chain connected to Rio de Janeriro. An analysis of the members "fit" in the Brazilian subsea supply chain on a detailed level will not be made, nor does NCE Subsea hold accurate statistics on members that are delivering to the Brazilian market. Hence, NCE Subsea is only to be viewed as a representative section of the Norwegian based subsea industry and how this industry, broadly, may contribute to the development of the Brazilian R&D subsea supply chain. Secondly, NCE Subsea is representative as an example of how the Norwegian cluster model works in practice. It is not preconditioned that it is a "better" or "worse" method of developing the industry. The NCE Subsea program have however showed positive results in terms of interlinked activities and total growth, independently and collectively (Econ Poyry, 2009 and Menon, 2012).

2.5 NCE Subsea and Subsea Rio Cluster

The state of Rio de Janeiro, put forward by SEDEIS, has turned to NCE Subsea on assistance in the modeling and managing of the newly formed Subsea Rio Cluster. The local authorities are eager to learn from NCEs experiences, and are confident that the Memorandum of Understanding (MoU) will lead to a privileged position for Norwegian subsea companies in Brazil. The dominating members in NCE Subsea already have affiliates in Brazil, such as FMC Technology, Aker Solutions, DOF Subsea, GE, and Sintef. The main objectives are listed below;

1. To promote technological cooperation between enterprises of both countries, primarily SMEs
2. To facilitate partnerships between Brazilian and Norwegian enterprises, in the development of new products, processes or services
3. To implement actions to promote increasing competitiveness of SME s in Norway and Brazil and their internationalization through international cooperation and technology transfer
4. To collaborate in promoting the national innovation systems of both countries and exchange experiences in managing innovation and managing public and private resources (NCE Subsea, 2014).

Chapter 3: Theoretical Framework

3.1 Global Expansion Theory

"Globalization occurs when multinational enterprises engage in foreign direct investment to create subsidiaries which add value across national borders."

Rugman, 2002

Empirical research and an extensive amount of international literature show that exporting firms are on the average more productive than non-exporting firms, and that the exports as such helps to increase productivity (Wagner, 2011, Reve and Jakobsen, 2001). Exporting firms have to bear extra cost related to market research, adaption of products to meet local requirements, transportation and to overcome cultural barriers – just to name a few. Some experts also argue that salary expenses are higher in exporting firms (Bernard, Bradford and Lawrence, 1995). Following this reasoning, only the best companies manage to overcome these barriers. Hence, through the circumstances of self-selection only the most productive firms become exporters and less productive producers simply do not have resources to spare for internationalization.

The self-selection continues ex post as internationally oriented companies often experience harder competition, which means that they increasingly need to be able to adapt by cutting costs. As exporting companies have access to a broader network of contacts, they may capture the technological or market changes faster. This gives them a better basis for innovation and adaptation of production. Lastly, one aspect of achieving economies of scale is the ability to allocate fixed costs on more units, and it thus increases the incentives to invest in R&D. Hence, only the good go abroad, and only the best stay (Menon, 2013). According to figures from Rystad Energy, the largest Norwegian companies have a high degree of internationalization. By sorting oil service companies according to international turnover, one finds that the top-20 account for a total of NOK 143 billion in 2012, or three quarters of the international turnover. This equals to 68% of sales revenues that is coming from international business, whereas the percentage for the remaining companies have only 17%. It is

worth noting that many suppliers further down the chain have all of its income from other Norwegian oil service companies (Rystad Energy, 2013:17).

Foreign Direct Investment (FDI) occur when a citizen, organization or firm invest directly in an economy other than that of the investor with the objective of obtaining a lasting interest in an enterprise resident in another economy. The basic criterion defined by IMF is a ownership of at least 10% of the voting power, representing a significant influence by the investor on the management of the enterprise. Any inflow less than that is characterized as a portfolio investment. From the quote above we interpret that the economic phenomena FDI also captures socio-political changes and globalization processes. Hence, FDI must be understood beyond the transfer of capital, and rather as a complex composition and transmission of capital, knowledge and labor.

Trends in FDI signal that emerging markets attract more FDI than ever before, and has bypassed developed economies. Building on theories on trade and internationalization, the focus is directed towards multinational corporations' (MNCs) motivation for international production. Several types of market imperfections can explain FDI decisions, such as patent protection, imperfect competition, and achieving economies of scale. In this thesis, IMF's definition will be applied and the focus will be on FDI inflows and its relation to R&D in the subsea sector receiving the investment; the host country Brazil.

Theory focuses on three perspectives:

1. Why FDI is favored as opposed to other forms of internationalization such as exporting and licensing.
2. Why firms in the same industry often undertake FDI at the same time and why they favor the same localization.
3. The Eclectic Paradigm tries to combine the two into a single holistic explanation (Hill, 2011)

3.1.1 The Eclectic Paradigm – OLI Framework

The British economist Dunning is known for his eclectic paradigm. The framework is widely used for analyzing why, where and how MNCs undertake FDI as opposed to exporting or licensing use of their brand or product to foreign producers or sellers. The OLI acronym represents Ownership, Location and Internalization advantages that justify the FDI. Together, this tripod explains the scope and geography of value added activities by companies (Hill, 2011).

Firstly, there must be some *ownership* advantage of a specific asset, tangible or intangible, that enables the firm to lower cost or increase the price of their goods or services. The precondition to make investments abroad is naturally that these benefits exceed the inconveniences that may accrue from cultural and language barriers, and the fact that the foreign company does not have as good knowledge about markets and regulations as the local actors.

Additionally, a firm may capture *location-specific* advantages by utilizing resource endowments or assets that combined with its own unique assets, create value (Dunning, 1988). Location factors are typically separated into economic, political or social/cultural advantages. An obvious example of economic advantage is the exploration and extraction of natural resources, which explain the heavy FDI in the oil industry. This is referred to as horizontal FDI, i.e. when MNEs produce the same product in multiple plants and service local market through affiliate production (Wit and Meyer, 2010). Vertical FDI, on the other hand, is characterized by decentralization of the firm's production chain to realize arbitrage on quantities or qualities of factors of production.

Internalization suggest that there are advantages to carry out certain activities internally within the company, because not doing so would generate a high risk of losing ownership advantage, for example loosing proprietary knowledge to potential competitors. Even if the production is more profitable in the host country, it does not mean that the firm must own facilities. Rather, a local company could produce under license, or enter into management contracts or alliances with shared control. If such

renunciation of control implies diminishing value for the business as a whole, an internalization advantages to conduct FDI is present.

For Norwegian subsea companies, these factors are highly relevant to consider;

(O) The firms typically control key resources such as intellectual property and capabilities. Theories of internationalization argue that FDI is a favorable alternative to licensing because the high-tech subsea firms run the risk of giving away valuable know-how to a potential competitor (Hill, 2011). Potentially as hazardous is loosing control over manufacturing, marketing, and strategy in the foreign market. Such capabilities are not amenable to licensing and the competitive advantage may therefore be lost. Owning local subsidiaries also gives access and priority to various funding programs for R&D such as the "BNDES Petroleum & Gas" and FINEP's "Innova Petro". The largest companies are naturally more widespread in the use of subsidiaries abroad and many multinational subsea suppliers will delivered finished goods by a combination of deliveries directly from Norwegian as well as foreign subsidiaries (Rystad Energy, 2013).

(L) Out of the 189 countries compared on the "Ease of Doing Business", Brazil is ranked as number 116 (The World Bank, 2014). Unattractive factors such as high import tariffs, an extensive bureaucracy and one of the world's most heavy LC regime have obvious deterrent effects. As will be discussed later, the Brazilian business landscape presents challenges that are difficult to manage remotely. Agents not familiar with the complexity of Brazilian processes and culture might prove both costly and fatal. On the other hand, agents or contractors who are familiar with the local market but do not represent the company's identity, might also result in unpleasant surprises. Regardless, Brazil will throne as the world's biggest offshore market, and the demand for subsea services and equipment is an undeniable result of Petrobras' ambitious investment plans.

In accordance with local policies, you cannot obtain local content without having a subsidiary in Brazil, nor qualify most goods and services for the Petrobras Master Vendor list and other supplier registries (as elaborated in section 5.A2) (Inventure Management, 2013). Vendors in this list are automatically qualified for Petrobras'

projects, which is claimed to be a great advantage. Additionally, only companies with local entities may present a letter of interest or "business plan" to the several funding programs available in Brazil. For a number of the Norwegian SMEs delivering products and services to Petrobras and Brazil, their part of the major projects are so small that the main contractor include them in the international supply part of the project, and thereby bypass the LC requirements.
Due to the factors explained above combined with the *Brazilian cost*, Brazil is not necessarily the market of choice. On the other hand, some of these arguments, such as the local content regime, risk of dissipation of knowledge and the resource-bound nature of upscale oil, stem in favor of FDI.

3.1.2 FDI as a Catalyst for Development

Analyzes of correlation between capital inflows and domestic growth in host country has been the object of many studies. The Washington Consensus holds, in broad terms, that FDI flows will generate positive externalities for domestic firms (UNCTAD. Hill, 2011). Particularly in large-scale extraction projects, foreign capital inflows could be essential to overcome financial constraints. The foreign actors share the risks associated with exploration and extraction of oil and may provide access to global markets. Washington Consensus has been raised for its focus on the quantity rather than the quality of FDI. Besides capital, the source of growth generally come in form of technology and expertise which in turn may generate growth through four activities; employment, exports, increasing competitive pressure in local market and externalities or spillovers (Scott-Kennel,). Central to the research is to value the spillovers of FDI, i.e. the benefits to the host economy beyond what can be captured by the foreign investor himself. A recent study revealed that an FDI inflow to the offshore industries in Norway is a greater source of synergy in the knowledge-based developments of the western regions than the university environments in Trondheim and Oslo (Leydesdorff, 2012).

Two different kinds of "spillovers" can be defined. One is the effect of knowledge flows being transferred from the MNC to its subsidiary, "leaked" in the host economy and absorbed/acquired by the domestic firms. The other is the increased competition

in the local market led by as the affiliate's competitive advantage caused by superior knowledge inputs. This may influence domestic firms to increase productivity regardless of knowledge spillovers from MNCs.

3.1.3 FDI as an Obstacle for Development

Experts and empirical evidences are dispersed; while some encourage FDI as a source of economic growth, others view it as a threat to development in less developed host economies. In fact, very little evidence exists to support economic effects arising from FDI-related spillovers, at least in a wide range (Lipsey and Sjoholm, 2002). Research conducted by Borenztein, Gregorio and Lee (1998) found that FDI contribute relatively more to growth than domestic investment, except in countries with the lowest levels of schooling. Robust findings indicate that the FDI in interaction with a stock of human capital below a certain threshold will have a negative effect on overall domestic growth. Countries with strong absorptive capacities, such as infrastructure, local financial markets or an efficient industrial sector, are those with the highest intensity and magnitude of technological upgrading and potential for capability development (Wong, 1992; Ozawa, 1992; Blomström and Kokko, 2001).

Several case studies from extractive industries conclude that in markets with imperfect competition, FDI may cause local firms to loose market share. Dependency theorists point out that foreign companies' tight control over technology, superior management techniques and export channels prevent spillovers and create monopolies.

Spillovers are expected to be less in resource-seeking activities as opposed to manufacturing FDI due to its high capital and technology intensity and limited timeframe (Farole and Winkler, 2014). Manufacturing, being more labor-intensive in nature and often driven by efficiency-related motives, makes it a strong candidate for spillover effects. "The resource curse" describes a set of negative experiences by oil-rich countries. The effect of oil revenues and foreign companies getting involved in those revenues are first and foremost dependent on the quality of prior political institutions. "The Norwegian model" is regarded as the best example of resource

management credited due to its already mature democratic institutions and practices before finding oil. Recent studies show a positive trend for vertical linkages in resource-seeking FDI, partly due to pressure for local sourcing.

3.2 Models for Industry – R&D Cooperation

The industry-academia experiences in Brazil are colored by two main elements; that public entities have traditionally relied on university teams to perform research needed to solve problems and the formalized policy recently implemented to skew this tendency towards private participation and strengthen the national system of innovation (Suiz, 2000). This is an example that the industry-academia relation has been used as the basis of national innovation strategies that can be analyzed on two axes. In a "bottom-up" approach, the industry actors are actively looking for knowledge to solve a problem and meet with academic knowledge producers. There are situations in which the problem is defined by the academic part, or even a "third" player acting as a bridge builder between the academic player and the industry. A "top-down" approach, one investigate some outcomes of the institutionalized efforts recently developed, for instance that the state give financial incentives for UFRJ to conduct joint R&D projects with an industry partner.

3.2.1 Cluster Theory

"Paradoxically, the enduring competitive advantage in a global economy lie increasingly in local things – knowledge, relationships, and motivation that rivals cannot match."

Michael E. Porter, 1998

Holywood, Silicon Valley, Wall Street and Oslo Cancer Cluster have one major characteristic in common. Within different industries, they are all examples of agenda-setting clusters that have a competitive success tied to their respective location. Clusters, as defined by professor Michael Porter who re-introduced the term in the 90s, are "geographic concentrations of interconnected companies, specialized suppliers, service providers, and associated institutions in a particular field" (Porter,

1990). Clusters arise through complementarity or similarity of needs and thereby realize external economies of scale. It has been argued that in an increasingly knowledge-based and globalized economy, the interdependence between ownership and location advantages grow stronger.

Three basic features have emerged from studies of economics of geography, regional innovation systems, national innovation systems, knowledge transfers and social networks that seek to explain clusters. These centripetal forces that explain the location of some industries are a) *knowledge spillovers, b) related and supportive industries* and c) *specialized labor force* (Krugmann, 1998 and Marshall, 1920) and will be discussed below.

a) Alfred Marshall wrote in his Principles of Economics that "If one man starts a new idea, it is taken up by others and combined with suggestions of their own; and thus it becomes the source of further new ideas" (Marshall, 1920). External knowledge spillovers occur when a positive exchange of ideas take place between employees from different firms, often stimulating technological improvements in a neighbor through one's own innovation. From this, one can assume that as companies are geographically closer, knowledge transfer is convenient and innovation and growth is best facilitated. Knowledge-based theories argue that tacit and subtle knowledge will only be exchanged when being in the same local environment. This learning process is named "dubbed buzz" and a distinction is made between, on the other hand, codified knowledge that are much less space-sensitive and may roam the globe through channels of communications called "pipelines", located outside the local milieu (Bathelt et al., 2004).

b) To examine the advantage of related and supportive industries one may distinguish between the horizontal and vertical part of the cluster. First, horizontal dimension refer to firms that produce similar goods and hence create competition. Clusters encompass resources and competences important for competition, such as specialized suppliers, service providers and linked industries and institutions, which together foster high level of productivity and innovation at the affiliate level. Accordingly, rivalry is one of the main pillars of cluster competitiveness. As Porter (1998) points out, competition is affected in three ways; by increasing the

productivity of companies in the area; by driving the direction and pace of innovation (product differentiation and variation), and hence growth; and by stimulation the formation of new ventures, which eventually strengthen the cluster itself.

c) The vertical dimension consists of those firms that are complementary and interlinked through a network of suppliers, services and customer relations (Bathelt et al., 2004). Once a cluster is established, suppliers have incentive to be near the demand for specialized services and supplies through which they can and gain economies of scale at low transaction costs. The value-creation relationships between a buyer and a seller, both upstream and downstream, must naturally be filled by employees. A vibrant cluster offers better access to specialized and experienced employees, enhancing the recruitment process. By signaling opportunity, young and aspiring actors are drawn to Holywood, talented investment bankers seek to London and so forth.

Collaborative arrangements facilitate the process of "co-specialization" by the means of division of labor. It is assumed that non-core activities that are outsourced by one organization in a network become the specialization of another, hence the value-creating activities become more efficient and effective (Wit and Myer, 2010:373). Such symbiotic groups of collaborating firms are often based on a high level of trust and perceived mutual interest. However, such dependence upon relationships comes at the risk of opportunistic[9] behavior by the actors, abuse of trust and exploitation of dependence. In many ways, this paradox of competition and cooperation lie in the heart of cluster theory (Wiliamson, 1985).

Vital in the cluster model is that firms are the premise makers –the R&D is driven by the needs of the specific industry -, and the R&D institutions are the premise takers. The "National System of Production" as introduced by Lundvall (1992), view market forces – demand and supply – as the starting point, rate and direction of innovation. This is not to disfavor or degrade the role of universities, institutions and academia integrated into the cluster, which is highly essential. The underlying model is however

[9] Defined as "Opportunism refers to the incomplete or distorted disclosure of information, especially to calculated efforts to mislead, distort, disguise, obfuscate, or otherwise confuse." (Ron and Wit, 2010:374)

analytically different from the next model, the Triple Helix, in which one assumes the R&D institutions as the driving force for innovation, and the firms as premise takers in this strategy.

3.2.2 Triple Helix

The Triple-Helix Model (TH) envision increased innovation as the outcome of interaction between the three parties; academia, industry and government. The model's origin is study of long-term university-institution relations (Etzkowitz, 2002), positive overlaps of communications (Leydesdorff and Etzkowitz, 1995), and how the knowledge infrastructure mechanisms intervene with market forces. Together, the three subdynamics are both bi-lateral as well as tri-lateral and may destabilize, hyper-stabilize, meta-stabilize, or eventually globalize a relatively stable system (Leydesdorff, 2012). For example, the universities work closely together with the industry (double-helix), and the government support this synergy by providing innovative policies or incentives.

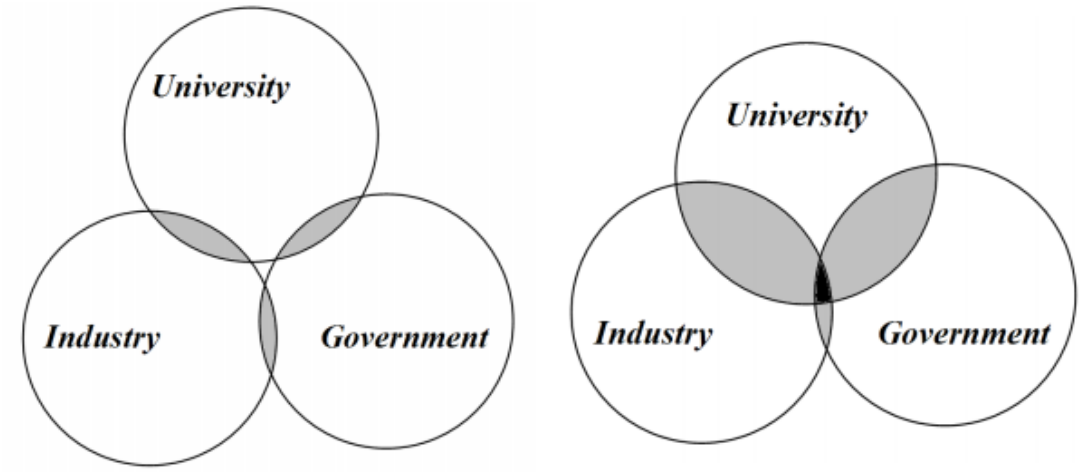


Figure 6: A Triple Helix configuration with negative and positive overlap among the three sub-systems

Unlike cluster theory, the TH model considers R&D institutions (universities) as the driver for innovation with its academic-based research and development activities. The industry is viewed as the provider of R&D based on the customer demand in its commercial activities, and the government as a policy maker. It is argued that the institutional dynamics are integrated historically into "functional subsystems" (Leydesdorff, 2006). An important consideration is also that the system in hybrid in

the sense that the system remains in transition and transactions as the organizations are continuously developing individually and collectively. This also implies that geographical proximity is not a pre-requisite for the involved parties. This allows for interaction effects among domains (e.g., national systems) and institutions with specific functions (e.g., knowledge production). Hence, it represents a model used as an operational strategy for knowledge-based economies.

The TH model may be applied for policy advice on network design. For instance, in university-industry relations the information flow may be enhanced or hindered dependent on the institutional context. The framework of patents will for instance have an effect on how the transfer of knowledge is enacted and the institutional arrangement may thus be evaluated in terms of how well the industry serve the transfer of new knowledge in exchange for university income.

Another example, in which the TH model was applied for policy advice on network development, is the study on incubation on new industries in Brazil. In the late 80s, incubators started to appear in Brazil due to a new concept of Brazilian science and technology policies (STI). The society is shaped historically by relying on an active central planning and government programs. The new context brought about greater participation of the universities in the country's socio-economic development, particularly by forging closer links between the academic world, industry and government. TH became a “movement” for generating incubators in the university context by “bottoming-up” with the local level – in collaboration with civil society (Almeida, 2005).

3.3 Modes of Innovation

FINEP, the Brazilian Funding Authority for Studies and Projects, apply the following definition of innovation, “the introduction of novelty or improvements in the productive or social environment that results in new products, processes or services”. A requirement is that the innovation must be made available in the market, applied in organizations or transferred to society.

A general distinction is made in the oil supply industry between innovation in application development and technical development (Asheim, 2012). The first is the ruling form of innovation and is often the spinoff of a real-life, specific challenge in relation to the development of large oil fields or similar projects. Such processes are characterized by small-step innovations that occur during the interaction between qualified engineers, competent suppliers and demanding costumers. Experience forms the basis of this incremental innovation process and literature refers to it as the "Doing-Using-Interaction" (DUI). Technical development builds on research or R&D-based methods of innovation, and is therefore given the name "Science-Technology based Innovation" (STI). STI revolves around cooperation between university and industry R&D projects to develop new technological platforms (applied technological research).

	STI	DUI
Knowledge bases	R&D, basic or applied (analytical and synthetic) knowledge	Experience based, (synthetic) knowledge
Main type of knowledge base developed from	Research and development projects	Daily problem solving
Main method used in the process	Scientific and research methods	Methods generated from trial-and-error processes
Main external innovation partners	Universities and research institutes	Customers and suppliers, centers of real services, cf. Third Italia, (consulting and training organizations, etc.)
Possible types of innovation	Technology push/supply-driven innovation, i.e. radical innovation	Market/demand - driven innovation, i.e. incremental innovation.

Figure 7: Characteristics of the STI and DUI modes of innovation. (Source: Isaksen and Karlsen, 2012)

Chapter 4: Methods

The methodology is structured according to Saunders' metaphoric *research onion,* in which layers of research issues must be "peeled off" until the data collection method best fit is revealed.

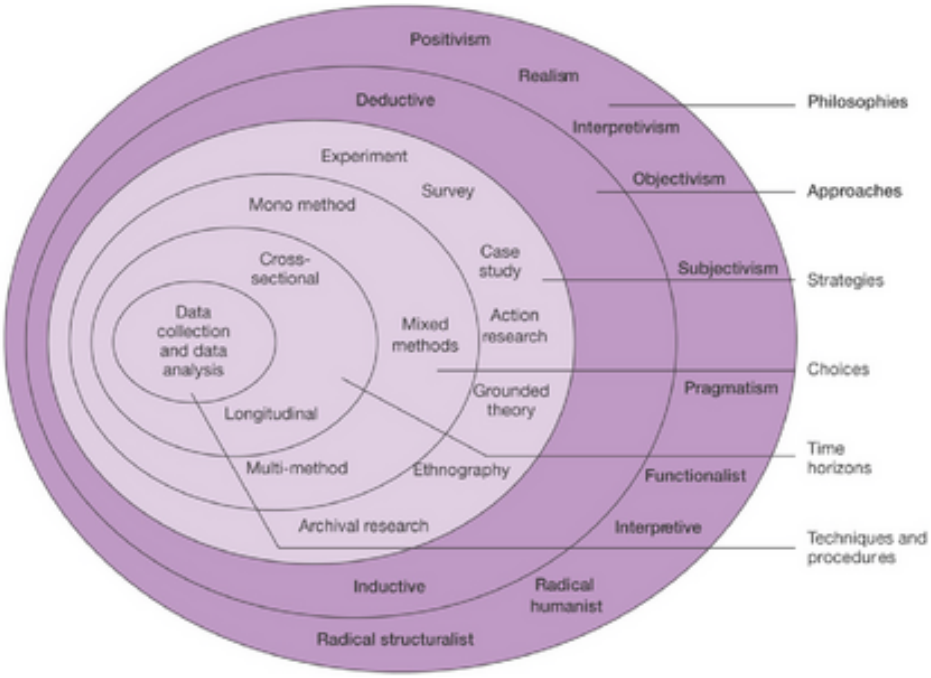


Figure 8: The Research Onion. (Source: Sanders et al., 2007).

4.1 Research Philosophies and Approaches

The choice of **research philosophy** set the standard as to how the world is viewed throughout the thesis. Crucial information on insights into Brazil, important dynamics of the subsea sector and complexity of cluster co-operation might be overlooked and neglected unless the aim is to uncover the interviewee's personal view, impressions and subjective experience of the topics discussed. Logically, it is preferred in this thesis to apply a philosophy of *interpretivism* rather than a more "scientist-like", fact based approach.

It is important to note that the **research approach** was inductive, as general knowledge and information-searching about the Brazilian market was the starting

point for the idea behind the thesis, long before a theoretical framework was explored. The role as a researcher is to understand the Brazilian market conditions, and the Norwegian subsea suppliers' role in this context. Interpreting this phenomenon can be dome in numerous ways. One of the main challenges during the data collection process is to remain an objective understanding of the research subjects. In many ways, it is difficult not to become a part of the study, as interpretations and conclusions are inevitably affected by personal mindset and opinions.

4.2 Research Design

The research design represents the overall plan to answer the research question and consists of **research choice, strategy** and **time horizon**.
This thesis employs a qualitative research framework, strategically chosen to gain a thorough understanding of the relevant representatives' attitudes, perceptions and experiences on Norwegian participation in R&D of the Brazilian subsea sector.
In line with the interpretivist perspective, a single case study will be pursued. Case study is not to be understood in a traditional sense, as I do not examine one specific organization/company, but rather several embedded units involving the state, the oil supply industry and clusters. In the final layer before approaching the core, it is important to keep in mind that what is being researched is a function of a particular set of circumstances and individuals at a specific time, i.e. current time. The in-debt interviews were conducted over a limited time horizon, and the most recent secondary data are emphasized. The problem is addressed cross-sectional and although historical details are utilized as a background for understanding, data are not collected over a long timespan.

The purpose of this thesis is to touch descriptive, exploratory, as well as explanatory aspects. Firstly, it is descriptive in the presentation of the areas of special potential for synergy between the Norwegian supply industry and the Brazilian market, characteristics of the petroleum market, R&D models and cluster development. Following this introduction, the exploratory journey takes off to "seek new insight; to ask questions and to assess phenomena in a new light" (Saunders et al., 2007:133) by analysing NCE Subsea in the Brazilian context. The explanatory research led to

pursuing new ideas, insights and inputs towards a more accurate and beneficial focus. Ultimately, explanatory research was sought to connect the relationship between the variables identified. To be more specific, strong interest was directed towards knowing if the NCE Subsea, its members and the operating model it represents, could function as a catalyst for R&D in the Brazilian subsea sector, and what challenges that acts obstructive.

4.3 Data Collection Methods

Arriving at the core of the onion, the data collection consist of qualitative primary data from in-depth semi-structured interviews, supplied and complimented by secondary data. I returned to Rio de Janeiro in medio February 2014 and stayed for approximately two months to conduct qualitative research. It was an honor to be invited to stay in Innovation Norway's Rio office during my stay where I was able to get in touch with key-respondents in my research. When surrounded daily by relevant respondents at Innovation House Rio, Innovation Norway's incubator office, much valuable knowledge was attained simply through informal, day-to-day conversations. I scheduled in-depth interviews on a non-random basis in an attempt to cover different aspects of the population. The main objective while conducting interviews is to grasp the interviewee's personal view, impressions and subjective experience of the topics discussed. Although the interviews were fairly limited in number and may thus not be generalized across the population, it was possible to uncover patterns in experiences and opinions from the respondents, which was crossed-validated with other sources. For instance, the Norwegian respondents were generally tuned in explaining the bottlenecks in the Brazilian subsea sector, which is also backed by statistics and economic reports.

4.4 Collecting Primary Data by Conducting Interviews

As mentioned before, primary data was collected through qualitative, semi-structured research interviews. An interview-guide was created before the first interview took place, and the main structure of topics has been followed throughout the process. However, adjustments have been made both depending on the interviewee's

background and knowledge, and in accordance to the acquired insight personally developed through the research. This flexibility led to rather interesting digressions during the conversations with the selected informants. Conducting the interviews it is important to keep in mind that knowledge and evidence are contextual, situational, and intellectual, and that it requires the researcher to take a distinctive approach to reveal the topic in question.

11 interviewees were selected, representing nine different units, whom together have provided a rich and holistic set of data. On average, the interviews had a duration of one hour, and the majority were held in Rio de Janeiro, at the organizations/companies offices. Two of the objects were interviewed twice. The interviews were conducted in Norwegian or English, naturally decided depending on the mother tongue of the subject. All interviews except one were held face-to-face and audio-recorded whereas the meeting with Kjetil Solbrække, representing Sintef, took place trough Skype and could not be recorded. A summary of each interview is to be found in Appendix 1-9. All the summaries were emailed to the respective informants for approval and opportunity to make comments.

The following were interviewed:

Johanna Fiksdahl, Higher Executive Officer at the Norwegian Ministry of Petroleum and Energy (OED).
Johanna has been employed at the OED since fall 2013 working on issues of industrial and political relevance for the Norwegian oil supply and service industry and is highly involved in the project BN21. In her Master Thesis, she studied the Brazilian state's local content policy in the petroleum sector and its implications for industrial development. Her background is hence professional, academically, and personal, drawing on experiences from her exchange semester at FGV in Sao Paulo.

Therese Fuglerud and Anders Kapstad, respectively Administration manager and Country Manager in Panoro Energy do Brasil Ltda.
Panoro Energy ASA is an independent O&G company with a balanced portfolio of production, development and exploration assets in Brazil and West Africa. Panoro Energy do Brasil Ltda. holds assets through long-term concessions grated by the

ANP, which are shared with other companies. However, in 2013 the company conducted a restructuring process including a disinvestment from the Brasilian market. An agreement to sell the Manati Field to the Brasilian operator GeoPark is waiting to be approved by ANP. The remaining assets in Brazil, collectively referred to as "BS3", are currently without buyers.

Kjetil Solbrække, CEO in Instituto Sintef do Brasil

Kjetil holds extensive knowledge about the petroleum sector and the Brazilian market with leading positions in OED (inter alia in supervising LC on supplies to the Norwegian industry), Norsk Hydro (involved in development of Pelegrino-field in Brasil), Statoil and Paroro Brasil. The strategic collaboration between Petrobras and Statoil paved the path for scientific and technological exchange between CENPES and Sintef. To coordinate these activities, MARINTEK (Sintef's oil and gas division) opened offices in Brazil. Sintef Brasil is the first foreign research institution to be accredited by the Brazilian state, which potentially prove crucial for R&D development in the Brasilian oil sector and the Norway's position in it.

Gulbrand Wangen, Regional Director Brazil, India and Africa, INTSOK

"INTSOK is a foundation aiming to strengthen the long-term basis for value creation and employment in the Norwegian oil- and gas sector through focused international activities, based on the overall corporate competitiveness." INTSOK plays an important role in the research and technology cooperation in oil and gas entered between Norway and Brazil (BN21), where the purpose is to strengthen Norwegian industrial and research position in Brazil (Menon, 2013). Gulbrand provided me with more technically detailed understanding of the interdependency between Norwegian suppliers and the Brazilian oil extraction. Like he said "It is the industry we are doing all this for, after all".

Denise Medina and Leonardo Melo, Parque Technologica URFJ

The technology park is situated on the Federal Univeristy (UFRJ) campus, on The University Island, an area of 350 thousand square meters employing about three thousand researchers. In the period 2003-2014, investments in the Park accounted for more than NOK 10 billion. Several multinational companies have installed research centers on site, among them Siemens AG, Schlumberger, Baker Hughes, FMC

Technologies, Repsol YPF, Halliburton, Tenaris Confab and Usiminas. Nine SMEs are also present, whereas most are spin-offs from the COPPE/UFRJ Incubator located nearby. A more obvious example of cluster development can hardly be identified and Technology Park plays an important part in the Rio Subsea cluster.

Jose Marcio Vasconcellos, Marine Engineer and Professor at the Offshore Engineering Program COPPE/UFRJ.

R&D has traditionally been conducted by the academic institutions in Brazil, and UFRJ is one of the top rated and well respected universities. It has long ties with Petrobras, who strategically located its resarch center – CENPES – only steps away from the faculty. Jose is responsible for The Laboratory of Continuing Education (LabECO), created in 2001 to meet the demand for professional profiles and academic excellence able to manage projects, teaching and research activities applied to the oil and gas market. He has also been involved in numerous research projects conducted with private as well as public funding, on behalf of the industry as well as the government.

Rune Andersen, Senior Advisor in Innovation Norway Brazil

Rune has worked at strengthening the commercial relationship between Norway and Brazil for several years. He works in close cooperation with clusters and research institutions and is responsible for communicating the NCE cluster model to Brazilian counterparts. He also holds extensive knowledge about the Brazilian culture, institutions and language.

Erik Hannisdal, CEO Inventure management

From Erik's 14 years of experience and accomplishments in Brazil, I would like to emphasize that he was one of the initiators to establish the IN house incubator office in Rio de Janeiro. As of 2009, he has been CEO of Inventure Management, a company he founded as a consequence of observing foreign companies struggle to penetrate the Brazilian Offshore and maritime sector. The business model proved successful and they now offer a complete operational platform to start up, manage and develop companies in Brazil.

Helge N. Austbø, Executive Vice President in DOF Brasil
Helge has broad experience from the Brazilian oil sector. DOF Subsea provides specialised surveys, subsea construction and inspection repair and maintenance services and owns a large modern fleet of subsea construction, intervention and survey vessels. The group is headquartered in Bergen Norway and has been present in Brazil since 2001 through Norskan Offshore. Norskan Offshore is an operator of offshore supply, support and construction vessels in Brazil.

4.5 Collecting and Analyzing Secondary Data

Secondary data, i.e. data already collected for some other purpose, used in this thesis range from various reports, databases, printed material and company websites to books, blogs, journals and newspapers.
The whole process has meant proactively seeking information, attending meetings and seminars to widen my knowledgebase. I was able to learn from interesting presentations at a whole-day seminar regarding "How to achieve local content in Brazil", a presentation made by FINEP on how to finance R&D in Brazil, and an introduction to the anti-corruption law in Brazil with comparisons to the Norwegian anti-corruption law. Secondary data was also beneficial to back up findings from interviews and discussions.

Besides quantitative data on FDI, and sales revenues, the data collected were primarily qualitative. My results were derived from soft data, making it challenging to systemize according to conceptual framework rather than diagrams and statistics. The core themes identified initially were theoretically supported to assume something about the effect and outcome of the relationship. This was further refined and explained by elements revealed in primary and secondary research.

I am aware that the reports and evaluations prepared by consultants such as Ecön Poyry, Inventure Management, Menon and Bain & Company used in this thesis, may be biased in favor of the respective organizations the reports are prepared on behalf of.

4.6 Credibility of Research Findings

The issue of credibility draws attention to two elements: reliability and validity. *Reliability* can be seen as the extent to which a consistent result can be produced at other times by other researchers (Kvale and Brinkmann, 2009:250). First of all, this cross-section research is a result of a certain time and place, and is therefore unrealistic to fully replicate. One may only question my reliability as a researcher by unconsciously influencing the answers by imprecise formulation of questions, or in the categorization of interviewees' replies. I was very aware of my tone of voice and expressions, especially when conducting interviews with native Brazilians. One must also be aware of participant bias driven by personal motives and loyalty toward the institution that he is representing. I was thoroughly prepared before meeting with my informants, knowing about possible sensitive issues and was attentive towards reactions revealing thresholds of comfort. Generally speaking, Brazilians tend to be less confortable with direct questions, have less clear lines between opinions and facts, and might "overexpress" their feelings compared to an ordinary Norwegian. Although the respective respondents have approved my transcriptions of the interviews, arbitrary subjectivity and biases may be present. *Validity* is broadly referring to what extent the research method explores the phenomenon or variables we intend to explore (Kvale and Brinkmann, 2009:251). In many ways I am studying a social phenomena, seeking an interpretation of the world through other peoples eyes. Such a social constructivist position can hardly be generalized, as it is merely subjective. However, it may be argued that applying the broad definition above principally enables qualitative research to give valid, scientific knowledge. An important issue worth discussing is gaining access to the appropriate sources, a primary motive for returning to Rio to conduct qualitative research. I will assert that my physical presence provided an armlenght access to desired sources.

I recognize three possible shortcomings. Firstly, it would be preferred to interview a representative from the SEDEIS regarding their strategy of the subsea cluster, but it was not possible to carry out. The representatives from the Technology Park were fortunately able to provide me with updated information. Secondly, to get inputs from Petrobras on R&D collaboration with Norwegian subsea suppliers and thoughts on cluster participation would be interesting. I made a few attempts, but realized quickly

that it is challenging to reach the right person to speak to and made no further efforts. Lastly, I should advantageously have interviewed at least one of the Norwegian-based companies with manufacturing and research units in Rio de Janeiro. FMC Technology, Aker Solutions or OneSubsea would have been excellent informants, and I clearly acknowledge that their inputs most likely would affect my conclusion. Another seemingly natural object is a representative from NCE Subsea. The organization is this year undergoing a management shift, implying that my object of choice, the previous CEO Owe Hagesæther, who was responsible for monitoring and contact with the State of Rio, no longer is available. I have obtained information on a few issues through e-mail correspondence with Heidi Skålevik (Branding Manager in NCE Subsea), and Audun Otteren (Senior Facilitator Technology Development in NCE Subsea) and felt no further need to precede interviews.

4.7 Alternative Methods and Expected Findings

Alternative methodological choices may have been followed, and potentially reached different conclusions. To exemplify, the development of the Brazilian subsea sector could be analysed from a positivist approach. It could be reasonable to measure quantitatively the local value creation and employment by one or more members from NCE Subsea in the Brazilian subsea supply sector. In order to pursue this method, it would require access to detailed data on turnover and financial statements. This could potentially lead to a more concrete conclusion, however many of the effects are difficult to measure quantitatively, and irrelevant. For instance, if a Norwegian subsea company creates 100 manufacturing jobs in a subsidy in Rio, how can one determine what value this represents to the subsea industry in Brazil?

Chapter 5: Analysis of the Findings

Part A: FINANCIALLY

Attracting Norwegian subsea investments

Drawing on theory outlined in chapter 3.1, this part will discuss how encouraging Norwegian subsea suppliers to take part in the Brazilian market can be justified. Additionally, to determine whether FDI is an appropriate means to do it. Elements that collectively are referred to as "Custo Brasil", the Brazilian Cost, might overshadow the ownership, localization and internalization advantages identified in Dunning's Eclectic Paradigm, implying that exports could be the favorable entrance. Studies indicate that FDI have greater spillover effects in the host country than export does, also in terms of R&D, which is why mode of entrance is highly relevant to determine in order to best answer the research question.

5.A1 Size and Technology

A complementary support system has been established in Rio de Janeiro to encourage and ease penetration into the Brazilian business environment. Innovation Norway and the incubator office house institutions such as INTSOK, the Ship Owners' Association and the Norwegian-Brazilian Chamber of Commerce (NBCC), and share premises with the General Consulate. Separately and collectively, they offer institutional, logistical and advisory assistance to Norwegian SME and play a valuable role in fronting the Norwegian companies in Brazil. While writing this thesis, I was able to observe how they fulfill their purpose with devotion.

The focus on Brazil and Rio is with reason. Brazil is *the* best match in the world where Norwegian supplier can deliver what they are best at: offshore and subsea, Hannisdal state confidently. Pre-salt discoveries open up great opportunities for the oil industry, with its large demand for goods and services. Since 2001, we have witnessed the total purchases of goods and services from Norwegian suppliers to the offshore oil and gas recovery triple; sales of subsea-equipment and rigs in particular. This demand is driven by the high oil price as well as the breakthroughs in offshore

areas such as Brazil. Currently, Brazil is the second largest international market for oil service in terms of revenues[10], world's largest subsea market according to NCE Subsea and Inventure Management, and is associated with high expectations for further growth.

As Solbrække proclaims, Brazil is currently one of the most exciting areas in the world to develop technology. For decades the Norwegian expertise from the continental shelf and internationally has been pioneers of technology development in offshore oil production. The Brazilian reality is deeper water and even tougher challenges and Petrobras is pushing the technological limits. Solbrække insist that to be part of this, and be able to bring Norwegian expertise into a new breakthrough area, will prove important for technology development going forward. Several of the interviewees claim that CENPES is in fact an explanation to the massive interest from multinationals to establish research centers. The representatives from the Technology Park experience that the cluster is growing around Rio *because CENPES is located there,* making it the hotspot for deep- and ultradeep water technology development. In this sense, Norwegian suppliers can meet demands, be part of technological innovation, as well as influence the technological development. INTSOK is, on their member's behalf, presenting innovative technologies and solutions for the FPSO program. Wangen is hopeful that Petrobras will agree to buy the solutions adapted to their needs based on Norwegian technology that the suppliers apply elsewhere.

5.A2 Attracting SMEs

Every supplier is required to be certified in the Brazilian certification system before it can pursue any sale. According to ONIP (2011), about 40% of the equipment groups have not been considered as local suppliers. The figure below clearly backs that the estimated value of the market represented by national suppliers is very low.

[10] Total revenues of NOK 27 millions in 2012, only following South Korea with NOK 30 millions. Source: Rystad, 2013.

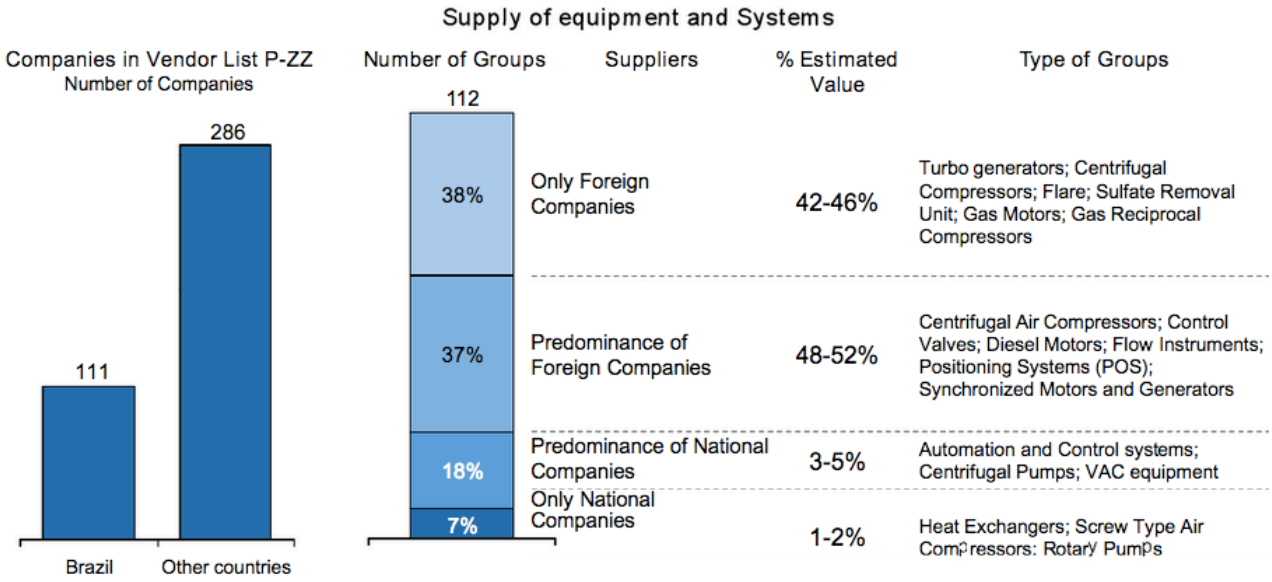


Figure 9: Supply of Equipment and Systems in the Vendor list P-ZZ. (Source:ONIP 2011)

One is therefore inclined to believe Hannisdahl when he claims that acquiring the right products, to the right quality at the right time is a challenge in Brazil. This experience cost Aker Solutions NOK 600 million in 2011. Delays and quality problems associated with its Brazilian suppliers of subsea equipment caused project costs to accelerate and delivery time for Petrobras could not be complied with (Dagens Næringsliv, 2011). Hannisdahl explain that as a consequence of the weak oil service supply chain in Brazil, more advanced planning and process management is required. Much equipment simply is not available in the market and it implies higher inventory costs. This, in addition to Brazil having one of the worlds highest import tolls, makes an efficient supply chain management crucial to survive.

The need is obvious, however Kapstad indicate that the business size truly matters in this industry, and especially in Brazil where Petrobras holds such a dominant position. Panoro experienced additional challenges by being a small oil company both in terms of the "weight of their voice" and in maintaining a strong balance due to heavy capital demands. Norwegian suppliers do not necessarily need to be associated with Petrobras directly, it can also link up with one of the larger providers already contracted in Brazil. Paulo Guimarães point out in his book on collaboration between Brazil and Norway, that strong mutual dependencies exist in the production process in Norwegian business clusters, which is also supported by figures reported by Rystad displaying that many SME deliver to Norwegian companies only. The fact that many

Norwegian-based companies are present may therefore act as a stepping-stone into Brazil for the smaller companies.

5.A3 The Brazilian Cost

The Brazilian cost, as described in the special issue of The Economist (2013) refers to the very real extra operational costs associated with doing business in Brazil, making Brazilian goods and services more expensive compared to other countries. This cost is a result of several factors, such as legal restrictions, slow progress, poor infrastructure, excessive taxation, governmental inefficiency and extensive bureaucracy. These issues are clearly consistent with the key challenges for Brazilian companies as listed below and topics discussed with many of the interviewees.

After the world oil exhibition took place in Rio de Janeiro in 2010, the expectations were euphoric. Statistics collected by Inventure Management (2013) report that during 2000-2009, 26 Norwegian companies were established in Brazil, whereas 33 were established in the three following years. Innovation House Rio expanded its incubator office space in order to meet the intense interest. Hannisdal recall similar experiences with Inventure Management during this peak. The macroeconomic scenario is no longer as attractive as four years back when Brazil could demonstrate an astonishing 7.5% annual growth in GDP. Yet, Hannisdal underlines that although the interest has declined, the number of contracts offered now compared to four years ago has not been subject to substantial change. This may be seen as a reality-check by the Norwegian suppliers, rather than a genuine interest drop for participating in the Brazilian oil market (Andersen, Fiksdahl and Hannisdal interviews). One might say that the bubble burst and what came into view is captured in Figure 10 below.

Figure 10: The Brazilian Cost. (ONIP 2011)

Austbø explains the Brazilian tax model creates sincere obstacles. Not only because the general level of taxation burdensome, but also the complexity is unlike anywhere else.

Local content requirements are generally seen as a constraint in the strategic business decisions of the internalizing firms, especially due to lack of qualified labor that in many ways can be said to be the root of the problem. The respondents from Panoro and Solbrække comment that there is no "brain-drain" in the local labor market, the problem is to catch them and offer a competitive salary, keeping in mind that both are mostly recruiting people with scientific and technical backgrounds. The scarcity of a national skilled workforce has naturally created a cycle increased labor costs, particularly in manufacturing. Lets follow Austbø's chain of thought. At the time being, there is not enough capacity to construct, produce and install everything demanded in Brazil, and there are not enough people to do it. Naturally, resource pressures cause the labor cost for expertise to rise enormously, high salaries and inefficient recruitment combined. Hence, manufacturing costs increase, making the alternative cost of imported goods less unattractive. DOF's providers are facing the same regime, and the same bottleneck; lack of competence. Due to a customs regime unfavorable of storage, inventory costs are high and time to delivery long. The result is a significant efficiency loss as the tax and tariffs are reflected in the price of goods.

Consequently, producing in Brazil is more expensive than producing abroad. Austbø assumes that everything combined implies that building a shipyard in Norway is

approximately 30-40% lower than in Brazil.

Even so, multinationals that are committed to the market on a long-term basis have obvious reasons to push their sub-suppliers to establish production locally as well. First of all, LC is calculated as a percentage of the finished product, and the more sub-parts produced in Brazil, the higher the level of LC. Secondly, it may contribute to a *leaner* process reducing import regime obligations and delivery time. However, there is expressed a sincere discontent in regards to the quality of local production (Andersen, Hannisdal and Austbø). Several suppliers fear that equipment produced locally will be at the expense of quality, and that it appear as a major hinder for setting up local manufacturing. Austbø explains that is often beneficial to import despite the heavy import taxes and penalties for not meeting required LC. Production in Brazil is often equal to "greater risk for the buyers and greater risk for the suppliers", and the risk generally increases parallel to technological intensity and engineering competence. From this, as exemplified by Austbø, one can argue that manufacturing of very technology intensive solutions such as ROVs lay further in the future than less high-tech systems applied in ROVs.

The bright spot appear to be the effort to build competent local offshore workforce. The quality of training facilities designed for seafarers are becoming acceptable. Austbø explains that many of DOF Subsea's suppliers have established training facilities in Rio de Janeiro on request from the contractors. Ricardo César Fernandes from Norwegian Ship Owners' Association/Abran tells me that they are highly involved in developing the skills needed for their members –who often have 100% local crew– and is currently looking at possibilities to establish a simulator center for training of personnel (Ricardo C. Fernandes and Fiksdahl interview).

5.A4 Financial Support of SMEs

This being said, local presence is favorable in terms of funding. Building a local supply industry is prioritized on the political agenda and funding programs are important pieces of the overall picture. The MDCI is committed to cooperation though the BN21 program, in which several Norwegian-bound subsea suppliers are

already participating (whereas many of these are Norwegian-bound companies with Brazilian subsidiaries and thus perceived as Brazilian subsea suppliers). Fiksdahl and the BN21 are working to get the Brazilian supply chain on board as well. The Stakeholder task force of BN21 is currently submitting plans and proposing actions for collaborative efforts in projects within subsea technology.

BNDES, the Brazilian state-owned development bank, is the key instrument for implementation of Federal Government's industrial and infrastructure policies and the main provider for long-term financing in Brazil. BNDES has been actively involved in building local capacity in the supply chain as provider of necessary investments in the sector. The new strategic areas of focus introduced in the 21st century are innovation, sustainability and small businesses. More than 85% of the companies in the supply service chain are defined as SMEs, i.e. less than NOK 240 million (R$90 million[11]) in gross annual operational revenue (BNDES, 2014). The program "BNDES Petroleum and Gas" is specifically devoted to strengthening the local SMEs through efforts to modernize and increase productivity of supply capacity, access to working capital and by supporting innovation and technological development in the oil and gas supply chain. Notice that the favorable loans are reserved for Brazilian equity controlled companies only. With respect to collateral, BNDES accepts the contract to provide a product or a service with the company (BNDES, 2014). It is also the major sponsor to other programs and agencies providing development finance/subsidized capital to SMEs, such as Promnip and FINEP, respectively.

As previously mentioned, GIEK and Petrobras signed a framework agreement which guarantees for the financing of Norwegian deliveries to Petrobras for a maximum value of 1 billion USD (MoU, 2009). GIEK has expressed concern due to severe delays in the SETE shipbuilding program (briefly described in section 1.3 Five highlighted areas). Wangen comments that the current recommendation of the Board in GIEK is that it is too risky to provide credit guarantees. Petrobras has a history to pursue strategic plans too ambitious to meet schedule. As an example, he points out that some of the ships are ordered before the shipyard is even built. Such uncertainty expose the suppliers delivering to Petrobras to significant risk as well.

[11] 1 Brazilian Real=2.68 Norwegian kroner as of May 18th 2014

5.A5 Governance (Internalization)

"You must have a paranoid manager to succeed in Brazil"

Panoro Interview.

It is difficult to remotely control operations in Brazil because one has to be "hands on" constantly. A foreign agent can hardly handle the complexity of the Brazilian business environment without extensive experience from doing just that. The majority of companies entering the market spend an alarming amount of money and energy (especially the two first years) to understand the Brazilian business environment (Hannisdal interview). As they tend to have a different commercial understanding than the "western", sending an agent fronting the company's values and culture is a cost one is recommended to budget (Panoro interview). Finding a country manager that fit both requirements might be difficult, which explains the demand for consultants in connection to market entrance. Inventure Management (IM) fulfills this role with a team consisting of specialists with cultural understanding and different academic/working backgrounds able to build a complete operational platform customized for the respective firm. Innovation Norway offers three packages to the companies interested in entrance support, depending on the level of assistance, whereas the most complete package is the most popular.

5.A6 Regulatory Framework of LC

It is clear that Governmental Agencies in Brazil – MDIC, ANP, BNDES, FINEP, and the State of Rio de Janeiro – have the same primary objective; building a competitive domestic supply industry and the read thread is *to maximize LC on a competitive and sustainable basis*. This may create obstacles as well as possibilities for Norwegian subsea suppliers.

It is expressed from several sources that the timeframe and scope laid out by the government agencies might be too ambitious seen in comparison to the available capacity. The existent bottlenecks are undeniable. Domestic supply of equipment and

services are not competitive, and there is a lack of necessary technological capabilities (Olivieira, 2011). Profits are hurt as the firms are forced to acquire more expensive local equipment and often face delays in the delivery due to capacity constraints. In Andersen's opinion, the suppliers delivering to the traditional Brazilian industries have been somewhat immature and lack decent incentives to make the investments necessary to be able to deliver to the oil industry. An industry is not transformed overnight and one must not forget that the Norwegian was built in 40 years – Petrobras ceased to be Brazil's legal monopolist only in 1997 (Fiksdahl interview). Petrobras' president Graca Foster announced in Mach 2014 that "increasing the production is *higher in the agenda* than local content policies". She added that "it is not possible to accomplish everything locally, and Petrobras cannot prioritize contracts that pose a threat to the *oil production curve*." (Innovation House Rio newsletter, 19th march 2014).

All of those who were interviewed confirm that LC is principally a solution to support, but it causes trouble in Brazil due to the low level of general education, experience and infrastructure. The regulations have caused headaches for many foreign companies and substantial adaptations to achieve what is required. Purely operational, it represents an enormous paper mill delay in collecting certificates from all levels and links in the value chain before handed over to the ANP for final evaluation (Hannisdal interview). Hannisdal and Panoro are relieved to observe a few signals of moderations, as a result of expressed discontent by the industry and Petrobras. To exemplify, the LC may be bypassed (i.e. product may be imported) if proven that such technology is not available in Brazil. Note that price, quality or time to delivery is not taking into consideration. It is argued that the protectionistic environment is giving the industry "crutches" as local suppliers and subcontractors will be favored despite their inability to compete with international providers. In any case, many Norwegian suppliers are providing highly specialized products, and no local competitors exist, and are therefore not affected by the policies. According to Dunning's work, these specific assets carry ownership advantages being technology not available in the market, and export may be preferred over FDI. Regardless, Hannisdal finds it surprising that many companies do not invest more effort in understanding these regulations in depth, and rather attack the issue by asking "How can I maximize LC without increasing the price on my product?".

The rapid growth of FDI inflow simultaneously as a growing number of Brazilian manufacturing subsidiaries and research centers have been established may be proof that many realize they have no choice if they want to deliver. However, the cost associated with LC may be too large for SME to bear. Thus, it may prevent new players and technologies from penetration due to investments needed prior to deliveries. Ultimately, Hannisdal does not think that LC policies has affected the *quality of the suppliers* in Brazil due to the fact that the focus is mainly on the material content in the product, and not giving equivalent credit for building engineering capabilities.

5.A6.1 The New Regulatory Paradigm

Although ANP have made changes in some areas to make demands and expectations more realistic, others areas are the opposite. The "Pre-Salt law" introduced a stricter regulatory system of E&P in 2010[12]. As summarized by Deloitte, the new framework lay down guidelines on Production-Sharing Contracts (PSCs) to be applied to the unlicensed pre-salt area and other areas deemed strategic by the Federal Government. In practice, it implies that Petrobras will serve as the sole operator with mandatory participation interest of minimum 30% in each winning consortium.

Please note that the type of contractual form does not directly impact the oil service providers as they are usually sub-contracted under other agreements dependent on the delivery. It is however relevant to mention as it understates the fundamental protectionist attitude tightened after the pre-salt discoveries. The risks and rewards related to E&P activity is highly skewed in favor of the state in PSCs. The Oil Company must bear investment costs required to explore, develop and produce the pre-salt fields for which the associated risks is compensated through cost oil (only in the scenario of successful production).

Fiksdahl believes that the uncertainty created in connection to this framework may have caused Brazil to miss a window of opportunity that Pre-Salt helped create. The

[12] Law no. 12.304/2010 Pré-Sal Petróleo S.A. and Law no. 12.351/2010 Production-Sharing Agreement

licensing rounds were put on hold for five years until the long-anticipated auction date of Libra, the "crown-jewel" of pre-salt, was a reality October 2013. It is located on the largest reserves ever discovered in Brazil, estimated to contain 8-12 billion barrels of oil and the investments needed exceed USD 50 billion over 35 years. The situation was intense, but for a whole other set of reasons than hoped. Due to the new regulatory framework, the predicted commotion was absent. The only bidding, and hence winning consortium consist of Petrobras (40%), Dutch Shell (20%), French Total (20%), and Chinese CNOOC and CNPC (10% each). Despite the fact that the government hoped for 40 bidders, the state and Petrobras (and its shareholders[13]), was tremendously relieved. Under the PSC, the investors fared that the worlds most indebted National Oil Company could be burdened by a majority stake (and finances) for the Libra field. Specialists claim that the outcome of the auction only postponed the necessary changes to the regulatory framework before the next bidding scheduled for the beginning of 2015 (Rodrigues, Napolitano and Paduan, 2013). It appears to Fiksdahl that the unrest has settled somewhat, but the new rules are still being tested, and changed, and confidence between Petrobras and its investors is still unstable.

5.A7 Conclusion Financial Aspect

Governmental, political and industrial actions and intentions signal that Norwegian industry is seeking a strategic positioning in the Brazilian market, in competition with foreign companies, with the aim of exploiting potential activities in the pre-salt area. Likewise is Brazilian state apparatus and local affiliates welcoming Norwegian suppliers to participate and creating incentives to conduct research, realizing that the foreign technology and experience is needed to develop the supplier industry in Brazil (ref. 1-2% of value is only national companies, figure 9).

The local content policies aim to translate the massive investment programs into generation of jobs and income for the country, much similar to the Norwegian motive decades ago. It is fair to insinuate a disparity between the level of ambition and delivery capacity, which might give the local industry artificial nutrition rather than create a competitive oil service industry. It seems that neither is the case to the extent

[13]Petrobras shares rose 5% on the day of the auction, and fell 1.7% the following day.

it should. The local industry is far from competitive enough to even go for a stroll with their cushioned crutches and ultimately imported quality products triumphs the risk of producing technology locally. The outspoken desire to meet LC is not always reflected in what could be built with existing and projected demand, so as to enhance local capability and allow capturing more value in the future. The policies are mainly focused on the material content in the products as opposed to engineering, and therefore had insignificant affect on the *quality* of the subsea supply chain. The bright spot appear to be training of Brazilian seafarers to operate Norwegian-controlled offshore vessels. The effects towards closing the gap of local competence will probably be enhanced as the Ship Owners' Association seek to establish a Norwegian Simulator Centre, given that the result of the current Feasibility Study is positive.

There is a general consensus that the Brazilian environment – despite all its shortcomings – represents opportunities for Norwegian subsea suppliers that simply cannot be overlooked. In Dunning's words, ownership and localization advantages are present for Norwegian subsea suppliers. The means of penetration and continuing management must be considered in depth in terms of internationalization advantages. Regardless, the key is to lower the cost while doing it and win orders by being smarter in other parts of the products "price". Doing business in Brazil is challenging in terms of regulatory framework as well as cultural aspects, and ultimately the SMEs must choose if local presence carry lower risk to exporting based on the same price-quality-time ratio that their contractor apply. Nevertheless, it is suggested to deal with the market as closely as possible, and one must have a representative that corresponds with the company's intensions and is familiar with the Brazilian patterns of business behavior. Drawing on services offered by agents like Inventure Management may still decrease total risk, even after taking the risk of loosing ownership advantage into consideration. A different commercial understanding combined with a tendency to juggle the facts - an opinion is often outspoken by Brazilians as statistics are for Norwegian (Inventure Management, 2013) - implies that one might get an unpleasant surprise if crosschecks of information are not verified and closely followed.

PART B: TECHNOLOGICALLY

Co-operation across and within universities, research centers (industry), and research institutions

Argumentation in this part will be made under two assumptions, namely that E&P in the pre-salt area is subject to innovation, and that mobilizing cooperation between and across different players is a powerful model. Drawing on theory outlined in chapter 3.2 regarding models for industry-R&D cooperation, this part will discuss recent trends in the Brazilian Innovation System, with special attention on holistic "top-down" incentives institutionalized to boost private participation in R&D and promote joint projects between academia and industry. Interestingly, in the industry-academia relation, well-defined problems are to a larger extent than traditionally, identified by the firm who seek assistance for knowledge production in the university. In this context, Sintef may represent a crucial "third" player for enhanced cooperation.

5.B1 The Norwegian Model of R&D

The Norwegian Government proclaimed sovereignty of the Norwegian Continental Shelf in the early 60s, while at the same time opening up for licensing that gave oil companies or consortiums, exclusive rights to carry out exploration, development and production in the awarded block (Lerøen, 2006:167). Consequently, this initial phase were dominated by foreign companies, and Statoil remained the "underdog" for a while after its creation in 1972. To attain technology and experience, Statoil turned to international companies in the oil sector as well as other leading industrial actors such as the American airplane producer Boeing for assistance. The Norwegian government used political mechanisms to promote industry collaboration across borders and viewed Statoil as an instrument in this strategy (Tuber and Istad, 2012).

The year 1979 marks an important milestone as Statoil's very first research leader, Knut Åm, was appointed. The R&D was organized not only to meet the future *needs* in terms of operational tasks, but also to create an exceptional level of insight- and knowledge with an *effect* on safety and socio economic wellbeing. The basic research

program VISTA[14] was funded to promote the cooperation between Statoil and academia by ensuring, amongst other;

- multidisciplinary contact between Statoil and Norwegian research milieus
- stimulate and promote Norwegian scientists and their communities within the prioritized areas significant for the petroleum industry (Lerøen, 2006:169).

This also laid the foundation for the first agreement between Statoil and the University of Oslo signed in 1985. Extremely complex solutions are found within and through the interference of academic disciplines such as geology, geophysics, math, physics, chemistry and biology (Johnsen, 2008:221-224). It is claimed that the most advanced development within national knowledge and competence building are when resources are mobilized like in the VISTA-projects. The project have resulted in a series of PhDs, Post Doc projects, publications in international journals and most importantly; the results have been applied and utilized in many of Statoil's petroleum projects (VISTA, 2010).

Sintef was originally established in 1950 by the Norwegian Institute of Technology (NTH, today incorporated into NTNU), as NTNUs instrument for performing contracted research (Sintef, 2014). It illustrates clearly how the institute sector was consciously assigned the responsibility to conduct applied research and soon became a natural center of knowledge generation within the nascent oil and gas industry. Investments in research to the Higher Education sector and the Institute sector have roughly accounted for ¼ each, and the private sector accounting for the remaining investments in R&D (Norges Forskningsråd, 2013:18).

Parallel to the growth of Statoil was the Norwegian supply-industry. Johnar Olsen, representing Scana Industries, one of the companies facilitated by Innovation House Rio, highlights the valuable feature that enabled Statoil to hold shares in selected suppliers to ease commercialization of the patents. The ability for the industry to commercialize these technologies, especially small companies, was an important feature that enabled by the Norwegian system of suppliers to evolve (Olsen, 2006).

[14] Det Norske Vitenskaps-Akademi

The "Innovation law" in Brazil allows for a similar injection by the federal government in the stock capital of companies aiming at developing scientific projects[15].

Summarized, Statoil did far more than building a leading oil company because the alliances built towards the research and supply industry is what truly created the Norwegian model of R&D.

5.B2 Characteristics of Brazilian Model of R&D

Under Petrobras' monopoly combined with the import substitution policies of the Brazilian governments in the 80s, generous incentives were provided to the development of domestic suppliers of equipment. Unlike Statoil, the main rational for interacting with other organizations was to acquire equipment and services according to the operational needs, and flows of knowledge was a secondary by-product of the transfer (Dantas and Bell, 2009). Eventually, the 80s were colored by massive macro-economic instability that led to innovative inertia for the domestic suppliers. Combined with the repeal of the monopoly in 1997, it is no surprise that international competitors outplayed the bundle of unsupported domestic suppliers. The local content policies were introduced as an instrument to counteract the inevitable decrease of domestic content in Petrobras' projects. Petrobras engaged in more actively in learning networks to internalize know-how important to pursue more R&D activities independently in the future. Collaborative agreements shifted from being primarily suppliers to include universities, research institutes, and other oil companies. The company also joined multiple arrangements for knowledge production, for example one with Smedvig (former Seadrill) to obtain knowledge on subsea drilling (Dantas and Bell, 2009). In the beginning of the 21st century, it is claimed that Petrobras was "increasingly involved in internally-driven asymmetric arrangements in which Petrobras itself was the leading performer of R&D activities within a given network arrangement, for instance, when Petrobras led joint industry projects and invited others to join in." The reality is perceived differently from a Norwegian perspective. Austbø claims that the knowledge transfer is mainly from

[15] Law no. 10.973/04 Technical Innovation Act

international companies to Brazil, and that very little of their experiences with Petrobras can be utilized in other markets. Plus, Sintef's unique competitive advantage in the Brazilian market is simply its knowledge about conducting an innovative research process.

5.B3 The STI and Industrial Policy in Brazil

International comparisons conducted by actors such as the OECD reveal weak *Science, Technology and Innovation (*STI) performance in Brazil, in particular by SMEs (OECD, 2012). Figure 12 below display a section of comparative statistics on competence and capacity to innovate and indicate that cheering would be premature (keeping in mind that these are total investments rather than sector-based). The weak data is explained by difficult framework conditions backed by a low entrepreneur index, combined with a demanding social context colored by a general low level of education and income inequality. The red dots represent Brazil, the black Norway, and the blue rectangles are the middle range of the OECD values (OECD, 2012).

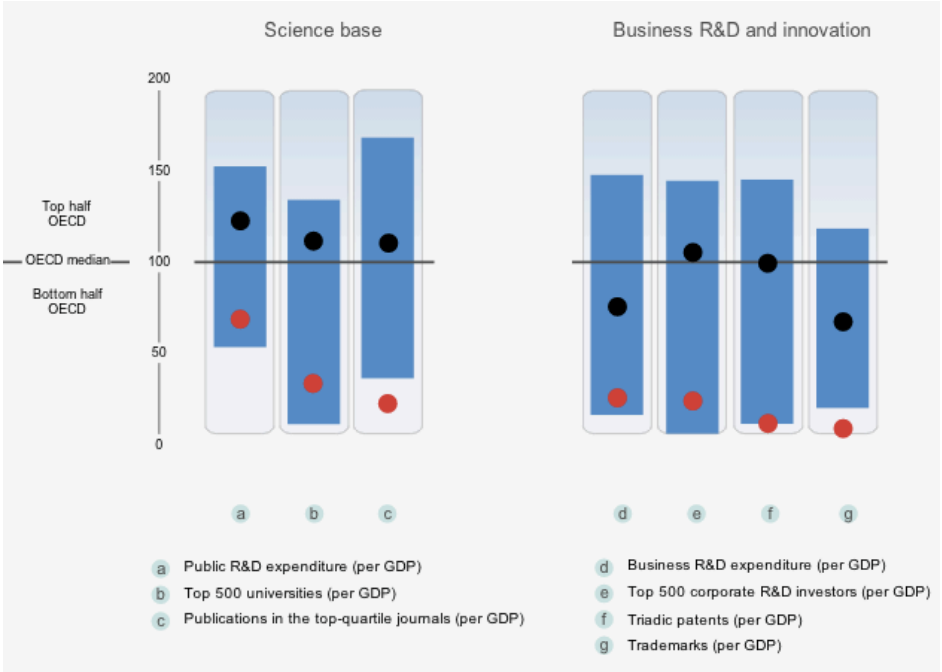


Figure 11: Comparative performance of national STI systems. (Source: OECD, 2012).

The Greater Brazil Plan (Brasil Maior) intends to encourage innovation and incorporating value in the production sector through incentives worth USD 16 billion during 2011-2014 (Mercosul, 2011). Moreover, the National strategy for Science,

Technology and Innovation (ENCTI) was designed to: i) close the technological gap with developed economies; ii) support Brazil's leadership in the nature-related knowledge economy; iii) strengthening the internationalization of the national research system; iv) foster the development of a green economy; and v) address social and regional inequalities (inclusiveness) (Andersen interview and OECD, 2012).

Figure 12: STI and Industrial Policies in Brazil. (Source: Luiz Antonio Elias, 2013)

Another program worth mentioning is Inova Petro, a joint initiative by FINEP (a funding authority for science and technology under the Ministry of Science of technology) and BNDES, with technical support from Petrobras. The program is worth BRL 5 billion (second tender additional BRL 3 billion) and subsea suppliers (submarine installations) are one out of three company categories that may participate. Its goal, as presented by Relgada in FINEP, is to promote projects that involve R&D, engineering, technology absorption, production and marketing of products, processes and/or innovative services aimed at developing Brazilian suppliers for the supply chain of petroleum and gas industry (FINEP, 2014). Brazilian subsidiaries of Norwegian companies may apply if proven a gross turnover of minimum BRL 16 million, or net equity equal to BRL 4 previous fiscal year. Both Helle Moen, CEO of Innovation Norway Rio and Relgada comment that Norwegian subsidiaries are very attractive receivers. It is expected that this program will contribute to policies to increase local content and for the competitiveness and sustainability of the national supply chain.

Helle Moen, CEO of Innovation Norway in Rio wrote in an email received by the author on May 26th 2014, that a co-funding agreement for research projects is currently being established. Funding is on the agenda in BN21, and FINEP, Innovation Norway and The Norwegian Research Council are currently setting the terms of the agreement.

5.B3.1 Private Sector Investment in R&D

Direct government funding for domestic R&D has played a significant role in Brazilian technology development (Sutz, 2000). The vast majority of both basic and applied research has been carried out in public universities and research centers, often at the request of a public entity. Hannisdahl have noticed that there exists ingrown notions of what R&D can contribute to, but that the Brazilian industry is slowly realizing that one can actually profit from investing money in research. It seems as if the tables might be turning. Vasconcellos explain that before they had to offer ideas [research projects] to the companies, but now the companies contact UFRJ because they have observed that the university can bring results important for them.

According to The Norwegian Research Council (2013), a lower threshold for research in enterprises will theoretically lead to higher research capacity, greater technology diffusion and increased ability to adopt and disseminate technology. As presented by Mr. Elias at the R&D, Innovation and Industrialization seminar in Rio de Janeiro, policies are redesigned to increase expenditures by the private Brazilian industry, which currently is significantly lower as a ratio to GDP compared to other countries such as the USA, China, Germany, Korea and Norway – to name a few (Elias, 2013). Media and Melo are pleased to see that many of the newcomers in the Technology Park are bringing business models and mentalities that are accustomed to R&D budgeting, and agrees that it might affect the attitude ruling in the market. Additionally, as production in the blocks increase, the 1% rule might prove as an efficient tool in surging foreign investments. The Brazilian concessions are increasingly operated by international companies, and obligations are expected to generate a cumulative total of USD 9,5 billion in R&D spending by 2020, as graphically presented below. The representatives from the Technology Park at URFJ

reflect that this rule might play a notably role for the companies to establish research facilities in Rio and elsewhere.

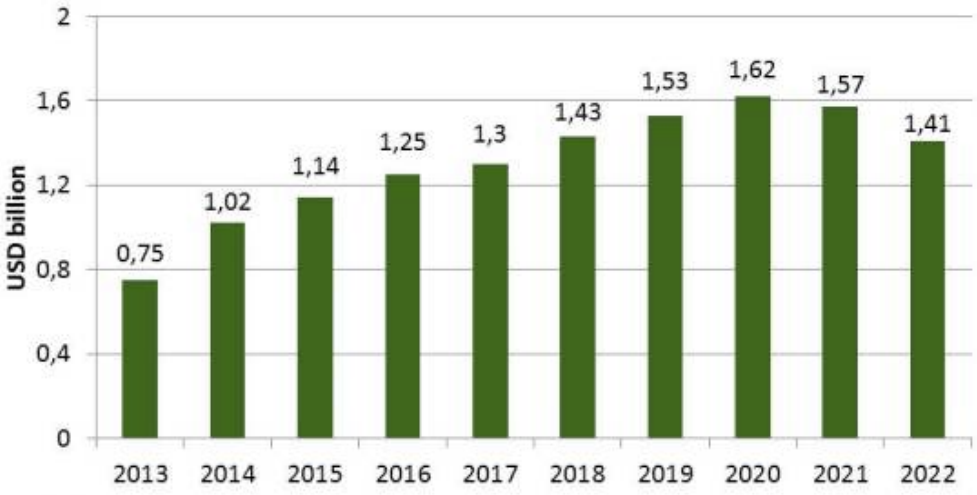


Figure 13: Forecast of Investment Obligation in R&D through 2022. (Source: Innovation House Rio, 2013)

Subsea suppliers are generally not bound by this law, but will most likely notice the activitygrowth in number of partners and projects. As an example of how great spillover effects related to R&D could be, E&P Magazine estimated that for every one CENPES researcher –there are 1.800 of them– 15 external researchers are working in one of their partner institutions (universities and providers of goods and services).

Previously, grants were given directly to the URFJ as outlined in section 3.2 and confirmed by Vasconcellos. Following the enactment of the Innovation Law in 2012, UFRJ must cooperate with a company in order for FINEP to evaluate funding for projects. These "competitive grants" permits direct funding of business and the annual budget amounts to approximately USD 348 million (OECD, 2012). As discussed after an informative presentation about FINEP held by Relgada, there exist a unique possibility to invest resources in R&D in Brazil, as there is currently more funding available than projects. As previously discussed, large Norwegian subsea suppliers such as Aker Solutions are investing significant amounts in R&D in Brazil, which is likely to challenge both the existing technology as well as attitudes towards private sector contribution to R&D. Hannisdal comment that now is the time for Global companies to evaluate the possibilities of moving its international R&D operations to Brazil as well. He adds that for the SME it might be more relevant to develop existing

products to make it adaptable to the Brazilian market conditions, i.e. DUI mode of innovation. In this case, it might be useful that another tool introduced by the Innovation Law is the sharing of laboratories among very small and small companies, which is also available at Ilha do Fundão (Vasconcellos interview).

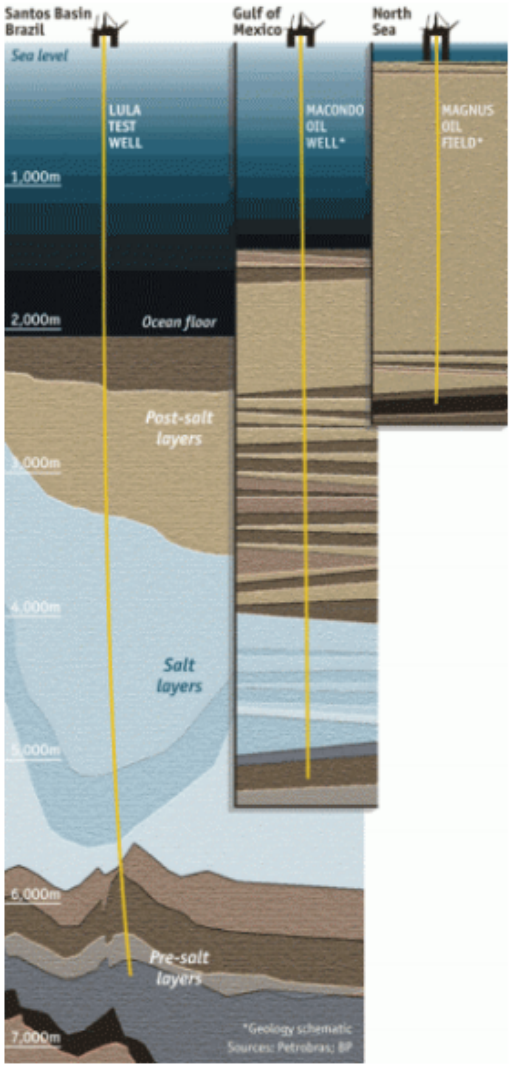
5.B3.2 Applied Science and Sintef Brasil

In applied science, research is primarily directed towards a specific practical solution and applications. It differs from basic research where one seeks new knowledge by analyzing the underlying foundation of a phenomenon and observable facts, whereas applied research will often be the offspring of problems with an original character.

One of the major differences between the Brazilian and the Norwegian R&D landscape is size of the institute sector, meaning entities primarily devoted to research that are not part of neither higher education sector nor the industrial (Solbrække interview). It produces science (which separates them from consultants) and serves the business and public administration on contracted assignments (which distinguishes them from universities and colleges). Thus, fulfill a distinctive role in the research dynamics due to its relevance to applications in business, a gap causing the sector to bleed in the Brazilian O&G sector. Sintef may narrow this gap, as the only research institution in Brazil that can conduct applied research projects for the oil industry from problem to solution. Solbrække experience high demands for their services and seek to expand the current workforce from 20 to 50-100 researchers in a 3-5 year period. Last year, Sintef was given public accreditation by ANP, which entitles access to apply for funding from the sizeable "Special Participation Fund" (SPF). CENPES remains their main partner, however contracts are won with multinationals as well. Panoro, bound by the “1%-rule” as a concessionaire, found Sintef as a useful and excellent partner to manage the required research spending.

5.B4 Collaborative efforts for Pre-Salt E&P

Deep below sea level, trapped underneath rock, sand and a geological layer of salt, lie the enormous riches of the Pre-salt oil. This could, in many ways, be the opening of the Brazilian oilfairytale. The pre-salt oil discoveries in a period of higher oil prices mark as a transformation in the Brazilian oil sector and may, according to the U.S. Energy Information, have a vast impact on the world oil markets.



Source: the Economist (2011)

Figure 14: Pre-Salt Layers.(Source: The Economist, 2011)

However, the salt layer pose severe technical issues to penetrate, and massive investments in E&P and infrastructure are preconditioned to support innovations over the next decades. In order to achieve the oil production targets, Petrobras budget to invest USD 153.9 billion in E&P in Brazil of which 60% are earmarked pre-salt and 40% post-salt (Petrobras, 2014). Petrobras represents an exception to the general industry behavior with its generous budgets fueling CENPES.

It is however important to note the reality the highly indebted Petrobras face in PSCs as discussed in Part A, and what constraint this potentially could imply in resources originally intended for R&D. Nevertheless, the industry development cannot depend on Petrobras to pull the train for them; not only is the job far too capital intensive, but it will only foster Petrobras' dominance as research conducted is exclusively based on inter-firm value creation (Solbrække and Vasconcellos interview).

Vasconcellos explains that the UFRJ receive several projects due to capacity constraints at CENPES. However, interaction between the firms in the technology park is very limited. Medina and Melo explain very little is arranged to engage the

industry participants to interact, and Andersen claim the multinationalcompanies independently large enough. Many of the subsea suppliers are currently experiencing such high demands for existing goods and services that R&D is not prioritized (Holmedal, 2013). The situation is somewhat disfavoring disruptive innovations, as capacity is sustainable without. Warning signal or not, it might be fair to agree to Wangen's point that the industry and research development is not necessarily parallel and gaps between the operations might appear.

It is therefore vital to anchor research programs on government level, which is why Fiksdahl is convinced that BN21 carry much weight. Brazil is a country in which the industry normally does not engage in technology cooperation without help from the authorities, and perhaps political leadership of the TTAs will prove momentum. In fact, it Petrobras said that they would continue their discussions with the group or the ongoing partnership with Statoil unless the contract was signed. One recognized a mutual potential that would benefit both parties if efforts were aligned to face challenges with regard to development of offshore oil and gas technology, and particularly within subsea technology. It is proposed, among others, to establish a "subsea factory", where modules are placed down to the seabed. Fiksdahl tells that the follow-up BN21 meeting which took place in March give reason to believe that underwater technology will be a strategic TTA for cooperation, subject to changes in further discussions. The industry is led by Statoil and Petrobras (that would not continue cooperation unless agreement was signed) together with Det Norske Veritas-GL, Aker Solutions, FMC Kongsberg Subsea, and Norwegian Ship owners' Association. The academia and research institutions are broadly represented by universities such as Sintef, CNPq, University of Stavanger (IRIS), NTNU, UiO, UiB. The governmental body include OED, Innovation Norway and the research council from the Norwegian side, and the MCTI, the Ministry of Mines and Energy, FINEP and CNPq from the brazilian side, as well as embassies from both sides.

5.B5 Conclusion technological opportunities

To illustrate the cooperation across and within universities, research centers, and research institutions in both countries, the author designed two models based on

industry-academia-government relations found in this study. This is not to claim that the Norwegian Model of R&D is to be perceived as "perfect", however its relatively balanced interaction is a good starting point to untangle how the Brazilian model disperses.

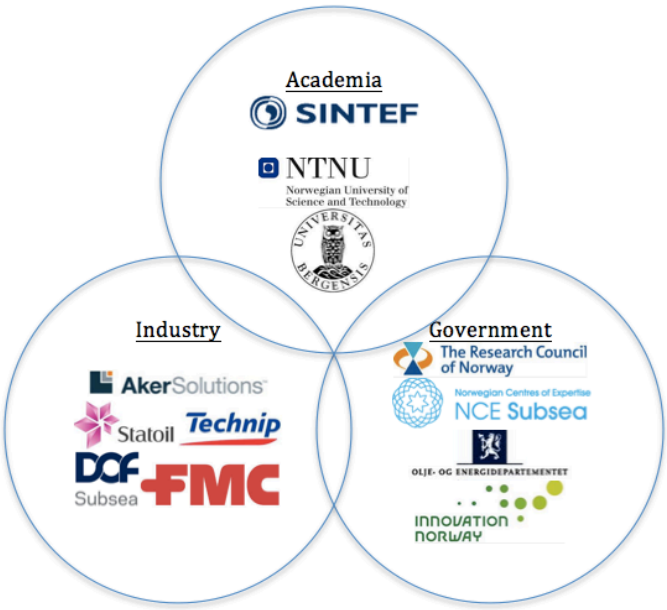


Figure 15: Triple Helix in NCE Subsea

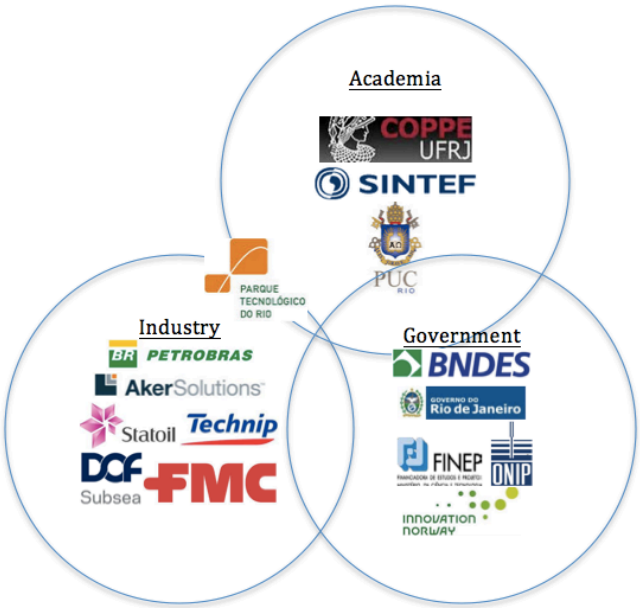


Figure 16: Triple Helix in Rio

The programs in the Brazilian STI strategy propose groundbreaking shifts in legal framework supporting private business participation in research projects. It also creates various financial motives, many with special attention to SMEs. With reference to Andersen, there is reason to believe that Brazil has finally found a reasonable and integrated innovation system across states and state level inspired by the Triple Helix model. However, potential improvements in industry-research cooperation have witness that the STI in the Brazilian subsea supply chain is still immature, mainly based on the historical neglect of technology innovation. The industry need time to "learn" to engage in technology cooperation, and BN21 can potentially gain momentum as forces are gathered from government, universities, research institutions and industry to solve technological challenges related to subsea solutions, partly *because* it is administered by the state.

The surge of entry by multinationals are essential contributions to high-technology solutions for bottlenecks in the Brazilian oil service chain, and may definitely give reason for small SMEs to follow. The enormous Technology Park represents a very optimistic facilitator for advanced co-operation between industry and university, which is why its logo is overlapping the two circles in the above figure.
Although still a "drop in the ocean", it seems as tough Sintef has found a reasonable niche in the Brazilian market connecting science to application, and hereby strengthening the "bottom-up" mechanisms. Solbrække is confident that taking part in R&D processes locally will also strengthen Sintef as a whole by gaining expertise and access to projects otherwise unlikely.

Funds though competitive calls that provide better repayment conditions if projects also involve collaboration with universities, and funds earmarked solemnly for joint projects, links academia to the industry – indirectly away from the government. One is therefore likely to see the upper circle shifting toward the center.

It is difficult to identify how LC requirements impact the cooperation, and findings indicate that the effects pull in separate directions; the policies encourage cooperation while causing constraints that hinders it. There is reason to believe that the scheme makes cooperation within the industry more dependent on each other as they are faced with the same challenges. A practical example is the training centers provided by the sub-contractors of DOF Subsea, so that DOF Subsea's employees are sufficiently trained to operate in Brazil. At the same time, the fact that one of the major challenges is related to capacity might reduce R&D to second order of importance.

PART C: INSTITUTIONALLY

Research and innovation structure in research and innovation

This part seek to analyze if the successful experiences of NCE Subsea can be credited characteristics of how research is structured, and weather these features can contribute to R&D in Rio Subsea Cluster. In chapter 3.2 and 3.3, a distinction is made between

the cluster model and the TH by settling the driving force behind innovation. Drawing on traditional characteristics of research development in Brazil and Norway respectively, it is perhaps no surprise that the Norwegian model is best described as a cluster model, whereas Brazil falls in the other category. What appears true is that the implications by applying NCE Subsea model in Rio Subsea Cluster is perhaps more related to cultural aspects rather than a premature national system of innovation.

5.C1 Evaluation of NCE Subsea

Collaboration and links between the members of the cluster was limited before the establishment in 2006, and has grown considerably since. Collectively, the members of the cluster have had a higher growth in both employment and value creation than comparable business sectors, in Norway as well as abroad (Econ Pöyry, 2009). A report prepared by Econ Pöyry concludes that NCE Subsea in a short time attained functional structure and has proven to be efficient and effective, and that the clusters' identity and the members' relations is largely a result of NCE Subsea. The program will terminate in 2016, and is currently qualifying for a new program, Global Centres of Expertise (GCE).

The R&D and technology development takes place on several levels, as described by Audun Otteren in NCE Subsea in an email received on May 25th 2014. These levels are a) further development of its own technology in each company or business cooperation (with or without public R & D support), b) through collaborations with research institutions (initiated by companies or research institutes) and c) longer-term R & D projects initiated by research institutions funded by public research funding and/or industry/companies.

The cluster model still seems to be the current model for co-operation between SMEs and R&D-Institutions within the cluster. This is justified by cooperation that exists to a large extent on the industry's premises, which is also confirmed by Otteren, yet with significant research contributions from institutes and part funding from the public institutions such as Innovation Norway and the Research Council. With reference to Figure 7, Characteristics of the STI and DUI modes of innovation, it seems relatively evident that the SMEs act as premise makers for Industry-R&D cooperation.

5.C2 NCE Subsea as a Role Model in Rio Subsea Cluster

Medina and Melo are proud to tell that the Rio Subsea cluster was officially launched in medio March 2014 with ten official partners onboard. The University Island would be an obvious location for the cluster administration, however the island is restricted to R&D and manufacturing is forbidden. The cluster will therefore be a virtual structure rather than a physical one, incorporating the companies relevant to the subsea sector in the Rio area, still within such proximity that mobility and communication between companies in the group will not be hurt. The Rio Subsea Cluster are aiming to attract the whole supply chain of both SMEs and the larger service and supply companies, and are experience lots of interest from the industry.

The Technology Park is highly involved in the cluster development and highlight that Norway is used as a cluster model. The representatives from the Technology Park express sincere interest to learn about the Norwegian experience in organizing clusters, and government participation in this picture. Medina and Melo

Comments made by Fiksdahl, Wangen and Vasconcellos indicate skepticism to the practical implications. The Norwegian system of cluster development is not transferable to the Brazilian context as the countries are in completely different stages of development. Vasconcellos believe that Rio could copy the Norwegian system of cluster development, but the obstacle is a general attitude by the people that do not support cluster culture, which only can be changed by raising the level of elementary education. Both Wangen and Andersen claim that Brazil is more advanced (at least comparative) to Norway in terms of cluster competence. Wangen was impressed to observe, in a recent workshop arranged by INTSOK with visits to shipyards in Rio Grande do Sul, a close cooperation between the industry and that they work structured to establish cooperation between businesses. What might be helpful, on the other hand, is drawing on Norway's experiences of cooperation to get university milieus, research and education in connection towards the industry that is to as the Norwegian model for R&D. It is by many claimed that Norwegian-based oil supply and service industry's world leading edge is largely thanks to these regional cluster environments that built a domestic industry (Fiksdahl, Hannisdal, Wangen interview). Three-way cooperation is quite underdeveloped in Brazil. Basically, Wangen explains, most

industry companies focus on their own tasks toward Petrobras, and occasionally in collaboration with the universities. Technology is however driven inside Petrobras, and need to develop an independent industry around it is pressing.

5.C3 Aspects Concerning Rio Subsea Cluster

The fact that Innovation Norway is one of the coordinators of the NCE program creates benefits for exchange of experiences with Brazil. Senior Advisor Andersen in the Rio Office is responsible for communicating the NCE Subsea model to Brazilian counterparts. He never recommends what one should do, but simply inform how it is done it Norway. There are multiple reasons as to why he might encourage the development of Rio Subsea cluster.

First of all, clusters attract resources necessary for clusters and positive for Norwegian subsea suppliers. In terms of FDI, workforce, competition, local buzz and global pipelines – all factors which arguably could prove crucial to attract for Rio de Janeiro to grow as a subsea hotspot.

Sub secretary of Rio de Marcelo Vertis announced that "the cooperation initiated with the signing of the MoU gives the Norwegian subsea companies a privileged position in Brazil". As we have seen, many of them already do. Nevertheless, Fiksdahl and Andersen are pleased to hear such a promising statement from the state and agree that its signal value carry weight. Ultimately, Wangen points out that there must be a match between members of the NCE Subsea and the relevant businesses located around Rio de Janeiro. The Subsea Index, a matchmaking tool created by NCE Subsea and several Brazilian partners in 2012, might be efficient in discovering potential partnerships (NBCC, 2013).

Several of the respondents indicate that a major problem is lack of personnel rather than orders and that it merely a question of resources to meet the local demands. It may therefore be little incentive to spend resources to focus on research and disruptive innovations as company sustainability is maintained regardless.

5.C5 Cultural Hinders

What became visible throughout the process of collecting primary and secondary data was a general underestimation of how sincere the cultural differences between the two nations is and how it cause friction in all levels of interaction. A report prepared for Innovation Norway on *How to do business in Brazil* state that "mismanaged cultural issues are one of the main contributing factors to failed establishments and unsuccessful market entries in Brazil" (Inventure Management, 2013). The perceivably "soft" aspect of culture gets a different flavor when miscommunications directly cause losses amounting to millions.

The business environment is highly colored by creating relationships on a personal level with the costumers, and meetings are generally held face to face -over and over and over again. Following this, continuous presence is key to maintain and develop client relationships. Sufficient trust to do business is delicate, timely and difficult to achieve in Brazil. Upon being asked; "Generally speaking, would you say that most people can be trusted or do you need to be very careful in dealing with people?", According to a survey performed by ASEP/JDS, Norway scores the highest in the world on interpersonal trust. In Brazil on the other hand, the majority reply that you can never be too careful. Long-term efforts in building trust and relations are therefore crucial to get anywhere and require customization for transaction-based business culture like the Norwegian.

Vasconcellos exemplifies by range the importance of feelings towards different institutions in the following order by priority; yourself – family – company – country. Andersen backs his point and claim that the ownership structure in Brazilian companies is scarred by recent historic instabilities and insecurity. Hyperinflation and sudden political changes has caused a culture for taking profits out of the company as opposed to re-investing surplus back into the company. This might also explain the reluctance observed by the private companies investing in R&D. Generally speaking; the business culture is shaped by the need to look out for one self, rather than the company and country.

Wangen describes Brazil as a very "association oriented" country. He has the impressions that the Brazilians have the attitude "yes we want to join, but why do we

have to pay for my membership?". The attitude is quite different from Norway where one is accustomed to pay half of the costs, and in turn financed half by innovation Norway and the Research Council[16]. Again, the willingness to participate could be seen as a different evaluation of risk. There are tax incentives to stimulate cluster commitment and R&D investment, but it seems that the industry is still haltering to truly be on board with the idea (Medina and Melo interview).

One way to avoid uncertainty is by defining all possible scenarios at a very detailed level. Responsibilities, authorities and tasks tend to be more clearly defined than viewed necessary by Norwegians. The relatively flat organizational structure may also arrive on a collision course with the high power distance culture in Brazil. The hierarchical distance implies that subordinates should be involved in processes and decisions, and their supervisor usually assigns all tasks. Hoftede's Power distance index measures the extent to which members of the organization expect and accept that power is distributed unequally. It is important to catch the fact that it captured the willingness and possibilities to take independent initiatives defined from below, a feature central to cluster synergies. According to the GINI index, a common method for measuring inequality in distribution of income or consumption expenditure among the population, Brazil and Norway represent opposite poles. By speaking with the Brazilians employed in Innovation Norway Rio, it was expressed that features of the fairly flat structure, visible for example by the normality of speaking directly to their superior, is highly appreciated. A friend working on a shipyard in Rio told me that they face regular delays, as the workers are unwilling to take event the smallest decisions without consulting its supervisor, who then will ask the following supervisor, in terror of having responsibility if something were to happen. Rune Andersen claims that such individual responsibility is highly destructive in the Brazilian labor market.

5.C6 Conclusion institutional opportunities

There are many examples of successful clusters in Brazil, among them the shipyard cluster in Rio Grande do Sul. The University island is truly unique in its nature as

[16] OECD statistics from 2012 reveal that Industry-financed public R&D expenditures (per GDP) in Norway is well above the OECD average.

elements from the TH is located within proximity; SME are established as spinoffs from the UFRJ, moved to the incubator to grow with access to laboratories in the Technology Park and the University labs. The Park host a combination of large multinationals and local SMEs and the anchor company Petrobras has cooperation agreement with many of the members, and 50 years of cooperation ties with UFRJ. Apparently, this should testimony that Rio de Janeiro has a solid foundation to formally develop and manage the Rio Subsea Cluster. Yet, there seem to be an x-factor hindering acceleration and it might be culturally determined. For NCE Subsea's mantra "Cooperate when you can, compete when you must", trust between and contribution from the actors are prerequisite. The problem arises, as the NCE Subsea cluster model does not cope with some of the main characteristics in the Brazilian landscape. The main objective is thus to improve the "top-down" policies to counterbalance some of the inhibiting effects of the current situation. Again, even tough transferal of the Norwegian cluster model is inappropriate, one may still utilize the feature of applied science to better implement the R&D policies.

Chapter 6: Conclusion

This thesis has aimed at answering the problem defined as:

"How can NCE Subsea Contribute to Research and Development in the Brazilian Subsea Supply Chain?"

Results reveal that a variety of factors, directly and indirectly, have an effect on R&D in the Brazilian subsea supply chain. However, only two outcomes can be defended properly, namely the contribution to qualified workers and applied science. As for development in technology, my research only indicates weak contribution to the local subsea supply chain. The Brazilian Cost is graphed to illustrate the self-sectioning of firms whose benefits exceed the inconveniences to overcome barriers, while participating in the Brazilian market. The barriers come in many forms, but especially worth mentioning are the tax regime, bureaucracy, lack of qualified labor, cultural and language differences. The process is graphically sketched in the below figure.

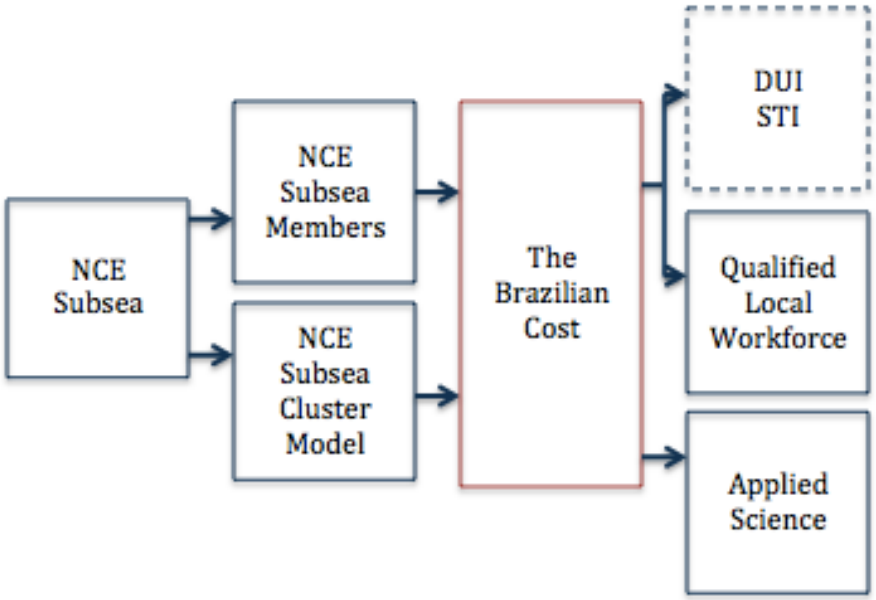


Figure 17: How NCE Subsea contribute to R&D in the Brazilian Supply Chain. (Source: The Author).

Subsequently, as defended initially, the research question is broken down and we ask;

1. *How can members of NCE Subsea contribute to R&D in the Brazilian Subsea Sector?*

Many of the members of NCE Subsea bring substantial technology useful in the Brazilian subsea sector. It this point in development, it is perhaps more important that the SMEs adapt existing products to fit the specification in the Brazilian market. Alternatively, that Petrobras set specifications to fit the products and services the Norwegian companies can meet, which is much likely in the case of FPSOs. Capacity constraints imply that mobilizing the supply chain surpasses heavy research in terms of development in the subsea sector. The transfer of technology outcome is presented in a dashed line because certain factors bound in the Brazilian Cost entail that export may in several cases be a more profitable mode of internationalization for the suppliers, particularly the case of SMEs. Accordingly, spillover effects are considerable reduced. Naturally, the OLI-framework give room for firm-specific assessment, and there is reason to believe that a firm that already have strong ties to companies present in Rio is likely to impact the decision.

I find that radical innovations will most likely be a result of direct technology cooperation with CENPES or under the direction of BN21, which hopefully will give positive results. According to cluster theory, the rational behind STI, and practical experiences from collaborative research programs such as VISTA advocates that radical innovation are often found by bringing players and milieus together. These cooperative agreements are likely to foster dynamics, and sub-dynamics, across players in the subsea industry. The SMEs in the supply chain are not so dependent on external expertise and research will largely be undergone within the firm, or together with its local partner. I hold no doubt that Rio could become the cradle of groundbreaking subsea innovations. Leading industry members, sufficient financing, and the need for new solutions is a powerful mixture. I am however reluctant as to the effects this will have on local development of subsea supply chain, as findings indicate that absorption

capacity is still too low for manufacturing of such technology intensive solutions to take place in Brazil for years to come. Indirect effects caused by increased competitiveness of the cluster, is said to have a positive effect on the local milieu, and hence the supply chain.

It is an established fact that lack of competent workers is a pressing constraint, and something that is in everyone's best interest to solve. Aligned with objectives in LC requirements, all of my interviewees report that the vast majority employed are Brazilians. Without speculating whether LC is accelerating the efforts or not, it is safe to say that one does not have the option of "importing" workers, as might be the solution when it comes to material. Training programs and simulator centers are much used to prepare employees how to operate subsea equipment on vessels, to exemplify. Findings indicate that Norwegian FDI contribute to closing the gap of local competence by qualifying the local workforce offshore.

As for manufacturing, some theory outlined in chapter 3.1 argues that spillover effects are likely to occur. It is not unreasonable to assume that members of NCE Subsea that produce parts of the product line in local facilities *do* contribute to qualifications of the employees, increase availability of local equipment, and so forth the development of the local supply chain. However, I do not hold sufficient evidence to claim such effect, and some of my sources actually claim otherwise; that the *quality* of locally produced equipment has not improved.

2. How can NCE Subsea Cluster Model contribute to R&D in the Brazilian Subsea Sector?

One cannot transfer the Norwegian model for R&D to another context, but they can draw on the experiences of cooperation across players. There seem to be fundamentally counteracting aspects in the Brazilian business culture that hinders optimal dynamic. Trust and ownership structure have previously been discussed. "Top-down" polices in the Rio Subsea Cluster could aim to undermine effects of the current situation.

It is evident that the supply chain can benefit if the link between the industry and universities is strengthen and to a larger extent characterized by applied science. One of the key differenced between The NCE Subsea Cluster model and the TH applied in Brazil, is the driving force behind innovations. If Rio Subsea Cluster is inspired by the Norwegian cluster model, it should imply that the universities conduct research more relevant for appliance in the market as projects are designed to solve problems identified by the company. The Government is united with relevant incentives to reduce the positive overlap between University and Government and increase the positive overlap between University and Industry. Sintef's accreditation may bridge this movement and hence contribute to applied science in the Brazilian subsea sector.

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Appendix - Summary of interviews

Appendix 1: Interview with Johanna Fiksdsdahl

Representing: The Norwegian Ministry of Petroleum and Energy
Date: February 18th 2014
Location: OED offices, Akersgata 59, Oslo

Summary of interview

Johanna started working in OED June 2013 - after the partnership between Brazil-Norway on research oil and gas technology was initiated. Dr. Elias in MCTI suggested the cooperation during the former State Secretary Per Rune Henriksen's visit to Brazil 2011. The reason for this proposal was that one recognized a mutual potential that would benefit both parties if efforts were aligned to face challenges together. Brazil and Norway face common challenges with regard to development of their offshore oil and gas resources, much advanced technology on each side, so why not build on this and create new technology together? The agreement has been negotiated for nearly two years, and Johanna together with the Norwegian delegation went to Rio in November where the State Secretary of the Ministry of Petroleum and Energy, Kåre Fostervold, signed the agreement. She explained how the agreement called BN21 (Brazil-Norway in the 21st century) is a guide to the co-operation containing of a stakeholder task force and a government group, and they should work together to promote cooperation.

Within the oil technology segments Statoil and Petrobras together have so far defined four TTAs (technology target areas) based on mutual challenges where both parties have something they can offer; subsea, increased/enhanced recovery, drilling of wells, geoscience (seismic section). BN21s vision is to establish a "subsea factory", where modules are placed on the seabed. Hence, achieving increased production and lowering costs, in addition to the fact that there is no need for a workforce/crew to serve the platform.

In parallel with Statoil and Petrobras' collaborative work with MoU, the authorities involved are developing a "roadmap"; what will be delivered and when. OED values milestones such as the signing. Johanna and the Norwegian delegation is going back in March to discuss the mandates of the groups (specify the tasks) as well as continuing discussions between Statoil and Petrobras on the TTAs.

Both the industry and the researchers are interested in participating;

Industry: Statoil and Petrobras are nominated as Lead Parties. Nominated from Norwegian side : Statoil , DNVGL , Aker Solutions, FMC Kongsberg Subsea, NSA

Academia: all Universities. University of Stavanger, NTNU , UiO , UiB

Research institutions and funding: SINTEF, Research Council of Norway, IRIS, CNPq (the state agency under the MCTI and provides financing for researchers), FINEP .

Additionally, the aim is to get the Brazilian supply chain on board, whereas many of them are Brazilian subsidiaries of Norwegian bound companies (Norwegian companies have a local presence in Brazil is perceived for bras company). Traditional Brazilian suppliers have been somewhat immature, but they have very ambitious investment plans and construction is at full speed (less developed infrastructure in terms of the number of yards needed). She reminds me that we actually spent 40 years building ours!

I ask her where to find the expertise to build this industry and she claims that there is a knowledge cluster forming that foreign companies want to take part in. The federal University of Rio de Janeiro (UFRJ) is heavily involved in research mainly due to its close relationship with Petrobras' research center CENPES (located in immediate proximity to UFRJ). Large, multinational suppliers have established research centers in the Technology Park, also located on the university island, and co-operation with the university is likely. She points out that there is no coincidence that SINTEFs first overseas office is in Rio de Janeiro.

We discussed the reasons that the OED and the government devote resources to establish close ties to Brazil and Johanna points to two major reasons:

1. **Technology.** Brazil as a research laboratory. Petrobras is in front within deep-water. They were the first and only oil company able to first discover and extract the pre-salt oil. Huge funds earmarked for research controlled by ANP through the 1% rule that allows all companies are required to use my 1% of revenue on R&D (0.5% within the company and externally 0.5% (uni, research)). The entire oil industry is used as an industrial and community builder to not only create an oil industry, but a wider context to create jobs and build infrastructure and improve education.
2. **Size.** Very large offshore market with turnover of more than NOK 27 billion for the Norwegian supply industry. Expected to grow ahead of the Norwegian continental shelf in 2014. Together the two will be the largest offshore markets, representing more than $ 400 billion. Brazil is the third most important market for internationalization of the supply industry, after South Korea and Great Britain. The relationship between Norway and Brazil is nothing new; there have been strong ties for several decades. Pre-salt discoveries open up great opportunities for the oil industry, with its large demand for goods and services. Petrobras is supposed to build 21 drilling ships (7 is already delivered) and other business structure that involves a huge market for providers of goods and services. There has been a rise in the number of foreign companies, but we have seen that it takes patience to be in the market. In the future, perhaps players are drawn elsewhere, with USA signaling changes in the Mexico gulf and new areas in Australia. The situation is no longer as euphoric as in 2006 and 2007 when everyone was going to Brazil! Many companies are still interested in investing in Brazil, but they have a more realistic approach than in 2006 in connection with the pre-salt discoveries. These findings contributed to create a bubble in which many companies were drawn to the Brazilian market. However, due to the licensing round being paused for almost five years, many started to feel uncertainty towards the market, and other markets seemed more attractive to invest in. As a result, one can say that Brazil missed a window of opportunity that pre-salt helped to create.

Johanna's thesis concluded that LC requirements led to industrial development to some extent. However, it reduced the *pace* of development of the market. Few can disagree that LC can be a sustainable tool for industry development, given that the local content is based on principles to enhance competitiveness. The outcome of unfavorable policies might give the industry crutches. Statistically, Norwegian

investment increased remarkably from around 2009 to 2011, which might seem a bit contra dictionary as the new framework built on stricter LC requirements came into force in 2010 (Production -sharing contracts in pre-salt biddings). She argue that at the time of the first pre-salt rounds there was perhaps an uncertainty in the market, but that the situation has normalized

OEDs impression from talking to companies is dedication to local content. One *has* to deliver locally; there is no other way to do it and it eventually induces companies to have a local presence in Brazil. The ship owners' association (Rederiforbundet) reports that it is up to 100 % requirements for local crew, Rederiforbundet is looking into how to create a simulator center for training of personnel and they will be involved in developing the skills needed. She has the impression that ANP has made slight moderations on request Petrobras. For example, the fact is that unless the product is available locally so you can import it. Norway applied similar policies with moderation.

During her time working at OED, she has learned that one must see the picture through a more historical lens. Brazil less developed infrastructure in terms of the number of yards needed. Norway was lucky as it was many yards available, something Brazil did not have (does not have) and the situation is completely different. Norway has a very different educational level than Brazil and the lack of qualified knowledge in the industry is a major problem. Qualified labor is a scarce, and it is challenging to change all this in such short time! The regulatory framework is still being tested and they are still figuring out how it best should be applied. She reflects that the impression she got after having been there in November is that despite everything, this large market can not be ignored! You can complain all you want, things take time, but the fact is that if you want to work with the oil industry you should be in Brazil, and hence deal with the requirements and be patient.

When I ask in which specific areas of expertise Norwegian companies are stronger than Brazilian, she clearly dismisses my question and reply "It is not about who's the strongest, but how to be strong together". As we have common challenges in the resource base that is relevant both to the Norwegian continental shelf and the Brazilian continental shelf: long distances from shore, subsea activity, much similar to the geology in the Arctic. There is interest from both parties, as well as research,

industry, universities. In addition, Petrobras in many ways in the front and pushes the technological limits forward. It is in this case, Norway can learn to utilize their achievements, despite the fact we have a longer tradition of having an oil industry.

She tells that the University of Oslo (UiO) has experienced tenfold increase in applications from Brazilian students who will come to Norway. There is also an increased interest from the Brazilian authorities (including ANP), and several delegations have visited OED, the oil directorate (OD) and so forth to exchange experiences on the Authority's role in industrial development. We should not think that we should move the Norwegian model to Brazil, because we are in a completely different stage in development than Brazil is today. One cannot transfer the model to another context, but they can draw on our experiences of cooperation across players (Authorities, suppliers and research institutions = "Norwegian model for R&D"). Petrobras is a very strong player individually, however need to develop an industry around it. “The Norwegian model” and our experiences in building an domestic industry is an interesting model for them in this sense. The Norwegian-based oil supply and service industry is the world leader in a number of areas (73 % market share in subsea, 90% in drilling segment) and it is largely thanks to cluster environments (collaboration between the different actors) .

Her impression on behalf of the OED is that having signed an agreement on paper is of large symbolic value, serves as a catalyst for collaboration between the private sector and indicates that this is something worth prioritizing. Petrobras said that they would only continue cooperation with Statoil when the agreement with the ministries was signed. She points to the interactive cluster co-operation which is appearing in areas in Brazil, and how it makes the market much more attractive.

She is certain that Brazil will be a very important partner for Norwegian industry in the years to come. It's now it all starts! Pre-salt will not be in production for 20 years, and before that there will be a need for very large investments.

Requested clarifications received by email May 22nd 2014:

-It was created uncertainty in the market after the pre - salt discoveries, because licensing rounds were put on hold for five years. This uncertainty appears to have decreased since the new rules came into place, but still there will be changes in the rules - for example, when it comes to local content. It that it is natural to have some "bumps" in the road after such a tremendous hype as pre-salt helped to create, and the unrest has not settled completely. Petrobras has sincere challenges connected to capacity constraints, and their weak confidence to investors. However, ANP has already made changes to make demands and expectations more realistic.

As regards to the importance of the agreements at government level, it is definitely more important in some countries, such as Brazil. In other countries, such as Brazil, the industry engages in technology cooperation on their own (without help from the authorities). Petrobras said that they would continue their discussions with the group before the contract was signed. It is therefore essential to anchoring of political leadership - especially considering that Petrobras is still a politicized company. In this way BN21 Agreement works as a door opener for Norwegian companies interested in Brazil. In addition, we considered it important to establish cooperation with Brazil because there is a growing research laboratory, partly because the state has actively advocated that the oil companies' revenues will be directed toward research.

Appendix 2: Interview with Terese Fuglerud and Anders Kapstad

Representing: Panoro Energy do Brasil Ldta.
Date: February 28th 2014
Location: Panoro Energy Brasil Office, Praia do Botafogo, RJ

Summary of Interview

Panoro moved the HQ from Oslo to Rio in 2012 in line with its strategic commitment in Brazil. The company intended to participate in the 11th licensing round held in 2013. Effort and preparations were made and a good technical team was in place prior to the bidding. However, partly due to three unsuccessful drillings [dry holes] conducted in 2012, the company decided not to invest more money into in Brazil and

hope to have pulled out of the market within summer 2014. They concluded that Brazil was too complicated. The Brazilian business environment is far more immature than predicted and envisioned. They describe the market as very costly due to restrictions, slow progress, inefficiency and extensive bureaucracy. The authorities and the ANP are heavily overgrown and Petrobras is too dominating. They underestimated how long it takes to build an independent industry, and on top of that burdens it with tax and import tariffs. It is not to say that they lack the skills or capacity to do it, but they do not have respect in regards to how much time it will take or attitude to do it.
Although the LC (local content) requirements have not affected Panoro much as they are an investor and do not produce anything, they observe that it affects everything. They notice a ruling consensus among foreign firms taking part in the Brazilian oil sector that the original plan is unreasonable and they are happy to see small signs of adjustments. LC is principally a solution to support, but it causes trouble in Brazil due to the low level of general education and infrastructure. The Brazilians with the demanded expertise (finance and technology) can consequently demand very high salaries. The majority of the employees in Panoro were Brazilian. The people that do hold relevant education are generally very talented – the problem is to catch them. Many of the workers with technical (geologists etc) background were recruited from Petrobras.

Even so, they think that the large cultural differences are perhaps the largest challenge. The Brazilians simply "have an other commercial understanding than we in we are used to in the northern hemisphere". They work differently and have a different attitude towards doing business. The culture is relatively defensive in solving problems and the difficulties lie in the local human nature. Somewhat humoristically, it is pointed out that one have to be paranoid to operate a business in Brazil. The agent/local leader must be hands-on constantly and represent the culture. If not, you are without a chance to succeed. As they work and think totally opposite of what we are used to – sending an agent fronting the company culture is a cost you have to take. Most Norwegian companies have realized that operation in Brazil cannot be remotely controlled and reported by just anyone. They are less direct and less impatient, foreigners are perhaps a bit discriminated against [naturally, as anywhere else]. One must remember that it is somewhat unrealistic to compare Brazil with

Norway's 5mill and high GDP per person. It calls for totally different realities and one must have it in mind and be a little humble about it.

Panoro is a relatively small oil company with approximately 30 employees in the Rio office a few years back. Upon being asked about challenges related to its size, they both agree that it makes it harder to participate in the Brazilian oil market. Given Petrobras' dominant role, the voice of a small company will rarely be heard. They are not prioritized, and it is very demanding to provide enough capital to cover risk premium and maintain a strong balance.

Upon being asked about the Rio cluster and the value to many local Norwegian organizations and institutions, they underline that the NBCC is quite valuable as a network. The Norwegian government is a door opener and a bridge-builder, but there is "no free lunch". The market is here, they have the resources and talented people, but face large challenges in the system: the people's attitudes, corruption, and bureaucracy. Many locale believe there is a need for international expertise, but they have not learned to work in the western way. Panoro work with locale partners and internal partners (on the same license), in-house knowledge and external consultants for knowledge. Depending on the license, Panoro may offer analysis of risk and seismic data. This knowledge sharing is standard and not specific to Brazil.

As a concessionaire, the 1% rule applies to Panoro. They explain that they in collaboration with Sintef Brasil discussed what project to spend the R&D money on and Sintef proposed a process to accomplish it. Sintef got acceptance from ANP to go forth with the project funded by Panoro. It encompasses a project that they themselves can take advantage of - a geological project. SINTEF has found a sensible niche in the bras market. Upon being asked about the likelihood for them to spend resources on R&D in Brazil, they note that Panoro is too small for that focus, but for larger companies - it may be sensible. It exists some useful schemes / programs socially to get tax deductions.

They note that Panoro's future in Brazil was never certain even if the explorations proved successful. The general appetite for investments is reduced and nothing will change the fact that Brazil represents a difficult market to operate in overnight.

Everything is “syrup”, but it is moving slowly in the right direction.

Appendix 3: Interview with Gulbrand Wangen

Represent: INTSOK
Date: March 17th and 20th 2014
Location: Innovation Norway house Rio, Rio Torre do Sul, RJ

Summary of interview

Wangen gives a short introduction to the idea behind the establishment of INTSOK and its purpose. INTSOK promote its members’ competencies considered important for oil industry abroad collectively. When INTSOK was formed in 1997, we saw a recession in the Norwegian shelf, but knew we had a great technological competence that needed to be profiled. The question was: can we can sell it internationally? In 1997 the international revenues for Norwegian suppliers was approximately NOK 17 billion and in 2012 NOK 183 billion, however INTSOK facilitates and created meeting places, but can not say how much this increased is thanks to INTSOK.
Looking at offshore investment and expenses, Brazil is the largest and Norway the second; therefore many opportunities for Norwegian suppliers. Brazil is therefore prioritized as a “main market”.
He explains technology within the Norwegian industry which is particularly attractive abroad and gives me a short and precise introduction to the five major areas (interactions) in which Norway do business in the Brazilian oil and gas market:

1. **Subsea;** Brasil and Norway are set benchmark within subsea, and employ pretty similar expertise. (Also by having one dominant national oil company, Statoil 85% of Norwegian market, Petrobras 90% of the Brazilian). One must remember that these are international companies; Brazilian in Brazil, Norwegian in Norway, and the reporting does not go directly to Norway and R&D is decided locally in the Brazilian market. The only exception he can think of is Aker Solution which has a reporting line to the HQ in Norway. Hence, technology transfers in that sense is not so relevant as the governance and control is usually not directed from Norway.

2. **Drilling rigs construction**. Sete Brasil delivering 28 drilling rigs to Petrobras, worlds biggest rigproject set out to five shipyards. Shipyards have signed contracts with NODE cluster in south of Norway won all contracts (Aker Solutins Drilling Technolgy and NOV Varco) Water, rocks, presaltlayer – everything needed to get through this will be delivered by two Norwegian companies. This is pure technology-sale on specified technology and contracts won on sale and no technology was developed.

3. **Offshore Maritime**. 25% of all ships in relation to the platform supply in Brazil is Norwegian controlled (ancherhandeling etc.). Dynamic Positioning (DP) both for supply vessels and drilling rigs: won contracts on equipment (Kongsberg Maritime). These contracts are standards and the timeframe is 2-5 years and this is established because it takes that much time to build this rig.

4. **FPSO** a big Brazilian market and some companies with links to Norway are eager to win contracts. 12-15 FPSO are scheduled during the next 4-8 years. INTSOK are trying to present new solutions for Petrobras which are not yet specified. In this sense we are talking development of technology, as this is knowledge familiar to the Norwegian companies (use it in other locations such as South Korea) but not present in Brazil. In addition, Libra pre-salt project need 12-15 FPSOs, hence there are many possibilities in expanding its sales. Two more companies worth mentioning that represent a technology cooperation between Norway and Brazil. BW Offshore (Skøyen, Oslo, Main Office Singapore) some tenders run from Oslo and Singapore. TeeKay Petrojarl operate FPSOs in Brazil partly managed from Norway.

5. **Drilling operations**: Five shipyards have contractors from Sete Brazil. Rig operators such as Norwegian Odfjell will invest in construction and operate after rigs are built. Long term contract with Petrobras ensures that it is the contractor interest that the rig is build with quality equipment. Odfjell drilling Brazilian subsidiary contracted by Petrobras on three rigs, will own and operate 20% of the rigs when completed. To get in position, Oddfjell are investing during the construction. Seadrill is no longer HQ in Stavanger, moved to London last year.

Although research cooperation is just a small part of the whole Norway-Brazil

relationship, he underlines that Sintef's accreditation is very important for further development. Industry development and research development is not necessary parallel in this industry, so it is important that Sintef complements the other operations.

Wangen is impressed by the way they work with clusters in Rio Grande do Sul and claims that it is more advanced (at least comparative) to cluster work in Norway. In the recent workshop arranged by INTSOK with visits to shipyards in Rio Grande do Sul he observed close co-operation between industry and that they work structured to establish cooperation between businesses. However, not as good at three-way co-operation in Brazil, to get university milieus, research and education in connection towards the industry. Every industry company focus on their own tasks toward Petrobras, and then sometimes together with the universities. Technology is driven inside Petrobras (Statoil more cooperative towards the industry). We have been much better at creating strong relations between costumer, suppliers, and universities: new technologies, new challenges! They are trying to copy and become like us in that area.

One would think that the cluster in Møre should partner up with the cluster in Rio Grande do Sul as they both represent shipyard clusters. However, the companies selling to shipyards in Rio Grande do Sul may come from everywhere in Norway, not only come from Møre [Two comp Palfinger, Norsafe (M&A with local comp]! Not given that there is a match for cluster cooperation. The key is to find a cluster that is "similar to oneself". He claims that we do not have a harmonized subsea cluster in Norway. NCE subsea in Bergen runs the operations and subsea valley on the technology.

Wangen agreed that culture difference might hinder the drive for cluster development and value creation. One must stimulate and create motives for the firms to join forces and work towards common goal. Very "association oriented" country, they are members, but do not intend to contribute. He has the impressions that the Brazilians have the attitude "yes we want to join, but why do I have to pay?". Difference: in Norway you must pay half of the costs, but you will be financed half by innovation Norway and research council. The cluster structure here is much more complex and lack commitment. There are tax incentives for cluster investments, but it seems that

the industry is still haltering to truly be on board with the idea.

INTSOKs role in Rio Cluster is that it is interesting for partner members and the local companies to take part of the cluster. Required that our members fit businesses in Rio. To find business, but you must offer technology that is worth something in the market.
We are the international cluster of Norwegian competence and will profile this globally. We do not work internally to build the members, we promote them abroad. We have proven that when we present our members within subsea segment together, they will win contracts abroad. All the time the focus is towards the clients. We could work with the cluster in Brazil, for example by arranging a workshop, because it is easier to get connected to the clients. However, we do not look at a cluster as important/necessary for internationalization, but a convenient facilitator.

We discuss the recent announcement from Petrobras' CEO messaging that keeping up with the production curve is more important than meeting LC requirements. LC is intended to spur more production and fabrication in Brazilian companies, but the results does not keep up with the increasing demand. If you drive it to hard, you will not get access to all available technology because it is too demanding to insert it in the Brazilian market. Many firms, especially SMB do not have capacity to enter because of the strict LC requirements.

I ask for his thoughts on the gap between the reported Investment figures published in Rystad [for INTSOK] compared to numbers published by Inventure Management [for Innovation Norway]. Rystad, as a consultant feel that the Petrobras' strategic plan will not be met and have therefore reduced the forecasted investment figures. This is also why the agreement with GIEK is still on hold. The recommendation of the Board that it is too risky to provide credit guarantees as some of the boats are ordered before the shipyard is built and that petrobras have a history of not meeting schedule.

Appendix 4: Interview with Kjetil Solbrække

Representing: Sintef do Brasil

Date: March 14rd 2014
Location: Skype (Kjetil is permanently located in Rio, but was in Norway at the time)

Summary of interview

SINTEF's first major engagement abroad is in fact in Rio de Janeiro. Kjetil explains that opportunities would be lost if not positioned in the market and Sintef being in Brazil is tantamount to being involved in technology development. So far the Norwegian continental shelf have been pioneers of technology development in offshore oil production. The current reality is deeper water and even tougher challenges in Brazil. To be part of this, and be able to we bring our expertise from the north sea into a new breakthrough area, will prove important for technology development going forward. Brazil a one of the most exciting areas in the world to develop the technology at the moment.

Sintef's competitive advantage in the Brazilian market is its knowledge about a research process, for which Kjetil experience a demand. Only in exceptional cases depending on the projects do Sintef assists with specific knowledge / expertise: this is not the core activity. Historically, Brazilian institutions have not engaged in applied research. All research is being done in the universities -which are excellent- but there is no applied science. There are plenty of scientists who research for its own sake. CENPES manage and conduct research based exclusively on the needs of Petrobras to create value. Everything else that does not have a direct positive effect will not be given priority.
He points out that this gives SINTEF in a unique position as a research institution, being the only research institution in brazil that can conduct applied research projects for the industry. SINTEFs niche is not concrete technology that in the true sense, but we hold the knowledge of running research projects. From SINTEF Norway, we bring the experience of undertaking major research projects; provide a solution for the client, follow deadlines, report quarterly, follow budgets. dialogue with customers.

Sintef's work is purely innovative. By generating access to counselors, expertise, new perspectives, innovative thinking, new information is created and applied.

The business model is similar to the one in Norway. Our employees are constantly developing as they are exposed to new missions regularly. To date we have around 20 researchers – of which 90% of employees are Brazilian - in their spacious Rio offices, and seek to increase to 50-100 in a 3-5 year period. Brazil is a large country with interesting, talented people that we are recruiting for SINTEF both in Brazil and possibly Norway. He argues that we can clearly draw on bras knowledge. They are hiring young graduates deliberately because they are easy to shape young.

Petrobras has set several world records when it comes to deep water operations. Hence, Brazil is a very competent country where SINTEF certainly can learn a lot also in terms of its Norwegian operations.

Petrobras' research center, CENPES is the principal partner with whom we conduct projects. They say what they want to know, we propose a plan, and they provide corrections to what we should do. The project for Petrobras is primarily related to multiphase flow.

Kjetil highlights that they have a good and close cooperation with the universities in Rio (URFJ, PUC, Catholic University).

Sintef is a foundation, not a company. This corporate form prevents it from transferring revenues to the Norwegian unit. This is highly unusual in the Brazilian context for a research institution to be a foundation, but the form opens possibilities for funding. Companies operating offshore Brazil, must spend at least one percent of revenues from on R&D in Brazil. The money is managed by ANP in a sizeable "Special Participation Fund" (SPF). Foreign corporations cannot access this pot. Last April Sintef was given a public accreditation, which gives us a right to apply for project funding from the Fund. Minimum half of the "1% " shall be used in accredited universities and research institutes. Both projects SINTEF Brazil have received, and the research funding foundation has applied for, is attached to this scheme.

Appendix 5: Interview with Rune Andersen

Representing: Innovation Norway in Rio de Janeiro
Date: March 28th 2014
Location: Innovation Norway house Rio, Rio Torre do Sul, RJ

Summary of interview

Innovation Norway and the Norwegian cluster program are organized as follows. IN have the ARENA program, with small clusters (many are qualified) and many of these are perhaps strong enough to be given the status NCE. However, this is a matter of budget constraints and only 12 NCEs can receive funding. Next step is becoming a Global Centers of expertise (GCE) of which there are 4 and NCE Subsea is a candidate.

Why Rio want assistance from Norway is explained because Norway is strategically important for Brazil within oil and gas. CENPES is world leading within deepwater. Petrobras is a cluster in itself, but need the rest of the industry that is supposed to deliverer products and services to Petrobras. And due to LC requirements, they need to attract the supply chain to Brazil.

When being asked how Innovation Norway is promoting the Norwegian cluster model, he sais that they say YES every time anyone ask to have a presentation etc. They never tell Brazilians how they should do it; only how we do it in Norway, and what have been successful in Norway. Our main tool is information to the board of directors in to the Norwegian companies, have programs to gather interested and relevant companies. After the process, it is up top the company to find a niche to penetrate the market.

He explains the declined interest from the Norwegian companies to enter the Brazilian market is a result of increased investments and possibilities in the North Sea. Many have therefore put Brazil “on hold”. He believes that there is room for them in the Brazilian market.

The Brazilian institutions are solid, well-constructed, a lot of knowledge is present. Perhaps too many institutions, but then again Brazil is 200 million and not 5 as in

Norway – so it is difficult to compare. He walks me through the major programs and structure of the governmental organs devoted to research based on a presentation given by Mr. Elias (as referred to several times in the thesis). Previously, nobody spoke with eachother and research were conducted more or less individually in each area, on municipal, state and federal level. PACTI was a program made to collect these loose threads, which he claims they have managed to do, taking into consideration that they are 200 million people. Collaboration, universities, financing, education and other actors that are focused on the same.

Why should the old industry go into an area they do not know – the oil sector? Petrobras is trying to mobilize supplychain. The competence lay in universities. All universities have a TTO - technology transfer office that takes care of commercialization and control the patents. Brazil is competitive in other traditional industries such as aircraft and mining, but has not been adapting to the nascent oil industry because they do not have the same pressure as Norway did. The companies must *want* to change, no one can force them to change. Incentives and schemes is a tool that can be used more to get these companies to adapt their technology base to be applied in the oil and gas sector. First of all they need the knowledge to do it. Secondly, the process to be certified by ANP an approved supplier takes a long time and is very thorough.

The reason why Brazil lack a supply chain is due to ownership structure in businesses. The industry did not focus on oil related production and besides Petrobras – the "gigantic amimal" – there is no one else. He underlines how big Petrobras is by exemplifying that the recent tender offer was larger than Statoil. Plus, one need to keep in mind that this is a highly investment intensive sector. Petrobras has thousands of projects ongoing, they do not need more research projects. Additionally, it is very resource demanding for Petrobras to take part and operate in all concessions with minimum 30%.

He claims that the 1% rule is used to build institutes, new equipment, labs and improve infrastructure in universities. Instead, should spend money to fill the institutes with people and projects. Time to market from idea to production is very long. They lack a basic understanding that time is money in Brazil.

Upon being asked if there is a gap between university and the industry he says that the universities are not commercial; they do research. The effect of Sintef is too soon to say – they are currently too small. That Sintef is a foundation and not an institute created a problem for ANP as they are only familiar with public research. CNPq have not fully approved Sintef yet because of this.

Rune argues that Brazil does not have a traditional foundation for cluster creation. Important features such as high trust index, culture for innovation and sharing, and horizontal organizational structures, are not present in the Brazilian cultural landscape. They are protectionist because of historic reasons. Portugal came to utilize their resources, and empty the country to bring the riches back to Portugal.

He also highlights that only the Brazilians can lift the Brazilian market further.
He describes the market as introvert, and that they have a protectionist behavior because the market is big enough. He jokingly claims that they lack the "Vågå-gene", to say that globalization is not a crucial factor for Brazil to survive like it is for the people in Vågå.

He illustrates the extent of the Brazilian bureaucracy and say that a business that in Norway would have 80% engineers and 20% economists would consist of 80% economists and 20% engineers in brazil. Example of the Brazilian cost: The hammer produced in Brazil was 40% more expensive than in Hamburg. But a Norwegian subsidiary holds a comparative advantage as only a part of your business is exposed to brazil, and does not loose the global competitive. Once established in Brazil, they compete by the same rules as the domestic companies.

Appendix 6: Interview with Denise Medina and Leonardo Melo

Representing: The Technology Park at Ilha do Fundao
Date: April 3rd 2014
Location: Parque Tecnológico UFRJ, Ilha da Cidade Universitária, RJ

Summary of interview

The Technology Park was established in 1997, and Oceantank (oceanlab) first resident 2003 (like the one in Trondheim). With pre-salt announcement in 2007, they noticed huge interest from all over the worlds. Multinationals from all over the world come here *because CENPES is located here*. They have long experience in research and their leading knowledge in pre-salt technology. Old partnerships such as Halliburton make it more natural to stay close. The future challenges cannot be resolved by only one country or company and high-tech companies is more easier to see the reason for collaboration.

We move on to speak about the Subsea Rio cluster, and they stress the fact that they look so much to Norway in the way you organize the cluster. They explain that the Government took action to create subsea cluster. Currently the government are at the stage where they are deciding how to improve LC in technology, and make form a strategy on how to compete globally. It is necessary to establish cluster in RJ with focus on subsea technology because it is technical-intensive sector. For that it's important to work with Norway institutionally and they see Norway as a reference.

The interviewees wanted me to tell about the Norwegian experience, and how our way of organizing the cluster. We discuss the effects of government incentives to the industry to invest in R&D, and how Brazil best can boost this slowly appearing trend. We also talk about the cultural differences shaped by a history of a strong, centralized government controlling and funding all R&D activity hindering the willingness for firms to focus on R&D. Denise tells a story from Japan. "The Brazilians are very intelligent individually, but when they come together it difficult work together. Japanese people on the other hand, do not create value individually, but together they work very well". Culture is something that do not change over night, but both are optimistic.

They are asked on changes in regulatory framework and contribution by the industry in R&D investment. They see the effects of the law of innovation, which required the companies to invest 1% of revenue for investments in innovation. The park might be a result of the innovation law, as they have seen a good development since around

2007-2010. We exemplify it by Simens, that have a research plant here may put 50% in the URFJ laboratories (or other ANP-certified organizations), and the other in internal R&D activities on campus or in other facilities in Brazil (specialized people, new equipment). And the investment brings results, both for the firms and the students!
Policies are changes in favor of innovation and expenses in investment R&D are tax deducted. The incentive is perhaps not strong enough, but they are slowly learning. Both agree that brazil is too bureaucratic, but are optimistic about the future changes regulation wise.

Very interested to learn about the Norwegian experience, the Norwegian history of R&D. Upon being asked what specifically the NCE Subsea is interesting for them, they both agree on the business model and the structure the government participation. How to form a policy of business establishment. In Brazil, the Government is the driver of this policy, but main point is to create more private contributions. The interviewees are surprised the learn that research institutions take a greater role in research than the universities, it is the opposite it brazil. We agree that it is important that the private industry contribute to a greater extent. Next week innovation Norway and the companies from the incubator will come and make a presentation. Soft-landing, not only for Norwegian to come to brazil but also for brazil to go to Norway. We speak about the potential for synergies between URFJ and innovation Norway to improve a better network.

The cluster is officially launched now and the first meeting was held last week. So far ten official partners is onboard. Next step is to attract firms to participate, government is the driver now. How to give the directions to firm to participate?
Due to difficulties to find a location to establish this cluster in one place, it will be a virtual structure, a big one. The companies will stay where they are around Rio, not in a physical location. It is not allowed to produce or manufacture at Ilha Fundao, only research and development. They are experience lots of interest from industry. Aiming at the whole supply chain of both SMEs and the big companies in the suppliers. Some of them are big, for instance FMC which are members already. Service comp and business companies.

Regarding the funding, the government try to build trust process between the companies in the industry as they hope think they should fund the project and not the state. In addition, the cluster –although not in need of much money currently- will search funding from all possible actors such as the development bank BNDES, Petrobras, FINDIP and ANP. Our science and technology system are getting stronger and the virtual network will ask for funding. (PROMID government program to improve training and educations and create more workforce, support the naval industry.)

I ask about the interaction between the units in located on the island, namely the university, the member firms, Petrobras and CENPES, and the tech incubator;

The park has contracts with the companies stating that they must invest a specified amount every year in the school (social activities count!), currently about R$300.000 per year. Annually, we decide together with the firms what projects they prefer to investment. The administration arrange workshops and get-togethers, individually with the firm (every other month) and intra-unit. It is worth noting that due to strict confidentiality, the meetings are often held privately with the members and adm, or members and UFRJ. They are currently working on improving the intra-links, company presence, dynamics and innovative solutions. They have indicators which show are growth in amount invested, and for example GE invested R$12 million over the past two years (the requirement is R&3 million per year). Yet, one must not forget that many of the big firms do not need the university as they are so established.

HR member of members are focusing of promoting the park as "the hot spot" to work for the students and are currently planning "open-day" events (Parque de portas aberta) where all the companies are opening up for the students twice a year. He stresses that the staff must be increased, as there is still a lot to do and be able to work directly towards the students (15.000 people) and the professors (3000).

Petrobras is very interested in having a cluster here, and also the main encourager. They need the suppliers, and the firms here are not competitors in that sense. Petrobras cannot provide all the needs in the Brazilian market. The leader of CENPES is also in the board of directors of the Technological park, and so they are very integrated in the strategy laid out by the board. One object is for example; How to improve our presence in subsea technology?

Of the six new companies, four are graded by Business Incubator Coppe / UFRJ and two of them are spin-off project of the University laboratories. Industrial focus since 50 years ago, and the URFJ developed strong ties with Petrobras. Second step was the incubator to facilitate for the students research and business ideas. When asked about the interaction with the incubator, 20 years old, ten years before the tech park, it is claimed that the tech park represent a natural progress from the incubator. Almost half of the companies are spin-offs from the incubator.

Denise concludes that the Fundao is interesting because we have SMB, Petrobras the anchor companies, and the laboratory. We have everything

I ask Leonardo to think of a specific technology that has been used in the Brazilian subsea market and led to technological development as a result of research conducted on "campus". Two equipments are serving as good examples of technological outcomes from collaboration. FMC technology did in co-operation with the UFRJ on the SSO, was tested in the Labocean and was partly developed/improved on site.
The other example is a company called Abidabi

Upon asking of the time schedule for the administrator to "pull-out" of the cluster, it is clearly that it is not in the near future. All in all, they notice a positive change towards investment in innovation from the industry and improved interest for co-operation, although slowly.

Appendix 7: Interview with Jose Marcio Vasconcellos

Representing: LabEco at the Engineer Faculty of UFRJ
Date: April 3rd 2014
Location: Labeco COPPE, Bloco I 205, Ilha do Fundao, RJ

Summary of interview

The Labeco and other labs at COPPE conducts research for the government or private companies, like Petrobras. Agencies such as FINEP may give money support if the firm applies for a research proposal. Sometimes the government comes to UFRJ and

asks for something that their experts see the need to do research on. He exemplifies that the traffic in Rio is very bad (actually the third worst in the world!), so they want research to be done to solve/improve this problem.

In addition to this, the R&D programs may be proposed through open calls twice a year. If, for example the professor knows an interesting field of study, they might grant him money to follow his idea. The ANPs 1% pool of money can be spent on projects where the university cooperates with the university.

He neglects that there has been a shift in favor towards R&D from the government. He thinks they have always has provided financial support.
Industrially, Petrobras is the exception because they put money and that's why they are in a good position in the market. He has the impression that the others firms spend money on R&D that they use elsewhere, or do the R&D elsewhere. Common to all is the desire to make money on oil, if they have to spend money on R&D to do that, they will.

I argue that the global companies in the technology park URFJ do have R&D centers in all major hotspots, even in locations where it is not required.
He replies that because the oil in brasil really belongs to petrobras, brazil differs distinctly from rest of the world. This scares firms from investing resources in R&D. if they come along for the exploration, they have to establish manufacturing because they are joining efforts with Petrobras. A few is not enough to create a movement.

I ask what role the Labeco fill that CENPES cannot do themselves. UFRJ have knowledge that CENPES do not have often related to engineering, and sometimes they ask the university simply because they do not have time/people to do it. CENPES do much time consuming basic design, but their main partner is by far CENPES and more than 80% of their products belong to Petrobras.

I ask about the intellectual property rules. A specialized contract is formed prior to the R&D program. The foundation takes care of this and we split with Petrobras. Register together, but Petro is not interested to develop this. They only need to use it to extract oil, they are not interested in owning or selling this patent.

About the Rio Subsea cluster he illustrates by saying “sometimes it is good, but not necessary. Sometimes it is necessary, but not good”, but he believes that it is necessary and that it will attract companies. He argues that Brazil and Rio can copy Norwegian system of cluster development, but it will not work here because we do not have the same people. He underlines that education is key, elementary education. It is a cultural problem and you can change it by education. In general they [the people I assume] are looking for money for themselves, not the country. He tells a story about Japanese business culture shaped by the need to act self-sustainable given its geographical features amongst others. The message is that Japanese range the importance of feelings towards different institutions in the following order: The first priority is the country, second comes the company (Japanese people rarely switch jobs for instance), third family, fourth yourself. In brazil it is the exact opposite.

I argue that foreign companies bring their business model so some extent, which might be more accustomed to R&D budgeting. He agrees and thinks that this is what is happening now, however very slowly. It is not easy to work together (GE and Petrobras example) and it is taking time.

He has one example of technology developed in cooperation with Petrobras for the past six years, and it will soon be tried in the north of coast north of Brazil. However, due to security surrounding the product he cannot mention its use. He claims there is possibility it can be used everywhere in Brazil, and that Petrobras has no intention to own the patent, just employ the technology.

Better co-operation may be created through general improvement in education. He thinks that they are currently doing well and cannot think of any specific improvements in communication between units. It is not long ago that industry was not allowed in the Ilha do Fundao, and now there is increasing interest. The main issue to solve the education. The continuing learning program are mostly people (90%) that have experience from the industry. Sometimes paid by the company. As a digression, He is invited to participate in Distance learning (e-learning) with students from Norway with connection to Huston as well. Do role in further promotion of their students to firms. Some student went to the techincubator and now they have their

own company. He assumes there exist around 20, but he doesn't know how many startups died.

The major importance to attract foreign companies are technology, partnership, experience and education. Petrobras are stimulation to get to know each other and attract firms because they are dependent on a supply chain. The firms establish centers in the tech park to stay close to the other companies. The university have moved the labs to the technological park, open to the firms. They actually had the first tank with wave maker etc. like in Trondheim, but deeper! FMC have subsea lab.

FINEP has a policy if you want to get the money, you have to be associated with a company. Before the government gave the money directly to the university, now we have to be together with the companies.
He refuses to admit that the universities are playing too big of a role in R&D in brazil, while also stating that they do not have research institutions. He remembers that before he had to offer ideas to the companies, but now the companies come to UFRJ because they have seen that they can bring result important for them. He concludes that the activity is growing, that this is only the beginning and they are doing it together with the university.

He said that Petrobras and FINEP are two contacts very important to get the whole picture.

Appendix 8: Interview with Erik Hannisdal

Representing: Inventure Management
Date: April 14th 2014
Location: Inventure Management's offices in Botafogo, RJ

Summary of interview

Erik and his partner Jan Ramberg formed the company in 2009. From their experience, companies that come to Brazil spend an extensive amount money and

energy (especially the two first years) to understand the Brazilian business environment. The cost by sending one of their best expats (country manager, often with tech background) to open up a subsidiary and do a job that nobody can possibly be prepared for without being in Brazil for a long time to know its complexity. Inventure Management (IM) fulfills this role with a team of specialists with cultural knowledge and different academic/working backgrounds. Their competitors are similar agencies, lawyers etc, but no other have our business model of a complete operational platform. Inventure Management is able to build the client's Infrastructure (workstations, have a industry-base in Macae (20 comp rent the place), office), offer administrative management (legal advice, recruitment, finance) and venture management specialists to close deals, create supply chain, strategy. He underlines that back office functions are far more demanding in Brazil and classic example is that everyone underestimate this segments due to poor planning. While Innovation Norway only acts as a facilitator and door-opener, their consultants get involved in the operational, and follow and establish the business hire people, move money. Start-ups and market penetrations experience fail to meet projected timeframe and cost. Therefore, one must have a administrative infrastructure to exist and you must have people out there to close sales. Additionally, the oil service supply chain is weak in brazil and more advanced planning and process management is required due to the fact that much equipment simply is not available in the market. The inventory costs are higher. This, in addition to Brazil having one of the worlds highest import tolls, makes an efficient supply chain management crucial to survive. To get the right products, to right quality at the right time is a challenge in Brazil!
Upon being asked of possible solutions to the challenges, he claims it is just immature market, but developing. The key is to lower the cost on penetration and win orders by being smarter in other parts of the products "price". For instance, the benefits are greater if you invest more to decrease efficiency gaps in Brazil.

Regarding LC, he finds it surprising that many companies do not invest more effort in understanding these regulations in depth. For many companies the LC is still not necessary, especially concerning highly specialized products, with no local competitors. LC represent an enormous paper-mill in collecting certificates, the suppliers of suppliers (3-4 links before finally give to the operator (like Statoil and Petrobras)) which ANP evaluates. The rules are known to everyone, framed and

specified! Instead they should think “How can I maximize LC without increasing the price on my product?”
Ultimately, LC has not affected the quality of the suppliers in Brazil due to the fact that it is only focusing on Brazilian material content in product, not giving equivalent credit for engineering. Gradually better, but no significant improvement. However, we must remember that it takes time for an industry to transform (the suppliers in brazil are currently not delivering to other industrial companies not oil industry).

Erik applauds the dialogue between INTSOK, Innovation Norway, the consulate and such organizations located in Norway. They play a valuable role in fronting the norwegian companies abroad.

There exists ingrown notions of what R & D can contribute to, and the Brazilian industry is slowly realizing that one can actually earn money from investing money in research! This is partly due to global companies bringing with them the mentality that the private sector must also contribute. In fact, there is currently a unique possibility to invest in R&D in Brazil because it is more funding available than projects at the moment. Global companies should evaluate the possibilities of moving its R&D operations to Brazil. For the SMB its more relevant to develop existing products to make it adaptable to the Brazilian market conditions.
Sintef being the first foreign accredited research institution is a milestone. Sintef does not act as a public institution, nor as a private. He has no doubts that Sintef will play a much-needed role in the Brazilian market, even beyond the extent that Brazil realizes. There is a missing link in applied science in Brazil. In Norway when researched its ready to be launched in the value chain of the industry. The Norwegian model has managed to connect the research and industry closely together, while enough lubricating by public findings that enables us to be excellent in those areas we have decided to be good at.
He thinks it is a very interesting, and a correct observation that Brazil might lack important cultural features important to cluster cooperation. Trust building is the biggest difference between norway and brazil. For Norwegians it is not natural to share information, and trust is easily built.. In addition, there is an element of organizing from the government yet to be proved. Macaé, Rio, espiritos santos – they all want subsea clusters, yet the obvious location is Rio. Same with shipyards, but result was a huge shipyard cluster in Pernambuco (north in brazil where Lula former

president was borne). This is part of the political game in brazil; for PT to get enough votes, they must create jobs for the people in random locations. Sadly, political powers are pulling in different directions depending on personal interest rather than the nations. Three layers of power – municipal, state and federal - currently no conflict between federal and the state of rio, but his is first for a long time. MoU with Norway is a sign of ”green lights”, so it will be interesting to see the implementation capabilities. Erik is very pro-cluster and sees Rio Subsea cluster as positive for his clients and hopes that the government will implement its announced plans. IM look for B2B for their clients, and networking is key.

The political landscape cannot be overseen. PT (ruling party for past 8yrs), created an inefficient governance and has placed political allies into the Petrobras management. 2014 is election year, and he welcomes a political shift to at least ”pull up the roots” of existing proven corruption originated by the political alliances. IM has only been faced by corruption twice in its five year of doing business in Brazil and referred to their process control as ”medicine towards corruption”, at least for the petty-corruption that can be found in some public institutions. IM has a clear anti-corruption policy implemented. Following this, the source of corruption is slowly strangled. IM applied anti-corruption program influenced by Statoil’s ethical program and he believed that taking this stand will show benefits in the long run.

IM experience that demand from Norwegian companies decreased from 4-5 years ago, but equally many clients/projects are closing new deals. The businesses are more realistic and are more prepared when searching for advice. Much to be criticized in Brazil, still he is positive toward the future in brazil. Despite all the efficiency gaps, it is ”relatively” efficient because there are some giant fields in Brazil, and the development cost the field will therefore be offset by the upside potential. It is the largest offshore market in the world, larger than Norway and the offshore industry should position themselves towards the opportunities. Brazil is *the* best match in the world for where Norwegian supplier can deliver what we are best at: offshore & subsea. Only solution is to manage the transition, and the firms that break the code how to operate here will have huge potential.

The main threat is a drop in the oil price.

Appendix 9: Interview with Helge Austbø

Representing: DOF Subsea
Date: May 14th 2014
Location: Skype

Summary of interview

Establishmentt in Brazil was originally through the supply unit. The current leader in 2000-2001 observed declining oil production in Norway at a time of oil discoveries were happening in brazil. The prediction was that the Brazilian offshore market would pass Norway and DOF's long-term commitment in Brazil is a result of strategic thinking.

Upon entering Brazil, DOF already had 20 years of industry experience from the North Sea and was an international competitive company working on international standards. Brazil was a very immature market with few established companies and DOF has a competitive advantage in basically everything we offer. Systems, ship designs that were developed in collaborated with Norwegian suppliers – several types of technology and knowledge were brought to Brazil. He describes the market as much more mature now, but reminds met hat 25 % of offshore vessels is still Norwegian owned. Offshore companies locally have Norway as a model and claims that Norwegian offshore companies are outstanding, if not the best. Norway is very prominent and very present in Rio.

The experience from operating in Brazil have very limited utility value elsewhere – perhaps in Argentina. Everything is operated very different and he is not sure if it is valuable. Technology is largely transferred from our international operations to Brazil, and much less the other way around. Brazil has a lot to learn from Norwegian companies, ex. the Norwegian experience in operating vessels.
Technological requirements are very high because of the challenging depth of the water, but most of the tech developed internationally and in Norway.
He adds that Petrobras uses contract setup very differently, which makes working with them very different than other international operators.

We go on to speak about the level of absorption of knowledge in Brazil. DOF is largely an operator (service provider), and does not produce or develop technology. Their suppliers on the other hand, are bringing technological solutions and equipment. One must remember that the industry is highly international – as is the technology – often tried out in the Gulf of Mexico, the North Sea and Asia.

DOF established in Brazil relatively early and have therefore been prominent part of the industry development. DOF has office/operation (purchase, logistics, crew coordinators) in Rio and Macaé, established warehouse, extensive experience of building boats in Brazil etc. On pressure from DOF, suppliers have opened training centers etc. Even so, the value chain has developed too slow - many have now established units with warehoused, but the chain is fairly weak.

Amongst the biggest challenges faced in Brazil he mentions bureaucracy first. The complexity of the tax model, Customs systems, large inventory cost due to the number of days to get supplies ten bras : far away and complicated system. Importing imply severe challenges. Lack of expertise (off and onshore): engineers, lack of expertise among sailors (no shortage of seafarers in general, but mariners with expertise), lack of providers struggling because they are fighting the same struggle: to get hold of competence! Consequently, the Brazilian cost is extreme. The bottlenecks are caused by a nascent maritime industry and low level of education.

He is convinced that LC helps to force the industry to establish itself permanent in Brazil. It does help bras to get a bras industry that works in bras with bras people. However, he criticizes LC for being so demanding that it contributes to cost pressures that are devastating for industry. It seems that the policies are not flexible enough. Gap between what is required in the LC and the present availability → resource pressures. There are not enough capacity to build all the yards that we need to build, and there is not enough people to do it. it we will not no ears enough to do what we should. LC is an important tool as a basic.

He points out that LC is resulting in training centers being built. DOF do not conduct research in brazil, keeping in mind that its not really relevant to their core business. 12

vessels are built and operating in Brazil - 100 % Brazilian crew! Need training to be able to use the equipment provided by our suppliers. DOF are renting spaces in training centers from companies such as Falk, Nutec, RR, (Kongsberg has something similar) provides us space. They even sent Brazilians to their training center in Kongsberg, as well as to Denmark. Local facilities in rio are improving which simplifies the process. SINTEF work with ship association on a project. To establish its own training facilities is a matter of ongoing assessment, but currently no concrete plans ...

All global suppliers are delivering to brazil, a limited amount is established in Brazil, and very few manufactures in brazil. What does it take to create a sustainable subsea supplier base in Rio? Large investments as they must have production facility in bras - and engineer competence. He claims that the hinder is that everyone is afraid of not getting the same quality of the equipment if produced locally. Greater risk for the buyers, as well as the suppliers. ”Building producing in Brazil is a risky sport!”
Very technology intensive solutions lay far, far ahead in the future. He exemplifies that ROV (advanced technology) will most likely not be manufactured in Brazil for a long time, but less high-tech systems applied in ROV might be a possibility to produce locally.

All suppliers are regularly evaluating this matter. DOF is pushing, but it is not sure that it beneficial for DOF as the quality will most likely be reduced as a result. Producing in Brazil is more expensive than producing abroad. Building a shipyard in Norway is approximately 30-40% lower than Brazil. The calculation on the finished products add up by high tax rates, lower labor efficiency, plus the struggling to find expertise that makes it even less effective.

Again, import and customs regimes cause challenges to lean processes. Very expensive for suppliers to order the goods, and very expensive for us to buy the taxed goods. Equipment must be booked in other factories and storing is not preferred as tariffs are larger if one does not know what boat it will be applied.
Without vessel (full tax), to specified vessel (less tax), however only to be used on that vessel!

Short term, the most relevant issue to resolve for DOF is local delivery of spare parts. It is not unusual for companies to find solution with spare parts that that already are produced in Brazil and remove it from our customs regime.

Qualifies workers are a major challenge and a scarce resource. Their senior workforce is generally recruited in the market. In the future it will is likely to recruit newly graduated engineer, depending on the progress of a potential service line.

Upon being asked if there exists a subsea cluster he holds no doubts. It is absolutely a cluster in Rio state including Macaé and the city RJ with very much activity. The environment involves major professional players within subsea sector, several providers of services and equipment, and more are joining us.

Its parent company DOF ASA is a member in NCE Subsea in Bergen. Austbø argues that if may even more beneficial for engagement in Rio subsea cluster due to the fact that the unit has links with NCE subsea. However, it has never been a subject of conversation with the HQ in Norway and he is unsure regarding its extent of participation and what it has meant to DOF as a company. They have been in contact with NCE subsea when their delegation has visited Rio.

They have been given information by NCE subsea, but no cooperation is engaged. He observes that it might be sensible to that NCE together with Innovation Norway try to link up towards Rio.

Taking part in Rio Subsea cluster is principally of interest. At this point it is irrelevant to take a stand on this issue as neither motive or goal are defined. He has some concerns on the level of prioritization it will be given, as things often are approached less practically. DOF is actively participating in several organizations here in Rio and must consider what is worthwhile. Among their Memberships are ABA (the brazilian shipowners' org), NBCC, ship owners' association, both Brazil and Norway. His impression is that Associations may have a tendency of being more disciplined, coherent, well planned with less distance between the organizations' members and the political apparatus. Tend to be more a platform for discussions and less committed to the resolutions.

The Norwegian support apparatus in Rio is very valuable. It provides a network for discussion viable for new arrivals and established. The forum is being used to announce issues of political art allowing Norwegian ministers visiting Rio to create political pressure in Norway. it is important to have a Norwegian network in a market of such importance to Norway as Rio is. DOF is not direct in BN21, but hold positions in boards participating and hence provided input to the strategy formation.

Appendix 10: E-mail correspondence with Audun Otteren

Representing: NCE Subsea
Date: May 25th 2014

1. *In NCE Subsea cluster, is it the industry or the academia (HiB, Sintef etc.) that is the major driving force behind the research?*

The short and general answer is that NCE Subsea trying to promote cooperation between research institutions and businesses through various initiatives, such as preliminary support for project creation and collaborative projects, seminars and conferences on research and technology challenges, consultancy to the establishment of joint projects and help to find funding for R&D and technology development. Specifically is R & D and technology development happening on several levels: further development of its own technology in each company or business cooperation (with or without public R & D support), through collaborations with research institutions (initiated by companies or research institutes) or longer-term R & D projects initiated by research institutions funded by public research funding and / or industry / companies. We are talking about technology / applied research. The initiator and the driving force in NCE Subsea is essentially the industry itself, but with significant research contributions from departments and with part-funding from the public institutions (Innovation Norway, the Research Council and others)

2. *With reference to the Breakfast Seminar: "Market Opportunities in Brazil". Is NCE Subsea experiencing much interest from its members to enter the*

Brazilian market? I notice that the focus is on export opportunities, is export a more appropriate for the SMEs in NCE Subsea than to establish operations in Brazil, or possible production units if necessary?

The general answer is that there is considerable interest in exports and the establishment in international markets among our member companies, and Brazil is of course one of the very relevant (due to the large subsea activities offshore Brazil). But we have the member companies with less than five employees up to large subsea supplier companies such as FMC, Aker Solutions, Subsea One, DOF Subsea etc. already international and established in Brazil. For the smaller and medium sized companies (which are not there already), it is obviously of great interest to explore the potential both for export and for establishing product/service production/delivery. But this is clearly a major investment and a long-term commitment and should be conducted in a network / collaboration with other companies and public institutions. It will be mostly dependent on the company's product and market strategy how the entrance will be.