

The greening of the offshore and marine industry business essay

[Business](#)



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ABSTRACT

The offshore and marine (O&M) industry has become a pillar of economic growth for Singapore. In this day and age, it is faced with many unprecedented changes and challenges. Such challenges include incipient stringent regulations, requirements for deeper oil and gas explorations and a plethora of sustainability issues. In light of these, green strategies and alliances seem to be the apt answer to better manage these intractable issues. This paper aims to study what drives the formation of green alliances, analyse the role of green alliances in contributing to sustainability as a whole as well as to elucidate the link between green alliances and global citizenship. On the whole, the formation of green alliances can be attributed to two main factors, namely, legislative (external) and organizational factors (internal). Green alliances are often the means to stakeholder management and the route taken to reap the bountiful benefits of having a strong social network. Green alliances are also involved when organizations source for partners extrinsic to their line of business to complement their business model and processes. Lastly, such green alliances form the stepping stones towards global citizenship and eventually a sustainable business model as pro-active and integrative approaches are taken.

INTRODUCTION

" Sustainable development" is the buzzword for the future of the shipping industry. Mr Koji Sekimizu, Secretary-general of the International Maritime Organisation (IMO). Singapore has one of the most thriving offshore and

marine (O&M) industries worldwide and is the largest manufacturer in Floating Production Storage Offloading (FPSO) conversion, jack-up rigs, oil and gas drilling units and offshore support vessels. In myriad parts of the world, it would not be uncommon to find O&M facilities which have been built by Singapore-based companies (Singapore Economic Development Board, 2012). Today, Singapore plays host to more than 3, 000 established O&M organizations. The massive scale of operations of this industry has enabled it to become one of Singapore's pillars of growth, reaping an average of S\$16 billion annual turnover in the past few years. With the demand for energy forecasted to grow at an exponential pace as economic behemoths such as China mature, further strain is placed on rapidly depleting natural resources like oil. This has resulted in the need to seek alternative energy sources and thereby undertaking more ambitious tasks to endeavour deeper to locate and retrieve oil and gas. These environmental stymies, together with globalisation and the tightening of environmental regulations, have presented organisations in this industry with a slew of new challenges especially with regards to profitability. Consequently, there is a growing recognition of the importance of sustainable practises/strategies. However, the viability of such strategies for companies, especially in terms of its impacts on financial performance, remains nebulous. In this paper, we will examine, in relation to industry conduct and performance, the role of such green strategies and the alliances formed with regards to a number of O&M technologies and applications, including oil rigs, FPSOs, renewables, subsea technology and waste management. In reality, different companies have their own unique capabilities and each area of technology would warrant

different measures. We thus have to analyze how green alliances can be deployed effectively on a case-by-case basis and their importance in bringing organizations closer to addressing pertinent global issues.

Key Environmental Concerns

A blooming O&M industry can be largely attributed to high oil and gas prices and an ageing offshore fleet. The extraction of oil and oil itself have resulted in substantial environmental concerns which includes the release of carcinogenic substances into the environment.

Oil-well Blowouts

One challenge for offshore Exploration & Production (E&P) is the need to control the vigorous changes in temperatures and pressures when drilling into rock formations located deep in the ocean (Rose, 2009). High-pressure and high-temperature gases present during the drilling process can cause dangerous oil-well blowouts. One example is the 1969 blowout off the Santa Barbara, California coast that spilled 80-100, 000 gallons of crude oil and inundated local beaches, killing thousands of birds, fish, and marine mammals.

Produced Water

Another disturbing concern is the volume and type of wastes generated by offshore activities. Produced water is the biggest waste associated with oil and gas E&P. By volume, 98% of the waste from E&P is produced water - a mixture comprising hydrocarbons, naturally occurring radioactive materials, dissolved solids, and chemical additives used during drilling. In year 2010, every tonne of hydrocarbon produced discharged 0. 6 tonnes of produced

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water to the marine environment and 1. 0 tonne of produced water was re-injected into the ground (OGP, 2011).

Oil Spills

The quick influx and concentration of oil during a spill is especially harmful to localized marine organisms and communities (Rose, 2009). When discharged into the marine environment, oil slicks and produced water may adversely impact local organisms. Some of the environmental damage caused by an oil spill can last for decades after the spill occurs.

Rigs Disposal

Decommissioning an oil rig refers to the act of flushing, plugging, cementing and subsequent removal of wells in order to make them safe (Mark J. Kaiser, 2006). Decommissioning is complicated by various considerations such as cost, safety, operational duration, environmental issues, risk and experience. Regulatory enactments in 2010 require oil and gas companies to plug 3, 500 non-producing wells and dismantle 650 unused production platforms in the Gulf of Mexico (TETRA Technologies, Inc, 2010). However, this has failed to elicit the appropriate response due to hefty costs necessitated. There is no common consensus whether old oil rigs should be removed. On the business perspective, sinking old oil rigs can help save costs (Peter, Ashley M. Fowler & David J, 2011). However, environmentalists believe that they should be removed, reasoning that the marine life around the oil structures is not a true marine life habitat. Furthermore, the major potential environmental effects from these platforms are resultants of the discharge of wastes. As

mentioned, oil spills often result in both immediate and long-term environmental damage which has resulted in a debate on decommissioning.

Potential Technological Solutions

In this section, we will examine various technologies and solutions that help to minimise the environmental impact the O&M industry brings.

Green FPSO Technology

A floating production, storage and offloading (FPSO) unit is a floating vessel for the processing of hydrocarbons and storage of oil. It is designed to receive, process and store hydrocarbons and oil until it can be offloaded onto a tanker or through a pipeline (Sailors Club, 2011). FPSOs are particularly effective in remote deep-water locations where seabed pipelines are less cost-effective. Being portable, they can be relocated to new oil fields when current ones become exhausted, reducing the environmental footprint. It is built in a way that resists any chances of oil spillage by effectively storing the distilled product from the crude raw-material. (Moses, 2012).

Offshore Renewables

It is now widely recognized that there must be a paradigm shift in energy production from fossil fuels to alternative energy sources to mitigate the effects of anthropogenically induced climate change (King, 2004). Renewable energies are often viewed as environmentally benign vis-a-vis carbon-based energy supplies (Rosenzweig, 2003). Amongst these, wind power has notably increased in capacity in recent years (Herbert et al., 2007).

Subsea Processing Systems

Subsea processing systems have been extensively accepted as solutions to boost field economics by maximizing recovery, enhancing production and minimising costs. Halvorsen, senior vice president for FMC Technologies Global Subsea Production Systems mentioned that " a true subsea development is very environmentally friendly" (SPG Media Limited, 2007). Oil and gas could be recovered from under the ice or in key fishing grounds and produced direct to shore, carefully circumventing many environmental issues associated with E&P in such sensitive areas (SPG Media Limited, 2007). In June 2007, the separator used at Tordis that ensures that residual oil droplets are discharged into separate subsea wells instead of the sea, won a EUREKA award for its outstanding environmental benefits (Net Resources International, 2007). If adopted across the industry, this kind of technology can make sure subsea continues to contribute towards a greener oil output.

Offshore Waste Management

Growing social pressure from public opinion has made it vital for the industry to adopt new principles and implement stricter controls in environmental waste management systems. Keppel Seghers is the environmental technology arm of Keppel. Its waste-to-energy plants use advanced technology solutions to generate green energy from waste and help in landfill diversion by as much as 90% through the reduction of volume of waste disposed, thereby maximising the value of waste streams and minimising the environmental impact. The Domestic Solid Waste Management Centre by Keppel Seghers is the first integrated waste

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management facility in the Middle East which features one of the largest composting plants in the world, improved seaborne garbage process. It is designed to handle and treat domestic solid waste for the whole of Qatar.

Green Alliances

Green alliances are long-term relationships forged between two entities with the aim of employing environmentally friendly and sustainable practises. A distinction between partnerships and alliances should be made. The nuance is noted in the time horizon perspective of the relationship. According to the Journal of Petroleum Technology, partnerships are defined as " short-term, project specific, relationships between supplier and client that seek to gain greater economic value for both parties" (Schlumberger, 1995). Alliances shares many similarities with partnerships, with the exception that they are forged to persist beyond the time horizons of individual projects, having a long-term view. In alliances, it is more than the supplier offering integrated services to the client. Rather, both parties collaborate to seek win-win solutions for both parties. In the case of green alliances, sustainability would be a key concern in the development of such solutions or strategies. The highest level of green alliances comes in the form of strategic alliances whereby both parties strive to achieve strategic objectives through interdependence (they engage in open sharing of strategies to arrive at common objectives). Due to the complexity and possible high costs for research and development (R&D) of green solutions, it may prove crucial for various organizations to come together and forge alliances to capitalize on one another's strengths in order to meet strategic objectives. The need to form green alliances to better utilize strategic sustainable strategies

commences with awareness of the importance of collaboration. The concept of green alliance is exemplified by a joint R&D project between Sembcorp Marine Technology, Ngee Ann Polytechnic's Centre of Innovation, SIF Agrotechnology Asia and Memiontec to develop a chemical-free ballast water management system (Sembcorp Marine, 2009). The aim of this research is to devise a safe and environmentally friendly way of treating micro-organisms present in ballast water on-board ships. This will minimise the potential impact on native ecology upon being discharged.

Strategic Implications of Green Alliances - Networks Model

The formation of green alliances can be elucidated by the Networks Model which focuses on the interrelationships of an organization and that each individual organization is but a single element/actor in the network of relationships formed. The model sets out to explain the role of social relations and interactions amongst individual actors (Wade, 2005). This model also highlights the strategic implications of forming green alliances at various levels of relationships. The O&M industry is currently evolving due to the need to operate in more inhospitable milieu and the increased emphasis on environmentally-friendly practices. As the industry matures and stabilizes, on one hand organizations are building up their niches, on the other hand, there is greater need for interaction between various stakeholders to achieve common goals. Actors in a web/network of relationships are interdependent. This can be tied to the perspective of the business ecosystem[1] which plays a vital role in determining how organizations are run, the access to information flow and problem resolutions at the company and industry level (Burt, Ronald S, 1992). No organization is self-sufficient in that it has all the

relevant competencies or resources to meet its growing objectives. Thus, the greater the number of relationships/alliances formed, the greater its access to resources." There is a general aversion across the region to inorganic growth, to establishing real joint ventures and true partnerships to the benefits of both parties." John Westwood

Most studies have shown that small and tight networks could be less useful than wide but weak networks (Granovetter, M. D, 2004). This is due to the fact that the tight network already possesses much shared knowledge and opportunities unlike a large network that has wider access to technology. To expand the network rapidly, the firm would first establish stable relationships with trusted partners. These relationships burgeon into extensive networks via mutual recommendations forming the basis of possible alliances. These networks could then be the means for the organization to gather information and work together on the business front and on corporate social responsibilities. As illustrated in the figure below, the Networks Model can be expanded into a 3-dimensional model (Brito, 1999) explaining the three main types of relationships forged as applied to green alliances - namely, horizontal, vertical and institutional relationships which Brito coined as " collective actors". The relationships are denoted in terms of nodes (individual actors) and ties. Collective actors to tackle communal issues

C: UsersShi HaoDropboxUntitled. pnghttp://homepages. feis. herts. ac. uk/~nngroup/images/neuroConstruct_Large. jpgInstitutional RelationshipsVertical RelationshipsHorizontal RelationshipsFigure 4: Types of Relationships Involved in the Networks Model (Source: http://homepages. feis. herts. ac. uk/~nngroup/software. php)

Research Questions and Objectives

The focus of this research paper is both in the formation and role of green alliances. As such the following are the stipulated research questions: 1. What are the factors that drive the formation of green alliances? 2. What is the role of green alliances in contributing to corporate sustainability? 3. What are the environmental and legislative challenges faced by the Offshore and Marine Industry and the actions taken to tackle these challenges?

Research Methodology

Given the focal point of our research is on the formation and influence of green alliances, the nature of our research is qualitative. In addition to information gleaned from myriad sources from the internet, we have conducted a number of in depth case studies on various organizations such as Keppel and Schlumberger. Following which, we conducted an interview with Keppel to enquire about what green strategies they have in place and to gain further insights into the role of green alliances in the Offshore and Marine (O&M) industry.

Proposed Sustainability Model

We propose a sustainability model (Figure 1) that encapsulates the process of implementing and reaping the benefits of sustainability practises. We posit that there are two main drivers of the greening in the O&M industry - legislative (external) and organizational (internal) factors. Profit generation serves as a pull factor while regulations serve as the push factor for organizations to adopt sustainable practices. – need to describe the model

Figure 1: Proposed Sustainability Model

External Pressures

Internal Operations

(i) Portfolio Management

(ii) Stakeholder Management

SuppliersRegulators & CompetitorsInstitutionsComplementors

Global Citizenship

Green Alliances

In this paper, we will discourse on the role of green strategies and alliances - from their conception to the importance of such alliances and lastly to the need to go beyond having a narrow view of alliances and to embrace global citizenship. Extensive research findings on Keppel Offshore and Marine and Schlumberger will be used throughout the paper.

External Pressures

It is not uncommon that, based on companies' internal assessments, they are not inclined to adopt green strategies or are unaware of the benefits. It is external factors which can be the catalysts for many organizations to make this pursuit.

Social Pressure to Protect the Planet

With the trend of industries hopping on the wave of environmentalism of late, the O&M industry is lagging behind. The International Maritime Organization (IMO) and many other organizations worldwide have recognized the need to tend to the environmental issues of this industry where its yearly emissions exceed that of the entire continent of Africa[2](International

Maritime Organization, 2009). The O&M sector has also come under fire with the scarcity of oil and the need to delve deeper into the ocean for oil extraction. This has several implications on the environment and thus involves much research to devise "cleantech" solutions or green technologies. With the nascent trend for this industry to go green, researchers are attempting to analyse the feasibility of green strategies for incumbent corporations. With the awareness of climate change and rapid urbanisation, there is rise in social pressure to protect the planet coupled with a growing demand for sustainable environmental solutions. This includes solutions to treat waste and wastewater and harnessing renewable energy sources to mitigate the impact of global warming. The development of environmentally-friendly solutions while contributing to sustainability, has become both an ecological responsibility and economic opportunity for firms. Companies alone can only develop solutions limited to their own expertise but joint efforts with partners, governments or institutions can undoubtedly yield more promising results.

Role of Regulations

The reason for the O&M industry for being a laggard in the green movement is partly due to its complexity and the lack of proper regulation (until recently). Several accidents have led to regulations being passed and amended over the years. For example, during the International Offshore Petroleum Regulators and Operators Summit in 2011, participants recognised that both the Montara incident and Macondo incident have been catalysts for major change in the regulation and operations of the offshore petroleum industry (IPIECA, 2010). The Montara oil spill was an oil and gas

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leak that took place in the Montara oil field in the Timor Sea. It was one of Australia's worst oil disasters that lasted 74 days and a discharge of a possible 2, 000 barrels. The Macondo Prospect, designated in the United States Exclusive Economic Zone of the Gulf of Mexico, was the site of the Deepwater Horizon drilling rig explosion in April 2010. The explosion killed 11 and injured 16 workers. It also caused the Deepwater Horizon to conflagrate and sink, causing a massive offshore oil spill in the Gulf of Mexico; notably the largest environmental disaster in U. S. history. Subsequently, the US government promptly adopted new standards and regulations, including halting 33 deepwater drilling operations in the Gulf. Indubitably, there are many stringent operating regulations in the O&M Industry. It is evident how regulations placed on the O&M Industry have led to the need for industry players to adopt greener strategies in order to survive and remain strong in the industry. For instance, heavy emitters of GHG are required by the U. S. Environmental Protection Agency (EPA) to collect GHG emissions data under a national reporting system for tracking and appraisal purposes. The information gathered would further understanding of available channels, including specific regulations to be enacted, to ameliorate GHG emission levels. As mentioned by Mr Foo[3], regulations are the central reason for the implementation of sustainability efforts. Different companies have varying business strategies that lead to dissimilar approaches in adhering to regulatory requirements. Keppel, being a global citizen and a firm believer of sustainability as the main driver to achieving full business potential, strives to move up the technology ladder. This led to the establishment of Keppel Offshore & Marine Technology Centre in 2007 to develop innovative solutions

that are commercially viable and adaptable to the industry's needs.

Regulations form the basis for actuating companies to look into greener strategies. Taking these green strategies to another level instead of simply meeting regulations depends on the company's business strategy and its attitude towards global citizenship[4]. Regulations are expected to continue changing and increasing over the years as environmental issues become more prominent. Thus, companies need to step up on their adoption of green strategies or forming green alliances to remain sustainable.

Internal Operations

Upon the external promptings and agnizing the importance of sustainable practises, organizations move on to an internal assessment of the organization, both at the portfolio level and the wider circle of stakeholders.

Role of Green Alliances in Portfolio Management

The bottom line implicates that a firm has to be able to generate profit before endeavouring any green strategy. The figure below demonstrates how profit serves as the bottom line. If external factors affect a firm's reputation which in turn affect a firm's profit generation, or if relationship building affects profits directly or indirectly through its reputation (possibly through the Networks Model elucidated later on), a firm will consider employing green strategies and enter into green alliances. Portfolio management, which can involve relationship building, enhances profit generation too." If it is not a regulation, nobody would want to do it especially if it costs money. Very few companies do it voluntarily if it is not required. For Keppel it is based on our business strategy. In order to be a

sustainable business, we have to move up the technology ladder so we set up the technology." – Charles Foo

Figure 2: Profit Generation as the Bottom-linePortfolio ManagementProfit GenerationRelationship

Building ReputationExternal FactorsBottom-lineBefore entering into alliances, a firm has to be cognizant of its strengths and limitations. It would not desire entering into alliances for which the partner's capabilities do not synergize with its own. Thus, firms should commence with their own portfolio management. The O&M industry, being high-specialised, heavily relies on premier technology to drive its efficiency and effectiveness in completing tasks. Technological issues thus play a significant role in O&M firms' portfolio management. Optimal portfolio management involves finding the right balance between "technology bets" and the organization's risk profile (Vivek & Tamas, 2012). The O&M industry faces high levels of market or systematic risk, with profits tied to the market prices of oil and gas, political factors and legislation, all of which are beyond control by individual companies.

Production cost and efficiency can be controlled by companies and this explains the need for R&D and other investments that boost productivity. In addition to managing risks and improving productivity, the time horizon of the investment (in green technologies and alliances) has to be reviewed. According to Schlumberger's report on "Preparing for Opportunity", there are three types of technology bets – incremental, substantial and breakthrough (Schlumberger, 2011). Incremental ideas enhance the value of existing or known technology. Substantial ideas leverage adjacent technologies[5]and aim to produce premium platforms and uses.

Breakthrough ideas bring about disruptive technologies that offer entirely

new value propositions and that change the game altogether. In forming alliances, firms make such a "technology bet" to improve their portfolio. For instance, two firms' technologies could complement each other to produce something even more monumental while ensuring the risks are not astronomical. Schlumberger and Keppel applied portfolio management relatively well in forming green alliances. The tables below show how these firms entered into alliances to optimize their portfolios.

Case 1: Keppel and the Seafox Group

Keppel's Competencies Keppel's Responsibility Technology Bet Time

Horizon Great expertise in offshore technologies such as FPSOs and jack-up

technologies KFELS provided its Multi-Purpose Self-Elevating Platform

(MPSEP) to be deployed for wind turbine installation Breakthrough-

Significantly improves safety, operations, time and cost to operators in harsh environments which are becoming more prevalent due to the growing

scarcity of oil. Long-term – Keppel aims to add greater value to the merging

offshore wind energy sector Table 1: Keppel and the Seafox Group Case 2:

Schlumberger and Archer Daniels Midland (ADM) Company and the Midwest

Geological Sequestration Consortium (MGSC) Schlumberger's

Competencies Schlumberger's Responsibility Technology Bet Time

Horizon Great expertise in Carbon Capture and Storage Schlumberger is in

charge of the project management for the design and construction of wells

linked with the storage part of the project Substantial – Schlumberger has

been leading the development of carbon capture and storage research,

being a stakeholder in the international Carbon Sequestration Leadership

Forum. New technologies in this area would enhance its premier

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performance in this area. Long-term investment to combat climate change as part of global citizenship" In the long-term, companies that obtain the right level of exposure in areas where they have an ability to execute will ultimately win out" SBC Energy PerspectivesTable 2: Schlumberger and Archer Daniels Midland (ADM) Company and the Midwest Geological Sequestration Consortium (MGSC)(MGSC)Organizations should note that they ought to develop their core competencies before attempting to engage in effective alliances. This may prove intractable for new start-ups with lower levels of experience and expertise. Long-term planning and foresight is crucial too. A SWOT[6]analysis can then be used to better map out the organization's strengths, weaknesses, opportunities and threats to better understand how it can leverage its competencies and to seize the right opportunities to propel itself forward. Thus, portfolio management entails building up and seeking opportunities to leverage the organization's strengths, while managing risks prudently.

Role of Green Alliances in Stakeholder Management

We first need to understand that a firm alone inevitably lacks all the resources it needs to succeed. The stakeholder management theory looks into the interactions within these relationships, postulating that each organization is at the centre of a series of mutually-dependent relationships with multiple interest groups (Freeman, 1984). We have identified four major groups of stakeholders in the O&M industry and their concerns as illustrated in Figure 3. Figure 3: Stakeholder ManagementStakeholder theory augments a firm's application of portfolio management theory in terms of its core competencies and what it lacks. Firms tend to pay more attention to

stakeholders who control critical resources essential for its survival. When firms establish relationships with stakeholders beyond normal transactions, they can benefit from significant competitive advantages (Fombrun, C. and Shanley, M, 1990). This would be greatly advantageous in sustainability efforts of any firm. We next utilize the Network Model to shed light on the formation of green alliances with respect to the above-mentioned stakeholders[7].

Relations with Suppliers

Vertical relationships refer to those between actors along the value chain beginning with the supplier and up to the distributor and customer (Ford, 1998). Vertical relationships are relatively more common as organizations understand that increasing the effectiveness and quality of the value chain boosts business for all involved. Schlumberger exemplified the concept of alliance through the value chain by sharing its Ocean Framework software technology with other companies (even including competitors) (Schlumberger, 2011). This software system allows users to add desired scientific modules into the system to suit their needs such as the running of exploration seismic data and searching for and analysing oil reservoirs. As an oilfield services provider, Schlumberger had worked on, designed and shared such technology with other companies from other industry sets (e. g. Geophysical services) in light of the alliances forged which will benefit both Schlumberger and the business ecosystem. This also aids in Schlumberger's expansion into various fields and this is in line with the Networks Model of gaining control over resources.

Relations with Regulators and Competitors

" It would be oxymoronic to ally with a direct competitor"- Charles

FooHorizontal relationships refer to those organizations with overlapping business interests at the same level in the value chain (Araujo, L. and Mouzas, S, 1997). While these relationships are rare due to the high possibility of conflicting interests, they may prove viable in strategic arrangements. According to Mr Foo of Keppel, the possibility of horizontal alliances is a relatively inchoate concept with respect to the O&M industry. He feels that it is oxymoronic to ally with a competitor but does not winnow out possible collaborations. Levy (2003) introduced the term " co-opetition" to show that both cooperation and competition can coexist (Levy et al, 2003). More often than not, competing firms are indirectly collaborating with one another without realizing the subtle relationship. A third-party can aptly play the role of a mediator for such collaborations between competitors. Keppel O&M has worked together with regulators to develop new regulations on safety, environmental and reporting standards. These new regulations, when approved, would subsequently be imposed upon and adopted by the other parties (who also contribute invaluable information to regulators) in the industry. This represents a form of indirect alliance between major industry players with a third-party as a focal point. Similarly, Schlumberger plays a role in the setting of regulations on climate change such as through its contributions on " Carbon, Capture and Storage" (CSS) to the United Nations Intergovernmental Panel on Climate Change[8](IPCC). Dong Energy also contributed insightful perspectives on energy utilization to mitigate the adverse impacts of climate change. The IPCC serves as a confluence for the

consolidation, analysis and presentation of scientific, technical and socio-economic information pertaining to climate change. It puts together assessment reports for use by regulators and major decision-makers. As illustrated in Figure 5, these organizations are indirectly working with one another towards a common goal to handle climate change. Adoption of new regulation & guidelines

FeedbackSchlumbergerCompetitorThird Party (IPCC)Common Goal* Regulator sets standardsPreparation of reports

Figure 5: Formation of Horizontal Relationships *Hypothetically, all stakeholders – industry players, institutions and regulatory bodies - will gravitate towards a common goal, e. g. tackling climate changeWill gravitate towards the co

Relations with Institutions

Institutional relationships involve regulatory bodies like classification societies and the government and research institutes stepping in to tackle various issues. In the case of the O&M industry, pertinent issues comprise safety, technological efficiency and environmental protection. An example of an institutional relationship would be the Energy Research Institute's (ERI@N of Nanyang Technological University) Joint Industry Programme in Offshore Renewables (Nanyang Technological University, 2011). It began with companies including Rolls-Royce, DNV, Vestas and Keppel Offshore & Marine, IBM and DHI. Its purpose was to construct efficient offshore power systems, develop innovative methods to fortify offshore wind turbines and nano-coatings resistant to corrosion. This idea of a strong social network is one of the propelling forces for the diffusion of innovation. According to the diffusion of technology theory (Rogers, E. M, 1995), when a highly respected actor adopts new innovation within a network, it is probable that diffusion

throughout the network would be much higher. This is especially so when there is a relative advantage over past innovations and the effects are observable.

Incorporating the Three Types of Relationships in Networks – Schlumberger's Approach

The concept of "green alliance" which involves all three types of relationships has been exemplified by Schlumberger. Schlumberger strongly believes in the idea of being a global citizen and had developed a global citizenship framework (Schlumberger, 2011). Through this framework, it incorporated technologies and strategies targeting issues of global concern into its business solutions. For example, with regards to tackling the climate change issues, Schlumberger pioneered the new technology of CCS[9]. Schlumberger played a pro-active role[10] in vouching for other stakeholders' interests, endeavoring to haul more players onto the bandwagon. It mapped out its CCS strategy delicately and gained the endorsement of the IPCC which would extract salient points to produce in its reports to aid the entire industry. Moreover, it had an initial partnership with several government organizations and the alliance network rapidly grew as more firms were convinced of the effects of global warming and the increasing government regulations. The rapid expansion and diffusion of technology to both along the value chain and to its competitors (who adopted the sustainable technologies) was attributed to Schlumberger's high density of networks and contacts. Playing a prima role in supporting international forums, collaborative research and providing aid to organizations dedicated at addressing carbon dioxide also bolstered Schlumberger's reputation and

expanded its client base. The figure below illustrates the pivotal role Schlumberger plays as a nexus of networks/relationships. Figure 6: Networks Model as exemplified by Schlumberger

Schlumberger

Competitors Competitors Customers Suppliers Third-parties

Global Objectives

Research Institutes Regulatory Bodies The Network Model thus demonstrates that having a strong social network strengthens a company's position and business model in the market. If a firm is part of a large network, diffusion of technologies can be adopted at a much higher pace as compared to one without such a network. Table 3 summarises the strategic implications of green alliances (being part of networks) to organizations and the industry as a whole.

Organization	Industry
Increased resource, competencies and information base	Best practices available for benchmarking purposes
Working around technological "blind spots"	Diffusion of technology
Aids in expansion and diversification	Greater customer value and improving the whole value chain for all involved
Building up good reputation	Better working relationships between parties

Table 3: Strategic Implications of Green Alliances

Role of Complementors - Social Exchange Theory

With the trend of organizations outsourcing various components of their business and seeking partnerships extraneous to their business line to cover loopholes in their business model, the role of a fourth stakeholder, complementors, is increasingly crucial. Complementors refer to organizations

outside the supply chain or industry that offers products or services that add value in the final delivery to end users. It has become passé to source for partners within the same industry. Allying with complementors can result in well-informed decisions hence creating a greater platform through which a firm can engage its customers. Complementors would fit into Brito's 3-dimensional model (Figure 4) as a diagonal vector that spans across all three dimensions/planes as shown in Figure 7. Complementors aid in augmenting the strengths of two planes to greater heights. Institutional

Relationships
Vertical Relationships
Horizontal Relationships
Figure 7:

Complementary Relationships vis-à-vis the Three Levels of

Relationships
Complementary Relationships
We will use the Social Exchange Theory to illustrate complementary relationships forged in green alliances.

The Social Exchange Theory sets to explain the social exchanges between parties and is often construed as a process of repeated negotiated exchanges of rewards resulting in win-win situations (Kendra Cherry, 2013).

The sole aim of economic exchanges is the maximization of profits and as such, presumes a rather short-term view. On the other hand, social exchange, valuing mutual trust, compatibility and long-lasting relationships, embodies a long-term view. Social Exchange Theory therefore emphasizes social relations which are crystallized through mutually beneficial

interactions over time and are anchored upon trust and good faith trust

(Scanzoni, J, 1979). In spite of such rudimentary basis, reciprocity is

intrinsically a voluntary behaviour and occasionally spawns free riding. In the

O&M industry, however, this problem is downplayed due to the highly

specialised nature[11]of the industry. Firstly, it will prove insightful to assay

the substance of an alliance based on the motives behind it. Strategic alliances can be categorized based on motives, namely, for exploitation and for exploration (Solevik, M. Z. & Westhead, P, 2010). Exploitation presides in alliances that seek to improve upon efficiency or to gain access to resources or market. Exploration entails learning, knowledge transfer, innovation and research over the long-term. The distinction between the two motives brings about the different time horizons of relationships. Exploitative relationships tend to be project-based while explorative alliances tend to be long-lasting with continual exchanges. Notwithstanding these benefits, in order for complementary relationships to play out, there usually needs to be strategic fit between the partners, in terms of both a technological overlap and a cultural overlap (depicted in Figure 8). Organizations need to rely on such complementary relationships to attain goals not possible otherwise.

Complementary Relationship

Common Goal:

Greater value in the final delivery of products and/or services

Figure 8: Basis of a Complementary Relationship

Technological & Cultural Overlap

Company from Supply Chain B

Company from Supply Chain A

Short-term Social Exchange

We now illustrate complementary social exchange with an example involving parties coming together for a common goal. Gutteling, a manufacturer of

flexible hoses for transportation of liquefied natural gas (LNG) entered into an alliance with TNO Offshore and Maritime, an independent research organisation (TNO, 2011). Others involved in the alliance were Exmar, a Belgian shipping company, and Excelerate Energy, an LNG importer. The alliance's aim was to develop a new kind of hose which was cheaper and more flexible. Gutteling possessed the technical expertise on hose-manufacturing while TNO had the research facilities and innovative factor to develop this new technology. Exmar, on the other hand, had the financial capabilities to support the project. Lastly, Excelerate provided a solid asset base and resources to expedite the research progress. As a result, as explicated by the Social Exchange Theory, the four entities entered into a mutual exchange in which they rode on one another's competitive advantage to achieve mutually beneficial outcomes as shown in Figure 9.

Figure 9: Complementary Relationships in Social Exchange

The alliance was formed over a shorter time horizon as it was project-based. It was effective as there was both technological and cultural overlap between the partners. All offered technology applicable to the O&M industry and research, innovation and efficiency were common ideals. The complementors, while not in the same business line, complemented one another to create greater value in the final product/delivery. The project was completed in a shorter span of time than could be done individually, while reaping the benefits of greater energy-efficiency.

Long-term Social Exchange

Next, we analyse long-term complementary social exchange[12]. IHC

Merwede Offshore & Marine had known TNO for a long time and the two

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have leveraged on each other's expertise (TNO, 2011). Recently, together with the collaboration with Greenpeace, an environmental organisation, the three organisations developed a type of drilling vessel which saves fuels and reduces emissions. As a result, new ships developed have 20% lower impact on the environment as compared to conventional ships. This exchange of ideas and knowledge suggests that though the three firms are involved in different areas of businesses, they complement one another in developing products to attain long-term goals that are beneficial to the entire industry and environment. In such instances, cultural overlap (in this case a desire for knowledge transfer) plays a more integral role than technological overlap to achieve a win-win situation in the alliance. The O&M industry, while being highly specialised, has room for different organizations to play a part in the conception of a product, from cradle to grave – regulation and standard-setting, research, design, production, testing, support, etc.

Global Citizenship

Pro-active and Integrative Approaches

Global citizenship refers to the attitude involved in acknowledging that we (both individuals and corporations) are civilians of one globe and should respect and proactively protect it for future generations to come. Promoting sustainable practices as viable business strategies is key to motivating companies to jump on the green bandwagon and go beyond the reactionary (i. e. beyond just compliance with regulations) and embrace global citizenship. If companies do not comprehend the value of investments in green solutions and alliances, coupled with high initial costs and uncertain returns, they are probably unwilling to be pro-active in the area of

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sustainability. The Networks Model has shown how green alliances are more efficacious in furthering sustainability goals than through unaccompanied efforts. Being part of an alliance enables companies to mutually benefit from the greening expertise of each party. However, global citizenship entails moving beyond alliances. In order for the whole industry, and the whole globe for that matter, to take a step forward in its battle against environmental issues, firms and alliances should play their part in disseminating green solutions, knowledge and technologies where plausible. Schlumberger has proven this point with its CSS project. Schlumberger is a good example of how sustainability practices have been integrated into its business model and dealings with other stakeholders – an integrative and proactive approach to global citizenship. Holding conferences and forums at local, regional and international levels are vital in promulgating the viability of green solutions. For example, Germany held her first trade fair, Windforce, in 2012 to provide offshore networking opportunities and to showcase expertise in the offshore wind industry. Offshore Energy 2012 Exhibition & Conference also featured strategies for successful offshore wind farm development. Companies involved in such conferences learn more about current greening practices in the O&M industry. In addition, when corporations collaborate and develop joint strategies, they offer greater credibility than self-formulated decisions and in turn, become less likely to be targeted by the government and environmental groups. Likewise, the government and NGOs stand to benefit from an alliance through achieving macro-environmental goals. Also, Mr Foo of Keppel discussed the positive "ripple effects" throughout the supply chain when a major player adopts

greener technologies. With regards to global citizenship, firms can be subsumed under four categories based on their attitudes towards green strategies and alliances. These are illustrated in the table below. Action-based Thought-based Contemplative Incorporates sustainable measures in its long-term vision but has yet to show concrete plans carried out Pro-active Goes beyond mere compliance and actively finds means to improve business processes in terms of sustainability and shares the information in alliances and publicly Complacent Completely or nearly removed from the picture Reactive Following the crowd where necessary to comply with regulations or to survive

Table 4: Different Attitudes towards Global Citizenship

A befitting example of a firm that fits into the pro-active category is Keppel. Apart from having successfully forged many alliances, Keppel O&M has been exemplary in its efforts to share its sustainable practices through its sustainability reports and conferences. At the Offshore Technology Conference [13] in May 2010, Keppel O&M showcased its expertise in offshore rigs, ship-repair and conversions and how sustainability can be hard-wired in business practices especially through environmental protection and workplace safety. Such strategies can be shared and applied to individual businesses, aiding them to go beyond simple compliance but the utilization of best practices. The use of benchmarking can be established for the evaluation of sustainability of organizations and incentives rewarded accordingly by the government.

Public Disclosures – Sustainability Reporting

Public disclosures on sustainability measures are another viable method for knowledge sharing and benchmarking for performance management. As

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sustainability is a global issue, there should be some means to assess firms' performance on a global scale. In order to gain steam on sustainable reporting, the Global Reporting Initiative (GRI) was established. The GRI is a non-profit organization that provides a comprehensive sustainability reporting framework that can be used worldwide. Maersk and Keppel are examples of companies that have been adhering to its framework. Keppel had recently increased the number of GRI indicators[14]it disclosed from 33-44 showing the importance of sustainability reporting in its course of business. Sustainability reporting has to grow exponentially before it becomes a ' necessary and essential' part of businesses. As more stakeholders acknowledge the importance of sustainability measures, many are expecting a sustainability report. Most organizations consider sustainability reporting as a valuable tool in promulgating information about the profitability and aspects regarding corporate social responsibility of their businesses. However, although more organisations are adopting sustainable reporting, Mr Foo feels that many do so without fully understanding what it involves. This concurs with research on the role of sustainability including feedback by GRI (GRI, 2008). Three main issues can be drawn. Lack of reporting on actual changes, benefits or damage made to the environment or communityLack of clear goal-settingSimply reporting on issues outside the core business of the firmRegarding the first issue, firms tend to document all its efforts on protecting environment without emphasizing actual results which are more pertinent in assessing the viability of such practices. Regarding the second issue, while the GRI is striving to streamline its criteria, firms themselves should set clear goals on sustainability for which

they will be assessed. Benchmarking at alliance and industry levels would help too, as will seeking other ways to gain feedback. Maersk pro-actively sought its customers' feedback on its sustainability performance and initiatives through questionnaires. As for the third issue, some firms simply "thrash out" anything they conjecture might be relevant to "sustainability", somewhat conflicting with the true purpose of sustainability reporting which is to enable readers to effectively appraise a firm's efforts. Hence, if the reporting lacks a clear structure, it may confound readers. For instance, some firms report monetary values of largesse for philanthropic causes but do not specifically analyse the breakdown of the respective components, causing unwarranted difficulty in assessing the firm's efforts. Hence, if these three issues can be surmounted, sustainability reporting will prove to be a boon in promoting green strategies and assessing performance management.

Recommendations

In this section, we bring up three recommendations for the O&M industry in order to enhance the role of green strategies/alliances and to encourage more firms to take a pro-active role in global citizenship.

Regulations vis-à-vis Profit Generation

Profit is the main driving force and perhaps the deal-breaker in determining whether companies engage in green technologies and alliances. Regulations should be oriented to encourage the execution of such green practices as demonstrated by the flowchart below. Figure 10: Regulations vis-à-vis Profit Generation

Low Success Rate
Financial aid
Consultation
Forming green

alliances. As illustrated, the government has to implement apposite regulations to ensure organizations internalise any damage to the environment by imposing penalties. Penalties and fines alone create a reactionary attitude which has to be complemented by incentives like research grants for investments in green technology and financial rewards for top green organizations for outstanding contributions to the sustainability landscape. This is supported by Olsen's By-Product theory (Voteview, 2013) in that large organizations are better able to spur its members to contribute by offering private benefits. This two-pronged approach will motivate organizations to engage in green practises when they realise the benefits outweigh the costs. Organizations will then place greater emphasis on sustainability while striving for greater cost-savings. Green practises may boost efficiency, enhance working relationships, reduce compliance costs, and increase investor confidence to obtain funding. Upon a successful outcome, the organization will likely take a pro-active stance towards sustainability practises and form more green alliances. However, certain organizations may grapple with success but should not be left to bite the dust. On a case-by-case basis, financial aid from the government can be conferred, especially if the organization had conducted the research on behalf of the public. Consultation services from more experienced firms can be given. Also, these organizations should be encouraged to form green alliances (with strategic fit) which aid in defraying costs and enhancing performance. Lastly, monitoring and feedback are required to evaluate and fine-tune regulations. Sustainability reporting should be mandated (e. g. annual reports for listed companies) and consistent reporting standards such

as those established by the GRI should be used. Performance evaluation can then be executed more objectively.

Glocal Approach

Sustainability is a global concept. Climate change, for example, affects the entire globe and not simply localized regions. Thus, common standards/regulations should be set so that everyone can work towards a common goal. However, this will prove to be a miry quagmire as different countries face dissimilar problems and are at different stages of development. Thus a glocal approach should be taken whereby global goals are examined in relation to local contexts and problems. Indubitably, this calls for a series of global conferences to discuss and identify relevant goals. These goals can be managed as guidelines initially until countries are ready to embark on them as regulations. These goals, when scaled to a local level, should not adversely affect the country's development nor aggravate its problems. For example, when the Brazilian government broke the state monopoly on oil exploration and production exercised solely by Petrobras by enacting the Petroleum Law in 1997, many international oil companies were attracted to Brazil. On one hand, this boosted its economy, but on the other, increased its environmental footprint. A glocal approach will take into account both Brazil's economic growth and the role it has to play in contributing to sustainability efforts. Regulations can be set to control the growth of companies that enter Brazil while striking a balance between production and sustainability. It is noteworthy that such measures will take time as currently, the boundaries that form and identify the O&M industry are nebulous (partly explaining the lack of common standards). However, as

the industry expands and given its growing importance (e. g. renewables), the industry will become more recognised along with more potent regulations.

Cultural Mediation

According to research by Crane (1998), while there exists cultural differences between partners each having their own unitary culture, within partners/organizations themselves, there are collections of " subcultural groups". These subcultural groups represent factions in the organization that have a distinct culture from other factions or the organization as a whole. It is through these subcultural groups that the practise of sustainability can take root. A viable recommendation is as such - just like how organizations have internal audit departments, organizations should have a department which deals mainly with sustainability issues. This department, a subcultural group, may be multi-disciplinary in nature to tackle the variegated issues of sustainability. Naturally, this group must be given sufficient clout to influence the organization's decisions. In the balance between profit and sustainability, Crane calls these subcultural groups " cultural mediators" which weld crevices in cultural knowledge present in an alliance. We expand this idea in that such sustainability groups/departments can be the cultural mediators that link with other organizations' sustainability departments in order to diffuse relevant knowledge throughout the alliance. This ties in well with the social exchange theory described earlier that effective alliances require both technological and cultural overlaps to achieve a strategic fit. TNO formed many effective alliances as its partners often shared its penchant for sustainability and innovation. This recommendation is also substantiated by

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the importance of knowledge transfer in alliances. As shown in Figure 12, the sustainability departments will aid in both intra and inter-firm cultural mediation and the diffusion of relevant knowledge. In relation to the O&M industry, this is plausible given the scale and the highly specialised nature of the industry. Many firms should have the resources to dedicate to establishing such a department. Figure 11: Cultural MediationInter-firm Cultural MediationSocial Exchange

Firm A

Sustainability Department

Firm B

Sustainability DepartmentIntra-firm cultural mediation

Conclusion

In this paper, we have put forth a model mapping the formation and role of green alliances for the O&M industry, holistically addressing the stated research questions and objectives. External factors serve as the catalysts for organizations to embrace green strategies while internal factors, especially profit-generation, serve as the bottom-line consideration before adopting green strategies. We have analysed the successes of firms like Keppel and Schlumberger in their pro-active stances relating to green alliances. The value of green alliances is manifest under stakeholder management. Four major stakeholders, namely, members of the supply chain, regulators, institutions and complementors have been identified. The Networks Model underscores the value of having a wide and dense network and the importance of being involved at all three levels - vertical, horizontal and

institutional relationships – in order for the whole industry to benefit. The last group of stakeholders, complementors, are crucial as organizations source for partners outside the supply chain and industry to enhance the value of their products and services. The Social Exchange Theory elucidates such relationships. While alliances are crucial, the attitude firms take is more paramount. Firms should take on a proactive and integrative stance towards green strategies and alliances. This involves sharing and promulgating green technologies and knowledge. Lastly, we acknowledged the weaknesses of certain areas in the O&M industry and offered recommendations that can prove useful to the industry. Regulations can encourage firms to go beyond the mere reactionary by aligning firms' interests with global concerns. Glocal approaches are needed to account for the different stages of development of many countries in the world and cultural mediation will facilitate knowledge transfer and collaborations between diverse firms. Sustainability trends are set to become more prevalent in the O&M industry. It is a matter of the actions by regulatory bodies and firms and their alliances that will ascertain the progress, direction and fruits of such a movement.

Appendix

Keppel Offshore & Marine

Keppel Offshore & Marine (O&M) is the global leader in offshore rig design, construction and repair, ship repair and conversion, and specialised shipbuilding. Headquartered in Singapore, Keppel O&M has 20 yards and offices worldwide. Keppel's Offshore Division is helmed by Keppel FELS, a leading designer, builder and repairer of high-performance mobile offshore rigs. Its portfolio of proprietary designs and floating production solutions

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meets a broad spectrum of operating requirements, including deep waters and harsh environments. With technology innovation and competent design and engineering capabilities, Keppel offers viable, cost-effective and highly adaptable solutions for newbuilds and upgraded offshore units. These include: design and construction of jack-up rigs, semisubmersible rigs, floating production systems and other advanced vessels such as drillships; Repair, upgrading and conversion of offshore rigs; Design and development of critical rig equipment; Fabrication of offshore structures and rig components. Its Marine Division is represented by Keppel Shipyard, the trusted industry name for the repair, conversion and upgrading of a diverse range of vessels. Keppel has a strong commitment to Health, Safety and Environment and an established reputation of reliability, flexibility and quality for complex projects with quick turnaround. Keppel is the leader in the conversion of Floating Production Storage and Offloading, Floating Storage and Offloading and Floating Storage and Re-gasification Units.

Schlumberger

Schlumberger Limited is the world's leading oilfield services company supplying technology, information solutions and integrated project management that optimize reservoir performance for customers working in the oil and gas industry. Founded in 1926, today the company employs more than 118, 000 people of over 140 nationalities working in approximately 85 countries. The company comprises two business segments, Schlumberger Oilfield Services and WesternGeco. Schlumberger Oilfield Services supplies a wide range of products and services from formation evaluation through directional drilling, well cementing and stimulation, well completions and

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productivity to consulting, software, information management and IT infrastructure services that support core industry operational processes. WesternGeco is the world's largest seismic company and provides advanced acquisition and data processing services. Schlumberger services and solutions combine domain expertise, best practices, safe and environmentally sound well site operations, innovative technologies, and high-quality support aimed at helping its customers increase oilfield efficiency, lower finding and producing costs, improve productivity, maximize reserve recovery, and increase asset value in a safe, environmentally sound manner. Schlumberger believes in maintaining the highest standards of the quality, health and safety of its employees, customers and contractors, as well as for the protection of the environment.