International Journal of Economics, Commerce and Management
United Kingdom Vol. II, Issue 10, Oct 2014
http://ijecm.co.uk/ ISSN 2348 0386

STRATEGIC MODAL SHIFT FROM ROAD TO SEA TRANSPORT: A CASE STUDY OF STATOIL

Sakita, Benjamin Mosses
Faculty of Economics, Informatics and Social Change
Molde University, Molde, Norway
benjamin_mosses@yahoo.com

Abstract

Increased environmental concerns due to carbon emission and other greenhouse gases (GHGs) call upon a shift towards environmentally friendly modes of transport in oil and gas industry. Modal shift from road to sea has of late been highly encouraged in many policy documents, due to low carbon emissions in the latter than is the case in the former. However the challenge remains on the implementation of the strategic move towards green logistics. This paper proposes a framework which offshore oil and gas companies can adopt in moving from road to sea transport citing Statoil as a case study. Furthermore it explores and discuses methods in which Statoil could obtain a solution to environmentally friendly mode of transport as well as suggests the type of supply vessel that is cost-efficient and environmentally friendly. Modal shift will necessitate the use of third party logistics service providers. This will in turn influence transaction costs due to external market involvement. This paper posits that at the high level of environmental uncertainty when there is little / no trust between exchange partners, there is a high risk of ex-post opportunistic behaviour. On the contrary, opportunistic behaviour dampens with the high level of trust between exchange partners, thus reducing the transaction costs.

Keywords: Modal shift, Short Sea Shipping, Supply base operations, Oil & Gas Industry, Statoil, Environmental sustainability, Transaction Cost Economics.

INTRODUCTION

Business environment has of late been closely regulated due to increased environmental degradation that emanates from various business practices. The most important aspect of the subject matter in question is the impact various modes of transport has on the environment which has called for various measures such as MARPOL Annex VI which contains regulations for prevention of maritime pollution from ships, Marco Polo Programme, and such other regulatory frameworks as stipulated under Euro I – IV with respect to pollution from automobiles. For instance MARPOL Annex VI limits the maximum sulphur content of fuel to 3.5 per cent and rate is expected to be reduced further to 0.5% after 2020. In SOx emission control areas (SECAs) which includes the Baltic Sea and North Sea in Europe, the Sulphur limit in fuel is currently 1 per cent however the rate will change to 0.1 percent cum 1st July 2015 (Statoil, 2014; DieselNet, 2014).

Businesses are now urged to shift towards more sustainable modes of transport to reduce GHGs emission in the atmosphere with much attention being focused on reduction of $CO_{2,}$ SO_x, NO_x emissions. Companies are obliged to map their logistic systems towards green logistics. Fuel efficient as well as environmentally friendly modes of transport are nowadays sought after by many businesses.

However one of the basic barriers for modal shift is the lack of direct access of companies to railway networks and waterways and many companies still revert to road transport which contributes to a greatest extent environmental pollution in terms of greenhouse gases emission due to its ability to provide door to door freight delivery solutions which is lacking in the other modes of transport.

The bottom line for companies should be to move towards intermodal transportation system which combines two or more modes of transport to ensure environmental sustainability at the same time meeting businesses objective including inbound and outbound logistics.

Background to Statoil Company

Statoil is an international upstream, technology-driven energy company with operations in 37 countries worldwide. It was established in 1972 as the Norwegian state oil company having more than 40 years of experience in oil and gas production on the Norwegian continental shelf. Statoil is headquartered in Norway and operates in 37 countries with approximately 21,000 employees in this network; it was first listed on the New York and Oslo stock exchanges in June 2001. In Norway Statoil operates 7 supply bases as well as 6 helicopter bases in its logistics operations (Statoil, 2014).

Statoil is among the world's largest net sellers of crude oil and is the leading operator on the Norwegian continental shelf. Its ambition is to operate with zero harm to people, society and the environment, in accordance with the principles for sustainable development and therefore it recognizes a need to enhance environmentally friendly practices in light of its ambition to provide energy and to meet the growing demand that is necessary for social and economic development. In light of this Statoil recognizes the importance of reducing carbon footage in the atmosphere using its leading technology and innovative business solutions (Statoil, 2014).

Statoil has seven business areas which include; Development & Production Norway (DPN), Development & Production North America (DPNA), Development & Production International (DPI), Marketing, Processing, and Renewable Energy (MPR), Technology, Projects & Drilling (TPD), Exploration (EXP) and Global Strategy & Business Development (GSB). All these business areas work towards a unified purpose that enables Statoil to stand out among other oil and gas companies. Moreover Statoil is a world leader in the use of deep-water technology as well as a leader in carbon capture and storage (Statoil, 2014).

In October 2010, Statoil's energy and retail business became a stand-alone entity, Statoil Fuel & Retail ASA, through an initial public offering and listing on the Oslo Stock Exchange. However Statoil continues to own 54 per cent of the shares in Statoil Fuel & Retail, but on June 19 2012 Statoil ASA sold its shareholding in SFR (Statoil, 2014).

Supply Base Operations at Statoil

The use of supply bases at Statoil is partly controlled by licence conditions (Statoil, 2014). The base model used by Statoil comprises three aspects; technical service which includes receipt of goods, inspection, packing and securing of cargo; operational logistic which includes warehouse operations and stocktaking; terminal logistics which encompasses internal transportation, and loading and unloading of vessels. The technical service and operational logistics are carried out by Bring Logistics under service contract. The supply bases' demand is initiated by demand at offshore installations, these installations require frequent deliveries and short lead times, have limited storage capacity, high leasing fee for equipment, and large disruption cost in production and drilling (Statoil, 2014).

Supply Chain at Statoil

Statoil has one of the complex supply chains which stem from its operations with regards to upstream logistics, the supply chain includes the supply bases, vendors, and offshore oil and gas platforms hereinafter referred to as offshore installations, the supply chain needs to be responsive as any delay in delivery has a significant financial consequences due to ripple effect as links in the chain are highly dependent on each other, it is estimated that a 1 day stop of operations could result into a loss of 150 million NOK (Statoil, 2014). Such overhead is daunting to ever try to incur and therefore close coordination and communication among supply chain actors are imperative. However the installation of radio frequency identifier (RFID) technology is currently underway, this technology will enable each container to have unique identification number that can then be tracked at any point in time during transit in the supply chain.

Motivation for Shifting towards Sea Transport

Statoil wants to shift towards more sea transport so as to reduce emissions, reduce costs especially on long distance transport, and reduce road transport to enhance less accidents, less people exposed to emissions, less noise, less congestion, and less road wear (Statoil, 2014).. The overall objective of shifting modes is thus socially beneficial as well as environmentally friendly, put together cost savings can be achieved due to fewer penalties on emissions.

Barriers to sea transport (Statoil, 2014)

i. Need for the truck transport to the vessel (not – door –to-door) – from the vendor and to the port
ii. Increased number of loading/unloading operations – first loaded on the truck and then unloaded at the port and then loaded again on the vessels
iii. Increased risk if an accident occurs.
iv. Low frequency and flexibility (due to consolidation because vessels use scale effect
v. Old and not suited vessels
vi. Needs demanding cargo consolidation
vii. More intensive coordination and follow up
viii. Costs:
ix. Planning horizon and lead times.

Statement of Problem

The subject matter in the case of Statoil is how to achieve a shift towards a more environmentally friendly mode of transport with regard to upstream logistics. Currently supplies and cargo are distributed to various supply bases by trucks these are said to heavily pollute the environment and have negative external cost to society in terms of road wear, congestion, health related issues, accidents, and most importantly carbon emissions, the main component of (GHGs). The current modal split at Statoil includes 89 per cent freight transport by road, 8 per cent by sea and 3 per cent by air.

The supply bases are spread out along the Norwegian Continental Shelf, the vendors are centralized in Stavanger and thus Bring logistic company is responsible for shipping supplies on land from Stavanger to other supply bases in Fløro, Bergen/Mongstad, Kristiansund, Brønnøysund, Sandnessjøen, and Hammerfest. It is from these bases where cargo and supplies can then be shipped to offshore installations using supply vessels.

It follows that upstream logistics in the context of oil and gas industry on the Norwegian continental shelf entails among others providing the offshore installations with necessary supplies which are delivered by supply vessels from onshore bases (Aas et al., 2009). The definition could be expanded to include logistical activities between the vendors and supply bases which is the centre of attention of this case study.

Purpose and Research Questions

The purpose of this study is to bring to light ways in which Statoil could shift from using road transport to sea transport when supplies are transported from vendors to supply bases. This brings up the following questions that will help us solve the problem:

- How can Statoil achieve an environmentally friendly sea transport solution that is cost efficient and meets service requirements?
- How beneficial short sea transport is compared to road transport?
- What is a suitable type of vessel that Statoil must use sea transport in order to achieve an efficient and environmentally friendly sea transport solution?

Delimitations

This paper might have not taken into consideration all important factors pertinent to this case study due to lack of complete information that was necessary to assimilate the case and resolve it meaningfully, however this paper has focused attention more on qualitative aspects pertinent to the subject matter in question.

Research Paper Outline

The rest of this case study is structured as follows; chapter two presents relevant literature review. Chapter three presents findings discussions and recommendations, objectives and purpose of this case study are going to be discussed in this chapter. Chapter four presents conclusion and poses commendations for further research work.

THEORETICAL BACKGROUND

The oil and gas industry depend upon shipment of cargo to and from offshore installations. The emissions from supply vessels depend upon fuel consumed during sailing to and from offshore installations and supply bases and loading and unloading of cargo at both ends. Supply vessels use diesel or liquefied natural gas (LNG) and produce CO_2, methane (CH_4), NO_x, and SO_x emissions. CO_2 is determined by the carbon content in the fuel, and is therefore linearly dependent on fuel consumption (Norlund et al., 2013).

Moreover Norlund et al., (2013), posit that LNG has lower carbon content than diesel and therefore yields reduced CO_2 emissions, but the unburned methane emissions may reduce this gain. NO_x emissions are dependent on the engine conditions under which the fuel is burned. SO_x emissions originate from sulphur in the fuel oxidized in the combustion process, and emissions of particles are related to the type of fuel.

Upstream Logistics and Supply Base Operations

Upstream logistics in the oil and gas industry entails supplying offshore installations which comprise drilling and production units with necessary supplies on a regular basis; this is normally done using supply vessels. According to Aas et al., (2009), the use of supply vessels represents one of the largest cost elements in the upstream supply chain of oil and gas installations. To be able to operate from remotely situated offshore drilling and production different supply vessels are required to cater for heterogeneous needs, these vessels include; anchor handling vessels, offshore supply vessels (OSVs), crew boats and standby/rescue vessels. The high value of the production and the high cost of delaying offshore operations dictate the design of the upstream chain (Aas et al., 2009).

Aas et al., (2009) point out two categories of drilling and production units which represent varying logistical needs, the first category represent those units which mainly produce and stay at the same position for a longer period called production platform or production ships, and the second category represents those units that move around on exploration, these are called exploration rigs/ships. The size offshore drilling and production units vary from small to large constructions with the latter having with several hundred workers onboard. The varieties of offshore drilling and production units are referred to as offshore installations (Aas et al., 2009).

The authors further argue that there is inherent uncertainty associated with supplies requirements in drilling operations due to its fluctuating demand in contrast to production installations whose demand is fairly predictable. Installations need not only receive supplies but also return cargos to the supply bases including empty load carriers, waste, rented equipment and excess back up equipment (Aas et al., 2009). Such practice according to the authors, necessitate directional balance.

Despite the fact that the supply vessels are chartered as is the case with Statoil the oil company normally dictate their operations and activities such as scheduling and routing are the responsibility of the logistic company (Aas et al., 2009).

Environmental Sustainability and Marco Polo Program

The Marco Polo Programme is the European Union's modal shift programme that is designed to reduce congestion and contribute to efficient and sustainable transportation system. It was established in 2001 with the broad objective of enhancing mode interoperability (Perakis et al., 2008). Since its inception the programme has offered funding for projects that shift freight transportation away from the roads. The first Marco Polo Program started off in 2003 and ran up until 2006. The aim was to establish more robust system that captures accurate statistical cargo data, establishing 16 national promotion centres, facilitate reduction in paperwork and improving on port infrastructure.

On the strength of its achievement, the EC presented the second Marco Polo II programme in July 2004. This program ran from 2007 till 2013 under a budget of 400million euro. The main theme of this program included the Motorways of the Sea concept in four European regions. Marco Polo II programme expanded the program to other countries neighbouring the European Union (Perakis et al., 2008). Recently the EC has funded a research project named CREATE3S, which aims to develop a new generation of standardized short sea vessels which consist of two modules, one ship hull module, and one large cargo module, which allow the vessels to unload their cargo at a go (Perakis et al., 2008).

Modal shift

Environmental concerns stress on the shift towards more sustainable modes of transport that is from road to Sea where the latter is thought to have lower emissions rates than the former. However these efforts have been greeted with deferring nationals' opinions who claim to define their logistics strategies to comply with their objectives of pull supply chains which support economic growth and fierce competition which call upon effective and efficient modes of transport system. To this end road transport is considered to be the mode that to a higher extent meets customers' requirements in terms of transit times, flexibility, reliability, frequency and cargo safety and is often the chosen mode. Road transport still dominates the modal split and the future growth of EU freight transport is expected to grow by about 2 per cent annually between 1997 and 2017. Perakis et al., (2008); Paixão et at., (2002), call upon a careful analysis of short sea shipping as an alternative mode of road transport so as to be able to be integrated in multimodal and intermodal transport chains.

Perakis et al., (2008), further argue that short sea operations can create an intermodal transportation network that will modally shift cargo, from high ways to sea for medium and long-haul distances it is no doubt that while Short sea shipping (SSS) can be highly competitive for long-haul due to economies of scale and its fuel efficiency, the trucks can deal with the short-haul pickup and delivery activities to its final destinations.

Moreover advocates of SSS propose a system that uses ro-ro vessels that will carry out a ferry type of service and thus will end up removing trucks from the coastal highways, besides this system the trucking industry can be a partner for SSS operations (Perakis et al., 2008).

Short Sea Shipping

Short sea shipping in Europe involves an area that spans from northern Norway through Baltic, down past the British Isles to the Iberian Peninsula and thence to the Mediterranean and Black Sea (Nahar et al., 2011).

Several definitions of SSS have been put forward, Nahar et al., (2011) define short sea shipping as maritime transportation of relatively short distances where there is no requirement of ocean crossings. But European Commission defines SSS as the carriage of goods by ships among the ports located in the geography of Europe or among these ports placed in non-European countries having a coastline on the enclosed seas around Europe. Stopford, (2009), defines SSS as a mode which provides transport within regions; it for instance distributes the cargo delivered by deep see vessels and provides a port to port service. Ships are generally smaller than deep sea vessels ranging from 400 dwt to 6000 dwt in size. The designs are focused on cargo flexibility and there are no firm rules about the sizes. The author further posits that small tankers, bulk carriers, ferries, container ships, gas tankers and vehicle carriers can be found in most of the regions on short-haul routes and combined transport with this mode is not necessarily limited to Ro-Ro carriage of goods, vehicles or semitrailers as it can also be used to ship goods in containers (Nahar et al., 2011).

EU has been proactively supporting SSS through the funding it provides for short sea projects since 1992 under its common transport policy, and it has become a major component of the Marco Polo Programme and part of the Trans-European Networks (TEN-T) (Perakis et al., 2008). In addition to that the White Paper of 2001 on European Transport Policy for 2010 stresses important role SSS plays in mitigating the growth of truck traffic, rebalancing the modal split, and bypassing land bottlenecks.

In the EU, SSS is defined as a largely complicated unitized market due to the modal sophistication of competing transport system, whereas Ro-Ro services compete on near sea and short distances with road transport on the strength of cost and physical geography, the Lo-Lo services compete on longer distances, a direct competition with the rail mode, and the split of Ro-Ro and Lo-Lo ships is attributable to logistics cost (Paixão et al., 2002). While the Ro-Ro vessels concern mainly transportation of truck trailers and other forms of wheeled cargo, the Lo-Lo vessels have lift on lift off capability enabling transportation of containers on coastal and inland waterways (Perakis et al., 2008).

SSS forms an example of a broken logistic chain whereby it needs the deployment of the interfaces that provide for cargo transfer between modes. The interfaces include dry ports, desiccated terminals and ports as well as surface transport distribution network (Paixão et al., 2002). According to Paixão et al., (2002), SSS as an alternative to road transport embraces three distinct categories of markets; the feeder market, the pure intra-European market and the cabotage market. The feeder operations are today seen as an extension of the door-to-door services and that it can provide the critical mass necessary for SSS so long as its market share is well-integrated and coordinated with the pure regional trade. Furthermore the openness and closeness of feeder and pure intra-European markets put together can enhance integration of this mode in terms of multimodal and intermodal transport corridors to achieve economies of scale, scope, and fitness.

The cabotage market herein is considered as pure domestic and islands trade and can be integrated with the two aforementioned markets of which the holistic integration of the three markets constitutes the definition of SSS, an enlarged hinterland and foreland where goods and passengers can be moved (Paixão et al., 2002). Table 1 below shows the distinguishing characteristics of the two types of SSS operations.

Nahar et al., (2011), further argue in favour of SSS that it tends to emit lesser grams of emission in comparison with other modes of transport for most of the pollutants of interest today. Table 1 below supports their argument

Strengths of Short Sea Shipping

According to Perakis et al., (2008), SSS has many advantages over land based modes of transport because it is more energy efficient, environmentally friendly, safer and requires less public expenditures on infrastructure, moreover it can add capacity to the existing transport network, which is necessary to accommodate future growth of international trade at relatively low cost.

- High fuel efficiency per ton-kilometre
- Low amount of CO_2 emissions
- Competitive to road transport (over a long distance of course) (Nahar et al., 2011).
- Low cost for infrastructure
- Increase road safety and decrease highway congestion.

Weaknesses of Short Sea Shipping

The weaknesses are mostly related to the port environment and the quality of service that SSS can provide. Barriers to its expansion are the lack of efficient port operations, unreliable vessel schedules, excessive paper work and administrative costs (Perakis et al., 2008).

- Port handling costs
- High transit time for loading and unloading
- Low vessel speed (lead time matters here)
- Image problem, shippers' reluctance.

Intermodal Transport

According to Crainic et al., (2007), intermodal transportation entails transportation of a person or a load from its origin to its destination by a sequence of at least two transport modes, the transfer from one mode to the next being performed at an intermodal terminal, the freight is normally shipped by several carriers. The most comprehensive definition of intermodal transport was given by European Conference of Ministers of Transport (2001) and it entails movement of goods in one and the same loading unit or vehicle which uses successively two or more modes of transport without handling the goods themselves in changing modes.

According to Nahar et al., (2011), Europe uses three modes of transport other than road in intermodal transport, namely; rail transport, inland shipping and SSS. Rail transport has a strong position on North South routes however it is as well used to transport maritime containers in Eastern Europe, similarly inland shipping has a strong position in hinterland connections from Rotterdam and Antwerp and SSS has a strong position in feeders from and to the bigger container ports like Antwerp, Felixstowe and Hamburg.

Various studies conducted in US and Europe revealed that SSS needs to be integrated into the intermodal transportation and logistics chains for its success. For instance empirical research study conducted in the UK and the US revealed that on time reliability and door-to-door capability are the leading factors in their choice for transportation mode; this implies that

SSS should be an integral part of multi-modal transportation network that will provide door-to-door solutions and just in time requirements (Perakis et al., 2008).

The mode interoperability should be such that while short sea vessels will take over long-haul leg of cargo transportation, truck will pick up and deliver the cargo to the final destinations henceforth trucking industry can become an ally and a complementary mode for SSS instead of direct competitors for the long-haul freight transportation (Perakis et al., 2008). The authors here further comment that successful integration of road transport and SSS can be witnessed in Osprey Lines in the US, and Samskip in Europe where such success was attributable to working together as intermodal providers.

Accordingly, modern supply chains do not focus exclusively on speed but also on time reliability with just in time transportation and zero inventory costs, such holistic view calls upon an integrated approach that can be offered by intermodal transportation whereby combined truck and SSS can take advantage of their efficiency, reliability, and flexibility (Perakis et al., 2008). The authors further suggest that network techniques and consolidation of cargo flows can improve the overall efficiency and reduce the total transportation cost significantly; consolidation networks in the innovative bundling enhance energy efficiency of rail and sea transportation for the long-haul part and the flexibility of road transportation for collection and distribution of cargo. Such integrated intermodal systems are broadly recognized as sustainable and environmentally friendly means of freight transportation.

The main barriers to intermodal transport are listed as: Distribution of cost and benefits among the actors involved; poor innovation ability; liability and documentation issues; poor quality stemming from damaged goods, long transport time and overall reliability; high costs; poor information flow; poor area coverage an infrastructure; lack of formal network/chain/system management to mention but a few.

Outsourcing of Logistics Activities and Transaction Cost Analysis (TCA)

Outsourcing of logistics function entails contracting out to third party logistics provider part of logistics that is not core business in an organization for reasons such as in order to focus more on the core functions, gain world class expertise to mention but a few. According to Selviaridis et al., (2008), third party logistics entails outsourcing of logistics activities to specialized service providers as an economically viable method of achieving productivity and service enhancements. Aas et al., (2008), argue that it is preferable for companies to outsource activities and processes which are not considered core business in terms of creating unique value.

Accordingly the evolution of complex supply chains creates bottlenecks on the logistics outsourcing decisions. Such difficulties have necessitated increased inter-organizational links in the complex supply chains (Aas et al., 2008). However outsourcing a logistics function may create too much dependency on the service provider which necessitates increased inter-firms coordination mechanism and increase transaction costs.

The basic Transaction cost analysis considerations state that high asset specificity could motivate opportunistic behaviour and comprehensive transaction costs. The transfer of activity-specific knowledge and specific knowledge about the upstream chain without participation in the upstream supply chain, such specific knowledge will vanish in time and possession of such information by external logistics provider will enforce dependence on this actor and will make it easier for the actor to exercise opportunistic behaviour (Aas et al., 2008). Replacement of logistic service provider executing upstream activities is associated with high switching cost owing to the specific knowledge associated with the execution of these activities

In order to prevent and unveil possible opportunistic behaviour and mal-adaptation, intensive monitoring and performance evaluations together with safeguarding efforts must be accounted for.

FINDINGS, DISCUSSIONS, AND RECOMMENDATIONS

The main barriers to SSS are; commercial shippers view it as an outdated, slow and complex mode of transportation, and that it has not fully become integrated into intermodal door-to-door, cumbersome administrative procedures, and that SSS requires short sea friendly ports that can offer quicker turnaround times, procedures and good hinterland connections (Nahar et al., 2011).

Ways to Achieve Modal Shift

For Statoil to achieve a shift towards more sea transport it may consider looking into the following plausible solutions that I have suggested here underneath. The solutions partly address general concern but are more focused on addressing the barriers that Statoil present they are imminent in Statoil's effort to use more of sea transport than road transport.

Consolidation

This would enable Statoil to benefit from economies of transportation where supplies from various vendors will be consolidated at Stavanger before shipment to the various supply bases; this however needs to work hand in hand with efficient vehicle routing to ensure that no delays of cargo at supply bases are encountered.

Increasing Load Factor

It should be appreciated that neither road no ship transport is supreme over the other because each one of these modes has different emissions with respect to different pollutants therefore it is imperative to use a combined mode by increasing the load factor of vessels as well as that of trucks to 60 per cent would enable shipment of more cargo, the current capacity for truck is 80 per cent while for vessel is 60 per cent (Statoil, 2014). Thus should Ro-Ro be used the combined capacity becomes 48 per cent load factor (Hjelle, 2010). By increasing load factor of vessels more cargo can be accommodated which will then enhance economies of transportation at the same time saving unit transportation cost. Most importantly emissions per ton-mile decreases when the vessels are fully loaded (Hjelle, 2010).

Improving Vessels' Turnaround Times at Ports

By improving port operations such as having modern facilities at supply bases, cargo handling times can be significantly reduced, this reduction has had a direct impact on the ship operational costs because then more trips can be made thus increasing utilization rate of vessels through maximization of loaded days at sea (Paixão et al., 2002; Stopford, 2009).

Adopting and Promoting Intermodal Transportation

The use of both road and sea could provide optimal solution especially when cargo and supplies are to be carried long distances it is economically feasible to ship the cargo by sea, then at the port of embarkation use of trucks to the supply bases is desired, this will then reduce carbon print in the entire leg hence achieving socially as well as environmentally responsive mode of transport. Moreover intermodal transport will provide the benefit of door-to-door solution that will lack if short see shipping will be used alone.

RFID Technology

The use of radio frequency identifier technology will improve overall performance of the supply chain and needs to be shared with the vendors as well, that is the vendors should be willing to use this technology. Nahar et al., (2011); Perakis et al., (2008), suggest that new technologies such as tracking and tracing information systems can facilitate coordination and increase the level of service it may facilitate on time delivery to meet varying demand from different supply bases.

Communication and Collaboration

By reinforcing communication between third party logistic providers and Statoil, more reliability will be enhanced in the supply chain and this will develop confidence and consequently attain shift towards more sea transport, this is in line with suggestions from Perakis et al., (2008)., where better communication and information sharing among various modes is necessary.

Forging Long Term Relationship with Ship Owners

Partnership relationship with supply vessels' owners would enable Statoil to reduce opportunism on the part of vessel owners. This will help dampen transaction costs of safeguarding the contract including ex-post performance costs thus enhance fluid logistical activities between the supply bases at the least cost possible.

Expanding Capacity of the Vessels

For starters Statoil can begin with average size vessels so as to assess the need for more capacity. This strategy is cost efficient as unused capacity is wasted. However by expanding capacity of the vessels more cargo and supplies can be accommodated thus number of times a vessel can sail to and from supply bases can significantly be reduced, thus saving fuel cost as well as reduced emission.

Synchronizing Delivery of Supplies and Equipment with Real Demand from Supply Bases

The aim of this, is to strike a balance where frantic delivery of supplies are avoided, thus cruising speeds are maintained at economical speed thus consuming less fuel and emitting low pollutants. Perakis et al., (2008), propose that itineraries and time tables among intermodal transport should be synchronized and that fast and efficient cargo transfer is a key for the success of SSS. Synergy effect of increased loading factor and synchronization of speed will consequently reduce the frequency of vessels required to visit the supply bases thus economical.

Cost Reductions

Perakis et al., (2008), suggest that port-ship interface should be automated so as to eliminate unnecessary delays and friction costs. The automation can reduce both ship handling costs and turnaround times of the containers. Concepts such as lean ports and cross-docking can increase terminal efficiency.

By Comparing Actual Time for the Trips between Stavanger and Supply Bases with Average Time

The aim is to identify time savings that are available so that vehicle routing schedules can be planned accordingly to incorporate any time savings, such that sailing speed is reduced to economical speed thus low cost and low fuel consumption with added advantage of reduced emissions.

Using Standard Size Containers

In order to facilitate smooth intermodal transport and use of sea transport ISO containers are imperative choice, because it will facilitate sharing of common facilities by both modes meanwhile sea vessels cover long legs.

Expanding Capacity of Supply Bases

When the supply bases are well capacitated they can accommodate cargo arriving by vessels instead of trucks, this will then reduce the frequency the trucks need to transport cargo to and from supply bases.

Intensive Coordination and Follow up

More intensive coordination and follow up can be attained with the help of intelligent transportation system (ITS) for port traffic management. Similar achievement can be drawn from Rotterdam which established a successful SSS operation using container barges and state of the art cargo handling technology (Perakis et al., 2008).

Consideration for Type of Vessel

The choice of vessels to serve different supply bases depend largely on the type of cargo that needs to be shipped to various supply bases. Assuming the cargo is of general nature Ro-Ro vessels offer a more flexible alternative to containerization for shipping a mix of containerized and wheeled cargoes ranging from mini-bulks in intermediate bulk containers and pallets through to heavy lift units of 90 tonnes (Stopford, 2009).

The Ro-Ro vessels are suitable for carrying any cargo that can easily be handled by fork-lift truck such as pallets and containers), and wheeled cargo such as loaded trucks and trailers. Stopford, (2009), suggests that a major benefit deriving from Ro-Ro vessel is its ability to provide fast port turnaround without cargo-handling facilities

Improving environmental performance of vessels

Norlund et al., (2013), suggest design and operations as two ways of improving environmental performance of vessels. The authors argue that the offshore supply vessels sailing through the NCS use Liquefied natural gas (LNG), with low GHGs emissions, such design is imperative to ensure sustainable environment, moreover the authors posit that speed reduction in vessels is operational measure which can lessen the fuel consumed and hence less emission in ton-kilometre.

The supply bases serving the many oil and gas fields in the NCS are licensed and independent of each other in terms of operations in a sense that each supply base serves its own set of offshore installations and thus necessitating separate vessel route planning to and from supply bases.

The scheduling of vessels from a supply base is done on a weekly basis where as an installation requires one or more visits per week, and therefore the vessels departing to installations should be fairly spread throughout the week (Norlund et al., 2013). Therefore planning of vessels should be such that it reflects the number of installations served as well as the differing needs of these installations this calls upon highly responsive vessels planning from Stavenger to other supply bases along the Norwegian continental shelf to ensure just in time delivery.

Norlund et al., (2013), define supply vessel planning as the process of simultaneously determining the fleet composition and the schedule for the vessels combined in a weekly schedule, where as a vessel schedule consists of consecutive vessel voyages. A voyage is defined by the start day from supply bases and a sequence of installations to visit.

This paper recommends Statoil to use Liquefied Natural Gas (LNG) propelled engines, these are fuel efficient engines and environmentally friendly in terms of low CO_2 emissions. The LNG engines are superior for NO_X and SO_X removal.

Statoil may opt for Ro-Ro vessels based on its strengths as being efficient in terms of fuel consumption and most importantly can help eliminate the challenge faced by Statoil in multiple load-on-load-off operations. Once trucks have been loaded with cargo they can then be rolled on to the vessel at the port of embarkation and rolled off at the calling port thus saving time and costs.

Another economically viable option available to Statoil is to use multi-purpose vessels (MPPs). According to Stopford, (2009), MPPs are suitable in a situation where there is a continuing demand for flexible liner tonnage. The author further posits that MPPs are typically between 8,000 and 22,000 dwt (dead weight tonnage) with three to five holds each of which contains a tween deck. The MPPs are designed in such as manner as to allow carriage of a full load of containers as well as general cargo and heavy lift. They can permit heavy and awkward cargoes which cannot be containerized. Furthermore their ability to pick up bulk cargoes helps to increase deadweight utilization Stoford.

There is also an alternative of using abatement equipment on vessels to reduce pollutants release into the atmosphere this can help curb NO_X and SO_X albeit in the foreseeable future until LNG operated vessels become available.

CONCLUSION

Study conducted on the road and sea transport by Vanherle, (2008), found out that neither road nor SSS is clearly better off than the other mode of transport. The comparisons were made based on the premise that both modes of transport used same departure and arrival points. The study revealed that while SSS is better off than road transport in the field of CO_2, this quality is offset when NO_x, SO_2, and Particulate Matters are considered. With the introduction of emission standards for road transport, it is apparent the same has become environmentally friendly; a similar score of the environmental performance has not been achieved by shipping which makes road traffic score better than SSS on most pollutants (Vanherle, 2008).

Furthermore studies conducted by various researchers on environmental sustainability of different modes of transport suggest that sea transport and rail transport are safer, environmentally friendly modes of transport compared to road transport when it comes to environment footprint of CO_2. However these modes are not superior over one another when the overall emissions are taken into considerations. This also is in line with research study conducted by Hjelle, (2010), where he revealed that ships without emission abatement technologies installed have significantly higher NO_x emissions that modern heavy goods vehicles, several other cases in the article revealed that road transport is the most environmentally friendly mode of transport. While this contradicts the common belief that sea transport is more environmentally friendly the question remains why then politicians insists on modal shift? Further research work can be extended in order to find answers to the question above.

However this case study has looked into the benefits and possibilities of attaining economies of scope from using intermodal transportation system where Statoil will be able to reduce turn-around times, operational costs with respect to loading and unloading. Thus this paper has been able to address research questions albeit to some extent because further analysis necessitated numerical information that was not available at the time of preparation of this case paper.

It should be appreciated that modal shift is not an overnight affair; it needs strategic approach and involvement of several stakeholders such as road hauliers and ship owners. Cooperation is vital for ensuring that this goal is attained.

The bottom line may be to use LNG fuel on both trucks and vessels. While for supply bases that are near Stavanger trucks may prove to be economical viable alternative, those supply bases that are further north could embark on consolidation that is necessary to allow for optimum load factor in order to shift cargo on vessels.

However due to lack of data, it has proved difficult to draw comparison as to which mode of transport should be opted for in lieu of another, this leaves room for future research work. Data relating to emissions such as type of cargo, distance covered, average speed, and fuel consumption, engine technologies, load effects (whether empty, half-full, or full), and road slope effect could not be obtained and thus this could contribute in the area of further research.

REFERENCES

Aas, B, Halskau, Ø, and Wallace, W.S, (2009). The role of supply vessels in offshore logistics. Journal of Maritime Economics & Logistics. Palgrave Macmillan. Vol. 11, 3, 302-325.

Aas, B. Buvik, A. and Cakic, D., (2008). Outsourcing of logistics activities in a complex supply chain: a case study from Norwegian oil and gas industry. *International Journal of Procurement, Vol, 1, No. 3.*

Crainic, T.G. and Kim, H.K. (2007). Intermodal Transportation. Handbooks in Operations Research and Management Science. Volume 14, Pages 467-537

DieselNet, (2014). Emission Standards. http://www.dieselnet.com/standards/inter/imo.php (Accessed 10/03/2014)

Hjelle, H.M. (2010). Short Sea Shipping's Green Label at Risk, Transport Reviews: A Transnational Transdisciplinary Journal, 30:5, 617-640.

Nahar, R. Leinberg, P. and Islam, S., (2011). Sustainable Aspects of Short Sea Shipping: A Case Study of Europe. Interdisciplinary Journal of Contemporary Research in Business. Vol. 2, No. 9

Norlund, K.E and Gribkovskaia, I, (2013). Reducing emissions through speed optimization in supply vessel operations. Journal of Transportation Research Part D 23 (2013) 105-113.

Paixão, A.C. and Marlow, P.B., (2002). Strengths and weaknesses of short sea shipping. Marine Policy 26(3), 167-178

Perakis, A.N. and Denisis, A., (2008). A survey of short sea shipping and its prospects in the USA. Maritime Policy & Management, Vol. 35, No. 6, 591-614.

Statoil, (2014). About Statoil. http://www.statoil.com/no/about/pages/default.aspx (Accessed 08/03/2014)

Statoil, (2014). Statoil business case presentation.

Selviaridis, K. Spring, M. Profillidis, V. and Botroris, G., (2008). Benefits, Risks, Selection Criteria, and Success Factors for Third-Party Logistics Services. Palgrave Macmillan.

Stopford, M. (2009). *Maritime Economics, 3rd Ed.* Routledge.

Vanherle, K. (2008). The Road versus Short Sea Race. http://www.shortsea.be/html_en/publicaties/documents/finaal%20rapport%20race-EN-101008.pdf (Accessed 04/03/2014)

ANNEXURE

Table 1: emissions (in grams/ton kilometre) for freight mode

Mode	CO	HC	PM	NOx	SO2	CO2
Road	.479	.227	.078	.978	.031	98.301
Rail	.196	.098	.027	.472	.036	28.338
Short Sea Shipping	.036	.012	.006	.311	.290	15.450
Ocean Shipping	.048	.016	.0483	.499	N.A	N.A

Source: Adopted from Nahar et al., (2011)

Table 2: Comparison of two types of short sea operations

Vessels type	Ro-Ro ships	Lo-Lo ships/ container barges
Cargo carrying Units	Trailers (53')	ISO containers (TEU, FEU)
Carrying capacity	200-500 trailers	500-1200 TEU
Cargo origin	Domestic	International
Time sensitivity	High	Low
Load and unload time	Low	High
Port turnaround time	Low	High
Infrastructure costs	Low	High
Cargo handling costs	Low	High
Projected required freight rate ($/unit)	High	Low
Potential alliance with	Trucking industry	Ports

Source: Perakis t al., (2008)