**Competency Building and Capacity Enhancement of the Emerging Off-shore Gas and Oil Industry in Sri Lanka**

Workshop Proceedings

07\textsuperscript{th} & 08\textsuperscript{th} January 2013

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University Grants Commission

jointly with

Petroleum Resources Development Secretariat
Proceedings of Workshop on Competency Building and Capacity Enhancement of the Emerging Off-shore Gas and Oil Industry in Sri Lanka held on 07th & 08th January 2013 at Jetwing Blue, Negombo, Sri Lanka


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Printed and bound by
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PREFACE

Sri Lanka possesses a territorial sea of 21,500 km$^2$ and an Exclusive Economic Zone (EEZ) of 517,000 km$^2$ up to 200 nautical miles (370 km) from the coastal line (MFOR, 2002), and has rights to the resources in the water column, seabed and subsurface of the EEZ. In view of the possible availability of hydrocarbons in the EEZ, the Government of Sri Lanka initiated off-shore petroleum exploration some 40 years ago in the late 1960s, and obtained the assistance of several countries including the USSR, USA, Canada and Norway to drill wells in the Mannar and Cauvery basins. However, these efforts failed to encounter any significant reservoir rock, and hence the investigations were discontinued.

In 2007, the Petroleum Resources Development Secretariat (PRDS) was established under the President's Office and a Licensing Round was launched for three exploration blocks in the Mannar Basin. Exploratory work undertaken by Cairns India Ltd in the Mannar basin yielded promising results, based on which the Government of Sri Lanka, represented by PRDS, launched the Second Offshore Licensing Round in March 2013 offering a total of 13 blocks located in the Cauvery and Mannar basins for bidding.

Given the promising results from the exploratory work by Cairns India Ltd, and the potential manpower needs at technical, executive, managerial and scientific levels in the emerging petroleum sector, it becomes imperative for the vocational and higher educational institutions to be in a state of readiness to deliver relevant courses in the event of the investigations establishing the existence of commercially viable quantities of hydrocarbon in the seabed. Such preparedness is particularly important in view of the prohibitive cost of importing manpower as well as the need to generate such manpower locally in the face of economic sensitivities and geo-political vulnerabilities.
Currently, the Department of Geology, University of Peradeniya and the Department of Physics, University of Sri Jayawardenapura offer some modules related to the upstream segment while the Departments of Earth Resources Engineering and Mining and Mineral Engineering, University of Moratuwa offer modules related to the mid and downstream segments of the petroleum industry with some laboratory facilities for basic training. These departments also have some trained staff and laboratory and training facilities relevant to the petroleum industry. Yet, both human and physical resources available in the HEIs are far from adequate to design and deliver the requisite courses at undergraduate and postgraduate level. Likewise, the vocational training institutions too have neither the capacity nor the capability to offer the requisite vocational courses to meet the potential needs of the petroleum industry.

It is against this backdrop that the Standing Committee on Engineering and Architecture of the UGC joined hands with the Petroleum Resources Development Secretariat (PRDS), President’s Office to conduct a Workshop on “Competency Building and Capacity Enhancement in the Emerging Off-shore Oil and Gas Industry in Sri Lanka” with the participation of the key stakeholders.

The Workshop was attended by resource persons from the universities, Ministry of Power and Energy, Petroleum Resources Development Secretariat, public and private sector institutions, and from abroad, including senior scientists engaged in drilling for Cairns India Ltd in Sri Lanka. The deliberations of the Workshop principally addressed the following issues:

1. The present status of drilling
2. Policy and fiscal issues
3. Manpower needed at vocational, technical, professional and executive levels
4. Vocational and degree programmes required to meet the requisite manpower needs
5. Capacity building needs
6. Lessons from leading petroleum producing countries
7. Role of the private sector in training and providing the requisite services for the industry
8. Health, safety and environmental issues

In addition to the papers presented, the volume contains two invited papers to complement and supplement the proceedings of the Workshop. We are confident that the volume will be of immense value and relevance to legislators, policy makers, planners, leaders in vocational and higher educational institutions and public and private sector institutions engaged or are likely to be engaged in activities related to the gas and oil industry. It will also serve as a source book to teachers and students engaged subjects related to the exploration and production of gas and oil and allied fields.

Ranjith Senaratne
Sivanandam Sivasegaram
Editors
ACKNOWLEDGEMENTS

The Workshop on “Competency Building and Capacity Enhancement of the Emerging Off-shore Gas and Oil Industry in Sri Lanka” was conducted on 07th and 08th January 2013 at Jetwing Blue Hotel in Negombo in view of the promising results obtained following the off-shore exploration of gas and oil undertaken in the Mannar Basin. First and foremost, we express our deep gratitude to Hon. S.B. Dissanayake, Minister of Higher Education for being a source of encouragement and for gracing the Workshop.

The Workshop was organized with the unstinted support and cooperation of Mr. Saliya Wickramasuriya and Eng. D.T.K. Preeni Withanage of the Petroleum Resources Development Secretariat (PRDS), President’s Office. We wish to record our deep appreciation to them.

Thanks are particularly due to Prof. Stuart Burley, Head of Geosciences, Cairn India Limited for his keynote address titled “The Exploration and Production Industry: Global Perspectives and Sri Lankan National Prospects and Opportunities” which set the tone and tempo of the Workshop. Our special thanks also go to presenters of papers, chairpersons and rapporteurs of the sessions for their valuable contribution to make the Workshop a success. Particular mention should be made in this context to the contributions by Dr. Sunil Jayantha Nawaratne, Emeritus Prof. Kapila Dahanayake, Dr. Kapila Ediriweera and Prof. Dayantha Wijeyesekera.

Active participation in the deliberations of the Workshop by the galaxy of luminous personalities, including policy makers, intellectuals, institutional leaders from public and private sector institutions and the senior dons present contributed immensely in achieving the objectives of the Workshop, and their valuable contribution is highly appreciated.
Financial assistance for the Workshop was provided by the University Grants Commission and the Petroleum Resources Development Secretariat. The Workshop was organized under the auspices of the Standing Committee on Engineering and Architecture. Ms. Gayani Wickramarrachchi, Mr. Shammika Wijewardane and Ms. Shiromi Rajasuriya of the Office of the Vice Chairman of the University Grants Commission worked with great dedication and devotion in organizing the Workshop as well as in bringing out the volume. Their contribution is gratefully acknowledged.

The editors also thank the printer, Tharanjee Prints for the meticulous care with which the volume has been produced.
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Abstract

Sri Lanka’s energy industry, if directed towards new innovations and discoveries, would certainly bring greater socio-economic benefits. The natural gas discovery brought to light during the year 2011 today has indeed become a matter of favourable concern that is expected to support all national interests of Sri Lanka. Further justifying its previous ventures in oil exploration, Sri Lanka's Oil exploration project undertaken by Cairn Lanka in the Mannar basin is one of the most successful operations in the region. The back to back discovery of natural gas in the two wells Dorado and Baracuda (block SL 2007-01-001) within the Mannar basin, has made Sri Lanka’s hope of being self sufficient in its own hydrocarbon reserves a reality. However considering such projections and favourable domestic conditions, the growing trends in the world energy usage patterns towards natural gas consumption as a non-renewable fossil fuel offer Sri Lanka the scope and potential to develop natural gas as a progressive industry.

Introduction

The Oil and Gas industry, with its changing trends and new energy discoveries, has been identified as one of the fastest growing industries in the global context. Sri Lanka’s energy industry, if directed towards new innovations and discoveries, would certainly bring considerable socio-economic benefits. Sri Lanka’s oil exploration activities have a history of 50 years, with its commencement dating back to the 1960s. This, while giving an indication of its potential for new future discoveries, is indicative of Sri Lanka’s keen interest to grow in the direction of energy supplies. Based on research analysis and statistical estimates, it has been observed that natural gas is expected to play a progressive role in the global fuel
energy mix over the next thirty years, greatly supported by technological developments that will help improve the production and supply of this clean, abundant energy resource. Natural gas is affordable, reliable, available and is considered the least carbon-intensive of the major energy sources. Therefore, this gradual leap towards increased consumption of natural gas will help consumers in availing greater benefits in an eco-friendly manner. The present growing trends in the global energy sector towards natural gas consumption as a non-renewable fossil fuel has shown Sri Lanka the future scope and potential of natural gas as an economical energy source, which is best suited for consumption. Capturing the market for natural gas will help Sri Lanka in defining the discovery of natural gas as an economic growth driver. The essence of it all depends purely on the realisable market potential for natural gas in Sri Lanka. Bringing to light the value of the natural gas discovery Sri Lanka is in possession of at present, this paper presents a comprehensive analysis of the prevalent domestic power sector issues and conditions surrounding the discovery that may prevent or hinder the speedy development of the discovery and how well such impediments could be eliminated in order to channelise the projected potential of Sri Lanka’s off-shore natural gas discovery in economically viable directions.

A glimpse of the dynamics governing the global energy arena

Energy is vital in every sphere of human activity and holds a history of many decades with its intense use dating back to the maiden oil discovery which took place in 1859. The world at large meets all its energy requirements with the use of various available energy sources namely: petroleum, coal, hydropower, natural gas, nuclear and other primary as well as renewable energy sources. However, as per the International Energy Agency statistics 2013, petroleum is in the lead as the most widely consumed energy source accounting for 895 kb/d in 2013 and is expected to further pick up to 1.1 mb/d by 2014. Along with the global demographic shifts that take place gradually, the speedy economic growth as well as the rising living standards that the world at large is experiencing will eventually drive up the global energy demand. In this regard, as clearly laid down in the Outlook for Energy Report 2013 (A view to 2040) published by ExxonMobil, the Global demand for energy is expected to reach 700 quadrillion BTUs by 2040 and will be mostly directed towards the consumption of oil, gas and coal consumption. There is a gradual rise in consumption patterns towards gas usage pertaining to the changing
trends in the global energy industry. Quite significantly, based on the British Petroleum Statistical Review 2011, it was predicted that the present global energy consumption patterns will soon be replaced by natural gas. Further justifying these forecasts, as per British Petroleum Statistical Review 2011 estimates, the global demand for natural gas grew at the rate of +7.4% (the most rapid increase since 1984) and was way ahead of the global demand for petroleum which grew at the rate of +3.1%. It is observed that in the near future, natural gas may replace several main sources of energy. Most OECD nations have been identified as growing markets for natural gas.

**Current orientation of Sri Lanka’s energy consumption**

Domestic energy consumption at present pertaining to all chores of daily life and commercial activity clearly states that energy is a vital element in the present Sri Lankan context. When catering to the growing energy demands, Sri Lanka as a developing nation mostly focuses on a combination of three main energy supplies namely: indigenous primary sources of energy, imported primary sources of energy and imported secondary sources of energy. While indigenous primary sources can be narrowed down to an excessive use of biomass and hydropower, imported primary sources of energy mostly consist of crude oil and small quantities of coal, and, as a secondary source of energy, Sri Lanka resorts to refined petroleum products. Taking in to consideration the present energy mix and the level of consumption, it could be observed that Sri Lanka’s energy consumption at present is largely directed towards crude oil importation.

As per 2012 CBSL statistics, expenditure incurred on crude oil importation which grew by 5% approximately amounted to US$ 5,037 million, notably accounting for a substantial portion of the country’s GDP. The gradual growth and development witnessed across many industries in terms of infrastructure, transportation, power generation, urbanisation, and the rise in household energy consumption have immensely contributed towards increased crude oil importation and consumption. As highlighted in the Sri Lanka Energy Balance 2010 report published by the Sri Lanka Sustainable Energy Authority, the primary energy source contribution catering to the total energy requirement of the nation consisted of biomass 45.82%, hydropower 11.07% and imported petroleum 40.86%. In addition to primary energy sources, electricity is regarded as a significant secondary source of energy which is a product of the energy conversion process. Total electricity generation as presented in the Sri Lanka Energy Balance
2010 report was rated at 10,783 GWh out of which over 40% was produced using petroleum.

Firstly focusing on the imported petroleum content based on the Energy Balance 2010 statistics, a sudden shift from crude oil imports to the importation of refined products is clearly visible during the years 2006, 2007 and 2008. While crude oil importation reduced slightly during the period 2009 to 2010, the rate of imported refined oil increased accounting for approximately 34.2% of the country's non-petroleum export earnings. Furthermore, data analysis as per the Sri Lanka Energy Balance 2010 report statistics reveal that the aggregate demand for petroleum has gradually grown by 2010 accounting for a share of 34.21% of the total energy demand. Diesel, petrol, kerosene, LPG, furnace oil and naphtha can be seen as the most widely consumed and greatly demanded petroleum products. Diesel which is a main contributor to the total petroleum product content, does not show a consistent demand growth rate during the period 2000 to 2007, mainly due to rapid demand fluctuations for diesel in the domestic market.

Out of a total demand growth rate of 2.9% for petroleum products, demand for diesel has secured a 0.20% growth rate over the seven years, in contrast to petrol that has reached an annual average growth rate of 18%. It can be observed that the continuous increase in the demand for transportation has resulted in this growth. Furthermore, a continuous decline in the demand for kerosene can be seen at the rate of 3.18% over the same period, mainly due to the intensified implementation of rural electricity generation projects and LPG substitution in place of kerosene for household consumption. The demand for naphtha from 2000 to 2007 although at 2.63% a rather insignificant component of the total demand, has shown a market growth rate of 99% per annum. This could be due to the increased trend towards electricity generation using naphtha.

**The dilemma encountered**

It is noteworthy to however begin by saying that, every problem that is identified with the primary aim of moving in search of practical treatments can often be associated with any new discovery or finding. However, the natural gas discovery brought to light during the year 2011 today has indeed become a matter of favourable concern that is expected to support all national interests of Sri Lanka. The oil and gas industry in the global
context has been identified as one of the fastest growing industries with its changing trends and new energy discoveries. Sri Lanka’s energy industry, if directed towards new innovations and discoveries, would certainly bring greater socio-economic benefits. Sri Lanka’s Oil exploration activities date back to 1960s. Further justifying its previous ventures in oil exploration, Sri Lanka’s Oil exploration project undertaken by Cairn Lanka in the Mannar basin is one of the most successful operations in recent times in the region. The back to back discovery of natural gas in the two wells Dorado and Baracuda (block SL 2007-01-001) within the Mannar basin, has made Sri Lanka’s dreams of being self sufficient in its own hydrocarbon reserves a reality. Growing trends in the world energy usage patterns towards natural gas consumption as a non-renewable fossil fuel offer Sri Lanka the scope and potential to develop natural gas as a progressive industry. However as recommended and stated in Sri Lanka’s energy policy, the country expects to increase its renewable energy power supply up to 7% by 2015. Considering such targets, these new discoveries if tapped rightly will help Sri Lanka in becoming an energy hub as highlighted in the present Mahinda Chinthana development agenda. In this context it can be said that problems relating to the discovery require suitable solutions to be developed in many directions.

The natural gas discovery which the Government of Sri Lanka is in possession of at present has opened up many avenues of thought for policy makers, researchers, industrialists as well as pioneering oil and gas companies in the industry to contemplate and arrive at economically viable investment decisions. As previously discussed, with the discovery there lies vital areas of concern that need attention. However, amidst the vast array of provided recommendations and prescribed strategies, the underlying problem as I have identified is that the forecasted shift in the domestic power mix does not seem to project a significant shift towards the consumption of natural gas. This suggests that the potential demand for natural gas in the domestic market could be modest, despite the recent discovery that has made natural gas a locally available energy source for consumption. Further contributing towards the stated situation is the gradual change observed in the composition of the domestic power mix which shows a tilt towards higher consumption of thermal power by 2022. Such challenges, unless taken up and handled properly, may stand in the way of Sri Lanka utilising the existing discovery to gain manifold economic benefits. In this sense, treating this core problem superficially may not serve well, unless proper alternatives can be offered to find lasting solutions.
The present scenario

Data analysis and interpretation can always be considered a vital portion that needs to be dealt with, in order to support the arguments raised in the process of resolving the established problem. Accordingly when closely observing the problem being discussed, we may analyse various branches that may well be linked towards finding out why forecasts indicate that Sri Lanka is likely to experience moderate levels of demand for natural gas pertaining to the energy mix and how appropriately the discovery could be utilised by Sri Lanka with the primary aim of attaining a state of energy self sufficiency. However, this paper mainly focuses on the analysis of secondary data retrieved from already available sources of information, which in fact form the grounds for the research methodology and techniques adopted to evidently support the arguments raised.

Looking at the Global energy picture at large as per the statistics in the Outlook for Energy Report 2013 (A View to 2040), the spurring of economic growth in the Asia Pacific region will eventually compel the region to open up for greater volumes of energy trade. Parallel to such forecasts, it is also expected that the region may rely on energy importation in order to cater to a substantial portion of regional energy requirements. Such scenarios are expected to occur as a result of disequilibrium conditions which may prevail between the domestic energy supply and demand levels, further compelling the region to depend on imported sources of energy. Furthermore, as the global energy mix continues to evolve, the projected growth pertaining to sources of fuel supply such as oil, natural gas and coal are expected to dominate the supply chain. By 2025, natural gas, through replacing coal in the energy mix, may position itself as the second largest fuel source in the energy composition.

Further, statistics published by ExxonMobil in the Outlook for Energy Report 2013 (A view to 2040), identify natural gas as the fastest growing major fuel that is likely to replace several of the major sources of energy to meet global energy demands. The technological advancements that have thus far contributed immensely to all the improvements that have taken place within the industry, have indeed supported the speedy growth of unconventional fuel supplies. Natural gas as a source of unconventional energy has, in this sense, shown rapid growth trends, whereby it could comprise one third of the Global Gas supply in 2040. Moreover, estimates provided by the International Energy Agency, identify natural gas as an abundant, widespread resource with an available volume of approximately
28,000 TCF, which is considered sufficient to meet the growing global energy demands for the next 200 years or more.

Sri Lanka's present energy policy and strategies forecast an energy deficit in the primary energy supplies by 2020. According to the Energy Policy published by the Government of Sri Lankan under gazette no 1553/10 (2008) titled “National Energy Policy and Strategies of Sri Lanka”, the total primary energy demand shall increase to about 15,000 kTOE by the 2020. Catering to the varied demand patterns for energy as per the provided statistics in the Sri Lanka Energy Balance 2010 report, supplies were concentrated in the areas of biomass (47.3%), petroleum 45.3%, hydropower (7.4%) and non-conventional energy (3.5%). It is estimated that by 2020, primary energy demand will grow at a diminishing pace of 3% annually, while the demand for petroleum and electricity is expected to grow rapidly at the rate of 7-8%. Reduced consumption of biomass with the enhancement of living standards along with economic constraints lowering the exploitation of the remaining hydropower sites would lead to this anticipated decline in primary energy production and demand.

Therefore in consideration of this expected deficit in primary energy supplies, Sri Lanka should focus on imported fossil fuels in the medium term and gradually move towards the development of indigenous petroleum resources and non-conventional energy resources. However, as recommended in the Energy Policy, if Sri Lanka is able to further optimise and develop the natural gas discovery as a local energy source, Sri Lanka could be self-sufficient in energy and not be affected by external pressures arising from socio-economic and political turmoil in the international market. Based on the CEB statistics as well as the analysis in the RAM Ratings Report titled "Sri Lanka Power Sector 2012", thermal and coal power are expected to spearhead the national energy mix by 2022.

The consumption of such sources of power, although not necessarily economical, is likely to increase, as the nation has already taken great strides to further incorporate such energy consumption patterns into Sri Lanka's power and energy sector. Furthermore, the provisions laid down in Sri Lanka’s Fuel Diversity and Security Policy highlight the need for electricity generation through coal power. However, consistent with such provisions the "Sampur Coal Power Project" undertaken by the Government of Sri Lanka in collaboration with the National Thermal Power Corporation of India is expected to contribute a power capacity of 500 MW to the National Grid, which indeed will pave the way towards meeting the rising domestic electricity demands.
Formulation of timely remedial strategies

The present demand for energy in the domestic market is growing rapidly and it should be noted that such demands are often a result of the economic expansion and population growth which Sri Lanka is presently experiencing. These are also supported by the friendly investment climate that is developing in the industrial and the manufacturing sectors. The CBSL 2012 statistics indicate that while the economy grew steadily at an overall rate of 6.4% in the year 2012, the electricity and gas sub-sectors grew by 4.3% and 5.1%, respectively. Further contributing to this growth, electricity sales rose by 4.5% to 10,475 GWh in 2012 from 10,024 GWh in 2011. This sales growth comprised a 4.2% increase in electricity consumption in the household sector, and increases of 5.5% in the sales made to general purposes and hotel categories, and a 4.9% consumption growth in the industrial sector. However, alongside these rising domestic energy consumption patterns, electricity generation grew moderately by 2.4% to 11,800 2012 GWh from 11,528 GWh in 2011. Given this scenario, it is not hard to realise that meeting the present domestic demand for power and energy is no longer an easy task. The Government of Sri Lanka, although has unfolded a long term power generation plan to reach a target generation capacity of 5,430 MW by 2020 mainly by venturing into various power and energy related projects, it is time that the nation initiates the development of the natural gas discovery and further supports the diversification of the sources of energy available for consumption.

It is transparent that Sri Lanka is heavily dependent on crude oil importation for the purpose of catering to domestic energy requirements. In this situation, the Ceylon Petroleum Corporation is often overburdened by heavy import expenditure, the consequences of which in turn tend to affect the entire industry. As per CBSL 2012 estimates, the average price of crude oil imported by the CPC grew by 5% to US $114 per barrel in 2012. The sudden reduction in the import of Iranian light crude oil due to sanctions imposed on Iran by the US, forced the industry to divert suddenly crude oil imports from Iran to other costly sources. Since Iranian Light Crude is among the best suited for the refining process at the CPC Refinery, the Refinery, was greatly affected by this development. Although average international crude oil prices remained stable during the years 2011 and 2012, the domestic industry was adversely affected by this political issue in the Middle East. Further contributing to this scenario, was the concurrent effect of the depreciation of the rupee during the year 2012 on imports. In order to resolve the consequent financial constraints on the
CPC, the domestic retail prices of the petroleum products were revised upward along with the re-imposition of the Fuel Adjustment Charge (FAC) to electricity tariffs. Based on the experiences of the domestic energy sector in the recent past, one may conclude that the heavy dependence on imports can at times be detrimental especially to domestic operations, which in turn could weaken the financial position of the domestic energy sector. The necessity to diversify the sources of energy presently being used by Sri Lanka is a timely aspect to be addressed and the discovery of natural gas can be identified as a key path along which the nation may move forward in search of more economical ways and means of addressing all domestic energy consumption patterns.

Energy diversification can at present be considered mandatory to avoid sudden power outages in any part of the Island, so that a continuous supply of power can be ensured to the national grid to overcome power supply interruptions. Such sudden power supply shortages can often disrupt economic and investment activity in the country. However, adverse weather and prolonged drought conditions that prevailed during the period June 2012 to October 2012 caused a sudden decline in the share of hydropower generation. As per CBSL 2012 statistics, during the year 2012 the economy experienced a drop of hydropower generation by 28.6%. Furthermore, based on the RAM Ratings Report, it is clear that the nation has also been constantly experiencing technical difficulties in the management and functioning of power plants located in various parts of the Island, as for example the Coal power plant located in Norochcholai. Moreover, the estimates based on a study under a United States Agency for International Development (USAID) project indicate that the outages in Sri Lanka in the past have cost the economy the equivalent of one-half of percent of the GDP in 2004 and 2008. Considering the negativity the economy may encounter owing to the harmful outcome of such power supply disruptions, Sri Lanka needs to initiate the speedy development and production of diverse sources of energy and in this sense utilising the discovery of natural gas optimally can be looked at as a timely solution.

**Recommendations**

In relation to the Power and Energy sector of Sri Lanka and the Oil and Gas industry in particular, it is vital that the Government of Sri Lanka analyses the suitability of every possible precautionary measure that can be adopted to deal with the impediments in the energy industry. All in all, it is
important to identify some of the strategies to be formulated and practiced so that the discovered natural gas resource is efficiently streamlined into various consumption channels. The Petroleum Resources Development Secretariat functioning as a regulatory body directly attached to the President's Office of the Government of Sri Lanka which is presently responsible for regulating all off-shore oil and gas operations of Sri Lanka is in total control of the natural gas discovery and has undertaken the continuous monitoring and reporting of every development taking place pertaining to the discovery. The Model Petroleum Resources Agreement 2013 as well as the Petroleum Resources Agreement entered into by the Government of Sri Lanka with Cairn Lanka Private Limited during the previous off-shore oil and gas operation in 2008 are regarded as the base documents governing all off-shore oil and gas exploratory drilling and production ventures. Careful review of these agreements would point to practical methods of resolving the current problem, as the concerned area of discussion is often tied to fulfilling national policy obligations. In this sense as measures of overcoming the negativity associated with the problem being analysed, Sri Lanka as a nation still holding on to an emerging oil and gas industry may need to implement the recommendations to further move forward.

**Market potential and development of market parameters based on Sri Lanka's economic climate**

Based on CBSL yearly statistics and especially the more recent 2011 and 2012 figures, a large portion of the GDP is accounted for expenditure on the importation of crude oil and petroleum products. This shows that Sri Lanka still relies on oil importation in order to cater to nation’s energy requirements. Bringing hope for energy diversification and better balance of energy, the discovery of natural gas wells during Sri Lanka’s first ever oil drilling phase as many believe, may pave the way for a natural gas driven energy industry while reducing the heavy dependence on oil. The study by Jayasinghe (2011) on the feasibility of natural gas inclusion in Sri Lanka’s energy supply, gives a clear picture of the future of natural gas in Sri Lanka. His study also reveals that, notion prevalent among many Sri Lankans is that the establishment of a natural gas market may not be a favourable option for Sri Lanka, as it is doubtful if the present market size for energy could sustain an economically viable natural gas industry. However, his analysis identifies the possible development of three future market scenarios for natural gas, if the resources are put in place accordingly. Firstly, an ideal market structure for a natural gas industry
including demarcation of roles for ex ante and ex post regulation can be proposed based on best international practices. Secondly, by providing attractive opportunities for New Product Design and Development and Market Design, natural gas supply can be introduced as a green field industry. Finally natural gas can be looked at as an economic determinant, enabling higher economic performances towards achieving an 8-10% economic growth rate. Rising oil prices in the International oil market and Sri Lanka’s heavy dependence on imported oil greatly contribute towards the continuous increase in the annual trade deficit. Such factors leading to economic uncertainty in Sri Lanka can be mitigated if the discovery of natural gas as a locally produced energy source can be made use of for domestic energy consumption. Sri Lanka Energy Balance 2010 report data and statistics indicate that Sri Lanka’s exports of surplus petroleum products have slightly diminished over the years. Hence, if natural gas can be identified as a potential energy resource of economic value, excess supplies could be directed towards the international market.

**Market potential based on New Product Development strategies and market share forecasts**

Discovery of Natural gas undoubtedly raises the need for market capturing and securing market share. Looking at the broader picture with this discovery, Sri Lanka will have to focus more on new product development and design to make the best use of the available resource. A study titled “Customer-oriented new product development models for entrepreneurial firms” by researches in New Zealand, (Elizabeth, 2005) presents several NPD models and theories that can also be adopted by Sri Lanka. This study focuses on early stage product development methods, with more customer product involvement at the initial development stage, which is considered vital for product success pertaining to SMEs and entrepreneurial firms.

Although natural gas as an energy source caters to large scale industry requirements, its use as a consumer good is also essential for a developing country like Sri Lanka. Hence it is necessary for Sri Lanka to concentrate on some of these NPD approaches to ensure better and effective usage of natural gas. A study titled “Marketing research and new product development succession in Thai food processing” (Suwannaporn and Speece, 2002) highlights the importance of competency building and capacity enhancement in the emerging oil and gas industry in Sri Lanka marketing in New Product Development. It identifies cross functional
communication and collaboration and also strategic orientation of NPD as essential elements for incorporating marketing issues into the NPD process, for estimating the marketing fit. Many studies also speak of the role of communication, research and development in new product development towards achieving product succession. If Sri Lanka is to move along the path of natural gas usage, such tools and techniques of marketing need to be considered.

Market forecasting is important for economic decision making when developing a new product or capturing a new market. In assessing the market potential for natural gas, market forecasting is vital for Sri Lanka. Extracting techniques from studies such as “Forecasting Market Share using a flexible logistical model”, (Quagrainie, 2004) Sri Lanka could further concentrate on developing mathematical models targeting natural gas usage. The study titled “Analysis of the potential solar energy market in the Caribbean Islands” (Anja, 2010) observing the market potential for solar energy in the Caribbean, would greatly help Sri Lanka in its endeavours to develop a natural gas market. Sri Lanka being an island should necessarily focus on studies carried out under similar demographic, geographic and socio-economic conditions just as the Caribbean Islands. This will facilitate the application of pre-developed models, theories and techniques for new market ventures. Solar energy is an energy source very much similar to natural gas. The study speaks of the use of solar water heater systems commonly used in Barbados, which is economical as well as a good substitute bringing down electricity consumption. Application of such technology and methodology would be beneficial for Sri Lanka in terms of natural gas. The Indian gas market is regarded as one of the fastest growing markets for gas in the world over the next two decades. “Natural gas in India 2010”, a working paper of the International Energy Agency provides the history, evolution and forecasts of the Indian natural gas market and the recent consumption patterns and trends in the Indian energy industry. Use of natural gas in India as an energy source began during the late 1970 and as per IEA estimates, gas demand in India would increase at the rate of 5.4% per annum over the period 2007 - 2023. Sri Lanka as a neighbouring nation sharing similar socio-economic conditions and maintaining very close ties with India, should observe such salient features of the growing gas market in India, in order to incorporate some of their mechanisms in the development of domestic findings.

“Market potential for compressed natural gas cars in Swiss passenger car sector” (Gian, et.al., 2004) is a useful study, which presents the growing trends in the use of compressed natural gas cars in the Swiss market. The
use of natural gas could be effectively directed towards the manufacturing of natural gas cars. Based on the analysis given in the study, the manufacturing and operating costs of these cars are relatively low and they are expected to become a real alternative to diesel fuelled and cell fuel vehicles over the next 15 to 30 years. Nations such as India, Venezuela, Argentina that have a favourable fuel price ratio (natural gas price to petrol price) could easily move into compressed natural gas car manufacturing. Sri Lanka would greatly benefit if such innovations in the context of new energy sources could be adopted for further defining its natural gas market, although it may cost heavy initial financial investment in the provision of proper infrastructure, model variety designing, market building and achieving an attractive fuel price ratio.

**Conclusion**

Arguments are too many to be ruled out, yet there remains one solution we may contemplate upon to take control of the discovered resources with the primary aim of securing an energy driven future. To be self sufficient in her hydrocarbons, Sri Lanka not only should explore and expedite, but should also support the development and improvement of all such findings to unleash the potential such discoveries may project. An examination of the key aspects of the discovery of natural gas brought to light during the first off-shore exploratory drilling operation undertaken by Sri Lanka several years back will show that achieving a state of development and production may not be as simple as one may think. In this regard this paper may not only serve as a vital source of information, but can be regarded as a comprehensive guide that will enable the reader to study and understand the projected potential of the discovery and the drawbacks within the domestic power sector that may disrupt its development along with the reasons that may support the need for strategising ways and means of utilising the discovery efficiently. Furthermore, the paper also presents a glimpse of the strategies and remedies that can be recommended to be adopted and practiced to overcome the obstacles encountered.

Capturing the domestic market to introduce and infuse energy consumption patterns driven mainly by natural gas may be time consuming, yet the longer it takes the better it would be in terms of the manifold benefits the country would be able to subsequently enjoy. Thus, assessing the market potential and demand for natural gas in Sri Lanka is mandatory to facilitate the process of developing market parameters and
new products supported by natural gas. Simultaneously changing consumer minds and their line of thought to accustom themselves to this new energy source would be the next challenge that the nation shall confront, to name and consider the discovery a national success. However, in conclusion, it is noteworthy to state that, if Sri Lanka intends to focus on the discovery of natural gas as an engine of economic growth, there lies a huge task ahead and its accomplishment is one of the greatest responsibilities placed before the nation.

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Webography


DEVELOPMENT OF PETROLEUM RESERVES IN SRI LANKA IN THE LIGHT OF EXPERIENCE FROM THE NORTH SEA

Kapila Ediriweera

Abstract

North Sea oil and gas, the largest, most successful, single enterprise in the modern economic history was also massive in concept, in employment and in the generation of wealth. The production of hydrocarbons from some of the most unforgiving waters on Earth has been a triumph of human endeavour. Following the confirmation in the 1960s of the existence of reservoirs of hydrocarbon in the North Sea, began in the mid-1960s, the first oil production started in 1971 from the giant oil and gas field, Ekofisk in the Norwegian North Sea. The UK followed suit in 1975 in the part of North Sea adjoining Aberdeen and the North East.

The paper briefly compares and contrasts the circumstances under which oil and gas became the largest industry in both regions, and the impact of the oil and gas industry on the local industry and national employment in the oil sector, and discusses the roles of government economic policy and local government efforts in both regions to prepare the infrastructure necessary to attract foreign companies and for domestic capability to make the industry attractive over an extended period of time. Finally, the paper draws on policy orientations for the petroleum industry in Norway, their value and relevance, the experience, lessons learned and best practices which can be used for the benefit of the competency building and capacity enhancement for emerging oil and gas industry in Sri Lanka.

Introduction

The exploitation of North Sea oil and gas has arguably been the most important development in the UK and Norwegian economies since the end of the Second World War. The tax revenues in the first half of the 1980s
have made a notable contribution to overall government revenues and to the reduction of public sector borrowing requirement.

But all of this was achieved only through a major human effort by many people employed throughout supply chain in the sector. Many innovations were made in the design, construction and operation of platforms and other facilities required to produce oil and gas. The operating environment was harsh and the human effort and cost was large.

When oil and gas exploration activities began in Norway, the country already had an international maritime industry and industrial actors in the fields of fabrication and construction. Norway, however, lacked oil and gas-specific competencies, and the government therefore introduced policies to attract global competency development programs.

The first key change was the introduction of the mature acreage licensing round system to ensure that mature areas are fully exploited. This was followed by the decision of the Norwegian Parliament in 2004 that an exploration tax refund, reimbursing 78% of the exploration cost for companies, regardless of their tax status. As a result of these policies, many new companies were able to meet the prequalification criteria. The Norwegian Petroleum Directorate (NPD) reported in 2010 that 62 new operators have been prequalified or established since 2000.

At the beginning of the exploration activities in Norway, there was no indigenous workforce with the relevant qualifications for employment. So, the most senior positions were held by foreign nationals with the majority from the US.

As the Norwegian labour market was at capacity, the Norwegian government did not take any initiative to boost national educational capacity in oil and gas-related disciplines. Even without state support, several universities and community colleges established courses in oil and gas-related disciplines. However, in 1978, the Norwegian government informed foreign petroleum companies that the use of Norwegian personnel would be an evaluation criterion in assessing applications for new licenses on the Norwegian Continental Shelf (NCS).

Current Norwegian oil and gas industry is viewed as having a very high level of competence compared to other oil and gas hubs (i.e. Houston and the UK). Norway-based companies cover all technical aspects of the value chain, and Norway has become the global hub for many of these activities.
The institutions in Stavanger developed relevant technological capabilities based on implicit and explicit coordination and collaboration with government and industry.

Practical challenges encountered in the oil and gas activity on the Norwegian continental shelf have given birth to a number of important innovations through close cooperation between operators and suppliers. This has made Norway an attractive location for an oil and gas R&D hub with many international oil and gas companies supporting the effort.

Taking into account the North Sea development as a guideline, the author analyses a few key areas where Sri Lanka can benefit as a nation seeking to develop offshore oil and gas resources.

**History of the North Sea exploration**

After the discovery of gas in Groningen in the Netherlands in 1959, global oil and gas companies, mostly from US, directed their attention to the Norwegian Continental Shelf (NCS). In the autumn of 1962, Phillips Petroleum (a US company) officially asked Norwegian authorities for permission to start explorations on the NCS. At that time Norwegians doubted the presence of hydrocarbon resources in the NCS. After prolonged discussions and negotiations, the first Norwegian concession round started in 1965, and the majority of the production licenses were awarded to foreign companies including Phillips Petroleum and Amoco.

Tormented by the North Sea’s notorious gales and towering walls of water, the multi-national consortium led by Phillips Petroleum, had all but abandoned their search. Then, on Aug 21, 1969 - from the very last hole - came the exciting discovery, which was validated as a giant oil and gas field, Ekofisk. The estimated reserve was over 3 million barrels of oil. The commencement of production at the Ekofisk field was on June 15, 1971, which marked the beginning of the Norwegian oil and gas era. (See Fig. 1).
Until 1960s all UK oil supplies were imported, at huge cost. The UK Continental Shelf Act came into force in 1964 and UK exploration licenses were issued for the UK North Sea. The first well was drilled in 1967. The first major find was AMOCO’s Montrose field in 1969, followed by BP with Fortiesfield in 1970, and Shell with the Brent field off Shetland and Total’s Frigg gas discovery in 1971.

Recoverable reserves originally present in Brent 264 million tonnes of oil (2 bill bbl), 316 million bbl of liquids and 120.5 billion standard cubic meters (scm) of natural gas, Forties held 2.5 billion bbl of oil, 79 million bbl of liquids and 3 billion scm of gas.

The exploitation of North Sea oil and gas has arguably been the most important development in the UK and Norwegian economies since the end of the Second World War. The tax revenues in the first half of the 1980s made a notable contribution to overall Government revenues and to the reduction of public sector borrowing requirements. (See Fig. 2).

In 2009, 65 producing fields on the NCS yielded 2.4 mil barrels of oil per day and 103 billion scm of natural gas per year, making Norway the world’s 13th largest producer of oil and the fourth largest producer of natural gas.
Oilfield operatorship and investments

Investments on the NCS have been substantial. The 130 billion NOK invested in the NCS in 2010 represented approximately 10% of total global oilfield investments. Non-exploration investments in the NCS have also been substantial (Fig. 3).

Figure 02: Volume and Rate of discoveries in NCS: 1960-2008 Source: NPD

Figure 03: Investments on the NCS from 2006 to 2015 (billion NOK) Source: NPD
From 1973 to 2003, the Norwegian Agency for Employment (Aetat) provided annual surveys of petroleum-related employment based on a population of petroleum-related companies developed with the assistance of local employment offices. In 2003, the final year in which these surveys were published, Aetat collected data from 800 companies, which employed a total of 76,600 people in NCS (2007).

The main concern of the Norwegian Parliament has been to ensure that the maximum amounts of oil and gas resources are extracted from the seabed. To this end, the Norwegian Parliament (white Paper No. 39: 1999 - 2000) allowed an increase in the number of licensees or operators on the NCS and introduced a system for prequalification of potential new licensees. As a result, a large number of new companies were able to meet the prequalification criteria. The Norwegian Petroleum Directorate (NPD) reported in 2010 that 62 new operators have been prequalified or established since 2000 (Fig. 4).

![Figure 04: Production licenses and operatorship following 20th concession round (2009)](source: NPD)

In 2009, small companies accounted for about 50% of all exploration on the NCS. The emergence of many small operators holding production licenses and operatorships resulted in a dramatic change in the composition of the investing companies.
The employment in the industry has more than doubled over the past twenty years. As employment among operators remains almost constant at around 20,000, the growth can be attributed, in its entirety, to the supplier industry. (See Figs. 5 and 6).

**Figure 05:** Number of employment in the Norwegian oil and gas industry by sector (1900-2009)

**Figure 06:** Number of employment in the oil and gas industry (1990-2009)
*Sources: employment: 1990-2002 (Aetat) and 2003-2009 (IRIS/BI); investments: Norwegian Petroleum Directorate*
In 2000, 80% of all exploration costs related to NCS was incurred by large companies. However, by 2009, this share had been reduced to 40%. New companies are now responsible for more than 50% of exploration costs, while the remaining 10% is invested by medium-size companies according to NPD.

In the first concession round in 1965, the majority of production licenses were awarded to foreign-owned companies. Out of 81 blocks, 22 were awarded to companies or partnerships with Norwegian interests,

**Economic growth and development of employment**

Despite the Norwegian government informing foreign petroleum companies in 1978 that the use of Norwegian personnel would be an evaluation criterion for new licenses on the NCS, the share of foreign workers in the petroleum workforce steadily increased to 20% for the country as a whole and to more than 30% in the main petroleum county, Rogaland.

Figure 5 shows employment peaks in 1993 and 1998; these peaks were related to construction of platforms and rigs (Topside). Following the slump in 1999-2000, employment in Topside in 2008 returned to roughly the same level as in 1998. As this sector is vulnerable to low-cost competition from abroad, the current growth may be due to maintenance and modification activities, which by their very nature, must be conducted in the country.

The current Norwegian oil and gas industry is considered to have a higher level of competence than rival oil and gas hubs (i.e. Houston and the UK). Norway-based companies cover all technical aspects of the value chain, and Norway has become the global hub for many of these activities.

Value creation per employee ranges from 1.2 million NOK for suppliers to 6.5 million NOK for operators (Fig. 7). In comparison, value creation per employee in the tourism industry is 0.4 million NOK, while it is 1.4 million NOK in the maritime sector, which includes parts of the oil and gas industry.
Historically, the global oil and gas industry has often been seen as “low tech” and generally not viewed as a “knowledge-based industry”. This is valid to some extent as many oil workers tend to be poorly educated in many oil and gas regions. The Norwegian oil and gas industry has, in contrast, emphasised the need for a vast majority of the workers to hold at least a certificate of apprenticeship (Fig. 8).

**Figure 07:** Total reported sales in the Norwegian petroleum industry (2008)  
*Source: Brønnøysund register, IRIS/BI*

**Figure 08:** Distribution of labour force in oil and gas industry by educational level (2008)  
*Source: Statistics Norway, IRIS/BI*
Figure 09: Distribution of general labour force by educational level (2000-2008)

Source: Statistics Norway, IRIS/BI

Figure 8 illustrates the educational level breakdown of the labour force in the Norwegian oil and gas industry in 2008. The distribution is similar to that for the entire privately employed workforce in all industries in Norway (Fig. 9). Therefore, on aggregate, the oil and gas industry does not attract a disproportionate percentage of advanced human capital relative to the available workforce. However, this pattern could change as the oil and gas industry begins to use advanced technology.

Education, research and development

The ability of an industry to successfully compete in its relevant market increasingly depends on investment in human capital. The energy sector is keen to hire more graduates with the required skills to deliver best value and economic viability for their projects.

The educational programs in geology at the universities of Oslo and Bergen have been strengthened; the program in shipping and mining at the Norwegian Institute of Technology (NTNU, former NTH) was adapted to the needs of the petroleum industry; and Rogaland Community College (now the University of Stavanger, UiS) started training petroleum engineers. Established in 1969 as a regional college, the UiS always saw
its role as serving the educational needs of local industry, and developed key capabilities in relevant fields such as petroleum engineering.

Figure 10 shows the higher education distribution in oil and gas related positions. The share of bachelor’s degree students is increasing, while that for higher degrees is decreasing. In 2008, while 39% sought Bachelor’s degrees, 58% were engaged in Master’s-level studies and 3% in PhD programs.

**Figure 10**: Employments in oil and gas related disciplines by level of study (2005-2008)
*Sources: NSD & IRIS/BI*

An attractive educational program should lead to an increasing interest in both absolute and relative terms. Absolute term concerns the availability of qualified personnel in the discipline, while relative terms concern the relative attractiveness of the program to the general student population. All else being equal, lower figures in relative terms will lead to the relevant industry representing a lower share of GDP in the future because a growing number of graduates will find employment in other sectors (Fig. 11).
Roles of universities and public research institutions

Innovations on the NCS related to either field development or improved recovery are mainly the result of practical challenges encountered during operations. Often, innovations come about as a result of collaboration between operators and suppliers in large field developments. The process of innovation, based on solving practical challenges, has given Norway-based companies a head start in petroleum technology.

Institutions in Stavanger developed the relevant technological capabilities based on implicit and explicit coordination and collaboration with government and industry. The International Research Institute of Stavanger (IRIS), created in 1973 by the regional authorities as the research arm of the University College (UiS), soon developed into an independent research institute with capacity to undertake applied research and testing for the oil and gas industry. Working closely with the oil and gas industry to provide key educational programs was a central feature of the IRIS mission (Fig. 12).

The IRIS and UiS can also be contrasted with what in some respects are their institutional twins in Trondheim, the Norwegian University of
Science and Technology (NTNU) and the independent research organization SINTEF, which were both well established by the time the first North Sea oil discoveries were made.

In this case, however, IRIS and UiS moved more quickly to develop applied technological capabilities in petroleum engineering, partly to differentiate themselves from existing institutions such as NTNU and SINTEF.

When measured in terms of the number of academic staff and the number of scientific publications, the Norwegian oil and gas-related academic research has been growing (Tables 1 & 2). Norwegian-based companies also conduct a significant number of Research & Development projects. More than 31% of all companies in the region spent more than 4% of sales revenue on R&D.

![Figure 12: Relationship triangle showing cooperation between Universities, Industry and R&D](image)

In Aberdeen, the universities developed ties to industry not as a result of institutional efforts to respond to industrial needs, but rather through the actions of individual academics in a diverse range of disciplines.

In contrast to the situation in Stavanger, Aberdeen’s two universities - the University of Aberdeen and Robert Gordon University (RGU) - were both
well-established institutions when the first North Sea oil discoveries were made.

While the University of Aberdeen, a 500-year old academic institution, opted out of working with the oil and gas industry, which it saw as a transitory presence in the region, the RGU, a former polytechnic, moved in quickly to meet the industry’s training needs and continues to offer petroleum-related graduate educational programs, though mainly through the use of its location and the importation of external expertise rather than by developing an internal capability.

Herriot - Watt (HW) University, located in Edinburgh, about two hours by train from Aberdeen, developed a national and later international reputation for petroleum engineering, but largely through its own initiatives.

The University of Manchester, a leading university in the UK with a 150 year history in higher education and an internationally distinguished centre of research and innovation with the number registered students in 2007/08 in excess of 35,000, including over 9000 postgraduate students, showed interest in off-shore petroleum as did Imperial College London, with an established reputation in petroleum related fields at the time of the first North Sea oil discoveries.

However, since the introduction of a broader array of academic subjects, the University of Aberdeen has been as prolific in producing industry-relevant research, while contributions from other institutions such as NTNU/SINTEF, Herriot-Watt and Imperial College are correspondingly larger.

The publication record in two industry-related bibliographies: the papers contained in the E-library of the society of Petroleum Engineers (SPE); and Petroleum Abstracts (PA), a database administered by the University of Tulsa, shown below provides a fairly well understood activity levels and institutional differences in operation.
Table 01: Number of publications in petroleum abstracts (1965-2005)

<table>
<thead>
<tr>
<th>Institution</th>
<th>Publications in Petroleum Abstracts</th>
</tr>
</thead>
<tbody>
<tr>
<td>UiS</td>
<td>248</td>
</tr>
<tr>
<td>RF</td>
<td>574</td>
</tr>
<tr>
<td>NTNU</td>
<td>1020</td>
</tr>
<tr>
<td>SINTEF</td>
<td>810</td>
</tr>
<tr>
<td>Aberdeen</td>
<td>586</td>
</tr>
<tr>
<td>RGU</td>
<td>48</td>
</tr>
<tr>
<td>Heriot Watt</td>
<td>1073</td>
</tr>
<tr>
<td>Imperial College</td>
<td>1473</td>
</tr>
</tbody>
</table>

Source: Petroleum Abstracts

Table 1 shows that the contribution from the University of Aberdeen is much greater when the wider range of subjects covered by Petroleum Abstracts (PA) is included. The contribution of Herriot-Watt is larger, as before but the contribution of Imperial College is larger by a substantial margin. Among the Norwegian institutions, SINTEF and NTNU are together more than twice as prolific as RF (IRIS) and UiS.

A striking difference was found in the level of collaboration across institutional boundaries. Norwegian institutions were consistently more collaborative with industry than their UK counterparts – suggesting that they may have been more effective in providing ‘public space’ to their industrial partners.

Table 2 below shows that the two institutions in Stavanger (UiS and IRIS) published 308 papers in Society of Petroleum Engineers (SPE) between 1990 and 2004, which is far more than the 70 from the two Aberdeen institutions, but roughly the same as Herriot-Watt.
Table 02: SPE-papers from key research institutions in Norway and the UK, 1990-2004 (% of total papers in parentheses)

<table>
<thead>
<tr>
<th></th>
<th>Norway</th>
<th>UK</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stavanger</td>
<td></td>
<td>Aberdeen</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>UIS</td>
<td>RF</td>
<td>SINTEF</td>
<td>NTNU</td>
<td>UoF</td>
<td>RGU</td>
<td>Heriot Watt</td>
</tr>
<tr>
<td>Written solely by in-house researchers</td>
<td>38 (36%)</td>
<td>74 (36%)</td>
<td>34 (35%)</td>
<td>18 (24%)</td>
<td>24 (55%)</td>
<td>16 (62%)</td>
<td>166 (54%)</td>
</tr>
<tr>
<td>Written in collaboration with others</td>
<td>63 (62%)</td>
<td>133 (64%)</td>
<td>63 (65%)</td>
<td>58 (94%)</td>
<td>20 (45%)</td>
<td>10 (38%)</td>
<td>144 (46%)</td>
</tr>
<tr>
<td>Total</td>
<td>101</td>
<td>207</td>
<td>97</td>
<td>76</td>
<td>44</td>
<td>26</td>
<td>310</td>
</tr>
<tr>
<td>Regional total</td>
<td>388</td>
<td>173</td>
<td></td>
<td>70</td>
<td></td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Source: estimated from SPE database

**Industrial and state funding for education and R&D**

Major oil companies are continuously offering financial support for further education at Universities in both countries; British Petroleum (BP) and Shell International had been leading in this matter for many years. However, BP has now extended its lead with an even better scholarship program announced in 2012 where BP aims to build capacity in skills and knowledge and will focus on supporting undergraduate programs from a few selected universities around the UK.

The Norwegian government will continue to prioritize research in 2013, with overall funding rising 2.2% in real terms. In total, NOK 27.4 billion will be spent on research and development in 2013. In real terms, funding in 2013 will be 32%, or NOK 6.7 billion, higher than in 2005, which is a very substantial increase. The Norwegian government also plans to raise the amount it spends on international research cooperation by around NOK 440 million in 2013.
Knowledge sharing on the development of emerging business model in Sri Lanka

Procedures and rules

The experience and knowledge gained from the North Sea as discussed in previous sections is summarized in Table 3. The implications of each procedure or rule (listed in Column 1 of the table) is analysed along each row, in terms of experience, lessons learned, best practice, value and relevance to Sri Lanka.

The last column “Relevance to Sri Lanka (SL)” briefly comments on the relevance of the topic discussed in first column to the development of oil and gas business in Sri Lanka. This analysis is based on the author’s experience in the oil and gas industry in the North Sea and information gathered from public domain websites.

Emerging oil and gas industry: Impact on other industrial sectors

It is known that industries compete in the labour market to attract the most talented and experienced workforce. For an industry to be competitive over a long time, it must be able to attract highly competent human capital before committing resources to invest in new technologies and competence development.

It is also important to analyse the experience from North Sea region of reported labour movement with respect to emerging oil and gas industry. It has been reported that the traditional industrial sectors of both Norway and UK suffered a heavy loss of technical and labour force to the North Sea oil and gas industry which hired them for higher wages.

It has been the case that the oil and gas sector gained the upper-hand in getting the most experienced human capital under their umbrella mostly due to the higher wages offered. Under the circumstances, other industrial sectors cannot survive unless there is a surplus of technically trained labour force.
In order to deal with this steady movement of competent workforce to lucrative and highly paid jobs in oil and gas industry, it is important that industries as well as higher educational institutions understand the situation and adopt fast track tertiary technical training programs along with an increase in the undergraduate population by expanding university admissions over the next few years.

**Table 03: Knowledge matrix of relevance to oil and gas industry in Sri Lanka**

<table>
<thead>
<tr>
<th>Rule/Procedure</th>
<th>Experience</th>
<th>Lessons learned</th>
<th>Best practice</th>
<th>Value</th>
<th>Relevance to SL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tax concessions or incentives for investors</td>
<td>since 2004 in Norway</td>
<td>20-40% increment of small operators</td>
<td>Norwegian tax incentive program on exploration activity</td>
<td>More than double the number of operators and add 3.2 billion barrels of commercial reserves</td>
<td>SL tax and fiscal model in SL can be modified to suit for emerging business context, highly relevance to SL as a promotional offer for the establishment of the industry</td>
</tr>
<tr>
<td>Quotation on local employees as an evaluation criteria for licenses</td>
<td>since 1978 in Norway</td>
<td>Improvement on number of local employees and indirect business growth</td>
<td>existing model in Norway modified to suit for emerging business model in SL</td>
<td>Skilled technical staff from local environment</td>
<td>Highly relevance to SL as an emerging oil and gas business</td>
</tr>
<tr>
<td>Development of higher educational system to match the industry needs</td>
<td>both UK and Norway since 1960s</td>
<td>Increment of technical and management staff from the local environment</td>
<td>cooperation with established educational institutions such as: (a) University of Aberdeen (b) Imperial College, London (c) Heriot-Watt - Edinburgh (d) NTBU, Trondheim, Norway (e) UII, Stavanger, Norway</td>
<td>(1) smooth flow of technical and management staff (2) improved decision making process (3) competitive edge over expat community (4) cost reduction and quality output</td>
<td>Highly relevance to SL as an emerging oil and gas business</td>
</tr>
<tr>
<td>Industry collaborative research</td>
<td>both UK and Norway since 1970s</td>
<td>Improvement in all sectors of the business</td>
<td>Best practices reported in Norway can be studied ex: IRIS and SINTEF</td>
<td>Technical workflows, minimized impact on the environment and cost reduction and quality assurance</td>
<td>Highly relevance to SL as an emerging market for oil and gas business</td>
</tr>
<tr>
<td>Maintaining a database of information for investors, Universities and R&amp;D environment</td>
<td>NPD in Norway since 1972</td>
<td>NPD model is appropriately adopted and maintained with lessons learned</td>
<td>NPD best practices are highly acclaimed by oil industry</td>
<td>Well maintained information is valuable to all users</td>
<td>Highly relevance to SL as an emerging market for oil and gas business</td>
</tr>
<tr>
<td>Establishment of publicly own oil and gas company</td>
<td>(a) BP since 1901 (established in Iran as Anglo-Persian Oil) (b) Statoil - publically owned since 1972</td>
<td>Overall improvement of business management and project management</td>
<td>Statoil best practices can be modified to SL</td>
<td>Overall improvement on the business and asset management</td>
<td>Statoil's initial business model is highly relevance to SL as an initial working model</td>
</tr>
</tbody>
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(1) [http://www.woodmacresearch.com/cgi-bin/wmprod/portal/CorpPressDetail.jsp?id=410356851 - Wood Mackenzie analysis]

**Summary**

Some important issues relating to the North Sea oil and gas industry have been discussed. The development of the industry since its initial state and role of Universities and the Research and Development have been
analysed. The North Sea oil and gas hub has survived for more than 40 years and it is growing steadily ahead of the similar hubs in the world. Considering this innovative performance and steady growth in the North Sea industrial hub, it is doubtless that the policies, lessons learned and best practices adapted in the North Sea can benefit Sri Lanka in its pursuit of development of offshore oil and gas resources.

It is also important to understand that the university system has a key role to play in the industrial take-up. The conditions, practices and attitudes that lead to successful technology take-up and application in local industries depend on the specific characteristics of the industry and its development pathway. This means developing an understanding of the particular circumstances and needs of local industries and the strengths and weaknesses of their own institutions, and it means seeking a fit between local industry needs and internal university capabilities. Universities should discard the one-size-fits-all approach to technology transfer in favour of a more comprehensive, more differentiated view of the university’s role in local economic development.

A strategic approach to the local economic development role is compatible with the pursuit of excellence in the universities’ traditional primary missions in education and research. Indeed, success in these primary missions is a necessary condition for contributing effectively to innovation and growth in the local economy. The fear that these missions will somehow be harmed is not a good reason for universities not to play a role in local innovation processes.

**Bibliography**


Abstract

Many resource-owning countries did not in the initial stages of their development possess adequate volume of the highly specialized knowledge and the substantial funds required to successfully find and produce hydrocarbon (HC). This led to oil and gas exploration becoming a primarily private sector activity worldwide, dominated by international oil companies (IOCs) with the relevant skills, experience and financial strength to take on significant exposure. The main objective of all oil companies, international or national, namely to generate profits with which to reward shareholders or fund national budgets, is tempered by the highly speculative nature of the business, where potential returns maximize over a decade after investment. This unusual risk profile requires a specific approach to both project evaluation and accounting, as the sensitivities offer parameters that influence attractiveness that are different from conventional investments. Coupled with these special and often practiced financial skills, oil and gas companies also typically have a much better understanding of the asset than the resource owner. This asymmetry of information has led to inequity in resource sharing agreements worldwide, and emerging resource owners like Sri Lanka need to address the issue early.

The paper discusses the ingredients required to create an attractive investment climate in a highly competitive environment, while at the same time securing maximum national benefit. The underlying message is that oil and gas have the capability to deliver the quantum economic stimulus the country needs, but that in order for it to happen the hydrocarbons must first come out of the ground.
Introduction

On the 2nd of October in 2011, Cairn Lanka, the Contractor for the block SL 2007-01-001, Mannar Basin drilled their very first exploration well off the west coast of Sri Lanka and discovered a 25 meter thick column of natural gas. Sitting around 3.5km below the surface of the sea, in a water depth of 1300m, at a pressure of 4500psi and occupying around 10 square km in area, this reservoir was the first confirmation of the existence of a petroleum system in the Mannar basin on either side of the maritime boundary we share with India. Conventional first-order calculations put the estimated reserves at several hundred billion standard cubic feet of gas with condensate, a reasonable number by any standards.

Just six weeks later, the same team of explorers boldly deepened another risky well by an additional 1 km, to penetrate a 700m layer of basalt near the bottom they felt might be masking a deeper sedimentary sequence. Within this basalt outflow, they found a further 24m of natural gas and condensate. Owing to the masking effect of the volcanics, which strongly reflects seismic signals, a clear idea of the lateral extent of this reservoir could not be gained as in the first well. Indications are, however, that it could be at least as large as the first one if not much bigger.

Unfortunately, our newly discovered reservoirs are sitting 2 to 3 km below the seabed, in water almost as deep. In the petroleum industry, this represents one of the most hostile production environments on earth, akin to the deepwater GOM (Gulf of Mexico), offshore Brazil, and the Gulf of Guinea. Production from such depths is fraught with many technical challenges. Drilling costs are substantial, environmental and operational risks are high, and oil companies with the experience and financial capability to take such fields from discovery to production safely and efficiently are a handful indeed. In this context, we were in the big league in terms of future lifting cost. For example, in the deepwater GOM it costs more than 20 times the money to find and bring a barrel of oil to surface than it does in, for example, Iraq or Saudi Arabia.

Even if the volumes present proved to be enough to justify the enormous expense of complex sub-sea completion systems with sophisticated flow assurance techniques, and we were to bring the gas to surface, what would we do with it? Do we have off-take infrastructure and a distribution network, and do we have a domestic or international market for it? Do we have appropriate national policy with respect to resource tax and income allocation? These are all questions that feed back into the original one —
are the reserves economically and technically viable? It is a catch - 22 situation, in a way - we cannot prove so unless we have a plan, and we cannot make a plan unless we can prove so! No matter how much gas or oil we have sitting in our territorial waters, we cannot credibly call ourselves petroleum-new-rich without the correct combination of technology, market conditions and host-state regulations being in place. It is this situation that requires us to understand just what ingredients are necessary to attract capable oil companies to make the investment required help Sri Lanka realize her hydrocarbon potential.

With the exception of areas like the Jaffna peninsula, coastal regions of the north west, and the Thabbowa area, sedimentary rock thickness on land is less than 1 km. Conventional wisdom deems this too shallow to provide the temperature and pressure required for hydrocarbon formation. On the east side of the country we are confronted with a rapid drop off of the continental shelf leading to an abrupt margin with the abyssal plain in very deep water. Although this area includes the largest submarine fan in the world, and is potentially very prospective, it is in water whose depth is at the current edge of oil and gas technology. This means that we are looking at predominantly offshore exploration and production operations which carry much higher entry thresholds in terms of finance and technology compared with land operations and require very specific expertise and experience. Our strategy and policies in the future must take this into account. At this stage, we cannot expect to prevail alone ─ this is an international play, where we need competent equity partners until such time as we have the capacity to conduct operations ourselves.

But, before we get to this important area of discussion, let us understand what it takes to officially call ourselves "Resource Holders" in the petroleum world.

**Classification of reserves**

**Resource classification**

In order for the country to derive any dividend from its petroleum deposits, they would need to be clearly demonstrated as producible reserves. Over the years, several systems classifying oil and gas reserve estimates had been developed by professional bodies such as the SPE (Society of Petroleum Engineers) and AAPG (American Association of Petroleum
Geologists), and have found their way into formal oil and gas accounting practices and regulatory procedures. The SEC (Securities and Exchange Commission) in the US, for example, requires reserves to conform to a minimum confidence level before their economic worth could be recognized by a listed company. Nations too, under similar international classification frameworks, need to establish a minimum confidence in their ability to produce their hydrocarbons in order to "book" them.

Annex 1 is one such classification system. In simple terms, having reserves is not good enough, no matter how large they are, they must have a high probability of extraction. Annex 1 is a description of the framework used by the SPE to assign various confidence levels to petroleum reserves.

The only type of resource a company or country can declare for the purpose of economic considerations by the generally applicable rules of oil and gas finance are those classified as Reserves. This is the amount of oil and gas that can with a reasonable degree of certainty be recovered from a given date forward. The key factors in this determination are (a) technological or operational constraints, (b) prevailing market conditions, and (c) Government regulations. The degrees of certainty used by the industry are Proven (1P), Probable (2P), and Possible (3P). The SEC only recognizes Proven Reserves as "bookable", which is the most conservative number of the three, with the highest probability of recovery.

Interestingly, gas reserves are only classified as Proved if, in addition to the above, the developer of the field has taken the FID, and the host government has already approved the gas development under the applicable regulatory framework. In fact, to quote a current reference book, "Gas Reserves only exist if the commercial viability of a given gas project is demonstrated by appropriate technical and economic studies, and a decision for their development is taken or envisaged shortly". This means we, as a country, must have a master plan already in place before we can submit our deposits for classification, and correct classification is a prerequisite for deriving economic benefit, i.e. monetization.

Contingent Resources (CR) are not yet classified as Reserves (R) since at least one of the 3 factors above is not favourable: either technology, market conditions, or Government regulations. It is important to realise that since all three of them are essentially dynamic, that both the Reserves and Contingent Resources of a resource owner are moving targets, constantly liable to change. (Note: Government regulations include environmental rules). CR can be moved into the R category by either
advances in technology, firming up of market conditions, or amending of government regulations, which include the legislative framework and fiscal regimes.

We can see that we, owing to the geological quirk of fate that placed all our currently envisaged HC deposits under the sea, face significant barriers to monetization. The Proven Reserve number, particularly for a gas reservoir on land, is very much greater than its equivalent number in deep water offshore. The difference is the huge cost of development that comes in under the heading of "market conditions". The higher this cost is, the more the petroleum moves from R to CR, and vice versa. The only thing we can do to compensate for at least some of this movement, since we cannot influence the development of technology, is to design and maintain a progressive fiscal regime and a favourable investment climate. Therefore it is vital to create an enabling environment for private investment in O&G in Sri Lanka.

Resource sharing regimes

The central objective in designing petroleum fiscal regimes is to secure for the resource owner a fair share of the wealth accruing from the extraction of that resource, while at the same time encouraging investors to ensure optimal economic recovery. This is an eminently reasonable and well accepted concept, but actually achieving this balance is a subject of enduring controversy. The big problem, of course, lies in the vagueness surrounding the subjective concept of "fairness". This is where economic, political, social, cultural, environmental and a whole host of other complex issues can conflict with each other, leading to non-optimal policy. It is a decision that demands the clearest vision and highest level of political will for the best long-term outcome to be achieved. Many countries have faced this dilemma and failed to obtain the desired results.

For an example, a World Bank study in 2000 of discovered natural assets finds that, in the OECD (Organisation for Economic Cooperation and Development), the average square kilometer possesses known sub soil assets to the value of USD 125,000, whereas this number for the whole of Africa is 25,000. Since the OECD has been depleting its assets for much longer than Africa has, it is reasonable to assume the actual value of sub-soil assets there to be must be very much more. However, something prevents them from being discovered, and since there is insufficient incentive for discovery, the assets remain in the ground.
A solution is entirely within the control of host governments, but many have failed to see the huge importance of the discovery process. While legitimate concerns exist over the asymmetry of information between the (typically less skilled) resource owners and the (typically more expert and experienced) operators, which may encourage some of them to understate the size of the discovered reserves, exaggerate the cost of production, and use transfer pricing and other profit-shifting mechanisms to take undue advantage of a lax regime, suspicion of this should not become the cause of economic deprivation for citizens, particularly of low-income countries.

The most effective measure that a country can take in these circumstances is to resist the temptation to implement an over-conservative or punitive tax regime based on inadequate geotechnical knowledge, and to the best extent possible separate the prospecting process (which should be encouraged to the maximum with the lowest loading) from the extracting process (which should be taxed in a progressive manner to allow even smaller developments to be commercially viable while capturing more income for the state from more successful projects), while at the same time giving adequate protection from political interventions such as nationalisation and expropriation. The initial investment in E&P (Exploration and Production) programmes is so high, for infrastructure that usually needs only to be introduced once, that any suspicion of this being a possible future course of action of a host government will cause the operator to discount their project value highly to compensate for the uncertainty. Therefore it is a challenge to design the perfect fiscal regime.
RESOURCE CLASSIFICATION FRAMEWORK

PRODUCTION

RESERVES

1P  2P  3P

CONTINGENT RESOURCES

1C  2C  3C

UNRECOVERABLE

PROSPECTIVE RESOURCES

Low Estimates  Best Estimates  High Estimates

UNRECOVERABLE

Range of Uncertainty

TOTAL PETROLEUM INITIALLY IN PLACE

DISCOVERED PIP

SUB-COMMERCIAL

UNDISCOVERED PIP

Increasing chance of Commerciality
Classification of resource sharing regimes

There are three dominant resource sharing systems currently in operation worldwide;

1. **Complete state ownership regime**

Under this category, the government itself formulates and finances an adequate investment programme and executes it through a National Oil Company (NOC). This strategy requires the establishment of an NOC that operates in the upstream asset development. Saudi Arabia is one of the few countries that have been successful in this strategy since its NOC (Saudi Aramco) has access to abundant reserves, allowing self-sufficiency and independent asset development capability.

However, the disadvantages of the complete state ownership system are the inability to raise external capital owing to expensive national obligations and the consequent inability to compete at international level. Owing to the interference of the state, for example excessive employment, there may be a decline in efficiency levels and stagnation in capacity growth.

2. **Concessionary regimes**

The concessionary regime gives International Oil Companies (IOCs) the right to explore, develop, produce, transport and market the petroleum resources at their own risk, i.e. the company owns and disposes of the oil/gas so produced. However, during recent years, several host governments have played a more active role, curtailing the rights of the IOCs. Tenures of licenses have decreased, and the awarding of concessions became restricted to identified blocks. The host governments do not own the petroleum produced by the IOC, but instead impose a combination of Income Tax, Special Petroleum Tax and Royalty in an effort to tax operating profits in the normal way. Thus the concessionary regime is now commonly called a Tax/Royalty System.
Figure 01: Classification of resource sharing regimes
3. Contractual regimes

The contractual regime arose as a result of an attempt to modify the nature of the relationship between IOCs and the host governments, allowing the latter to have more control over ownership and the operation of the petroleum products. There are two types of contractual regimes. The first being the Production Sharing Contract, which originated in Indonesia and is a binding commercial contract between the State and the IOC whereby the IOC receives a share of the production after deducting the government share, and the second being the Service Contract where the IOC is paid a fee for the petroleum produced. In contracts where the IOCs assume the full risk of exploration and development, such contracts are called Risk Service Contracts.

Sri Lanka's is a contractual regime, with a Production Sharing Basis. (The current Model Petroleum Resources Agreement (MPRA), which defines the fiscal terms of the relationship between investor and Government, may be downloaded from the tab "Bid Information Package" on the PRDS website www.prdssrilanka.com)

Acknowledgement

Most of the topics discussed herein are from the Dr. A.N.S. Kulasinghe Memorial Lecture, delivered by me to the Institution of Engineers of Sri Lanka on 25 October 2012.
COMPETENCY BUILDING AND CAPACITY ENHANCEMENT IN THE EMERGING OIL AND GAS INDUSTRY IN SRI LANKA

Mangala P.B. Yapa

Abstract

The Oil & Gas (O&G) Industry is a complex and unique one. With the growth of this highly lucrative and potent industry in the Asian region, hitherto exploited by the Western part of the world, is bound to create many challenges and opportunities.

Complexities require multifaceted talent. Talents need to be harnessed and developed. Capacity planning and development to meet the diverse opportunities of the local content of this extremely complex industry, is indeed a challenge.

This paper attempts to identify the areas of the O&G industry in which Sri Lanka has the potential and strength to enhance its capacities to reap benefits from the O&G exploration activities in Sri Lanka.

Introduction

This capital-intensive industry whilst relying heavily on suppliers of material, modern technology, construction and heavy equipment, also demands a vast range of services of highly qualified and experienced technologists. In addition to the grounded jobs in its processes of exploring, extracting, refining, transportation, there arises a mass of opportunities in connected disciplines where a knowledge hub including expertise in technology, financial, legal and other related services are of paramount importance. Thus, it is hard for any country to exploit such opportunities easily. Building the requisite competencies and enhancing capacity to meet such emerging needs is vital for a country to exploit such opportunities.
Competency building and capacity enhancement

Building national competency is a systematic and planned activity which involves stakeholders in the domains of public policy development and implementation as well as the direct stakeholders engaged in the operational activities in the public and private sectors. Capacity enhancement can be seen as a result of the implementation of the plan for building competency. Often, the need for greater dialogue and sharing of ideas amongst the stakeholders is not identified and even if it is identified, there is no real dialogue, which unfortunately leads to the establishment of policies that do not support competency building and the resultant capacity enhancement.

In view of the complexity of the O&G sector involving expertise in multiple areas, as opposed to any other industry it is even more important that such dialogue and consensus is reached from the very beginning. Identifying the needs and harnessing the resources require careful and systematic planning and allocation of resources and gradually developing the requisite capacity over a period of time. Unlike in any other less complex industry, this venture of developing competency and enhancing capacity is not an easy task. However, one could not rule out that resources already developed in certain related fields of this industry such as down-stream petroleum industries and shiprepair and shipbuilding industries will move towards filling of such gaps sooner. Invariably, such natural flow of resources too would result in rendering some existing industries non-viable. Hence, it is very important to view the issues involved from a broader national developmental perspective, and not an isolated organizational perspective.

Since the industry is new to Sri Lanka and perhaps to many other countries in the Asian and African regions where natural resources are available, it is prudent to adopt varying strategies and policies to establish competencies. At the beginning, a country may not be able to establish the full range of competencies needed, and it is natural to involve foreign entities in the direct exploration and production sectors as well as the indirect service sectors. However, in the process, it is certainly important to identify and establish the true potential of a country in meeting the emerging needs of the industry: This demands a time frame in which capacity building can be achieved in such competencies. In this connection, it is essential for the PRDS to draw on existing learning, carefully analyze various models available, chose what is most suitable for Sri Lanka, and adopt and adapt them to the local context.

Thus, at the outset, there is a need for holistic, genuine, transparent and result-oriented discussions amongst all the stakeholders, both in the public
and private domains are underscored. It is only through such genuine engagement that the complex issues of competency building and capacity enhancement at National Level can be addressed.

A brief overview of the industry:

The American Petroleum Industry (API) divides the O&G industry into five sectors:

1. upstream sector
2. downstream sector
3. pipeline sector
4. marine sector
5. service and supply sector

The O&G sector is vast in extent, and encompasses both Onshore and Offshore oil & gas exploration and production, but it is the Offshore sector that would be more relevant to Sri Lanka.

Figure 01: Extent of the O&G industry
Understandably, the upstream sector, which involves higher-end technology, heavy investment and greater risk, is outsourced from competent global players while the local content, if any, is developed over a period of time. It may be difficult for Sri Lanka to acquire the technological, entrepreneurial, managerial and financial capability to build capacity in the short to medium term in the upstream sector, and therefore, the option is for the country to engage the international oil majors and other interested global players with the right concessions, while creating and allowing opportunities for possible new industries to gradually build such capacities and competencies.

A cursory review on the currently available competence and capacity in Sri Lanka, however, provides a sound basis for the potential to exploit other industry sectors, with the requisite augmentation of competencies and capacity.

The Marine Sector can be identified as the most potent industry to exploit the emerging opportunities. Colombo Dockyard PLC, with its existing ship repair & shipbuilding facility, is ideally located and capable of handling almost all the repair requirements of crude, product and gas carriers save for some limitations on the accommodation capacity of the repair docks, restricted to vessels below 120,000 DWT (Aframax vessels; below 42 m in beam and 260 m in length).

Historically, recognizing the potential and the importance of Colombo as a convenient location for commercial vessels plying in the Indian Ocean, the Arabian Sea and waters around India, in close proximity to international shipping routes, the first drydocks were built under British rule in the latter part of the 19th Century. The capacity has consistently been expanded and it has now emerged to be an industry to be reckoned in the South Asian Region. The addition of a 125,000 dwt drydock and ancillary facilities in the early 1980s, the collaboration with a well-established and a reputed medium scale Japanese shipbuilding entity in early 1990s and consistent capacity and competency enhancement. Since the beginning of the 21st Century the industry has moved into niche market; building capacity to cater for repair, conversion and upgrading of offshore support vessels, and their building, which is very much an integral part of the O&G sector. Such capacity and competence building directly addresses the national capacity and competency building needs in the Sri Lankan O&G sector.

Apart from infrastructure capacity, the sector has been able to build sufficient human capacity for design, construction, quality control, safety and other regulatory compliance, etc. Traditionally, the marine sector is one
of the crucial sectors that has enabled capacity and competence building to the O&G sector almost around the world and one could see that same trend continuing Sri Lanka as well.

Presence of drill ships, support vessels, FSO (floating storage and offloading) and FPSO (floating production, storage and offloading) facilities will also generate more repair and building opportunities. It may be important to evaluate the existing capacities and compare them with the emergent requirements.

A preliminary SWOT (strengths, weaknesses, opportunities and threats) analysis of the current and potential areas of the marine sector is presented in Table 1, below.

**Table 01: SWOT for marine sector participation in the O&G sector of SL**

<table>
<thead>
<tr>
<th>Seismic activities</th>
<th>By Sri Lankan Entities</th>
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<tr>
<td>Seismic Vessel</td>
<td>Highly Possible</td>
</tr>
<tr>
<td>Rigs</td>
<td>Possible</td>
</tr>
<tr>
<td>Drilling Ship</td>
<td>Remotely Possible</td>
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<tr>
<td>Anchor Handling Tugs</td>
<td>Extremely Possible</td>
</tr>
<tr>
<td>RO Vessel</td>
<td>Extremely Possible</td>
</tr>
<tr>
<td>MPS Vessel</td>
<td>Extremely Possible</td>
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</table>

**SWOT Analysis of the Potential for O&G industry in Sri Lanka**

The **Pipeline Sector** is another vital sector, but regrettably Sri Lanka lacks the knowhow and experience in the design, construction, laying, operation and maintenance of the requisite and sophisticated pipelines. Considering the location, size and other demographic factors of Sri Lanka, the necessity for large networks of pipelines in Sri Lanka would be somewhat remote and limited. However, gradual and systematic building up of capacity to meet the emergent needs may be of importance. It is a similar lack of exposure that Sri Lanka has in the area of **subsea pipelines**, i.e. the pipes used for transport of the natural gas (and oil) that would be extracted from offshore wells or
FSO/FPSO (floating production, storage and offloading) facilities. With limited experience and exposure, the designing and laying of such sophisticated pipelines may have to outsourced, although Sri Lankan companies could engage in fabrication, non-destructive testing, supply and application of coating & protection systems, and in the periodic maintenance of such subsea pipelines. Therefore, focus should be on these areas to build competency and capacity needs to meet such emergent needs.

The *Service and Supply Sector* is yet another vital and highly value-adding component of the O&G industry, which in fact starts with the commencement of the exploratory work. Such services may vary from very simple and basic services of organizing air-line tickets to sophisticated engineering and/or sub-sea services and the emergent needs have to be clearly identified and requisite capacities needs to be enhanced.

Another approach in looking at O&G industry categorizes the industry into four distinct sectors, namely Exploration and Production (E&P), Refining, Transportation and Consumer Distribution.

When analyzing the prevailing competencies and capacity of the Sri Lankan O&G sector, one could unhesitantly identify the strengths present in the marine sector. It is nevertheless possible that, with prudent dialogue amongst the policy makers, industry (both public and private sector players) and knowledge and training providers, especially the vocational training providers, the competencies needed could be built and the capacities necessary enhanced to meet the needs of the emerging O&G sector in Sri Lanka.

Summarized below in conclusion are the salient aspects which should attract greater attention as the way forward to meet future needs.

- Integrated Competency Building through prudent vocational training is underscored.
- Further **Capacity Enhancement** in identified areas is vital.
- Gap identification must be carried out between **Local Potential** and **Industry Needs**.
- Greater participation of **All Stakeholders** adopting prudent strategies is vital.
- Both the **Public** and **Private Sectors** have to work in tandem keeping national interests in the fore.

**Bibliography**


**Webography**


ROLE OF PRIVATE SECTOR IN SRI LANKA’S OFF-SHORE GAS AND OIL INDUSTRY

Ranithri Perera

Abstract

The private sector, presently accounting for almost 85% of activity in the economy, has been a long standing partner of Sri Lanka’s economic development even through tough times. Its active engagement in investments, trade and other significant economic activity has helped accelerate economic growth in Sri Lanka. Thus it is often believed that, an empowered private sector is essentially a key player of any economy.

Sri Lanka’s offshore oil and gas industry being in its infancy stages is yet to realize the full potential of the private sector. As an emerging industry the role expected still remains unclear while there is very little knowledge and awareness on industry potential and the opportunities it is likely to offer to the private sector as a whole while very few attempts have been made to outline in detail the expected role of private sector.

Discovery of potential gas reserves in the Mannar Basin and the launch of Sri Lanka’s second licensing round have awakened much interest among private sector firms with a need to identify the role of private sector in the oil and gas industry in Sri Lanka. Regarded as the engine of growth, the private sector is undoubtedly expected to play a key role in Sri Lanka’s oil and gas industry in order to drive it towards anticipated growth. This paper outlines the core areas of the industry, where private sector role is vital, while identifying the various means by which active involvement and contribution could be made. This paper also notes the various opportunities available to the private sector once the industry progresses into its different phases to establish itself as a fully-fledged one.
Introduction

In this study, we assess the core industry areas in which private sector of Sri Lanka could play a key role thereby outlining its role in the emerging industry. The study commences with a general analysis of the industry value chain and an analysis of the role of private sector firms in other regions. Regional benchmarking and analysis of industry potential would enable us to clearly identify the exact role of private firms in the emerging industry. The paper concludes with clear recommendations for business firms to enter the promising industry.

The problem at hand

Given the emergent nature of the industry, the lack of awareness and knowledge of oil and gas opportunities, the full potential of industry remains unknown. It is known that the private sector in any economy serves as the engine that drives the economy. Results have proved that its active contribution helps the efficient functioning of economy. Driven by the profit motive, the ultimate goal of the private sector is to enhance its returns. Thus, higher the opportunity for growth, higher would be its contribution and role.

Undoubtedly, private sector has a vital role to play in driving Sri Lanka’s oil and gas industry towards growth. However, the lack of clarity about the industry potential and the opportunities it offers to the private sector implies limited clarity on the optimum role of private sector with regard to returns.

Thus, the research problem has two faces. The first concerns identification of the opportunities that the oil and gas industry offers at various phases to private sector. The second, which derives from the first, is the identification of critical industry areas in which capacity building is necessary, which would also be the core areas where private sector role is vital.

Objectives

1. To identify and analyze the industry value chain in order to assess the opportunities that unfold as the industry progresses and the necessity to build capacity to embrace the industry challenges
2. To examine through industry benchmarking, the role of the private sector in the development of effective capacity building in various economies of the region.

3. To identify the core areas through benchmarking and value chain analysis in which private sector role is vital and suggest means by which the private sector could get involved.

**Methodology**

The methodology adopted in this study involved industry benchmarking and extensive literature search. The search was complemented with discussions with private sector industry experts and practical experience in industry operations. The information gathered from these sources was subjected to content analysis.

**Industry Benchmarking: Brief analysis of private sector role in other oil and gas regions**

**Case Study 1: Malaysia**

**Market structure**

According to a recent publication of the World Bank on Local Content policies of various oil and gas countries, (Anouti, 2013) Malaysian oil and gas industry, since its very inception, has developed, marking three major milestones in industry development;

- The first being the foreign dominated days during the colonial era, when oil was discovered (Anouti, 2013)
- The second was the Malaysian government enactment of the Petroleum Development Act, soon followed by the founding of the state company, Petronas (Anouti, 2013)
- The third milestone was the period of oil depletion marked by Malaysia’s ambitious moves on local and international fronts. (Anouti, 2013)
Discovery of oil in Malaysia dates back to 1910 where enabling oil exploration and development was entirely dominated by IOCs of which Shell was the major operator to discover and develop oil in Malaysia.

Following the World War II, a drive towards economic independence was witnessed. This drive was seen to affect the oil and gas sector through the parliament’s enactment of the Petroleum Development Act in 1974 (Anouti, 2013).

The enforcement of the Act led to the creation of the state company, Petronas, which has been involved in upstream and downstream activities. Petronas’ partnering with IOCs for the exploration and development of oil and gas resources has undoubtedly transformed the local knowledge and capabilities capital, but the IOCs often remained the providers of technology, especially in Malaysia’s oil and gas formation, which is dominated by technology demanding offshore and deep-water fields. Local capabilities were witnessed in the downstream sector, particularly in the petrochemical industry. The Malaysian government was successful in forming three major petrochemical clusters comprising international and local companies operating throughout the entire oil and gas value chain.

The most diversified of the petrochemical clusters is in Kertih, Terengganu; the second is the Gebeng hub; and the third is the Pasir Gudang (Anouti, 2013). The Petronas Petrochemical Integrated Complex (PPIC), for example, was formed in Kertih and contains gas-processing plants, petrochemical plants, utility facilities, training centres, tankage facilities and two ports.

**Domestic sourcing of goods and services**

Traditionally, Petronas has been the main driver for the domestic sourcing agenda in the Malaysian oil and gas sector. Petronas requires all contractors to either domestically source all goods and services incidental to upstream activities or obtain from the manufacturers directly. Also, as per the procurement process, suppliers of OFSE must receive a license from Petronas. Foreign suppliers can obtain the license, provided they enter into partnerships with local firms.

On another front, and to encourage the engagement of local supplier in oil and gas activities, Petronas has been holding a touring “clinic” initiative. The clinic offers a platform for local suppliers to interact with Petronas staff: local suppliers learn about the online procurement system of the NOC as they get help in registering and accessing future opportunities. These include
opportunities associated with the international activities of Petronas (Anouti, 2013).

Case Study 2: Nigeria

Nigeria is considered the most influential and most strategic country in Africa today in view of its population, its vast hydrocarbon resources and the commitment of the government to democracy, anti-corruption and African Unity (Ozigbo, 2008). There has been rapid economic development in Nigeria due to the deliberate policy of the government on building capacity though investment opportunities in the industry itself.

- Technological development in the Nigeria’s oil and gas industry has been facilitated by a number of systematic and deliberate policies directed toward building of a network of institutions for the promotion of technological capacity while institutional capacity building and co-ordination have also been a part of the key strategies adopted.

- The discovery of oil and gas in Nigeria has attracted many oil and gas international participants such as Mobil, Agip and Texaco/Chevron.

Capacity building is one of the key plans for achieving government targets and is being pursued through (Lesser, 2000):

- Training of Nigerians in targeted areas of competency and acquisition of technological and managerial capability.
- Development of infrastructure and upgrade of facilities
- Identifying new opportunities for local suppliers.
- Local Business and supplier’s enhancement.

In spite of several initiatives taken by the Nigerian government to build local capacity, it is also looking at possible means to attract private sector in investing in new refineries. Although Nigeria is one of the continent’s largest crude oil producers, is still importing a majority of its refined petroleum. This was one of the reasons why at the start of 2013 the government scrapped its fuel subsidy, leading to the doubling of the pump price of petrol; from 65 naira per litre to around 140 naira, and it was believed that higher petrol prices will stimulate investment in petroleum refineries.
The Sri Lankan scenario

Before approaching the question of what the role of private sector is in the emerging oil and gas sector it is important to outline in detail the various services required by the oil and gas industry, as whole, which could be considered potential opportunities for private sector to exploit. Thus, an in depth analysis of industry research coupled with knowledge and experience shared during the first licensing round, this paper attempts to outline the service requirements in each sub sector of the industry while arriving at the industry demands that satisfy the service requirements. A complete outline of opportunities will summarize the core areas of the industry in which private sector contribution and role is vital.

Oil and gas industry value chain and analysis and capabilities required to be developed to meet the industry demands

A World Bank study of the local content policies in the oil and gas sector (The World Bank, 2011) reveals that the oil and gas sector is spread along a value chain of recognizably different stages, some of which may even act as separate subsectors. Each stage of the value chain involves various technical, technological and skill-based inputs offering a host of opportunities for the private sector to contribute and exploit. The opportunities that the industry offers will also vary with the development of the industry from its initial stages.

The World Bank study further states that, over time, as the oil industry develops from its initial stages, the nature and extent of local content is likely to vary; some stages lend themselves more to the use of local inputs while others tend to rely more on imported inputs. The ability of the local economy to supply these various inputs also depends on its level of development and industrialization. Highlighting the significance of local economy at each stage, the study shows the typical goods and services utilized at every stage of the industry value chain.

In order to identify the capabilities and capacities required at each phase of the industry value chain of Sri Lanka’s offshore oil and gas industry, the paper attempts to analyze the various phases of industry and the activities demanded at each phase. A clear outline and understanding of the industry demands will be helpful in identifying the capabilities required to be built over time in Sri Lanka to serve this promising industry.
Figure 01: Goods utilized at each of the oil and gas value chain

Figure 02: Services utilized at each stage of the oil and gas value chain
The oil and gas industry is usually divided into three major components: upstream, midstream and downstream (Wikipedia). The upstream oil sector is also commonly known as the exploration and production (E&P) sector. This sector primarily involves searching for potential underground or underwater crude oil and natural gas fields, drilling of exploratory wells, and subsequently drilling and operating the wells that recover and bring the crude oil and/or raw natural gas to the surface. The midstream sector involves the transportation (by pipeline, rail, barge or truck), storage, and wholesale marketing of crude or refined petroleum products. Pipelines and other transport systems can be used to move crude oil from production sites to refineries and deliver the various refined products to downstream distributors. Natural gas pipeline networks aggregate gas from natural gas purification plants and deliver it to downstream customers, such as local utilities. The downstream sector commonly refers to the refining of petroleum crude oil and the processing and purifying of raw natural gas, as well as the marketing and distribution of products derived from crude oil and natural gas. The downstream sector touches consumers through products such as gasoline or petrol, kerosene, jet fuel, diesel oil, heating oil, fuel oils, lubricants, waxes, asphalt, natural gas, and liquefied petroleum gas (LPG) as well as hundreds of petrochemicals.

Table 1 identifies the various activities involved in the Oil and Gas industry Value Chain and Capabilities required to fulfill the industry needs.

**Findings and Recommendations**

Industry benchmarking findings of the extent of private sector contribution and a deeper industry value chain analysis reveal the following key areas of Sri Lanka’s offshore oil and gas industry where private sector role and contribution could be considered vital. The identified areas can be considered as the industry sub-sectors in which extensive capacity building is required to embrace and exploit the vast opportunities that the oil and gas industry would offer in future. The private sector, popularly known and considered the engine of growth in an economy, is expected to play an active role in the identified areas to drive the Sri Lankan offshore oil and gas industry towards success.
Table 01: Activities and capabilities in the oil and gas industry value chain

<table>
<thead>
<tr>
<th>Industry Services</th>
<th>Capacity building needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploration Phase</td>
<td>• Managerial capabilities for organizing and implementing a national petroleum exploration and development programs.</td>
</tr>
<tr>
<td>• Seismic Activities</td>
<td>• Technological expertise for taking decisions at critical stages of petroleum exploration and development, such as the ability to analyze and assess the results of geophysical and geological surveys.</td>
</tr>
<tr>
<td>• Drilling services</td>
<td>• Technical capabilities and knowledge of the oil field services and equipment.</td>
</tr>
<tr>
<td>• Marine support</td>
<td>• Adequate skilled manpower pool with technical know-how and knowledge of basic scientific principles such as Data, manuals, software, engineering design and calculating methods.</td>
</tr>
<tr>
<td>Production Phase</td>
<td>• Equipment and materials suppliers providing a wide range of pumps, valves, pipes, motors, instrumentation, process equipment etc for the specialized needs of the upstream industry.</td>
</tr>
<tr>
<td>• Engineering and project management</td>
<td>• Strong expertise on oil and gas logistics and supply chain.</td>
</tr>
<tr>
<td>• Hook-up and commissioning</td>
<td>• Investment in Long term strategic assets.</td>
</tr>
<tr>
<td>• Drilling rigs and services</td>
<td>• Strong regional partnerships.</td>
</tr>
<tr>
<td>• Construction and fabrication of structures</td>
<td></td>
</tr>
<tr>
<td>• Marine support</td>
<td></td>
</tr>
<tr>
<td>• FPSOs supply and operation</td>
<td></td>
</tr>
<tr>
<td>• ROVs supply and operation</td>
<td></td>
</tr>
<tr>
<td>• Operations and maintenance services</td>
<td></td>
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<tr>
<td>• Field review and optimization</td>
<td></td>
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<tr>
<td>• Retrofit work</td>
<td></td>
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<tr>
<td>• Structural maintenance and upgrades</td>
<td></td>
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<tr>
<td>• Equipment maintenance and upgrades</td>
<td></td>
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<tr>
<td>• Marine support</td>
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<tr>
<td>• FPSOs supply and operation</td>
<td></td>
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<tr>
<td>• ROVs supply and operation</td>
<td></td>
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<tr>
<td>• Well plugging</td>
<td></td>
</tr>
<tr>
<td>• Dismantling of structures</td>
<td></td>
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<tr>
<td>• Decommission machinery and equipment</td>
<td></td>
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<tr>
<td>• Marine support</td>
<td></td>
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<tr>
<td>Abandonment Phase</td>
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<tr>
<td>• Prime Movers</td>
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<tr>
<td>• Turbo-machinery Services</td>
<td></td>
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<tr>
<td>• Hydrocarbon Transportation</td>
<td></td>
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<tr>
<td>• Storage</td>
<td></td>
</tr>
<tr>
<td>Midstream</td>
<td></td>
</tr>
<tr>
<td>Pumping &amp; Storage</td>
<td></td>
</tr>
<tr>
<td>• Refinery MRO Services</td>
<td></td>
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<tr>
<td>• Energy Efficiency Services</td>
<td></td>
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<tr>
<td>• Heavy Oil Refining</td>
<td></td>
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<tr>
<td>• Supply Chain Management</td>
<td></td>
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<tr>
<td>• Biomass to Crude Technologies</td>
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<tr>
<td>Downstream</td>
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<tr>
<td>Refining</td>
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</tbody>
</table>

- Author’s compilation based on extensive literature review -

1. Development of a strong supplier base

Given the demand for goods and services at each phase of the industry value chain, building of a strong supplier base locally is mandatory. As we are well aware, most of Sri Lanka’s upstream activities are presently carried out abroad. Participation of private sector/local firms in the oil and gas activities with strengthened capacity, to face competition from the international players lies mainly in the continued development of capacity in the domestic supplier base of the country. Several domestic firms in Sri Lanka currently are involved in the logistics and supply chain activities of the E&P stage.
although there is a greater potential to contribute in other areas of the business. The value chain analysis of the oil and gas sector clearly highlights the services as well as the goods demanded at each phase of the industry. Thus, the procurement of goods and services - which requires greater technical and technological expertise - locally may not always possible in a developing country like Sri Lanka. However, the private sector firms could enhance the procurement opportunities within the country by adopting strategic business models, partnerships and alliances by which domestic strengths are combined with key international industry players. Such strategic business models include strategic partnerships, acquisitions or alliances.

**Partnership with international players**

One key method of strengthening the local supply base and accessing the expertise of international players is through the setting up and management of multi-sector partnerships. The oil and gas sector has engaged in a wide range of collaborative arrangements across countries mainly to gain access to technology, knowledge and skills. A recent study conducted by Ernst and Young report (Ernst and Young, 2011) also states that partnerships could potentially help leading companies to have a better relationship with governments of oil-rich countries, helping to avert the risk of rising global competition and unfavourable government policies.

**Cross-sector strategic partnerships**

Creating new market opportunities through cross-sector strategic partnerships is also considered a key means by which the private sector could play an active role in developing a strong supplier base.

As per the study conducted by Ernst and Young (Ernst and Young, 2011) the most frequently quoted examples include working with auto or technology companies investing in renewable technologies developed in the space technology; and the shipping and marine sectors will also be important enablers for developing tomorrow’s ultra-deep-water fields. Oil and gas companies are said to potentially benefit from technological innovations, new capabilities and business opportunities by working across sectors such as auto industry, energy, chemicals and agriculture. One instance is the strategic alliance for the development of hydrogen vehicles, alternative energy schemes and improved environmental safety.
Acquisitions or alliances to gain new capabilities

Entering into an alliance or an acquisition is also considered a way in which private sector firms could access new growth opportunities (Ernst and Young, 2011). Gaining access to new technologies, expanding company supply bases or accessing new markets would certainly be possible with new acquisitions. The study by Ernst and Young states that making use of acquisitions or alliances is also about selecting a portfolio of assets appropriate to a company’s capabilities and strategy. “Many new frontiers, whether geographical or technological, are frequently opened up by small, agile independent companies that are prepared to take risks avoided by the majors.

2. Building an oil and gas specific resource pool

Employment of local staff is an established objective of the industry, and many developing country oil and gas sectors are faced with significant challenges in the availability of skills and talent required to meet the workforce needs of the industry. Thus there lies greater responsibility on industry, government and educators to work together to build the pool of talent needed to sustain production and development. Regardless of size and structure of industry, the following resource pool will have greater demand in the oil and gas sector.

- Project Engineers: mining, electrical instrumentation, chemical, mechanical, petroleum, and civil engineers
- Mechanical and instrumentation technologists, drafting technologists and technicians
- Inspection technicians
- Production and procurement managers
- Drilling coordinators
- Oil and gas field workers, labourers and operators
- Trades: instrumentation technicians, heavy-duty equipment mechanics, welders, insulators, crane operators, millwrights and machinists, steamfitters and pipefitters
3. Infrastructural investments

With the changing global market dynamics the need for new infrastructure increases in order to connect resources and markets. As Ernst and Young analysis reports (Ernst and Young, 2011) the unconventional boom in North America is illustrative of the transformative capacity of technology; a large amount of infrastructure is now needed to transport the shale oil and gas from the middle of the continent to the coastal areas, where the demand lies. Another key illustration highlighted in the report is the build-up of LNG infrastructure to link the Australian North West Shelf venture to the Asian market while the main focus of many companies is in Europe gas pipelines. Similarly, the monetization of the two gas reserves in Mannar, Sri Lanka would be the main focus for many private oil and gas companies. Private companies in Sri Lanka will need to work closely with resource owners to ensure that such infrastructure is in place to meet the demands at the monetizing phase. Apart from the pipeline and subsea infrastructure, the oil and gas companies should consider investment in long term strategic assets. For instance investment in land which is an essential for oil and gas local supply base facilities, material handling equipment, transport equipment and other cargo carrying items that are of higher value. As the Sri Lankan oil and gas industry progresses the need for strategic assets will increase. Thus, the importance of infrastructural investments is a key opportunity for private firms in Sri Lanka to exploit as demand is likely to rise with the expansion of industry.

4. Technology transfer

Transfer of Technology is a significant issue in the oil and gas sectors. Many developing countries are concerned about the operations that take place in different phases of the oil and gas industry, and are also aware of the need to acquire at least an adequate understanding of the related industry. As studies indicate (Mabadi, 2007) ‘without some mastery of oil technology, petroleum developing countries cannot ensure, for instance, that their exploration efforts are adequate and that production rates are consistent with their national interest and oil requirements. Moreover, where the size of the prospective reserves is not large enough to be economic and attractive for international oil companies to invest in, but perhaps large enough for domestic or local consumption, the domestic technology and basic skills of the countries concerned might be the only way to use the potentialities’.
Economic wellbeing and development in any sector in today’s context depends on technology. In oil and gas context, the extent of local control is to a great extent dependent on the absorption and adoption of technology by the host country.

Most of technologies involved in petroleum operations are rooted in the science and engineering disciplines, and mainly involve geological, geophysical, seismic, drilling, reservoir engineering and computer software services, equipment and installations used in refineries and petrochemical plants, installation and building of plants, refineries and petrochemical processing facilities, seismic studies, logging and drilling, and project management among others (Mabadi, 2007). The entire gamut of services as described needs to be backed by adequate technology.

In the petroleum context, “Technology Transfer must necessarily refer to a process which enhances the ability of developing country concerned to monitor and control the petroleum sector activities, to acquire or hire directly the most appropriate means for petroleum exploration and development, and strengthens the domestic capability to utilize these means effectively by itself, if necessary, without outside assistance”. (UNCTAD, 2011).

Thus the role that private sector could perform in the industry involves close cooperation with technology owners, though which domestic personnel could be in close contact with the professionals and skilled workers for smooth transfer of experience and technology. On the other hand, joint venture contracts with international oil and gas companies is also an attractive method by which cost reduction and technology acquisition is possible.

5. Hub opportunities – oil and gas clusters and regional hubs

‘Mahinda Chintana - Vision for the Future’, aiming to use Sri Lanka's strategic geographical location effectively to develop the country has emphasized the Energy Hub as one of the Pancha Bala Kendras of Sri Lanka.

In order to develop Sri Lanka as an Energy Hub, Sri Lanka presently is in search of oil and gas reserves and renewable energy sources. As a start, Sri Lanka commenced its first oil block licensing round in the year 2007 in order to explore its hydrocarbon potential.
What it takes Sri Lankan Private Sector to make Sri Lanka a hub to serve Asia’s oil field services

- Attract major international Oil field Servicing companies to bring sizeable shares of their global operations to Sri Lanka
- Enter into Joint Ventures with International Oil & Gas companies
- Build regional champions

**Figure 03**: Private sector tasks to make Sri Lanka an oil and gas hub

With the development of oil and gas activities there also lies an immense opportunity not only for enhancing local capacity to serve the oil and gas industry but also to establish Sri Lanka as a regional hub for oilfield services. Considering Sri Lanka’s strategic location, close proximity to regional oil fields, expanded port related infrastructural facilities, strong supply chain integration, and cost-competitive work force Sri Lanka is well placed to become Asia’s leading hub for oil field services.

Thus there lies a greater role in the hands of private sector firms in Sri Lanka to increase competitive pressures in the domestic market, and become domestic champions and then subsequently regional champions as the country captures a larger share of the regional market. The regional hub will serve as;

- Field offices to coordinate and stage field operations
- Continuous engagement in research and development
- Supply chain management
- Logistics support to carry out oil and gas activities
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LOCAL CONTENT DEVELOPMENT WITH SPECIAL REFERENCE TO EMPLOYMENT AND TRAINING

Eng. D.T.K. Preeni Withanage

Abstract

Local Content (LC) has become very topical in the oil and gas sector globally. LC is subjective and is defined in many ways, depending on the country's level of socio-economic development.

LC in Oil and Gas (O&G) refers to the added value brought to a host nation through capacity building of national human resources and technological & industrial advancement of the country through the participation of international contractors in upstream oil and gas activities in the country.

LC is a frequent flashpoint between Contractor and Government as the government wants to maximize opportunities and benefits to its citizens, while the Contractor wants the best workers, supplies and, above all, quality and safety. Therefore a well focused Local Content Development (LCD) strategy shaped by business benefits and a well-defined strategic plan is vital to play a balanced role in providing a winning proposition for both Government and Contractor. The LCD strategy is not a quick fix or a route to achieving short-term benefits, but contributes to lasting benefits in the long term.

Regulatory requirements, and business and stakeholder expectations are the key drivers to be considered by the practitioners in achieving LC. Understandably, many O&G producing countries introduce LC requirements into their regulatory frameworks, and the employment and training of local workforce especially is one another established objective of the LCD strategy derived from the above requirements which has become an integral part of almost all countries engaged in petroleum activities. Developing a workforce to perform to the exacting standards of the O&G industry is difficult and time consuming as the challenges are compounded by factors outside the planner's control such as the quality of educational systems, O&G industry regulatory environment, the availability of finance, and the condition of infrastructure.
Four factors, namely local contextual analysis, starting early with strategic initiatives, strategic plan for a long-term perspective, and free-flowing and transparent information streams, comprise the key to successful implementation of an effective LCD strategy in developing the local workforce.

The aim of this paper is to bring about awareness of the concept of the local content as adapted globally and provide supportive information required to prepare a strategic LCD plan in order to build the competencies and the capacities of the academic as well as the technical & vocational training sectors to keep abreast of future oil and gas development activities in Sri Lanka. In this context, it is essential that local content development be considered as early as possible in the O&G project life cycle to ensure that opportunities are fully realized by the time the project demands such opportunities.

Background

Petroleum exploration in Sri Lanka began in the late 1960s with the collection of seismic data onshore and offshore in the Mannar area. A total of seven exploration wells had been drilled in the 1970s and 1980s but no hydrocarbon discoveries were made. After a long hiatus, the Government renewed petroleum exploration efforts by establishing the Petroleum Resources Development Committee (PRDC) under the Petroleum Resources Act No. 26 of 2003 with the PRDC as the main regulatory body for the administration of petroleum exploration and production (E&P) operations in Sri Lanka.

The first ever offshore exploration licensing round in Sri Lanka was held in 2007 and the exploration block SL 2007-01-001 of the Mannar Basin was awarded to Cairn Lanka Private Limited (CLPL), the local subsidiary of Cairn India. A Petroleum Resources Agreement (PRA) was entered into between the Government of Sri Lanka and CLPL in 2008. The PRA was effectively an exploration license spanning an eight year period and consisting of three phases of 3, 2 and 3 years respectively. During the first quarter of 2010, CLPL acquired three dimensional (3-D) seismic data over 1,750 sq. km at selected locations in their block. Based on the interpretations of the 3-D seismic data, CLPL launched an exploratory drilling programme during August-December 2011. Three deep water exploration wells were
drilled and hydrocarbon discoveries were encountered in two of the three wells. The discoveries were predominantly gas bearing with some additional liquid hydrocarbon potential.

Cairn has notified commercial interest in the above discoveries, but further drilling would be required to appraise the economic viability of the discoveries. However, the discoveries have confirmed the existence of a working petroleum system in the Mannar Basin. Accordingly, CLPL entered into the second exploration phase and the drilling of the fourth exploration well is currently in progress. The CLPL will continue with the work commitment agreed in the PRA for the exploration phase and further the appraisal of the discoveries made.

Subsequent to the interest shown by several Super Majors and International Oil Companies, Sri Lanka is preparing to call another international licensing round in early March 2013 to offer few more blocks in the Mannar and Caurvery Basins.

Purpose

The developments associated with recent hydrocarbon discoveries and the upcoming licensing round may significantly increase the petroleum E&P activities in future. Creation of new employment opportunities and demand for goods and services are some key benefits that would accompany these development activities. In this context the most significant challenge that the country would face is the limited supply of local professionals and the other skilled categories in the oil and gas sector.

Employment and career opportunities in the oil and gas industry around the world are growing. There is a high demand for technical, managerial, skilled and semi-skilled categories, numbering multiples of thousands. Also this fast emerging sector covers a wide range of subject areas including petroleum geosciences, engineering, economics, law, business, management, accounting, environmental, health & safety, etc. Further, this potential economic sector of Sri Lanka necessitates measures for the country’s preparedness, including capacity building of the educational sector. Therefore it requires to identify the knowledge gap and strengthen the academic, technical and vocational education sectors to meet the future potential human resource requirements of the oil and gas industry in Sri Lanka. In this context, the government's wish is to increase the local content
to ensure that the petroleum industry can be sustained primarily with Sri Lankan resources within the shortest possible time.

**Introduction to local content**

The fiscal regime (state take) associated with the petroleum resources sharing systems is a direct benefit to the host country. Royalty, profit share, NOC share, bonuses and taxes have a significant impact on the host country's economy. However, in many countries, owing to mismanagement and other problems, the benefits of this massive industry have not been shared out fairly amongst the whole community. Therefore the LC, commonly referred to as indirect benefits or added value, has become an important regime in the oil and gas sector. LC is subjective and is defined variously, depending on the country's level of socio-economic development. As per the Nigerian LC act, LC refers to the quantum of composite value added to or created in the local economy by a systematic development of capacity and capabilities through the deliberate utilization of local human, material resources and services in the oil and gas industry of the host county. There are, besides, definitions such as “added value brought to the host country through procurement of goods and services and development of the local workforce”, “strategic community investment”, etc. To achieve these benefits, countries have developed their own LC strategies and made LC a contractual obligation by incorporating in their resource sharing agreements all or part of the LC provisions such as improvement of livelihood of needy communities, transfer of technology, preference for the procurement of local goods and services, maximum use of local workforce, research & development and local knowledge enhancement through education and training opportunities. Also, LC is a frequent flashpoint between Contractor and Government as the Government wants to maximize opportunities and benefits to its citizens, while the Contractor wants the best workers, supplies, and, above all quality and safety. Therefore planners of a local content strategy need to play a balanced role in providing a winning proposition for both Government and Contractor.
Local Content Development

LC Development strategy

Oil and gas companies face a range of different regulatory environments that will influence the feasibility of implementing a local content strategy. Hence, an understanding of the local context is crucial to the development of a strategic plan. In many countries, regulatory requirements define explicit targets or objectives for local content development. But the objectives should be based on a thorough understanding of the local context, especially what is realistic and achievable. Particularly important are the demand-side requirements, the supply-side capabilities, and barriers that limit local participation. The drivers of a successful LC development strategy are the local context, regulatory requirements, business expectations, and stakeholder expectation and participation.

The LC development strategy starts with collaborative activities with individual institutions and foreign contractors and develops progressively in stages from a basic LC model to centres of excellence. Many countries are enacting laws to make LC mandatory. Nigeria signed its LC Act into law in April 2010 and emphasizes a Nigerian Content Plan that incorporates an employment and a training plan. Also countries like Norway, Brazil and Canada, which have reached a high level in petroleum activities, execute their LC requirements through centres of excellence delivering project-based total industry solutions. Overall, the development of LC strategies with special reference to employment and training has become an integral part of almost all countries engaged in petroleum activities.

Sri Lanka is a frontier basin which currently implements basic LC provisions in a collaborative and a friendly manner. In addition, Sri Lanka has taken a strategic step forward to implement "Sri Lanka Upstream Petroleum Local Content Guidelines" in line with the upcoming licensing round. The above guidelines prepared by PRDS in March, 2013 are mainly focused on developing a skilled workforce, procuring optimal supplies and services domestically, improving the livelihood of needy communities and enhancing Sri Lankan professional capabilities and competencies through education, training, knowledge and technology transfer. Submission of an activity specific Employment and Training Plan before the commencement of any petroleum activity and an annual contribution to the Petroleum Training Fund maintained by PRDS are some inclusions in the Guidelines that makes some special references to employment and training needs. Further, the LC policies will be reviewed from time to time in line with future E&P activities connected with appraisal, development and production phases. But the recent hydrocarbon discoveries in the Mannar Basin and developments connected
with the second offshore licensing round necessitate the country's preparedness for a basic local content strategy with special reference to employment and training. This could only be achieved through an effective participation of the key stakeholders such as the government, local industry, R&D, education and financial sectors, the oil & gas investors and service companies.

Findings

In view of developing an LC strategy for employment and training needs, the PRDS carried out an information survey to identify the LC provisions adapted in few countries in relation to employment & training and the educational/academic work related to oil and gas that is currently being implemented in Sri Lanka.

Table 01: LC provisions adapted in some countries in relation to employment and training

<table>
<thead>
<tr>
<th>Country/Description</th>
<th>Local Content provisions with special reference to Employment and Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nigeria</td>
<td>• Nigerians to be given first consideration for employment and training in work plans.</td>
</tr>
<tr>
<td></td>
<td>• Submission of an Employment and Training Plan (E &amp; T) which includes hiring and training needs, anticipated skill shortages in the Nigerian labour market, project specific training requirements and expenditures allocated for implementing the E&amp;T plan above.</td>
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<tr>
<td></td>
<td>• Reasonable efforts to be made to supply training locally or elsewhere if the Nigerians are not employed due to lack of training.</td>
</tr>
<tr>
<td></td>
<td>• Submission of a succession plan for an understudy to each incumbent expatriate for a maximum period of four years and the position to become</td>
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</tbody>
</table>
Contracts whose total budget exceeds USD 100 million to contain a labour clause mandating the use of a minimum percentage of Nigerian labour in specific cadres.

Mandatory carrying out of all fabrication and welding activities in-country.

Submission of a Research and Development Plan (R&D Plan) to the Board by the operator.

Submission of an annual plan outlining the initiatives aimed at promoting the transfer of technologies to Nigerian individuals and companies.

Mandatory obligation of the operator to employ only Nigerians in its junior and intermediate cadre or any other corresponding grades designated by the operator or company.

Establishment of a fund to be known as the “Nigerian Content Development Fund”, to be financed by the deduction at source of 1% of every contract sum on any contract awarded to any operator in the upstream sector of the industry.

The Nigerian government, NNPC, has issued a list of 23 categories of work which must be executed in Nigeria.

Angola

Angola is the second largest oil producer in sub-Saharan Africa and has been producing oil since its first commercial discovery in 1955. Angolan local content requirements start from the constitutional premise (Angolan Law 13/78 of 26

Maintaining a Fund to train and develop human resources.

All companies in O&G to have a plan to Angolanize their work force, including succession and career development planning.
August 1978). Steps were first taken to implement that premise in 1982.

- Submission of a Professional Qualification Plan.
- Submission of a recruitment and a training plan for approval within 4 months of the effective date.
- Staffing requirements
- 100% Angolanization for unskilled workers, e.g., drivers, janitors, etc.,
- 80% Angolanization for mid-level workers, e.g., travel agents, machinists, etc.
- 70% Angolanization for higher level staff, e.g. managers, geologists, engineers, etc.

**Ghana**

Since the discovery of major oil reserves in 2007, the active involvement and participation of locals in the oil and gas industry has become a major policy issue in Ghana. After a nation-wide consultation process, Ghana's Ministry of Energy formulated a policy framework dealing with local content issues in February 2010, which set a number of key policy objectives. In 2011 Ghana submitted the new local content regulation to Parliament.

- Providing employment opportunities for Ghanaians as far as possible.
- Submission of a detailed Annual Recruitment and Training Programme for recruitment and training of citizens of Ghana in all job classifications and in all aspects of petroleum activities.
- The Annual Recruitment and Training Programme to ensure that the following targets are met:
  - At least 50% of the management staff are Ghanaians from the start of petroleum activities and the percentage increased to at least 80% within five years;
  - At least 30% of the technical staff are Ghanaians from the start of petroleum activities and the percentage increased to at least 80% within five years and to 90% in 10 years.
  - 100% of other staff are Ghanaians.
- The training programme to include scholarships and industrial training
Local Content Development

- Both Government and the petroleum operators to develop the requisite capacity to international standards to be able to train Ghanaians to comparably high levels as required by the industry in drilling and support services, marine, catering and housekeeping, supplies and other support services. This measure will focus on all aspects of training, including the following:
  
  i. Lower skill artisanal training such as welding, catering services;
  
  ii. Middle-level skill training of technicians to provide maintenance services, offshore and on shore drilling etc.;
  
  iii. High level skill training including general management, engineering design, procurement and business strategy development.

- Government and operators to supporting academic and technical institutions to build the requisite human and material resources to provide effective training for Ghanaians and institutions are resourced adequately to carry out the training.

Brazil

Until 2002 there was no minimum local content requirement in Brazil. The government has been imposing local content requirements on oil companies since 1999, but the pre-salt offshore oil discoveries of 2007 increased pressure on the local oil services industry.

- PROMINP, the National Program for the Mobilization and Development of Oil and Gas Industry established in 2003.
  
- The objective of PROMINP's National Professional Qualification Plan (PNQP) is
  
- To increase the skilled Brazilian employees to 70,000 by 2008, providing 58% of trainees with basic
skills, but also providing technical training to a further 28% of recruits, with further provision for graduate and 'inspector' level training.

- Half of the students to be elected by oil companies and the other half through a public selection procedure.
- A substantial amount of the funding to be provided by the companies that participate in the scheme.

Iran

The most important source of legislation in Iran on local content is the Maximum Utilization of Iranian Content Act 1997 ("MUICA") which regulates the use of local potential in different stages of projects.

- Recruit qualified and experienced Iranian citizens. Employment of foreign nationals for occupying such positions must always be with the prior written consent of the NIOC.
- Provide training for Iranian employees and trainees as introduced by NIÖC from time to time, and bear its costs up to a maximum percentage of the Capital Costs as specified.
- The type of training, as well as the level, duration, time and place of training shall be mutually agreed by NIOC and in such a way that it will result in the transfer of know-how, upgrading of the technical capability of the Iranian employees and trainees, and the acquisition of the technology necessary to enable such employees to assume and perform the responsibilities and tasks for which they are being properly trained.
- The training programs jointly prepared by NIOC and Contractor and approved by NIOC shall be implemented in coordination with NIOC.
Sri Lanka

The first offshore bid round was held in 2007 and one offshore exploration awarded. Exploration commenced in 2008 and two hydrocarbon discoveries proving conclusively the existence of a working hydrocarbon system in the Mannar Basin in 2011.

The second offshore licensing round announced in early March 2011 for the remaining blocks.

Strategic step taken to issue its Upstream Petroleum Local Content Guidelines in March 2013 and make it a requirement for the investors participating in a licensing round to develop and submit a conceptual Local Content Development Plan based on the Guidelines as part of the bid package.

- LC Provisions in the PRA signed in 2008
- Employ, to the maximum extent possible citizens of Sri Lanka having appropriate qualifications and experience.
- Not later than six months after the Effective Date, establish and implement an annual training Programme for Sri Lankan Nationals in each phase and level of Petroleum Operations.
- Submit a Benefits Plan outlining the associated goods and services and education and training options earmarked for Sri Lankans before the commencement of any petroleum operational activity.
- Contribute an annual amount as stipulated to an Environmental Fund to support environmental research by the Government.
- LC provisions in Sri Lanka Upstream Petroleum Local Content Guidelines prepared in March 2013 by PRDS. (Downloadable from www.prds-srilanka.com)
- Consider recruiting a minimum specified number of permanent Sri Lankan employees who may be deployed globally to gain experience in the industry, and thereby increase the number and level of Sri Lankan technical and managerial staff in-country over the exploration, development and production phases with a view to progressive replacement of expatriates.
- Employ Sri Lankan nationals for Sri Lankan operations to the maximum extent possible, making allowance for additional training that may be required to build local competence to
the level required to meet generally accepted international standards, and encourage Sub Contractors to act in the same manner.

- Submit, for acceptance and approval by the PRDS, an Activity Specific Employment and Training Plan before commencement of any petroleum activity that involves a considerable number of personnel at any stage of the project, which shall include:
  - Hands-on Training/ internship opportunities with the breakdown of the skills needed.
  - Employment opportunities in support of clauses (i) & (ii) of section 4a of "Sri Lanka Upstream Petroleum Local Content Guidelines".
  - A time frame for the opportunities listed in the above two sub clauses to enable members of the Sri Lankan work force to prepare themselves for such opportunities.
  - Anticipated skill shortages in the Sri Lankan workforce.
  - Make an annual contribution to the Petroleum Training Fund maintained by the PRDS, and contribute in kind where possible to the various training programmes that may be coordinated by the PRDS from time to time.
Contributions of international O&G companies into educational and training

Although the regulations are designed to maximize the number of local employees, the deficiencies in local education and training systems are major barriers to O&G companies. Some major companies deal with this by investing in local education and training institutions which offers a win-win solution to both host government and the company through supporting wider skills development in the local economy and promoting the company’s long-term reputation as a good corporate citizen. Given below are few case studies by some major O&G companies.

Source: Presentation material by Jim Walton Director of Strategic Planning & Marketing Energy & Chemicals Fluor, 8th Annual Global Local Content Summit 2012.
O&G related educational programs in Sri Lanka

With respect to the educational programs that are being currently implemented in Sri Lanka related to oil and gas sector, it was observed that the Department of Earth Resources of the University of Moratuwa (UOM) provides some course modules related to the petroleum sector inclusive of petroleum engineering. Apart from these, the University of Sri Jayewardenepura (USJ) provides some course units on Geophysics as a part of the physics special degree program. The Department of Geology of the University of Peradeniya (UOP) conducts a degree program in Geology inclusive of some course units on petroleum geology. The University of Uva Wellassa, University of Ruhuna, Ocean University of Sri Lanka, the Vocational Training University and CINEC maritime campus have

Source: Presentation material by ExxonMobil, 8th Annual Global Local Content Summit 2012, Local Content Development – Intervening with a Difference (Case Study of ExxonMobil Nigeria Affiliates)
expressed keen interest to introduce new course modules related to oil and gas sector. With the above findings, the PRDS took the following initiatives to lay the foundation to strengthen the academic base of Sri Lanka in order to face the future challenges of oil and gas sector.

**Initiatives**

In view of preparing a LCD strategy to meet the future employment and training requirements in the oil and gas sector, PRDS has taken the following initiatives.

- Held informal discussions with UOM, USJ and UOP engaged in teaching petroleum related courses to develop a more focused curriculum to suit the future oil and gas developments in Sri Lanka.
- Held in-depth discussions with Department of Earth Resources of the UOM to introduce a postgraduate Diploma or an M.Sc. program. This department showed a keen interest in this matter and prepared a draft proposal to establish a Diploma in Petroleum Technology. Gaps in the knowledge and experience of the existing trainers, lack of professionals/experts locally in some specific subject areas and inadequate laboratory facilities to conduct practical sessions were some problems were cited in the proposal.
- A special discussion was arranged with the University Grants Commission to help identify means of addressing the problems cited by the UOM proposal.
- Shared PRDS resources with the universities and relevant government officers to conduct both student and postgraduate research projects.
- Provided financial support through the Contractor Cairn Lanka to a postgraduate student in the University of Sri Jayewardenepura to conduct a post graduate research related to oil and gas sector.
- Made arrangements with Schlumberger, a globally reputed oil and gas service provider to support UOM with a complete package of geological, geophysical and petrophysical interpretation and modelling software worth in excess of a million USD and Cairn Lanka to donate the hardware required to install the above software.
- Facilitated and assisted to engage teams of university students in an international software development competition. A team of UOM
students successfully completed the project connected with the above software competition related to oil and gas activities and gained invaluable knowledge, experience and exposure locally and foreign.

- Provided PRDS resources and assistance to CINEC Maritime Campus to conduct two short training sessions on upstream petroleum industrial setup and operations.

- Held an informal discussion with the Chancellor, Vocational Training University to introduce new course modules related to oil and gas sector.

- PRDS itself conducted several short training sessions to train the trainers of the universities and some key government institutions directly involved in providing supporting services for the oil and gas operations.

- Provided internship opportunities to undergraduate and postgraduate students both locally and foreign.

- PRDS jointly with University Grants Commission organized a two days residential workshop in early January 2013 to enable awareness of the current status & future prospects the of the oil and gas industry in Sri Lanka and further prepare a strategic plan to build the competencies and the capacities of the academic sector to be progressive with the future oil and gas development activities in Sri Lanka.

Recommendations and conclusions

According to the findings of the LCD initiatives adapted globally, it shows that Sri Lanka has already placed a good platform for the relevant stakeholders to develop the local capabilities and capacities in the educational sector. But it initially requires to conduct a countrywide research/study to initially identify the local context with respect to employment and training needs in the oil and gas sector. Analysis of national development priorities in the O&G sector, local capabilities study, supply chain mapping and analysis, environmental and social risk assessment, cost-benefit analysis, barriers analysis, access to finance and business support services and infrastructure analysis are some typical analyses that can be used to review the local context and develop a realistic baseline for local workforce development.
The findings reveal that the current educational set-up in Sri Lanka is less advantaged in terms of resources and knowhow of technical, managerial and operations aspects of the O&G industry. It is recommended to initiate a proper awareness campaign to make all universities, and technical and vocational training centers understand the requirements of the local as well as global oil and gas industry. A strategic Education and Training Plan should be the main focus in preparing the LCD strategy. It should comprise the short and long term training earmarked for Sri Lankan nationals including skilled, professional, executive & management positions covering almost all the subject areas relevant to O&G sector.

As per the findings, a few leading universities have already incorporated oil and gas related subject modules in their existing curriculum. It is timely to assess the resources currently available and the standard of the existing course curriculum and further develop a more focused curriculum identifying the knowledge and resource gaps. In the meantime it is recommended to review the local context analysis mentioned above and identify few universities to set-up new O&G degree and postgraduate (Diploma, MSc) level courses.

An effective LCD strategy usually features training and skills development elements to help less advantaged local populations achieve the minimum standards required by the O&G industry, particularly in terms of specialist skills. This can be achieved by strengthening the technical and vocational training centres in Sri Lanka. Basic understanding of the O&G industry, language training, locally-appropriate methods, practical experience, flexible training period determined by an individual’s rate of progress, and scholarship schemes are some important attributes that need to be considered in this initiative.

In many countries short-term O&G training requirements are handled by the private sector. Even in Sri Lanka there are many private and semi-government institutions that are capable of acquiring the necessary resources with least effort in terms of finance, timing and bureaucracy in order to cater such tailor-made training requirements. To start with, it is recommended to conduct an SWOT analysis that would help the government educational institutions understand the current local context. Then a strategic mechanism should be prepared to collaborate with such private institutions and adapt a resources sharing educational development model than making efforts to strengthen themselves individually.
Planning and implementation of the LCD strategy involves close collaboration with other stakeholders and their participation brings with it valuable knowledge, resources and commitment. The Government, National Oil Companies (NOCs), local service industry, relevant communities, NGOs and Community-Based Organizations (CBOs), International Oil Companies, Business Membership Organizations (BMOs), Chambers of Commerce, Financial Institutions and educational institutions are some key stakeholders that have a direct interest in LCD activities. Therefore it is recommended to identify the relevant stakeholders and develop friendly cooperation in order to build their individual capacities and competencies through internship opportunities, joint research/study projects, technology transfer, financial assistance, knowledge transfer, postgraduate opportunities, capacity building, practical training, etc.

As per the findings the initiatives already taken by PRDS in training the trainers to develop the future O&G workforce need to be further strengthened. Much emphasis should be placed for the training of trainers in the universities, technical and vocational training centres through a structured training program. The funding for these structured training programmes could be arranged through the LC contractual commitments by the O&G companies and the state take of the petroleum share.

Implementing and sustaining the LC is the most difficult task faced by many countries. Internal coordination, stakeholder participation, and monitoring and measuring LC play a key role in sustaining the LC. In conclusion it requires a countrywide study followed by a well-defined LCD strategy incorporating the information and recommendations given in this paper in order for the local workforce to face the future potential human resources requirements of the oil and gas sector in Sri Lanka.

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MANPOWER NEEDS AT CRAFT VOCATIONAL AND TECHNICAL LEVELS IN THE OFFSHORE OIL AND GAS INDUSTRY

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Abstract

Expectations on Petroleum potential in Sri Lanka have been greatly enhanced by the Manner basin tests carried during the period of 2002 and the Government of Sri Lanka attempts to attract exploration companies from the neighboring countries. On July 07, 2008 the Government of Sri Lanka, through the Minister of Petroleum and Petroleum Resources Development signed a Petroleum Resources Agreement with Cairn Lanka (Private) Limited marking the beginning of petroleum exploration of Sri Lanka. As per the agreement Cain Lanka (Private) Limited should employ Sri Lankan nationals for exploration process.

This paper would examine needs of manpower for the process of exploration of gas and oil. The process of exploration would begin with construction of wells, well platforms, feeder subsea pipelines, processing platforms, export pipe lines and tanks for evacuation of oil. Depending on the depth of water, different types of platforms are constructed using either concrete or steel.

A typical oil production platform is equipped to process oil and gas such that it can be either delivered directly onshore by pipeline or to a Floating Storage Unit and/or tanker loading facility. Elements in the oil/gas production process include wellhead, production manifold, and Production separator, glycol process to dry gas, gas compressors, water injection pumps, oil/gas export metering and main oil line pumps. The platform is self-sufficient in energy and water needs, housing electrical generators, water desalinators and all other equipment.

Looking at the overall scope of exploration and production processes involved, training and competency building should be concentrated on the following areas;

i. Petroleum Engineering and Geosciences

ii. Petroleum and Natural Gas Processing
Introduction

Oil and gas production industry involves complex processes and when it comes to offshore production, the processes are even more challenging and require specialized systems to work in marine environment. A brief description of the production platforms, major processes and systems is necessary to understand the nature of manpower requirements of the industry. Typical production rig is considered in the following categories for this purpose.

1. Major Elements
2. Main Processes
3. Specialized Techniques
4. Safety and Reliability

1. Major elements

Looking at the overall production system, major elements based on major functions, can be identified as follows (Shell-Alaska)

a. Wells
b. Well platforms or well servicing rigs
c. Processing platforms
d. Export pipelines for gas and oil
e. Tankers for evacuation of oil

Wells are drilled in different direction depending on the location to be tapped and these can be of vertical, directional, horizontal and multilateral
etc. Well monitoring and controls are essential task to be handed by expert knowledge based systems for safety and optimum operation and it should be possible to remotely close the well in case of an emergency. More modern system involves supervisory control and data acquisition (SCARDA) in which gather necessary information data from remotely located oil/gas wells and well platforms with the help of field transmitters and sends it to the data gathering and analysis point and then thereafter interpretation and decision making. This would help in optimal utilization of manpower for attending well problems.

An oil platform or oil rig is a large structure used to house workers and machinery needed to drill and/or extract oil and natural gas through wells in the ocean bed. There are different types of platforms used depending on the depth of water. Depending on the circumstances, the platform may be attached to the ocean floor, to make an artificial island, or be floating. Generally, oil platforms are located in shallow waters, though as technology improves, drilling and production in deeper waters becomes both feasible and profitable.

There are semisubmersible platforms having legs of sufficient buoyancy to cause the structure to float, but of weight and position of center of gravity sufficient to keep the structure upright. Semi-submersible rigs can be moved from place to place, can be ballasted up or down by altering the amount of flooding in buoyancy tanks, they are generally anchored with chain, wire rope and/or polyester rope during drilling operations, though they can also be kept in place by the use of dynamic positioning.

2. Main processes

Well fluid generally consists of oil, gas and water and in a large processing platform, following four major processes take place.

a. Separation
b. Gas compression and dehydration
c. Conditioning of produced water
d. Seawater processing and injection

Well fluid from various wells and subsea pipeline rises to the processing platform being processed under various stages. After dozing chemicals into the fluid, heating take place with hot oil in shell and tube heat exchangers
and then reaches the inlet separator where fluid is separated into crude oil, gas and water and delivers for further processing. Separated gas is directed to gas compression and dehydration chamber. Compressed gas is sent to the lift gas network for lifting the produce and excess gas is exported via pipelines to shore. Separated oil flows to the oil manifold. Separated water flows to further conditioning unit and then delivers to the sea after treating acceptable level of quality free of oil traces. Crude oil flows to crude oil heater in which crude oil is heated with hot oil. This enhances the separation of oil & water in surge tanks (second stage separation).

Seawater is treated after filtering through coarse and fine filters. Treating is mainly deoxygenation with added chemicals to prevent bacterial formation and corrosion resistance. The treated seawater is then injected to well suction to maintain necessary reservoir pressure and water flooding.

3. Specialized techniques

Specialized techniques have already been explained with related to the processes. Further intelligent wells, digital oil field with data acquisition and processing, multiphase pumping, subsea separation and re-injection, fire detection and suppression, and dynamic positioning are some of the special techniques that are used in oil and gas industry. Dynamic positioning assists a floating vessel to be geostationary, within acceptable limits, using thrusters positioned in several directions below the water level in the vessel.

4. Safety and reliability

Safety and reliability is the most important aspect when considering the oil and gas industry because of the complexity of operations and nature of the environment. Oil rigs are subjected to bad weather condition with heavy seas and always prone to corrosion. Productivity and efficiency as well as crew safety depends on the safety and reliability of the rig. Therefore total structure, all machinery and equipment, and each and every process should comply with accepted safety standards. At the same time health hazarders and environmental impact of the industry cannot be neglected.

A plant breakdown or accident in the oil and gas sector can have huge financial implications that alarm a strong emphasis on maximizing safety, reliability and performance in every aspect of operation. Reliability is influenced by many factors, ranging from the inherent reliability of individual components to the overall complexity of a plant, its operating conditions and the effectiveness of its maintenance regime. It is, therefore,
Manpower Needs at Vocational and Technical Levels

essential when specifying and acquiring new plant to adopt a proactive approach to ensuring reliability from the outset.

Manning requirements

Above explanation to the system and processes may identify the manning needs in the industry. The essential personnel can be categorized into the following.

Managers
- Offshore Installation Manager
- Process Manager
- Maintenance Manager
- Well Platform Manager
- Health Safety and Environment Manager

Operational Teams
- Process control room operators
- Mechanical/Electrical Instrumentation team
- Equipment maintenance teams
- Wellhead teams
- Pipeline maintenance team

These operational teams consist of Engineers, Technicians and Skilled craft level personnel with appropriate competency. Supporting teams for auxiliary functions such as management support, cooking, room services are also available.

Operational Personnel
- *Offshore Operations Engineer (OOE)* - is the senior technical authority on the platform
- *Operations coordinator* - for managing crew changes
- **Dynamic Positioning Operator** - navigation, ship or vessel maneuvering, station keeping, fire and gas systems operations in the event of incident
- **2\textsuperscript{nd} Mate & 3\textsuperscript{rd} Mate** - Meets manning requirements of flag state, operates Fast Rescue craft, cargo operations, fire team leader
- **Ballast Control Operator** - Ballasting and de-ballasting tanks and also fire and gas systems operator
- **Crane Operators** - Operate the cranes for lifting cargo around the platform and between boats
- **Scaffolders** - To rig up scaffolding for when it is required for workers to work at height
- **Coxswains** - Maintaining the lifeboats and manning them if necessary
- **Control Room Operators** - Especially for Production platforms
- **Production Technicians** - For running the production plant
- **Helicopter Pilot(s)** - The helicopter flight crew transports, workers to other platforms or to shore on crew changes
- **Maintenance Technicians** – instrument, electrical, mechanical maintenance

1. **Level of competency, scope and responsibility**

Qualification or level of competency to be achieved and, scope and responsibility of different level of expertise can be given as follows.

1.1 Level of Competency of Technologists

Degree in
- Mechanical Engineering with Instrumentation and Control
- Electrical/Electronic Engineering
- Chemical & Process Engineering with Oil and Gas Exploration
- Marine Engineering
- Manufacturing Engineering
Manpower Needs at Vocational and Technical Levels

- Petroleum Engineering
- Industrial Safety and Environment Technology

and sufficient relevant industrial exposure.

1.2 Scope and responsibility of Technologists are;

- Research
- Administration of Relevant Department
- Production Planning & Scheduling
- Optimization of Production
- Improves efficiency and Effectiveness
- Ensure Safety and Reliability
- Economic Analysis

1.3 Level of Competency of Technicians

Diploma in

- Mechanical Engineering with Instrumentation and Control
- Electrical/Electronic Engineering
- Chemical Engineering with Oil and Gas Exploration
- Marine Engineering
- Manufacturing Engineering
- Petroleum Engineering
- Industrial Safety and Environment Technology
- Welding Technology

and sufficient industrial exposure.

1.4 Scope and responsibility of Technician are;

- Preventive & Failure Maintenance and Operation of Machinery and Equipment
- Maintains all Instrumentation Controlling the Process and Utility systems, Fire & Gas protection/ detection
- Emergency Shutdown in a Safe and Competent Manner
- Ensure Production Targets
- Sample testing, Product Quality
- Ensure Health and Safety During Operation

1.5 Level of Competency of Technicians

NVQ level 5 or 6, as appropriate, in
- Mechanical Technology
- Electrical Technology
- Welding and Fabrication technology
- Manufacturing
- Mechatronics

1.6 Scope and responsibility of Craftsmen are;
- Installs, maintains and troubleshoots equipment used to control and monitor wells, pipelines, compressors, etc. remotely
- Installs, maintains and troubleshoots electrical/electronic equipment used in gas production, processing and/or transportation
- Performs testing, troubleshooting, maintenance and repairs on the electronic and electro-mechanical equipment used to monitor and control the mixing, metering and pumping equipment

1.7 Level of Competency of Craftsmen
- NVQ level 4 in relevant occupations.

2. Meeting specialized manpower at technical and vocational levels

Meeting specialized manpower requirements of offshore oil and gas industry in Sri Lanka will require a multiple approach.

a) Obtaining the services of Sri Lankans who have already served and experienced in oil and gas industry, mainly in Sri Lanka and in the middle east
b) Sri Lankans working in the Shipping industry; ship building, ship repair and ship operations, and providing them with short term specialized training to serve in offshore industry

c) Sri Lankans serving in general engineering, scientific and commerce areas and providing them specialized training.

d) Providing training in specialized areas by establishing training facility built for the purpose.

a) **Persons with related experience**

Sri Lanka has been operating an oil refinery at Sapugaskanda over the last several decades and has gained experience in crude oil handling, storage, refining through atmospheric distillation and thermal cracking secondary processes and pumping and delivery of refined products. Further, many who gained experience in the refinery have joined refineries and oil and gas production industry overseas, mainly in the middle-east, and have acquired valuable experience at operational and managerial levels. These professionals can be attracted to Sri Lankan oil and gas industry when comparable remuneration is offered to them.

Most operations in oil and gas production, storage and handling are automated and centrally controlled from control stations while the maintenance teams are operating in spaces where the machinery are located. Operators manning the control stations should be highly competent in their operations and safety aspects. Therefore, competencies in Marine and Offshore operations need to be continually upgraded and updated and the experienced professionals too require periodic training and operational acquaintance with systems and machineries.

Training using Process Simulators is the most effective way of training process operators. Simulators were first introduced in commercial scale for training of aircraft pilots and ship navigating officers but have now expanded to many other areas. Related simulator training in marine and offshore industry include oil refining, ship navigation, engine room operation, pumping systems, oil tanker and gas tanker operations, inert gas operation, dynamic positioning of offshore supply vessels etc. In the recent times, with the expansion of the Indian Offshore Industry, India has installed simulators covering range of operations in Mumbai.
b) Persons in the shipping industry

Persons who are already engaged in ship building, ship repair and ship operations are groups that can be trained for offshore platform installation, machinery operations and maintenance, piping systems installation and maintenance and all floating vessel operations for oil and gas production. Ship building and ship repair involves many engineering processes that are to be performed according to the internationally accepted standards. The engineering processes such as welding and fabrication, machinery installation including drive systems, electrical installations, fire safety systems etc. in a complex and confined spaces are common to both ship building and offshore industry. Therefore, short training programmes for these personnel to orient them to the offshore environment and to provide specific skills relating to intended work tasks is the most cost effective and quickest way of fulfilling the early needs of technicians and craftsmen for the offshore industry. The numbers of technicians and craftsmen initially needed for offshore industry will not be very large and therefore, it is envisaged that the outflow of certain number of skilled personnel from the ship building and repair industry will not adversely affect the industry.

Offshore industry requires drilling, supply, anchor handling and other types of vessels during exploration and production. Operation of such vessels requires navigating officers, marine engineers and ship crew who have experience and holding appropriate certificates of competency. However, officers and crew of vessels supporting offshore industry may require specialized skills in handling vessels and operating some machinery in addition to their generic skills in operating merchant vessels. Operation of the dynamic positioning of the vessel, which is a standard arrangement in supply vessels, is one such specialized skill. Such specialized skills must be provided to the staff by experienced personnel, on the job and with simulator training. This will require the hiring of experienced personnel as trainers or as senior operators initially.

c) Persons with general engineering, scientific and commerce skills

Technical and Vocational Education and Training (TVET) system in Sri Lanka provides training in variety of occupations in the industry and service sectors through networks of public institutions and private training providers. Training at craft and middle technical levels has been standardized by adopting a National Vocational Qualifications (NVQ) framework. Accordingly, there are four NVQ levels at crafts level (1 to 4) and two at middle technician level (5 & 6). Training and assessments are
according to the industry identified competencies and quality assurance measures are applied throughout. As such, trainees completing crafts level and middle technical training in engineering, scientific and commerce fields can be absorbed into appropriate positions in the offshore industry and for shore based offshore support industry with necessary orientation.

The occupation areas covered under NVQ in related engineering areas include welders, machinists, fitters, riggers, electricians, electronic technicians, industrial plumbers, pneumatic technicians, refrigeration and air conditioning technicians, motor mechanics, ICT technicians etc.

**d) Specialized training facility**

As the fourth approach, specialized training facility need to be built to train specialized manpower requirements of the offshore industry. This is a common feature in any industry in Sri Lanka or abroad. For example, when the Ceylon Shipping Corporation was established, one cargo ship was designated a ‘Training Ship’ with suitably qualified trainers, and deck cadet training took place while the ship engaged in normal commercial activities. Similarly, marine engineering training that requires considerably long theoretical and practical exposure for marine and related engineering disciplines was done by special facility established at University of Moratuwa and at Technical Training Institute at Katunayake initially.

Similar approach is needed for offshore oil and gas exploration and production. However, numbers of trainees at initial stages will be low and this will allow the gradual growth of the training facility without undue pressure to train large numbers. The training will be specialized and hence the trainers must be from the same industry with considerable industry exposure. Such trainers may be sought from the local as well as international market to maintain the relevance and quality of training abreast with the international standards.

Training Centres of this specialized nature has to depend on the industry to give exposure and to provide working experience in expensive equipment. Similarly, collaborations must be established with other training centres in the region to provide highly specialized training for which they have already built necessary facilities.
Conclusion

Providing trained manpower to an emerging industry is a challenge especially when the local expertise is also to be built at the same time. Innovative approaches are needed for training within manageable costs so that both the industry and the training grow to complement each operation. Lessons need to be learnt from similar innovative approaches in the past in Sri Lanka and abroad.

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Role of Sri Lankan Universities in Exploration and Exploitation of Off-shore Marine Resources with Special Reference to Oil and Gas

Ranjith Senaratne and Kapila Dahanayake

Background

Sri Lanka possesses a territorial sea of 21,500 km² and an Exclusive Economic Zone (EEZ) of 517,000 km² up to 200 nautical miles (370 km) from the coastal line (MFOR, 2002). Sri Lanka has the rights to the resources in the water column, seabed and subsurface in the EEZ. Stated differently, the oceanic area belonging to Sri Lanka is eight times its landmass. Thus only about 12% of our motherland is above water whereas 88% lies under water. Under the UN convention on Law of the Sea (UNCLOS), Sri Lanka is entitled to claim an extended area of seabed where the thickness of the sediment layer exceeds one km. This claim has already been made and if accepted, Sri Lanka could gain an additional seabed area. Therefore the EEZ is likely to expand further with the delimitation of the outer edge of the continental margin of the country, which could permit Sri Lanka to own an EEZ equivalent to 23 times (approximately 1.400,000 km²) its landmass (MFOR, 2002).
Ocean resources include chemical resources such as oil, natural gas, minerals and chemicals; physical resources such as wind, tidal, wave, geothermal and solar energy; biological resources such as fish and seaweeds; and non-extractive resources such as transportation, recreation and waste disposal. Nearly 90% of cargo transportation takes place by sea. The contribution of marine resources to the global economy has become so huge that international maritime laws governing their allocation and utilization have now come into being.

Petroleum resources are largely confined to the continental shelves, continental slopes, continental rises, and small ocean basins. About one third of known reserves of crude oil and natural gas in the world lie along the continental margins (US Energy Information, 2013). Subsea production of other minerals from the continental shelf includes heavy mineral concentrates, sand, gravel, shell, limestone, coal, iron, copper, sulfur, potash, magnesium etc. The manganese nodules and other metalliferous deposits that occur on and beneath the deep ocean floor are an enormous potential source for manganese, copper, nickel, cobalt, zinc and other metals.
The waves, tides, currents as well as thermal gradient in oceans can be harnessed to generate power. These non-conventional sources offer attractive alternatives to non-renewable fossil fuels that have contributed to global warming. The oceans can be a rich source of green energy. The estimated power theoretically available from waves, tides, currents and thermal gradient are 2.5, 2.7, 25.0 and 40.0 million megawatts, respectively (Englander and Bradford, 2008), which far exceeds the present global energy need. We need to develop our capabilities and capacity to tap the potential of ocean power.

Two major challenges associated with oceanic resources are to (a) devise a fair and equitable means of distributing the huge wealth of the ocean and (b) use the bounty of the sea without detriment to the marine environment.

**Off-shore petroleum exploration in Sri Lanka**

Petroleum exploration in Sri Lanka began approximately some 40 years ago in the late 1960s following an agreement signed between the Governments of Sri Lanka and Soviet Union. The Soviets drilled four wells in Pesalai on the Mannar island, but failed to encounter any significant reservoir rocks. The Ceylon Petroleum Corporation engaged Pexamin Pacific, USA in 1975, Cities Services, USA in 1981 and Phoenix Canada Oil Company, Petro-Canada, in 1984 for off-shore exploration in the Cauvery and Mannar Basins without success. From 2002 to 2006, the Government of Sri Lanka and TGS NOPEC in Norway made attempts to attract exploration companies to Sri Lanka through road shows at various venues. These efforts too were unsuccessful (PRDS, 2013).

In 2007, the Petroleum Resources Development Secretariat (PRDS) was established under the President's Office and the Licensing Round for three exploration blocks in the Mannar Basin was launched. After evaluations of the bids received, an agreement was signed with Cairns India Limited. Exploratory work undertaken by Cairns India Ltd in the Mannar basin has produced promising results after a hiatus of 25 years. Therefore, the Government of Sri Lanka, represented by PRDS has launched the Second Offshore Licensing Round in March 2013 offering a total of 13 blocks located in the Cauvery and Mannar basins for bidding.
Given the promising results obtained from the exploratory work carried out by Cairns India Ltd., and the potential manpower needs at technical, executive, managerial and scientific levels in the emerging petroleum sector, it becomes appropriate for the HEIs to take preparatory steps towards designing and delivering the requisite courses to meet the manpower needs, particularly in the upstream segment, to start with. This demands the universities to be in a state of readiness to deliver relevant courses in the event the investigations establish availability of commercially viable quantities of hydrocarbon in the seabed. This situation is particularly important in view of the prohibitive cost of importing manpower and the need to produce such manpower locally given the economic sensitivities and geo-political vulnerabilities. For instance, when Norway started off-shore exploration for gas and oil, they had to obtain all technical expertise from the USA at the outset. However, they were soon producing their own manpower from craft to managerial and scientific levels so that they could assess for themselves the real potential and harness the same for the benefit of their country without being exploited by others. Today, Norway has emerged as a global leader not only in producing requisite manpower and expertise for the global petroleum industry, but also in manufacturing high-end equipment and machinery, including rigs for the on-shore and off-shore exploration and production of gas and oil. It should be noted that Norwegian Universities have played a pivotal role in bringing about these enviable developments.

Figure 02: Mannar license round blocks on offer

Source: PRDS
Academic Contribution by Sri Lankan HEIs related to Fisheries and Maritime Sectors

Sri Lanka has 15 universities, 10 institutes and 7 post-graduate institutes under the purview of the University Grants Commission. These higher educational institutions (HEIs) offer around 90 undergraduate and 690 postgraduate degree programmes. They provide an outstandingly diverse and rich intellectual resource base including over 750 Professors, 1750 PhD holders and a comparable number of MScs and MPhils.

Sri Lanka is a maritime nation with an oceanic area equivalent to eight times its landmass abounding with rich biological, chemical and physical resources. However, only one out of around 90 degree programmes offered by the said institutions has a degree programme committed to Marine Resources e.g: Faculty of Fisheries and Marine Science and Technology at University of Ruhuna. A few faculties offer modules related to marine resources, i.e. under Zoology and allied fields at the Faculties of Science in the universities or under Earth Resources Engineering and Mining and Mineral Engineering at the Faculty of Engineering at University of Moratuwa. In addition, two public HEIs outside the jurisdiction of the UGC, namely Kotalawale Defense University (KDU) and National Institute of Fisheries and Nautical Engineering (NIFNE/Ocean University) and Colombo International Nautical and Engineering College (CINEC) offer degree and postgraduate degree programmes related to Fisheries and Maritime sectors (Table 1).

Table 01: Degrees related Fisheries and Marine Science offered by HEIs outside the purview of UGC

<table>
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<tr>
<th>University</th>
<th>Degree</th>
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<td></td>
<td>BSc in Marine Engineering</td>
<td>Special</td>
</tr>
<tr>
<td></td>
<td>BSc in Maritime Transportation Management and Logistics</td>
<td>General/ special</td>
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<tr>
<td>CINEC Maritime Campus</td>
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<tr>
<td></td>
<td>BSc Maritime Science</td>
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</table>
BEng Marine and Offshore Systems Engineering

BEng Marine and Offshore Systems Engineering

BSC International Transportation Management and Logistics

BSc Marine Engineering

MSc Maritime Safety and Environmental Management

Master of Maritime Engineering

MSc Transportation Planning and Logistics Management

MBA Logistics and Supply Chain Management

PhD Transportation Planning and Logistics Management

Modules related to Petroleum Industry offered by HEIs in Sri Lanka

The petroleum industry comprises three major segments, namely upstream, midstream and downstream. The upstream and midstream segments deal with the exploration and production, and refining and processing, respectively whereas the downstream, with the distribution and marketing. At present, the Department of Geology at Peradeniya and the Department of Physics at Sri Jayewardenepura offer modules related to the upstream segment while Faculty of Engineering at University of Moratuwa, relates to the downstream.

University of Peradeniya:

At the University of Peradeniya, Geology is offered as a subject in the BSc General Degree programme with provision for the four year BSc Geology Special degree. The Special degree undergraduates are exposed to lectures on Surveying, Soil and Rock Mechanics, Mineralogy, Sedimentary/Igneous/Metamorphic petrology, Geochemistry, Petroleum Geology, Paleontology,
Sedimentology. Stratigraphy, Engineering Geology, Hydrogeology etc. and they are provided with necessary practical training in the research laboratories of Geochemistry in addition to field geological studies. In keeping with emerging needs, the Department of Geology proposes to introduce modules in Petroleum Geo-science (3 credit course) and Seismic Surveying and Interpretations (3 credit course) in the special degree in Geology in 2014. In addition, a new window in Applied Geology has been proposed for the Special Degree in Geology. The Postgraduate Institute of Science (PGIS) at University of Peradeniya has decided to start an MSc programme in Petroleum Science and Technology in 2014.

**University of Sri Jayewardenepura**

The Department of Physics provides a good grounding in geophysics at undergraduate and postgraduate levels. At undergraduate level, it includes Geophysics, Waves and Vibrations, Shape & Figure of the Earth, Magnetic Field of the Earth, Gravity and Magnetic Anomalies and their interpretation, Refraction Seismology, Introduction to Applied Geophysics etc. At postgraduate level, more advanced geophysics including Modeling of Gravity Anomalies and Interpretation of Gravity Anomalies are taught. The Department of Physics is currently in the process upgrading its curriculum and plans are underway to introduce three new courses in Geophysics, namely Refraction Seismology, Applied Geophysics and Signal Processing which are relevant to the emerging Gas and Oil Industry.

**University of Moratuwa**

The Department of Earth Resources Engineering, University of Moratuwa offers modules related to Petroleum Engineering, including Geology Engineering and Petroleum Processing. It proposes to start a Petroleum Engineering-focused area for the undergraduate students, and a postgraduate diploma and a Master’s programme in Petroleum Engineering in the near future. The Department of Chemical and Process Engineering of the Faculty of Engineering offers modules in Chemical Engineering, Process Engineering, Energy Engineering, Fuel Science, Downstream Processing, Petroleum Reservoir Modeling, Petroleum Refinery Engineering, Petrochemical Engineering, Refinery and Off-shore Safety. Thus the University of Moratuwa offers courses and modules related to midstream and downstream segments of the off-shore gas and oil industry. The Board of Study in Earth Sciences (BOSES) at University of Moratuwa offers
Courses offered by some major petroleum producing countries related to the petroleum industry

The value of global petroleum industry exceeds US$ 402 billion, (Ernst and Young, 2012) and countries such are Saudi Arabia, UAE, Norway, USSR, Nigeria, USA, UK and Malaysia mainly contribute to it. Producing the requisite manpower to drive this huge global industry is a gigantic challenge as well as a formidable opportunity with huge potential for revenue generation; thus it is a lucrative enterprise. Because of the reasons enumerated above, major petroleum producing counties generally produce most of the manpower required for the industry within. However, it calls for a huge investment to building necessary infrastructure to provide necessary practical training the including off-shore and under-water. The type of courses offered by some major petroleum producing countries is given in Annex 1, which gives an idea as to the type of courses to be developed in the event availability of commercially viable quantities of hydrocarbons in the sea bed has been established.

Way Forward

In responding to the potential manpower needs in the emerging petroleum industry, it becomes necessary to identify the courses needed and the resources required, namely human, physical and financial, to design and deliver them in order to produce the requisite manpower in the upstream segment of the petroleum industry, which deals with exploration and production (E & P) of gas and oil. Given the time lag involved and heavy capital outlay required for capacity development in E & P sector, the following prove useful:

1. Appointment of a Capacity Development Committee led by the UGC representing the relevant key HEIs, and public and private sector institutions
2. Identification of undergraduate and postgraduate course modules and courses related to producing necessary manpower to meet the needs of the E & P sector

3. Development of a database of human and physical resources available in Sri Lanka at the higher educational (Universities of Peradeniya, Moratuwa, Sri Jayewardenepura, and Ruhuna, and CINEC), public sector (Sri Lanka Port Authority, Geological Survey and Mines Bureau, Ceylon Petroleum Corporation, Petroleum Resources Development Secretariat etc.) and private sector (Colombo Dockyard Pvt. Ltd., Lanka Hydraulics Institute, Master Divers, LAUGHS Lanka Pvt. Ltd., Hayley’s Pvt. Ltd. etc.) institutions related E & P sector (Annex 02)

4. Development of a database of Sri Lankan expatriates with knowledge and experience related to E & P sector who can contribute to competency building and capacity enhancement of the E & P sector (Annex 03)

5. Conducting a gap analysis to assess the resources required (human, physical and financial) in the light of 2, 3 and 4.

6. Development of link programmes with relevant renowned foreign universities and, research institutions. for capacity building including curriculum development, short- and long-term training and infrastructure development

7. Formulation of proposals to secure requisite funding for capacity building in selected HEIs

The above will keep the HEIs in a state of readiness so that if the availability of commercial viable quantities of gas and oil is established, they would be able to deliver the requisite competency building and capacity enhancement programmes related to the upstream segment jointly with the relevant public and private sector institutions. When the situation demands, those activities could be extended to cover the manpower needs in the mid- and downstream segments as well.
Bibliography


Webography


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**Annex 01:** Undergraduate and postgraduate courses related to petroleum industry available in some countries

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<td>Geological Science</td>
<td>Marine Bioscience</td>
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<td>Marine Biosciences</td>
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<td>Oceanography</td>
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<tr>
<td>USA</td>
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<td>BSc Marine Geology</td>
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<td>Canada</td>
<td>Queen's University</td>
<td>BSc in Geological Sciences</td>
<td>Applied Geology</td>
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<tr>
<td>Canada</td>
<td>University of Toronto</td>
<td>BSc in Mineral Engineering</td>
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<tr>
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<td>B Eng Marine Engineering</td>
<td>International Marine Environmental Consultancy</td>
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<td>B Eng Naval Architecture</td>
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<td></td>
<td>BEng in Offshore Engineering</td>
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<td>The University of Manchester,</td>
<td>BEng in Petroleum Engineering</td>
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<td></td>
<td>Manchester</td>
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<td>BEng Mechanical and Offshore Engineering</td>
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<td>MSc Maritime Technology Science</td>
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<td>MSc Design of Dredging Equipment</td>
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<td>Oil and Gas Storage and Transportation Engineering</td>
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**Annex 02:** Human resources available at the Sri Lankan higher educational and public sector institutions related to the exploration & production of oil & gas

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<tr>
<td>Eng. Preeni Withanage</td>
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<tr>
<td>Mr. Damsith Weerasinghe</td>
<td>- do -</td>
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<tr>
<td>Mr. Chaminda Kularathna</td>
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<tr>
<td>Mr. Damith Senadheera</td>
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<tr>
<td>Professor Ananda Gunathilke</td>
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<td>Professor R.L. Rohana Chandrajith</td>
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<tr>
<td>Dr. H.M.T.G.A. Pitawala</td>
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<td>Mr. L.R.K. Perera</td>
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<tr>
<td>Dr. Jagath Gunatilake</td>
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### Role of Universities in Exploration of Off-shore Marine Resources

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<tr>
<td>Dr. H.A. Dharmagunawardane</td>
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<tr>
<td>Mr. S.K. Seneviratne</td>
<td>Energy, Tribology,</td>
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<tr>
<td>Dr. S.D.G.S.P. Gunawardane</td>
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<tr>
<td>Dr. J.J. Wijetunge</td>
<td>Coastal Engineering and</td>
<td></td>
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<tr>
<td>Dr. P.B.G. Dissanayake</td>
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<td>Mrs. H.K. Nandalal</td>
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<tr>
<td>Dr. N.P. Ratnayaka</td>
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<tr>
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<td>Eng. P.V.A. Hemalal</td>
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<td>Dr. (Mrs.) S. Karunaratne</td>
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<td>Mr. L.P.S. Rohitha</td>
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<td>Dr. (Ms) M. Y. Gunasekera</td>
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<td>Dr. T.A. Piyasiri</td>
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<td>Dr. W.K. Wimalsiri</td>
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<tr>
<td>Dr. H.A.K.S. Ariyarathne</td>
<td>University of Ruhuna</td>
<td>Ocean wave, Wave breaking process, Wave interaction with structures, Sediment transport, Coastal structures</td>
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<td>Dr. Pradeep Nalaka Ranasinghe</td>
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<td>Applied Geology</td>
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<td>Dr. P. Geekiyanage</td>
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<td>Professor Dhammika A. Tantrigoda</td>
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<td>Dr. Madhuranga Fernando</td>
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<td>Dr. N.G.S. Shantha</td>
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<td>Seismology</td>
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<tr>
<td>Prof. Mahinda S.</td>
<td>Sabaragamuwa University</td>
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Role of Universities in Exploration of Off-shore Marine Resources

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<td>Dr. Tilak Hewawasam</td>
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<tr>
<td>Mr. N.R.R. Jayasekara</td>
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<td>Mr. A.R. Abel</td>
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<td>Mr. G.A.S.P. Gunawardana</td>
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<tr>
<td>Dr. W.K.B.N. Prame</td>
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<td>Mineralogy</td>
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<td>Mr. Saman Kalubandara</td>
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<td>Dr. Starin Fernando</td>
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<tr>
<td>Mr. Ajith Prema</td>
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<td>Mr. Udaya De Silva</td>
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<td>Mr. D. Sajjana De Silva</td>
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<td>Mr. Upali Wijesinghe</td>
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<tr>
<td>Mr. N.M.K.B. Nayakarathne</td>
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<tr>
<td>Mr. S. Prabhakar</td>
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<tr>
<td>Mr. T.G. Weerasinghe</td>
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<tr>
<td>Mr. H.N.R. Perera</td>
<td>Lanka Hydraulic Institute Ltd.</td>
<td>Hydraulic Engineering</td>
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*Note:* This is extracted from the database developed by the Coordinating Secretariat for Science, Technology and Innovation (COSTI).
Annex 03: Some Sri Lankan expatriates with knowledge and experience related to exploration & production of oil & gas

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<tr>
<th>Name</th>
<th>Field of work</th>
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<tr>
<td>Mr. Samantha Hulathduwa</td>
<td>Shipping</td>
<td>Oslo, Norway</td>
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<tr>
<td>Mr. Chan Senaratne</td>
<td>Accounting, Aker solutions</td>
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<tr>
<td>Mr. Rafi Cader</td>
<td>Product solutions, SIS-SLB</td>
<td>Stavanger, Norway</td>
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<td>Eng. Ranjith Molegoda</td>
<td>Aker Solution-Project Manager</td>
<td>Kristiansand, Norway</td>
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<tr>
<td>Dr. Kapila Ediriweera</td>
<td>Business Mgr, SLB</td>
<td>Sandnes, Norway</td>
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<td>Professor Jayantha Liyanage</td>
<td>Prof. and Chair, UiS</td>
<td>Stavanger, Norway</td>
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<tr>
<td>Professor Sudath Siriwardena</td>
<td>Asso Prof, UiS</td>
<td>Stavanger, Norway</td>
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<tr>
<td>Mr. Lalith Attanapola</td>
<td>NTNU, IT section</td>
<td>Trondheim, Norway</td>
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<td>Mr. Chamila Attanapola</td>
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<td>Professor R.M. Chandima Ratnayake</td>
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<tr>
<td>Dr. Amara Ranaweera</td>
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<td>Mr. Sunil Govinnage</td>
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<tr>
<td>Mr Padmasiri Ranasinghe</td>
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<td>Dr. Pakkeerthamby Abdul Salam</td>
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HSE CONCERNS AND MANAGEMENT IN THE SRI LANKAN OFFSHORE OIL AND GAS INDUSTRY

Ajith De Alwis and K.G.V.K. De Silva

Abstract

This paper addresses key HSE issues which concern the Offshore Oil & Gas Industry in Sri Lanka. The different definitions of Health, Safety and Environment as well as their overlapping nature are considered. Typical areas of concern are then discussed and their significance highlighted. The essential features of an HSE Management System (HSEMS) suitable for Sri Lanka are identified, and the Regulatory, Infrastructural and Human Resource requirements for the effective management of HSE issues is presented.

Keywords: Environment, HSE, Human Resource Management Systems, Impacts, Infrastructure, Occupational Health, Offshore, Safety, Regulation, Risk Based

Introduction

Offshore based exploration and production of Oil and Gas has been at the forefront of modern day industrial development. The world’s insatiable appetite for petroleum resources and the steady depletion of readily accessible petroleum reserves has driven the Offshore Oil & Gas Production Industry to explore regions and depths hereto considered as extremely challenging. The continuous quest for more oil and gas in Offshore Oil Fields brings with it both opportunities as well as extreme challenges. The operating companies (hereafter referred to as OPCO’s) in the Offshore Oil & Gas industry at present operate not only in a volatile economic climate but also in remote and hostile locations requiring state of the art technologies, competent manpower and enormous commitment. The scenario facing the fledgling Offshore Oil and Gas Industry in Sri Lanka is not very different.

The management of Health, Safety and Environment (HSE) in the Offshore Oil & Gas Production Industry has become a matter of paramount
importance owing to its ability to affect the bottom line of an OPCO. In a world of stringent regulation, public awareness and transparency, mismanagement of HSE can result in adverse effects on the people and the environment, and the assets and reputation of an OPCO. The “Mаcondо Well Blowout” in the Gulf of Mexico is a recent example.

**Health, safety and environment—different distinctions**

The acronym HSE implies the existence of distinct boundaries between the three components: Health, Environment and Safety. However, depending on how definitions are established, there are considerable overlaps between them, which affect:

- Standards, Guidelines and Codes of Practice
- Organization responsibilities
- Performance Monitoring

Hence Health, Environment and Safety have to be defined based on the distinctive activities of each component. The different activities of each component are identified below.

**1. Distinctive activities of health management**

Health Management can be considered as consisting of five broad categories, namely Preventive Medicine, Occupational Medicine, Occupational Hygiene, Environmental Health and Occupational Safety.

- Preventive Medicine—the prevention, recognition and treatment of illness and injury of personnel and their families
- Occupational Medicine—the prevention, recognition and treatment of illness and injury sustained during occupational activities and concerns injuries/illnesses resulting from lapses in Occupational Hygiene and/or Occupational Safety Management
- Occupational Hygiene—the recognition, assessment, prevention and control of hazards to health from industrial activities
• Environmental Health—the recognition, assessment, prevention and control of health hazards arising from food hygiene and catering facilities, accommodation areas, potable water supplies and infectious diseases

• Occupational Safety—recognition, assessment, prevention and control of hazards with potential to cause injury/illness to individuals from instantaneous events such as explosions, fires, chemical releases, falls/trips, cuts etc.

• Occupational health management - the promotion and maintenance of the physical, mental and social wellbeing of the workforce.

2. Distinctive activities of environmental management

The definition is based on three distinct impacts, namely

• Accidental Impacts - recognition, assessment, prevention and control of hazards with potential to damage the environment. Accidental impacts are caused by instantaneous events such as fires, explosions, chemical releases and accidental discharges including oil spills.

• Impacts of Routine Emissions/Discharges/Wastes - the recognition, assessment, prevention and control of emissions and discharges caused by routine and repeated events which are a function normal facility/plant operation and can potentially damage the environment.

• Social Impact - the recognition, assessment and management of impacts of operations on the social structure and behaviour of the surrounding third party community

3. Distinctive activities of safety management

Three distinct activities are considered:

• Occupational Safety - as in section 2.1.1 above

• Asset Integrity and Reliability - recognition, assessment, prevention and control of hazards with potential to cause damage to OPCO assets (i.e. plant, equipment and systems). Both instantaneous events (explosions, fires etc.) as well as long term effects of repeated negligence and/or erroneous operation are included.
Environmental Safety—recognition, assessment, prevention and control of hazards with potential to cause damage to the environment. Environmental safety mainly relates to instantaneous/accidental events.

The development of an effective HSE Management System (HSEMS) requires understanding of the aforementioned definitions and overlaps irrespective of whether it is an Offshore or Onshore facility. From an HSE Management point of view, the following demarcations can be made despite considerable overlaps between the components.

1. Occupational Health
   - Preventive Medicine
   - Occupational Medicine
   - Occupational Hygiene
   - Environmental Health

2. Safety
   - Occupational Safety
   - Asset Safety

3. Environment
   - Environmental Safety Accidental Impacts
   - Impacts from routine emissions, discharges, wastes
   - Social Impacts

The discussion of HSE Concerns that follows is based on the aforementioned demarcations and elements.
Areas of HSE concern in offshore exploration & production

Upstream operations of the petroleum industry pose a unique set of challenges usually not encountered in the downstream sector owing to the nature of remote/isolated locations, subsurface operations and exposure to adverse weather conditions. It has to be borne in mind that, although we have demarcated the distinct activities of each HSE component, the different aspects can interact.

1. Occupational Health

Exposure of personnel to Occupational Health hazards at an Offshore Oil & Gas facility may occur due to any one or more of the following factors,

- Physical agents (noise, vibration, heat, pressure, ionising radiation)
- Indoor air quality (of accommodation/offices/catering facilities)
- Ergonomic factors
- Food safety & welfare practices
- Chemical and biological agents
- Psychosocial aspects

The hazards and specific exposure groups should be identified, the occupational health risks assessed and the hierarchy of controls applied under all conditions. Typical occupational health hazards classified as high risk are listed below in Table 1.
### Table 01: Typical High Risk Occupational Health Hazards

<table>
<thead>
<tr>
<th>Hazard group</th>
<th>Hazard</th>
<th>Specific exposure group</th>
<th>Activity</th>
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<tr>
<td>Physical Agents</td>
<td>Heat Stress</td>
<td>Operators/Maintenance Crew</td>
<td>Sampling/Patrolling/Equipment repairs</td>
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<td>Physical Agents</td>
<td>Pressure</td>
<td>Divers</td>
<td>Diving Operations</td>
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<td>Physical Agents</td>
<td>Ionising Radiation (from NORM)</td>
<td>Wellhead Operators/Plant operators/Maintenance Crew</td>
<td>Sampling/Patrolling/Equipment repairs</td>
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<td>Food Safety &amp; Welfare</td>
<td>Food Handling Practices</td>
<td>All users of catering facilities</td>
<td>Messing</td>
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<td>Chemical &amp; Biological Agents</td>
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<td>Wellhead Operators/Plant operators/Maintenance Crew</td>
<td>Sampling/Patrolling/Equipment repairs</td>
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<td>Chemical &amp; Biological Agents</td>
<td>BTEX (Benzene, Toluene, Ethylbenzene, Xylene)</td>
<td>Wellhead Operators/Plant operators/Maintenance Crew</td>
<td>Sampling/Patrolling/Equipment repairs</td>
</tr>
<tr>
<td>Psychosocial Aspects</td>
<td>Psychology of Workers</td>
<td>Operations/Maintenance Crew</td>
<td>Working in remote locations</td>
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</table>

The hazards listed are common examples of potentially high risk hazards. However, the ranking of occupational health hazards for a specific offshore facility should be based on a comprehensive risk ranking exercise.

Management of Occupational Health Risks in offshore facilities will require an Occupational Health Risk Management Plan (OHRMP) with the following minimum requirements.

- Occupational Health Management Policy
- Assessment of Occupational Health Risks (Risk Ranking)
- Preventive and Control Measures (Application of the Control Hierarchy)
- Monitoring of Exposure
- Health and Medical Surveillance
- Training, Awareness and Competence Requirements
- Emergency Response and Medical Evacuation Plan
- Accident/Incident Reporting and Investigation
Occupational Health Risk at Offshore Oil & Gas facilities should be managed by professionals with the required training and competence, and possessing the following qualifications or their equivalent.

- Chartered Industrial Hygienist (CIH)
- Occupational Hygienist with registration in a Professional Body

2. Environment

The different activities of Oil & Gas exploration and production process such as exploration surveying, exploration drilling, appraisal, development and production have potentially disastrous impact on a variety of environmental aspects, unless managed properly. A broad range of environmental issues including habitat protection and biodiversity, air emissions, marine and freshwater discharges, incidents and oil spills as well as soil and groundwater contamination have to be managed through effective planning, pollution prevention, and mitigation and control techniques.

Environmental impacts of Offshore Oil & Gas Exploration and Production operations can arise due to either of the following two causes:

1. Planned environmental impacts due to routine operations and planned projects
2. Accidental environmental effects of mishaps or failures relating to loss of containment, procedure not being followed, unforeseen non–routine process upsets, equipment and processes not performing as per design requirements (e.g. spills, leaks, fires, explosions, process blow downs, loss of well control)

The different environmental impacts from Offshore Oil & Gas E&P activities can be broadly classified as,

- Atmospheric impacts
- Aquatic impacts
- Ecosystem impacts
- Human, Socio–economic and Cultural impacts
Atmospheric Impacts:

The primary sources of atmospheric emissions from oil and gas operations can be stated as follows:

1. Flaring, venting and purging gases
2. Combustion processes such as diesel engines and gas turbine
3. Fugitive emissions from loading operations and tankage/process equipment
4. Particulates from other combustion sources such as well testing

The principal emissions are carbon dioxide (Green House Gas), carbon monoxide, methane (Green House Gas), volatile organic carbons (VOC’s), nitrogen oxides (N₂O is a Green House Gas), sulphur oxides (SOₓ) and Particulates (PM₁₀ & PM₂.₅). Further, the possible existence and emission of ozone depleting substances from fire protection systems (principally halons) and refrigerants of pre–Montreal Protocol systems have to be considered.

The volume and the potential impact of atmospheric emissions are a function of the nature of the different types of Offshore Oil & Gas Operations considered.

Flaring of produced gas is the most significant source of air emissions during routine operations. Flaring as a safety measure during start–up, maintenance or upset conditions also contribute towards the air emissions.

However, the industry has proven its commitment towards the reduction of air emissions through the following:

- Moving towards zero–flaring by reinjection of produced gases and the use of gas–lift operations, minimizing low pressure flaring and eliminating high pressure flaring, application of source gas reduction measures such as minimum flaring from purges and pilots in facility design
- Adoption of efficient flare tips (smokeless flaring) and metering of flared gas
- Improving energy efficiency
- Development of low NOₓ gas turbines
- Control of fugitive emissions
Aquatic Impacts:

The major aqueous waste streams generated due to Offshore Exploration and Production operations are:

- Produced water
- Drilling fluids, cuttings and well treatment chemicals
- Process, wash and drainage water
- Sewerage, sanitary and domestic waste
- Spills and leakages
- Cooling water

The volume of aqueous waste produced is a function of the stage of exploration and production. Waste volumes are minimal during seismic operations and the sources are generally either camp or vessel activity. In exploratory drilling, the drilling fluids and cuttings consist of the bulk of the effluent whereas produced water is the primary effluent during production operations.

Produced Water:

Typical constituents of produced water are as follows,

- Inorganic salts
- Heavy metals
- Solids
- Production chemicals
- Poly Aromatic Hydrocarbons (PAH)
- Naturally Occurring Radioactive Material (NORM)

The discharge of produced water to the sea or other receiving body after treatment and its impact should be determined through an environmental impact assessment. The environmental impact highly depends on the quantity, the composition, the receiving environment and its dispersion characteristics. Further, the produced water volumes vary considerably with both the type of production (oil or gas) and the age of a field. The water cut
is usually low during the early life of a field but may increase to 80% or more towards the end of its economic life.

**Drilling Fluids, Cuttings and Well Treatment Chemicals:**

Water-based drilling fluids have the least impact on the environment, the major components being clay and bentonite, both chemically inert and non-toxic. Most other components are bio-degradable, while there could be other slightly toxic components. However, ocean discharges of water-based mud and cuttings may affect benthic organisms through smothering (to a distance of 25 m from the point of discharge) and thus affect species diversity (to a distance of 100 m from the point of discharge). The physical effects of water-based muds and cuttings are often temporary in nature. The effects of heavy metals associated with drilling fluids (Ba, Cd, Zn, Pb) have been found to be minimal as the metals are bound in the minerals and have low bio-availability.

Oil-based drilling fluids and oily cuttings have a stronger effect than water-based drilling fluids, owing to their toxicity and redox potential. The oil content of the discharge is the main factor governing the effects. Oil-based muds and cuttings affect benthic organisms through elevated hydrocarbon levels (up to 800 m from point of discharge). From an environmental point of view, water based drilling fluids are preferred over oil based drilling fluids.

**Gray Water/ Black Water Discharge**

Untreated sewerage (Black Water) and kitchen liquid waste (Gray Water) discharge from offshore accommodation, workboats and other marine vessels can lead to excessive local levels of nutrients causing eutrophication leading to decreased oxygen levels and death of benthic organisms (including fish).

Such discharges are regulated by MARPOL 73/78 Annex IV (as amended).
Ecosystem Impacts:

Atmospheric, aquatic and terrestrial sources of environmental pollution can affect plant and animal communities through variations in water, air, soil/sediment quality, disturbance by noise, extraneous light and changes in vegetation cover. Such changes lead to direct variations in habitat, food and nutrient supplies, breeding areas, migration routes, vulnerability to predators or changes in herbivore grazing patterns. Soil disturbance and removal of vegetation as well as secondary effects such as erosion and siltation can have indirect impact by upsetting nutrient balances and microbial activity in soil. Potential long term effects can be the loss of habitat affecting both fauna and flora, and induced changes in species composition and primary production cycles.

In the Offshore Oil & Gas Exploration and Production Industry the aforementioned factors are more pronounced with respect to marine ecosystems such as benthic communities, marine fauna and flora. The environmental impacts have to be determined based on a comprehensive environmental impact assessment and baseline survey of the area of concern.

Human, Socio-Economic and Cultural Impacts

The affect of Offshore Exploration and Production operations on economic, social and cultural aspects of communities is a critical factor. The extent of these changes on local groups such as fishermen, pearl harvesters and tourist operators on offshore as well as affected onshore sites and the affect on traditional lifestyles require careful consideration. The key impacts may be:

- Resource use patterns such as fishing and aquaculture as a direct consequence or as secondary consequence of the establishment of new access routes
- Local demographic changes due to immigration (labour force) and in–migration of a remote population due to increased access and opportunities
- Socio–cultural changes such as in social structure, organization and cultural heritage, practices and beliefs, rights of access and change in value systems influenced by foreigners
- Socio–economic changes due to new employment opportunities, income differentials, inflation, differences in per capita income,
completion between members of different local groups benefiting unevenly from induced changes

- Consequences of planning strategies, such as conflicts between development and protection and effects on the use of natural and recreational resources, and tourism as well as on historical and cultural resources
- Aesthetic effects relating to unsightly or noisy facilities
- Implications of changes to transportation systems (increased road, air and sea infrastructure and associated effects such as increased noise and accident risks)

Positive socio-economic changes can also result, if all stakeholders have been considered, consulted and partnerships developed. The aforementioned aspects can be controlled by careful planning, consultation, management, accommodation and negotiation.

3. Safety

The Offshore Oil & Gas Industry requires the maintenance of stringent safety standards and has been a pioneer in its development. The industry has also seen its fair share of disasters due to lapses in safety standards. The loss of “Piper Alpha”, the resulting public inquiry and subsequent report by Lord Cullen is a landmark in safety regulations.

Safety hazards can arise in any operational aspect of the following activities of an Offshore Oil and Gas Field,

1. Seismic and topographical exploration
2. Drilling and Well Completion
3. Field Development
4. Production Operations
5. Decommissioning and disposal
Table 02: High Risk Activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Sub activities with a high safety risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Seismic and Topographical Exploration</td>
<td>• Working with Pressurised gases&lt;br&gt;• Marine Operations involving on-deck and over the side work&lt;br&gt;• Working in Extreme weather conditions&lt;br&gt;• Lifting and mechanical handling&lt;br&gt;• Helicopter Operations</td>
</tr>
<tr>
<td>2 Drilling and Well Completion</td>
<td>• High-pressure/ High temperature wells&lt;br&gt;• Deep water operation&lt;br&gt;• Working in Extreme environmental conditions&lt;br&gt;• Exposure to High H₂S Content&lt;br&gt;• Vessel collision&lt;br&gt;• Helicopter operations</td>
</tr>
<tr>
<td>3 Field Development</td>
<td>• Fabrication–site hazards&lt;br&gt;• Inspection and testing hazards&lt;br&gt;• Load out, marine transport, lifting and installation hazards&lt;br&gt;• Hook up hazards&lt;br&gt;• High occupancy levels&lt;br&gt;• Different trades and contractors carrying out simultaneous operations</td>
</tr>
<tr>
<td>4 Production Operations</td>
<td>• Working on wells and wellhead equipment&lt;br&gt;• Loss of containment (LOC) in Process Equipment and pipelines&lt;br&gt;• Dropped and falling objects&lt;br&gt;• Vessel or helicopter collision&lt;br&gt;• Extreme environmental conditions (waves, currents, wind, earthquake)&lt;br&gt;• Simultaneous operations (SIMOPS)&lt;br&gt;• Special operations such as diving, heavy lifting</td>
</tr>
<tr>
<td>5 Decommissioning and disposal</td>
<td>• Decommissioning condition survey inclusive of remote inspection and diving&lt;br&gt;• Loss of containment of accumulated products (e.g. NORM)&lt;br&gt;• Purging, cutting, lifting and removal&lt;br&gt;• Marine operations&lt;br&gt;• On–shore demolition and disposal</td>
</tr>
</tbody>
</table>
Sub-activities with typically high safety risk are given in Table 2. Any one or more of these activities if not managed properly can result in a safety hazard. The event of a safety hazard can lead to a loss of Occupational Safety and/or Equipment (Asset) Integrity resulting in severe or catastrophic consequences (e.g., Piper Alpha, P36 Platform, Mumbai High North Platform, Macondo Well/Deepwater Horizon Rig).

Failure to contain a safety hazard may result in not only a major accident but also major environmental disasters (e.g. Macondo Well Blowout). Hence, a well defined and structured risk assessment and management process is required with emphasis on:

1. Occupational Safety Management
2. Process Safety Management
3. Asset Integrity Management

**Development of an HSE management framework**

The HSE concerns of Safety, Environmental and Health, as indicated earlier, cannot be considered in isolation from each other; and, for example, a safety hazard can have environmental and health impacts. The interactive nature of these hazards in the Offshore Oil & Gas Industry demands an integrated approach.

Effective HSE Management Systems are required during all stages of an Offshore Oil & Gas Installation and all related activities. The major stages of any Offshore Oil & Gas Installation Project are as follows:

- Stage 1 – Conceptual Design and FEED (Front End Engineering & Design)
- Stage 2 – Engineering Procurement and Construction (EPC)
- Stage 3 – Operation
- Stage 4 – Decommissioning/ Disposal

A key element of successful HSE Management System is a systematic approach. A systematic risk based HSE Management Framework applicable to all stages of an Offshore Project with an integrated approach for HSE is proposed for the Sri Lankan context.
The proposed HSE Management Framework emphasises the following:

1. Identification of Hazards (Health, Safety & Environment)
2. Assessment of Risk
3. Introduction of Risk Reduction Measures
4. Management of Residual Risk

It should be emphasized that the risk determination should be based on either nationally established or internationally accepted risk acceptance criteria and the assessment should be done by trained and competent personnel.

The scale of the Offshore Installation and its stage of life will determine the level and extent of hazard identification and risk assessment activities. The following are typical examples.

- Complex Installations (e.g. large production platforms incorporating complex facilities, drilling modules and large accommodation modules) – Detailed study required to address hazardous events such as fires, explosions, ships collisions, structural damage etc.)
- Simpler Installations (e.g., a wellhead platform with limited process facilities) – Application of recognized codes and standards
- Installations with as like design – Original design evaluation. (However, review and update may be required if new issues are identified or significant changes to the installation are foreseen)
- Installations in the early design phases – Focus on design issues rather than procedural or management aspects. (Any design criteria developed during the early stages will need verification once the installation is operational)

The aforementioned process is in essence a Health, Safety and Environment Impact Assessment Process (HSEIA). An HSEIA report will be required to be generated at each project stage with the following minimum requirements,

1. Systematic identification and risk classification of all HSE Hazards
2. Analysis and assessment of significant Environmental Impacts with demonstration of the relevant control, mitigation and recovery measures.
3. Analysis and assessment of Major Accident Hazards with demonstration of control, mitigation and recovery measures.


5. Documented implementation plan for monitoring and management of Significant Environmental Impacts, Major Accident Hazards and High Occupational Health Risk

6. A project/site/operations specific HSE Management System (HSEMS) for managing all other medium and low risk HSE Risk

7. Documented Emergency Response and Recovery Plans (on–site/ off–site) based on credible emergency scenarios (with relevant stakeholder consultation).

The typical outcome of an HSEIA study depending on the project stage would be,

- Hazards and Effects Register
- Environmental Monitoring and Management Plan
- Asset Integrity Management System
- Occupational Health Risk Assessment (OHRA) Report
- Occupational Health Risk Management Plan (OHRMP)
- Control of Major Accident Hazards (COMAH) Report
- Site Specific Emergency Preparedness, Response and Recovery Plan (e.g. Oil Spill Response, H₂S release and mass evacuation from an Offshore Site, Fire and Explosion etc.)

**Regulatory, infrastructural & human resource requirements**

The management of HSE Risk in the Offshore Oil & Gas Industry, in addition to a systematic risk based HSE Management System (HSEMS) requires support from:

1. Legislation, Regulation and Standards
2. Infrastructure for the implementation of HSEIA recommendations
3. Trained and Competent Human Resource base for the effective implementation and management of the HSEMS

The extents to which the HSEIA recommendations can be implemented strongly depend on the availability of the aforementioned resources.

1. Development of a regulatory framework for HSE management in the Sri Lankan offshore oil & gas industry

Sri Lanka at present does not have specific legislation or regulations governing the HSE aspects of the Offshore Oil & Gas Industry, except for the Petroleum Resources Act, No.26 of 2003. Activities with HSE implications may be governed by the following existing acts of legislation:

- National Environmental Act No.47 of 1980 (as amended by Acts No.56 of 1998 and 53 of 2000) and the Regulations under the Act
- Coast Conservation Act No.57 of 1981 (as amended)
- Marine Pollution Prevention Act No.35 of 2008
- Fisheries and Aquatic Resources Act No.2 of 1996 (as amended)

However, most of the above legislation and regulations are designed to prevent environmental issues. Regulations do not exist to address Safety and Occupational Health at Offshore Oil & Gas Installations. It is doubtful if the Factories Ordinance No.45 of 1945 (as amended) could address the legislative requirements of Safety and Occupational Health in Offshore Oil & Gas Installations.

It is assumed that international and regional conventions and regulations are currently followed by the Offshore Oil & Gas Operators functioning in Sri Lankan waters. However, Sri Lanka should review its legislation at present for adequacy to address HSE Concerns. The review should also include existing Offshore Oil & Gas regulatory regimes currently in practice in the UK, USA and Norway.
It should be borne in mind that Offshore HSE regulatory regimes can be broadly classified as,

- Prescriptive
- Risk/Goal Setting/Performance based

An HSEIA system as emphasized in this article is aided more by a risk-based regulatory regime than a prescriptive one. Further, a risk based regime would promote a behaviour based safety management system. However, the most suitable regulatory regime for Sri Lanka should be decided only after a thorough assessment.

The existing legislation can be further supported by specific Codes of Practice for HSE Management in the Sri Lankan Offshore Oil & Gas Industry. This can be done by the regulating agency (e.g. PRDS) where more stringent requirements as per International Standards can be set, while maintaining the existing local legislation as a minimum. The codes of practice can provide,

- Detailed guidelines/ procedures on conducting an HSEIA
- Risk Acceptance Criteria
- Guidelines on developing HSE Management Systems
- Training and Competence Assurance Procedures
- Legislation, Regulations, Conventions, Standards and Recommended Practices to be followed

2. Development of Infrastructure for HSE Management

Recommendations from an HSEIA are useless without the relevant infrastructure for their implementation. Management of NORM contaminated Petroleum Hydrocarbon (PHC) Sludge and equipment would be an ideal example in this case. Collection, storage, transportation and final disposal of NORM contaminated waste from an Offshore Facility (e.g. a pig receiver) has unique requirements such as NORM Management Procedures, Personal Protective Equipment (PPE), Personal Hygiene, Radiation Protection beginning from temporary storage on platforms, transportation on workboats and final disposal.
Further, the waste generated (e.g., PHC sludge, batteries, contaminated paint cans, laboratory chemicals etc.) from routine activities on Offshore Oil & Gas Facilities is hazardous. Even with the application of pollution prevention and control procedures, a residual amount would still be required to be treated and disposed of. Onshore Hazardous Waste Treatment and Disposal facilities will be a definite requirement. Laboratories with the capability to analyse and characterise the hazardous wastes are also required.

Marine Vessels meeting UN Recommendations on the Transportation of Dangerous Goods from offshore sites to onshore and carriers for the safe onshore transportation to the treatment and disposal facility are a must. Further, a hazardous waste transfer protocol and manifest system is required to ensure that the hazardous waste is properly transferred from Offshore to Onshore treatment and disposal facility.

The availability of marine vessels and helicopters with Medevac capabilities should also be considered as it is an essential requirement in Emergency Response.

Also, the availability of infrastructure in the event of an Oil Spill is critical. The equipment required can broadly be categorised as,

- Dispersant Systems
- Offshore Response Systems
- Shoreline Response Systems
- Command equipment
- Ancillary equipment

3. Human Resource Requirements

The dynamic component of the HSEMS is the human resource involved in its management and implementation. Personnel with training and competence are required for the effective functioning of an HSEMS. This implies the following minimum requirement of the following professional categories:
Competency assurance should be maintained from the recruitment process onwards. Training and competency should be maintained throughout the employment.

Acceptable levels of competence for each professional category should be established by the regulatory body (e.g., PRDS). Relevant training requirements should be mapped and provided for each category of professionals.

It should also be stressed that HSE Management is the responsibility of all workers and all personnel working in Offshore Oil & Gas Installations, and they should be trained in the relevant Safe Work Practices (SWP). Safe systems of work such Permit to Work (PTW), Job Hazard Analysis (JHA) and pre-job briefings should be incorporated into the everyday work culture. The personnel managing HSE should ensure that all workers are part of the Behaviour Based Safety (BBS) system of the facility. In contrast to onshore operations, offshore operations have unique training requirements such as Helicopter Underwater Training and Sea Survival Training. Hence, the training and competence requirements of workers other than HSE personnel are also primary requirements.

**Conclusion**

Sri Lanka has a long journey ahead and will come across the same challenges faced by any Offshore Oil & Gas Producing country. However, Sri Lanka can benefit from the mistakes made and lessons learnt by others before her in this particular industry by learning from their experiences. Robust HSE Management Systems (HSEMS), Regulations and Practices have been developed internationally based on the root cause analysis of major accidents. Sri Lanka should at the very inception take advantage of
existing resources to develop a robust and suitable HSEMS for its Offshore Oil & Gas Industry.

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COMPETENCY BUILDING AND CAPACITY ENHANCEMENT OF THE EMERGING OFF-SHORE GAS AND OIL INDUSTRY IN SRI LANKA: A PASSAGE PLAN FROM THE NAVY

Y.N. Jayarathna

Abstract

The prospects are high for the recovery of gas and oil in Sri Lanka’s maritime domain, despite the Island Nation’s present capacity to exploit the resources. The industry demands a skilled work force in all spheres of activity from exploration and exploitation to product output. By industry standards, Sri Lanka would have to labour for several years perhaps decades to fulfill the aspirations. In this context a SWOT analysis of the current state of capacities could be of help in deciding the best course of action. In implementing such a course of action, the role of the Sri Lanka Navy (SLN) would be pivotal in charting the course and staying in course to achieve the desired end results. The paper explores why a focused effort is essential to adopting grand strategies.

Preamble

For those unfamiliar with Naval vocabulary, ‘passage plan’ means how the navigator onboard the ship plans to take the ship from one point to another; safely and securely. For a passage plan, the navigator would look at many factors, such as the chart, how much up-to-date the chart is, the scale of the chart, navigational dangers, possible tracks according to the ship’s draught, tide and tidal streams, landmarks to locate the ship (to see whether the ship is on track or had drifted from the intended course) and timings. Timing is essential as the Captain may want to reach the destination in day light as during night navigation of the ship may require some extra effort. Furthermore, the navigator will need to consider the endurance of the ship in terms of fuel, water and provisions to ensure their sufficiency for sustainability. Having determined the factors that have an impact on his passage, and studied the assets that the ship already posses, the navigator
steers the ship on planned track, checking the position at regular intervals, adjusting to stay in course, and finally reaches the destination.

The purpose of the above paragraph is to stress the point that to meet the industry’s expectations, national aspirations and own perspectives, we need to plan our “passage” in order to reach our destination, i.e. one of having an environment of skilled personnel for an emerging industry in Sri Lanka, namely the off shore gas and oil. Skilled personnel are not produced overnight and we need to adopt a plan that would ensure that we reach our destination unhindered and unobstructed.

The Potential of the Navy

Sri Lanka Navy, is not alien to the off shore gas and oil industry. Owing to the subject involvement of hydrography, which Sri Lanka Navy inherited from the British, naval personnel are aware of the resources that lie beneath the ocean floor. Besides, off shore rigs demand seamanship knowledge, fire fighting and damage control abilities and, most importantly, practical understanding of the seas. Hence, Sri Lanka Navy, as player of a secondary but nevertheless important role, is geared and committed to support the emerging new industry. In fact, several ex-Naval personnel after retiring from their initial service engagement period have secured lucrative job opportunities and are employed in countries like Nigeria in the oil and gas industry mostly in the capacity of technicians.

Military science informs us how the grand strategy, the apex line of thinking of a country to achieve its wishes (see Box 1), is fed by maritime strategy (see Box 2). Maritime strategy does not represent naval strategy alone, yet naval strategy would be a strong and important aspect of the maritime strategy of a nation.

<table>
<thead>
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<th>Box 1</th>
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<tbody>
<tr>
<td><strong>GRAND STRATEGY</strong></td>
</tr>
<tr>
<td>Is the application of national resources to achieve policy objectives. This will invariably include diplomatic and economic resources as well as military.</td>
</tr>
</tbody>
</table>
For an island nation like Sri Lanka, maritime affairs are part and parcel of its day to day affairs. Ignorance of maritime issues had cost us dearly and history has many records to support this argument. For every kingdom that flourished in our chronicles, there was a trading port that connected with the economic development just as Mahathiththa was the trading port for Anuradhapura whilst Gokanna was for Polonnaruwa.

**Box 2**

**MARITIME STRATEGY**

The broad plan, which governs the method by which a nation pursues its maritime interests, is called maritime strategy. In other words, it is best way to witting the Navy and other maritime resources. The word maritime includes Naval and as well as instruments of air power whether under the Navy or the Air Force.

Maritime Strategy caters for the Grand Strategy by focusing maritime resources to achieve the policy objectives set forth by the Grand Strategy.

**Figure 01**: Co-relation of Maritime Interests and Jurisdiction for Sri Lanka
Figure 1, shows the co-relation of Sri Lanka’s maritime interests and jurisdiction. Sri Lanka owns an Exclusive Economic Zone (EEZ) of approximately seven times its landmass, a Continental Margin Boundary that encompasses a sea area 21 times the landmass, and a Search and Rescue Region (SRR) of 27 times the landmass. Thus the country has the main Sea Lane of Communication (SLOC) that connects the Far-West and the Far-East running through its maritime jurisdiction. In fact, 25% of the total length of SLOC from Bab-el-Mandeb strait (in the Gulf of Eden) to the Malacca Strait lies within Sri Lankan jurisdiction; and the ships that ply on this sea lane keep the economies running in the countries from or to where the Ship’s are sailing.

In this vast maritime jurisdiction, the Sri Lanka Navy is interested to find the country’s physical properties on real time or near real time basis. Physical properties of the Ocean such as flow patterns, surface and sub surface currents, surface temperature, moisture content and wind direction are of particular importance because each of them has a significant impact on land. It is important that we understand these physical properties because 40% of vessel traffic in SLOC are tankers. In an event of an oil spill the spread of the oil slick would be greatly influenced by the physical properties. Further the surface temperature induces moisture and the winds carry the moisture to influence our climate. The point the author wish to emphasis is that as a country, Sri Lanka needs to look at the marine environment as whole, and not just concentrate on the gas and oil industry.

Applying a SWOT analysis in this context would illuminate our thinking in making a ‘passage plan’ and following matrix is designed to briefly explain the analysis.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Factor</th>
<th>Strength</th>
<th>Weakness</th>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td><strong>Current vocational</strong></td>
<td>Established system of education</td>
<td>Not designed to cater to 'new' demands</td>
<td>Strengthening or collaborating with existing mechanisms</td>
<td>Mind set</td>
</tr>
<tr>
<td></td>
<td>education**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td><strong>Current university</strong></td>
<td>Established system of education</td>
<td>Inability to deviate from traditional thinking</td>
<td>Avenues for collaboration with foreign universities</td>
<td>Procedures and mind set</td>
</tr>
<tr>
<td></td>
<td>education**</td>
<td></td>
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</tbody>
</table>
A Passage Plan from the Navy

The purpose of the analysis is to show-case that Sri Lanka need not reinvent the wheel as there are many avenues available as well as many lessons available to learn from other countries which struck oil decades earlier. Therefore, let us now look the facilities available in SLN which may assist Sri Lanka in reaching its strategic aims.

Resources and prospects

Sri Lanka Navy has established a set of training institutions to cater to the needs of resource personnel to meet the Navy’s requirements as well as national demands. These training institutions covers wider spectrum of activities related to naval/maritime functions. The premier training institution of the network of training establishments is the Naval and Maritime Academy (NMA) in Trincomalee. Established in 1967, this Academy today provides for all Officer Training at entry-level and advanced training. The NMA has 17 schools undertaking different fields of training with facilities to conduct simulated training. This establishment today boasts a population of 783 staff and 1800 trainees. It conducts degree programmes, diploma programmes and qualification courses primarily to cater to navy’s requirements. However, long back in the 1980’s it also catered to merchant navy requirements under the aegis of then Minister for Ports and Shipping, the late Mr. Lalith Athulathmudali.
The Navy established three further training institutions, at Boossa, Punewa and more recently at Thaluthu Oya in Kandy as the NMA could not handle the growing training demands. These were entrusted with specific training programmes catering for general seaman and training in land operations. The Training institute at Boosa, Galle, established in 1994 and commissioned as SLNS Nipuna, today caters for advanced training of a non-technical nature. This facility has the capacity to cater for over 1000 trainees at a given time, SLNS Shiksha, established in 1997 in Punewa in Medawatchchiya, caters for advanced courses in land oriented subjects such as combat training, VIP protection etc. This facility can admit up to 1200 trainees in specialised training.

The Navy training institute at Thalathu Oya, Kandy was established in 2007 to offer advanced courses in languages. The facility is equipped for up to 300 trainees. The facility at Welisara in Ragama was dedicated for training in 2007 in view of the need to provide specialist technical training in certain areas at institutions other than Naval and hence requiring presence in Colombo area. This facility today caters for around 600 trainees and conducts electrical, electronic and other technical training courses for trainees.

The Navy, without restricting itself to traditional training, established a specialized school for artificers at Welisara in 2002, to train skilled technicians. The Naval Institute for Technology is today ISO certified and offers Diploma courses in marine engineering, electrical engineering, automobile engineering, electronics and telecommunication engineering, and Hull repair and ship construction. It accommodates up to 180 trainees and offers a Diploma in par with the National Diploma in Technology (NDT). The courses are all long-term and training is conducted on full time basis.

The Navy have a fully fledged Diver Training School in Trincomalee which trains personnel for several specialised fields of diving. They get advanced training in foreign countries and over the years have even developed capacity in underwater constructions. An oil rig or an installation would require highly diversified staff with different specialisations but with a common working culture based on safety and discipline. The staff may include boat handlers, to manoeuvre boats close to the facilities without colliding, cooks and stewards, to feed the staff, paramedics to attend to emergency medical care, riggers, to undertake all drilling work, divers, electricians, communicators and several other categories.
The notable feature of the training is the discipline force environment and cross functional capacity of the trainee. For example a sailor trained to serve onboard the ship will have knowledge in seamanship, fire fighting, damage control and naval matters. On a rigging platform such as an oil rig, safety takes paramount importance and hence the work force needs to be trained in cross functional discharge of duties. A layman may take several years to secure this know-how while a naval rating may take only a couple of months of specialised training to master the art as he already has the experience in working in a marine environment.

**Concluding remarks**

It has been recognized during the seminar proceedings that the demand for technicians is the largest in the industry, followed by scientists and administrators. The off shore technicians need to work under a party chief (see Box 3) in rigging the equipment for the task, operate and maintain onboard generators, upkeep the electricity system survey and test fire fighting apparatus, attend day to day maintenance schedules of the rig among others to keep the costly rigs operational throughout the year. Off shore rigs rely on discipline and competency, and there can be no room for error as it would invariably be costly.

<table>
<thead>
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<th>Box 3</th>
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<tr>
<td><strong>The Party Chief</strong></td>
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Party Chief is the person who manages and supervises activities of a group in highly technical working environment like on an Oil-Rig or Installation. He can best describe as the link between the working-hands and the scientists.

In carrying out the duties, the whole deck becomes the property of the Party Chief as safety and execution of the day’s schedule is solely on the shoulders of the Party Chief.

Under the circumstances, the best course of action would be to embark on several parallel programmes with short, medium and long term expectations. The Navy could play a key role in meeting short and medium term expectations by conducting applicable courses at the technician level while long term training is likely to require a university based approach. It is
opined that more emphasis should be placed on the technician category as the economy of efforts in meeting the demand in that sector is considered the best. The oil and gas Industry is highly competitive and costly hence penetration at the middle or highest level would be difficult. However, no industry can be sustained without the ‘blue-collar’ work force and that is where the Sri Lanka’s focus should be on. With time and experience, the middle & top level of the industry is achievable from a technical point of view.

**Disclaimer:** The view expressed in this paper is the author’s and does not represent the official standpoint of the Sri Lankan Navy.
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PROGRAMME OF THE WORKSHOP

Day 1 (07\textsuperscript{th} January)

08:30  Registration
09:00  Lighting of the Oil Lamp

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Inaugural Session

09:10  Welcome Address and Opening Remarks
By Prof. Ranjith Senaratne, Chairman of the Organizing Committee

09:25  Address by Prof. Gamini Samaranayake, Chairman, UGC

09:40  Address by the Chief Guest, Hon. S.B. Dissanayake, Minister of Higher Education

09:55  Keynote Address
"Petroleum Industry: Global Perspectives and National Prospects"
By Guest Speaker Prof. Stuart Burley, Head of Geosciences, Cairn India Limited, India

10:45  Refreshments

---

Session 01 Off-shore Exploration of Gas and Oil in Sri Lanka

Chair: Emeritus Prof. Kapila Dahanayake,
University of Peradeniya

11:15  Sri Lanka's Petroleum Legislation and Fiscal Regimes
By Mr. Saliya Wickramasuriya, Director General of Petroleum Resources Development Secretariat
<table>
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<th>Time</th>
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<tr>
<td>12:00</td>
<td>Exploring the Mannar Basin - The Story so far and Future Potential</td>
</tr>
<tr>
<td></td>
<td>By Prof. Stuart Burley, Head of Geosciences, Cairn India Limited, India</td>
</tr>
<tr>
<td>12:40</td>
<td>Development of Petroleum Reserves in Sri Lanka in the Light of Experience form the North Sea</td>
</tr>
<tr>
<td></td>
<td>By Dr. Kapila Ediriweera, Business Manager (North Sea Geomarket), Schlumberger Oilfield Services, Stavanger, Norway</td>
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<tr>
<td>13:20</td>
<td>Discussion</td>
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<tr>
<td>13:35</td>
<td>Lunch</td>
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**Session 02 Enabling Environment through Governance and Management**

Chair: Prof. A.M. Ishaq, Chancellor, South Eastern University of Sri Lanka

<table>
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<td>15.00</td>
<td>Challenges of Sri Lanka Petroleum Industry</td>
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<td></td>
<td>By Dr. R.H.S. Samaratunga, Secretary, Ministry of Petroleum Industries</td>
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<tr>
<td>15:40</td>
<td>Health, Environmental and Safety Concerns</td>
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<td></td>
<td>By Prof. A.A.P. De Alwis, University of Moratuwa and Mr. Veditha de Silva, Abu Dhabi Oil Company (Japan) Ltd.</td>
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<tr>
<td>16:10</td>
<td>E &amp; P Business Lifecycle - Timescales and Business</td>
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<tr>
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<td>By Prof. Stuart Burley, Head of Geosciences, Cairn India Limited, India</td>
</tr>
<tr>
<td>16:40</td>
<td>Discussion</td>
</tr>
<tr>
<td>15:15</td>
<td>- End of Day 01 -</td>
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</table>
Day 02 (08th January)

**Session 03 Manpower Needs for Off-shore Exploration and Production of Gas and Oil**

*Chair: Prof. Dayantha Wijesekera, Chairman of Tertiary and Vocational Education Commission*

- **8:30**  
  Development of National Competency of Gas and Oil Industry in Sri Lanka  
  *By Mr. Alexandre Lavelle, Managing Vice President, Head of Schlumberger Business Consulting, India*

- **9:15**  
  Development of Local Content with Special Reference to Employment and Training  
  *By Eng. Preenie Withanage, Director Benefits, Petroleum Development Resources Secretariat*

- **9:35**  
  Manpower Needs at Academic, Scientific and Managerial Levels  
  *By Prof. Ranjith Senaratne, Vice Chairman, UGC and Emeritus Prof. Kapila Dahanayake, University of Peradeniy*

- **10:00**  
  Best Teaching Practices in Geosciences and Industry - Academia Cooperation  
  *By Prof. Jonathan Redfern, Professor of Petroleum Geology at University of Manchester and Dr. Nigel Banks, Petroleum Geologist/ Senior Lecturer at Imperial College, London*

- **10:35**  
  Discussion

- **10:50**  
  Refreshments
Session 04 Capacity Building Needs for Exploration and Production of Gas and Oil

Chair: Prof. Stuart Burley, Head of Geosciences, Cairn India Limited, India

11:00 Capacity Building Needs in Vocational and Higher Educational Institutions
By Dr. T.A. Piyasiri, Former Director General of Tertiary and Vocational Education Commission and Dr. W.K. Wimalsiri, Senior Lecturer, University of Moratuwa

11:30 Capacity Building Needs in Industry
By Eng. Mangala P.B. Yapa, CEO, Colombo Dockyard PLC. and Mr. W.K.H. Wegapitiya, Chairman, Laugh Gas PLC.

12:00 Discussion

12:20 Panel Discussion on Future Course of Action (Short, Medium and Long Term)
Dr. R.H.S. Samaratunga (Chairman), Prof. A.M. Ishaq, Prof. Stuart Burley, Dr. Kapila Ediriweera and Mr. Saliya Wickramasuriya

13:00 Recommendations and Closing Remarks

13:10 Vote of Thanks
By Eng. Preenie Withanage, Director, Petroleum Resources Development Secretariat

13:15 - END -
# List of Participants

## List of Participants

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<td>Hon. S.B. Dissanayake</td>
<td>Minister of Higher Education</td>
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<td>02</td>
<td>Dr. Sunil Jayantha Nawarathna</td>
<td>Secretary, Ministry of Higher Education</td>
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<td>03</td>
<td>Dr. R.H.S. Samaratunga</td>
<td>Secretary, Ministry of Petroleum Industries</td>
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<td>04</td>
<td>Prof. S.V.D.G. Samaranayake</td>
<td>Chairman</td>
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<td>05</td>
<td>Prof. Ranjith Senaratne</td>
<td>Vice Chairman</td>
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<td>06</td>
<td>Mrs. Janadari Wijesinghe</td>
<td>Senior Assistant Secretary</td>
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<tr>
<td>07</td>
<td>Mrs. Gayani Wickramarachchi</td>
<td>Assistant Secretary</td>
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<tr>
<td>08</td>
<td>Mr. Shammika Wijewardane</td>
<td>Scientific Assistant</td>
</tr>
<tr>
<td>09</td>
<td>Mrs. Shiromi Rajasuriya</td>
<td>Personal Assistant to the Vice Chairman</td>
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<td>10</td>
<td>Mr. Saliya Wickramasuriya</td>
<td>Director General</td>
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<td>11</td>
<td>Eng. D.T.K. Preeni Withanage</td>
<td>Director benefits</td>
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<td>Prof. Stuart Burley</td>
<td>Head/Geosciences, Cairn India Limited</td>
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<td>Dr. Nigel Banks</td>
<td>Banks Geoscience Limited, College Farm House, Denton Oxford</td>
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<td>15</td>
<td>Dr. Kapila Ediriweera</td>
<td>Business Manager (North Sea Geomarket), Schlumberger Oilfield Services, Stavanger, Norway</td>
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<td>Mr. Alexandre Levelle</td>
<td>Managing Vice President, Head of Schlumberger Business Consulting</td>
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<td>17</td>
<td>Eng. Ranjith Molegoda</td>
<td>Project Manager, Akers Solutions, Kristiansand, Norway</td>
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<td>Chancellor, South Eastern University of Sri Lanka</td>
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<td>Emeritus Prof. Kapila Dahanayake</td>
<td>Faculty of Geology, University of Peradeniya</td>
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<td>Prof. Dammika Tantrigoda</td>
<td>Department of Physics, University of Sri Jayewardenepura</td>
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<td>21</td>
<td>Prof. Rahula Attalage</td>
<td>Deputy Vice Chancellor, University of Moratuwa</td>
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<td>Prof. P.G.R. Dharmaratne</td>
<td>Department of Earth Resources Engineering, University of Moratuwa</td>
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<td>Prof. A.A.P. De Alwis</td>
<td>Department of Chemical and Processing Engineering, University of Moratuwa</td>
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<td>24</td>
<td>Prof. Padma Amarasinghe</td>
<td>Department of Chemical and Processing Engineering, University of Moratuwa</td>
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<td>Dr. Nalin Ratnayake</td>
<td>Department of Earth Resources Engineering, University of Moratuwa</td>
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<td>Department of Earth Resources Engineering, University of Moratuwa</td>
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<td>Dr. W.K. Wimalsiri</td>
<td>Department of Mechanical Engineering, University of Moratuwa</td>
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<tr>
<td>29</td>
<td>Mr. Mafaz Ishaq</td>
<td>Director, Calamander Capital and Visiting Lecturer, Postgraduate Institute of Management, University of Sri Jayewardenepura</td>
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<td>Sri Lanka Navy</td>
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<td>Sri Lanka Navy</td>
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<td>32</td>
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<td>33</td>
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<td>Chairman, Sri Lanka Geological Survey and Mines Bureau</td>
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<td>34</td>
<td>Mr. Sarath Weerawarnakula</td>
<td>Former Director, Sri Lanka Geological Survey and Mines Bureau and Senior Lecturer, University of Moratuwa</td>
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<td>35</td>
<td>Mr. R.P. Perera</td>
<td>Secretary General, UNESCO’s Sri Lanka National Commission</td>
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<td>36</td>
<td>Mr. P.C.P. Jayathillake</td>
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<td>37</td>
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<td>40</td>
<td>Eng. Raja Amaratunge</td>
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<td>41</td>
<td>Mr. Anura Gunawardena</td>
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<td>Project Director, SOREM</td>
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<td>Mrs. Anoma Seneviratne</td>
<td>Technologist, Ceylon Petroleum Corporation</td>
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<td>46</td>
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<td>Managing Director, Master Divers (Pvt.) Ltd.</td>
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<td>48</td>
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<td>Former Environment Engineer, Abu Dhabi Oil Company (Japan) Ltd.</td>
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<td>49</td>
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<td>CEO, GAC Shipping Ltd.</td>
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<td>Group Managing Director, Ceyline Group of Companies</td>
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<td>Head of School, CINEC Maritime Campus</td>
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<td>Deputy General Manager, Heyles Energy Services Lanka (Pvt.) Ltd.</td>
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<td>Manager, Diesel and Motor Engineering PLC.</td>
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<td>Diesel and Motor Engineering PLC.</td>
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Off-shore petroleum exploration initiated in the late 1960s in the Mannar and Cauvery basins bore fruit since the establishment in 2007 of the Petroleum Resources Development Secretariat (PRDS) under the President's Office. Exploratory work undertaken since has produced promising results. The promise of offshore oil and gas also poses challenges to Sri Lanka with no prior exposure to offshore technology. For the country to get maximum benefit from this potential resource, manpower needs in the emerging petroleum sector need to be addressed at technical, executive, managerial and scientific levels, which, given the economic sensitivities and geo-political vulnerabilities, need to rely on local human resources in the long run.

In recognition of the lack of both human and physical resources in the higher educational institutions of Sri Lanka to design and deliver the requisite courses to develop the necessary technical competence and expertise, the Standing Committee on Engineering and Architecture of the University Grants Commission joined hands with the PRDS to conduct a Workshop on "Competency Building and Capacity Enhancement in the Emerging Off-shore Oil and Gas Industry in Sri Lanka" with participation by key stakeholders. This volume comprising the Proceedings of the Workshop as well as two invited papers addresses the following aspects:

1. Present status of drilling
2. Policy and fiscal issues
3. Manpower needs at vocational, technical, professional and executive level
4. Vocational and degree programmes for the requisite manpower needs
5. Capacity building needs
6. Lessons from leading petroleum producing countries
7. Role of the private sector in training and providing the requisite services
8. Health, safety and environmental concerns

It is expected that the volume will be of immense value and relevance to legislators, policy makers, planners, leaders in vocational and higher educational institutions and public and private sector institutions that are engaged or likely to be engaged in activities related to the gas and oil industry, and serve as a source book to teachers and students engaged in subjects related to the exploration and production of gas and oil and allied fields.