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ENVIRONMENTAL MANAGEMENT PRACTICES OF THE OIL AND GAS COMPANIES IN LEBANON

by
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AN ABSTRACT OF THE THESIS OF

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There is no doubt that the oil and gas sector plays a dominant role in today's global market; nevertheless, the activities that are related to oil exploration, production, processing and distribution causes alterations to and adverse impacts on the environment. Rationally, adopting efficient and effective environmental management practices is highly commended and important when activities have high possibility of adverse environmental impacts. Unfortunately, it is not always the practice. In light of the potential commencing of petroleum production in Lebanon, this study attempted to investigate the environmental performance and management practices of the existing national and international oil companies operating (primarily storage and distribution) in the country. This research is timely and constituted a first attempt at a systematic identification and evaluation of the environmental practices of the oil and gas companies in Lebanon which is expected to provide baseline information needed for future regulatory and developmental national projects. Accordingly, a survey questionnaire was developed and administered to evaluate the environmental management practices of oil and gas distributing companies as well as to assess the incentives, barriers and limitations for implementing an Environmental Management System. Survey results were processed and analyzed using the Statistical Package for the Social Sciences (SPSS) and relationships between variables were examined. Moreover in-depth interviews were conducted with key stakeholders to explore the potential concerns regarding the environmental performance and prospects of the oil and gas sector in Lebanon. Thematic analysis was employed to thoroughly examine and evaluate the transcripts comprehensively, following the set objectives of the research.

Findings revealed that Lebanon is experiencing regulatory failure in environmental governance of the oil and gas sector. Effective environmental regulations are completely lacking due to limited capacity of public organizations, lack of accountability, absence of suitable environmental monitoring programs, presence of conflict of interest and inadequate distribution of tasks among Lebanese governmental institutions. Hence, addressing these deficiencies along with maximizing transparency and accountability are crucial steps to be taken by the Lebanese government when facing the challenges of the oil and gas sector. Moreover, a lack of commitment was identified with regards to environmental management practices in the oil and gas companies. The main perceived drivers for improving environmental practices were reduce operational cost, improve environmental performance and meeting national regulations. Findings revealed that the main challenges hindering the implementation of environmental management practices are lack of government support, lack of top management commitment and the unclear benefit of environmental initiatives. The enhancing factors that were recommended by companies revolve around enhancing knowledge, collaboration programs between

private and public sector and establishment of policies and regulations. Hence developing and enforcing a convenient regulatory framework along with strengthening human and institutional capacity are key steps toward realizing effective environmental management practices.

CONTENTS

ILLUSTRATIONS

TABLES

ACRONYM

%: Percent

API: American Petroleum Institute

APIC: Association of Petroleum Importing Companies

BC: Before Christ

BP: British Petroleum

BTEX: Benzene, Toluene, Ethylbenzene and Xylene

CD: Civil Defense

CFR: The Code of Federal Regulations

DRDU: Disaster Risk Reduction Unit

EIA: Environmental Impact Assessment

EMS: Environmental Management System

EPA: Environmental Protection Agency

HSE: Health Safety and Environment

ISO: International Organization for Standardization

LIBNOR: Lebanese Standards Institution

LNG: Liquefied Natural Gas

LPA: Lebanese Petroleum Authority

MNOCs: Multinational Oil Companies

MoE: Ministry of Environment

MoEW: Ministry of Energy and Water

MoF: Ministry of Finance

MoPW: Ministry of Public Works and Transport

Mtoe: Million tons of oil equivalent

NORM: Naturally Occurring Radioactive Material

OECD: Organization of Economic Co-operation and Development

OILPOL: International Convention for the Prevention of Pollution of the Sea by Oil

OSHA: Occupational Safety and Health Administration

SEMP: Safety and Environmental Management Program

SEMS: Safety and Environmental Management System

SPSS: Statistical Package for the Social Sciences

UN: United Nations

UNCLOS: United Nations Convention on the Law of the Seas

US: United States

CHAPTER I

INTRODUCTION

The oil and gas industry is composed of two sectors namely the upstream which deals with the exploration and production and the downstream which deals with refining and processing of crude oil and gas products, their distribution and marketing. Depending on the effectiveness of the planning, pollution prevention and mitigation measures, the operations of the oil and gas industry have significant potential adverse impacts on the environment. Throughout the years, oil exploration and production had led to several health, safety and environmental consequences (Patin, 2002). Several studies pointed that human exposure to oil spills could result in acute physical, psychological, genotoxic and endocrine effects (Aguilera et al., 2010). Generally, adverse environmental impacts and issues span from the local to the global level including but are not limited to biodiversity loss, air emissions, soil and water pollution, intensification of greenhouse effect in addition to incidents and oil spills.

Several oil related disasters resulted in human losses, environmental contaminations, and huge economic costs. Numerous oil spills occurred during the last few decades. Deepwater Horizon, Exxon Valdez, Torrey Canyon tanker spill, Santa Barbara oil spill and Niger delta oil spill are examples of oil spill disasters that resulted in severe health and environmental impacts (Vallero et al., 2013). The Exxon Valdez oil tanker that ran around in Alaska's Prince William Sound in 1989 caused a major environmental disaster with dire financial consequences (Alazzani et al., 2013). Recently, Deepwater Horizon in 2010, caused by an explosion at a British Petroleum (BP) drilling rig in the Gulf of Mexico, inflicted major damage to the ecosystem and

had major financial implications for BP. Moreover, several studies (Dare et al., 2009; BBC, 2012; Ambisisi et al., 2015) showed that oil and gas storage and road transport have been largely responsible for accidents and disasters that pose risks on human safety and the environment.

International organizations, governments, and lobby groups have cautioned petroleum companies to be more environmentally responsible, and to consider their impact on society and the environment (Alazzani et al., 2013). Consequently, many firms had voluntarily implemented occupational health, safety and environmental (HSE) management systems to minimize adverse impacts on health and ensure safety of employees. Considering that health, safety and the environment have much in common, they are often being considered collectively largely at the expense of environmental issues. Generally, companies adopt reactive approaches to environmental management instead of pollution prevention practices. Their environmental policies and strategies are customized towards the compliance with rules and regulations established by environmental authorities.

As an oil importing nation, Lebanon has always been dependent on the import of fuels from foreign countries to fulfill its domestic consumption and electricity production needs. The importing companies sell their fuel to private owned retail stations and to individuals at retail stations owned or managed by the importing company itself. The regulatory framework and responsibilities for the petroleum sector are scattered between different Ministries and governmental authorities and likewise for the permitting process and the control function. Recently, the possibility of oil and gas production from the Lebanese offshore has been seriously discussed and evaluated. A growing interest in the oil and gas sector was observed after these discoveries. In light of the potential commencing of petroleum production, this study will assess the

environmental performance and management practices of the existing national and multinational oil companies (MNOCs) operating (primarily storage and distribution) in Lebanon.

A. Research objectives

- Evaluate the environmental management practices according to international standards of the local (national and multinational) oil and gas distributing companies.
- Assess the incentives, barriers and limitations for implementing an Environmental Management System.
- Explore stakeholders' concern regarding the environmental performance and prospects of the oil and gas sector in Lebanon.

B. Research significance

This research is timely and constitutes a first attempt at a systematic identification and evaluation of the environmental practices of the oil and gas companies in Lebanon which is expected to provide baseline information needed for future regulatory and developmental national projects. It will enlighten policy makers and sensitize relevant authorities on the potential risks of the petroleum sector in Lebanon. Moreover, it will bring into perspective the environmental impacts and the extent of environmental risks of existing operations and lay down the foundations for further in-depth research to better design appropriate strategies, measures, policy reforms and incentive schemes.

CHAPTER II

LITERATURE REVIEW

A. History of petroleum products

Ever since the early discovery of oil and gas, and petroleum products have been vitally important to the world economy. These products are a mixture of naturally occurring hydrocarbons that may exist in any state, depending on the conditions of subjected pressure and temperature. Petroleum is produced from reservoirs in either liquid (crude oil) or gaseous form (natural gas), depending on the state of the hydrocarbon mixture (Campbell, 2015). These mixtures once collected are processed or refined into petroleum derivatives. Generally, petroleum is formed from the natural accumulation of hydrocarbons. Hydrocarbons are accumulated thousands of feet below the surface of the Earth and consist of the decomposition of organic materials such as plants and marine animals that died many years ago. Table 1 shows the overall elemental composition of petroleum (Viswanathan, 2017).

It is still not clear when humankind first used petroleum products. However, some references state that ancient people worshipped sacred fires that were fueled by natural gas seeping into the surface through pores and cracks (Giebelhaus, 2004). Asphalt, a derived hydrocarbon product, was used to waterproof boats and heat homes as early as 6000 BC. Other references stated that Asphalt was used in the construction of the walls and towers of Babylon (Jafarinejad, 2017).

Table 1: Overall elemental composition of petroleum (Viswanathan, 2017)

Element	Percentage composition
Carbon	83 - 87
Hydrogen	10 - 14
Nitrogen	0.1 - 2
Sulfur	0.05 - 6
Oxygen	0.05 - 1.5
Petroleum also contains trace levels of nickel and vanadium (≈ 1000 parts per million)	

Petroleum's importance to humankind took a giant leap in the late 1800s when it replaced coal as the primary fuel during the industrial revolution (Fagan, 1991). In 1847, the process to distill kerosene from petroleum was invented by James Young (Jafarinejad, 2017). In 1859, Colonel Edwin Drake drilled the first successful oil well, with the sole purpose of finding oil. The Drake well was located in northwestern Pennsylvania and initiated the international search for an industrial use for petroleum (Devold, 2013). From there on, researchers, engineers, companies, and countries helped to develop the petroleum industry.

B. World oil and gas production and consumption

According to British Petroleum (BP, 2017), the average global oil consumption in 2016 was 77 million tons of oil equivalent (Mtoe), followed by natural gas 57 Mtoe and renewable power 53 Mtoe. Oil remained the world's leading fuel, accounting for a third of global energy consumption. However, the global distribution of oil consumption

is not evenly spread as the advanced countries of the Organization of Economic Co-operation and Development (OECD) and oil rich countries consumes far more oil than less advanced countries (Petit, 2017). The Middle East represents 34.2% of total oil production, Eurasia (combined continental landmass of Europe and Asia) 19.6%, and North America 20.1%. These regions are referred as giant oil producers since they account of 74% of the total oil production worldwide (BP, 2017). From the consumption side, Asia Pacific, including China, is the most oil consuming region with a share of 35.2%. China, alone, accounting for 13% of these shares. North America is the second most oil consuming region with 23.7% of the total world consumption. Europe and Eurasia are third with 20% (BP, 2017). The North American continent is relatively autonomous when it comes to production, while Europe and Asia share the resources from Eurasia and from the Middle East (and, to a lesser extent, Asia itself and Africa). Around 60% of the oil consumed in the world is exchanged across regions. Europe and Asia (including Japan, China and India) are the two main importing regions. The needs of Asia are primarily covered by the Middle East, which accounts for 53% of demand. Oil needs in Europe are mainly covered by imports from Eurasia and to a lesser extent from the Middle East and Africa (BP, 2017).

In contrast, the strength of natural gas lies in the variety of its applications. It can be an alternative to both oil and coal in electricity production, heating systems, and several industrial applications. The OECD countries are the main natural gas consumers (Petit, 2017). Europe and Eurasia are the main producers with 28.2% of the global shares. North America is second with 26.7% and the Middle East is third with 18% (BP, 2017). The volume of exchanges of natural gas across regions is much smaller than for oil, corresponding approximately to just 18% of exchanged oil volumes. This is explained by the extremely expensive cost of transporting natural gas. Natural gas is

traditionally transported through gas pipelines, which are extremely expensive and are very complex to operate and maintain, especially in sensitive areas (e.g., Middle East, Eastern Europe) (Petit, 2017). Liquefied Natural Gas (LNG), which is transported by sea, now corresponds to 30% of total natural gas exchanges across regions (BP, 2017). The LNG market is accelerated by rising demand from Asian countries, which leads the Middle East, Africa and Australia in building large infrastructures to ship out LNG. Overall, international exchanges of natural gas remain limited and represent only 15% of consumption worldwide (Petit, 2017). One third of these exchanges correspond to distribution of Russian natural gas to Europe, while another third corresponds to Middle East exports to Asian countries. The vast majority of natural gas remains however produced and consumed locally, within the region itself. Natural gas is therefore essentially a regional market.

C. Oil and gas industry and the environmental impacts of the oil and gas sector

Oil and gas are produced by the petroleum industry. Overall, the petroleum industry includes the processes of exploration, drilling, refining, transporting (pipeline oil tanker/barge, truck, and rail), and marketing petroleum products (Olajire, 2014). The Upstream usually includes exploration, production and decommissioning of crude oil and natural gas. These activities could occur onshore or offshore according to the oil and gas location. Downstream activities usually include transporting, refining/hydrocarbon processing, marketing, and distribution. Some references state that transporting and storing crude oil prior of the refining process is considered the midstream sector (Jafarinejad, 2017). Companies involved in both upstream and downstream are called integrated companies. Companies with only upstream operations

are called independents. Environmental impacts are not only limited to one activity. In fact environmental pollution in the petroleum industry arises from various sources which range from drill cuttings, drilling mud and effluents to other major sources such as oil spillage and refinery operations (Olajire, 2014).

1. Upstream sector

Any oil and gas developing project start with the exploration process. This activity presents the least environmental impacts. It is further divided into two main components geological and seismic surveying.

Geological survey is carried out to better understand and evaluate the potential of the concession area, and to provide a topographic reference system for future operations and analysis. Surveying may be undertaken by tradition land based methods or by global positioning technology involving satellites. Whichever method is employed, access to the land for identifying reference points is needed. This activity has a minimal impact on the environment. Nevertheless effort should be taken to avoid any destruction of local vegetation (in case of onshore exploration) and to manage waste materials associated with the survey activity (Olajire, 2014).

A seismic survey, carefully planned, could also have a minimal impact on the environment. Seismic survey consists of placing a small explosive charge at the subsurface and placing pressure sensitive instruments in lines radiating from the energy source. The location of the energy source and the measuring points are carefully surveyed, so that the information concerning the time elapsed between the originating shock wave and its arrival at the various measuring points (either directly, or as a result of reflections from subsurface stations) can be systematically analyzed, providing data on the structure of the subsurface geological formation. Data from this seismic study is analyzed before choosing exploratory holes (Olajire, 2014). Impacts from this activity

are also minimal arising from the access to the sites and the possibility of disturbing sensitive fauna, along with the production of waste and litter associated with the seismic activity (Olajire, 2014).

Once oil is discovered through the exploration processes, drilling is initiated. During drilling, a hole is made in the ground to allow subsurface hydrocarbons to flow to the surface. Most oil and gas wells are drilled by pushing a drill bit against the rock and rotating it until the rock wears away. A drilling rig and system is designed to control how the drill bit pushes against the rock, how the resulting cuttings are removed from the well by the drilling fluid, and how the cuttings are then removed from the drilling fluid so the fluid can be reused (Silva et al., 2017). Drilling is by far considered the most harmful stage of the upstream sector. Impacts mainly arise from the drilling cuttings and the produced water (Sadiki, 2012).

Uncontrolled discharge of produced water loaded with hydrocarbons and pollutants can have a significant impact on water quality and sea life. Produced water has a complex composition and can include several thousand of compounds that vary in concentration between wells and over the lifetime of the well. Nevertheless the concentration of these compounds also depends on other parameters such as the volume of water produced and the technique used for production. Environmental concerns arise from the presence of the following compounds in produced water: heavy metals, polycyclic aromatic hydrocarbons and alkyl phenols, BTEX (benzene, toluene, ethylbenzene and xylene) and naturally occurring radioactive material (NORM) (Dorea et al. 2006; Zheng et al., 2016; Bakke et al., 2013). The environmental damages from produced water can be controlled through water minimization, produced water re-injection and offshore produced water treatment technologies. However, in offshore production, these techniques have some limitations. The former being expensive and

technically recent and thus the knowledge in this technique is limited. On the other hand, additional research is needed to investigate the efficiency of the offshore produced water treatment technologies (Silva et al., 2017). Finally, water re-injection requires various treatments at the surface level of the facilities prior of the re-injection process. Moreover, compared to seawater, the utilization of produced water is much more difficult and expensive. Therefore, produced water is frequently discharged into sea in offshore oil and gas production.

Additional to the produced water, drilling cuttings are the other dominant type of waste generated in offshore drilling activities. In fact rock perforation during drilling activities generates small rock fragments labeled as cuttings. The characterization of these materials is still vague. Their main impacts are mostly on marine environment (water column, sediment and benthic organisms). Several management options are available for drills cuttings (Paola et al. 2017):

- Offshore discharge
- Onshore disposal
- Cutting re-injection
- Use in civil construction
- Stabilization / solidification
- Disposal in salt caverns
- Bioremediation
- Thermal treatments

However drill cutting are mostly discharged offshore and follow variable regulations among countries.

Once the developed field reaches the end of its economic lifetime, decommissioning will be necessary. The operator start executing the decommissioning

plan, once approved by the concerned nation's local authorities. Decommissioning plan should also abide with international convention such as the UN convention on the Law of the Seas (UNCLOS). Decommissioning is considered a complex and risky operation (Fowler et al., 2014). In general, removing offshore platforms might be more complicated than building new installment. Thirteen decommissioning options for oil and gas projects are identified in the literature. These options range from a total facility removal to leaving structures in place. Five main consideration should be taken during this process (K.L.Na et al., 2017):

- Potential environmental impacts
- Potential impacts on human health and safety
- Technical feasibility
- Cost of the plan
- Public acceptance

These operational hazards release relatively small quantities of pollutants to the sea over a long periods of time if compared to accidental events. In case of offshore accidents huge quantities of hydrocarbons and pollutants may be discharged in the sea during relatively short periods. These accidents may result in severe consequences on the life and health of workers, pollution to the environment, especially the neighboring coastal areas, and both direct and indirect economic losses. The main hazards leading to these type of accident during upstream operations are (Michalis et al., 2012):

- Fire: if released hydrocarbons are ignited
- Explosion: if gas was released and ignited
- Spills: oil released on sea surface or subsea.

2. Downstream sector

When considering downstream operation the main environmental impacts arise from transporting, refining, storing and marketing petroleum products. The produced petroleum products are generally located far from the largest markets thus shipping often represents the most economical form of transportation for these materials. Different types of vessel are used to transport material in the oil and gas industry. The characteristics of these vessels depend on the type of product that is being transported (crude oil, refined products or more specialist cargo such as Liquefied Natural cryogenic vessels) (Clews, 2016). These tankers are subject to oil spill accidents during transportation. An oil spill is described as "*a release of a liquid petroleum hydrocarbon into the environment (especially marine areas) due to human activities or natural disasters."* (Pu Li et al., 2016). Some major spills include the Exxon Valdez incident, the Hebei Spirit spill, the Prestige spill, and the Deepwater Horizon oil spill. Spills occur worldwide in various types of environments such as land, ocean, and watershed (McCoy and Salerno, 2010). The world history witnessed a large number of oil spills; some of them had led to devastating impacts which raised public outrage and caused various environmental protection agencies to step-up such as the U.S. Environmental Protection Agency (EPA). Tanker oil spills may cause disasters such as fire and explosion, the ship may capsize or even sink, threatening the crew's life and human health and bringing huge losses to transportation enterprises and cargo owners (Pu Li et al., 2016). On the other hand, tanker oil spills also seriously harm marine economy development such as the fishery, aquaculture and tourism, pollute the marine environment and cause significant damages to marine ecological resources. The impact of oil spills on the ecological environment has been the interest of many scholars. Several studies were published on the subject. For instance, Peterson et al. (2003)

analyzed the ecosystem response to oil spill. Oil spill impact on vegetation was assessed by Wernick et al. (2009). Aguilera et al. (2010) studied the immediate consequences and the long-term effects of oil spill on human health. Moreover, Jenerloy (2010) explored the ecological damages caused by tankers' oil spills. Generally, oil spills impacts are divided into four main categories.

- Environmental impacts such as impacts on ecosystems, seabirds and benthos species.
- Economic impacts due to socioeconomic losses, cleanup costs, and environmental damages (Pu Li et al., 2016).
- Public health impact such as DNA damages, psychological stress, and physical health problems.
- In addition to social and community impacts.

Once crude oil is transported to refineries, the conversion process will be initiated and crude oil will be converted into a wide range of useful and valuable products. The processing steps required for any particular refinery depends on the wide variety of different crude oils available in the market (Clews, 2016). The major environmental challenges arising from refineries are air, liquid and solid emissions (Marafi et al., 2017).

Storage and marketing of oil products can also have a significant impact on the environment. Fossil fuels are the petroleum derivatives found in gas stations. By definition gas stations represent *"a business activity branch that works primarily with the retail sale of fossil fuels".* In these stations, fossil fuels are stored in underground tanks, and pumped when needed through a set of lines and pumps (Thales, 2015). The major environmental impacts of these stations are air, soil and groundwater contamination. Soil and groundwater contamination could occur from (Thales, 2015):

- Leaks in underground storage tanks of fuels knowing that the severity of this risk depends on the fuel toxicity, soil characteristics and the ability to detect leaks.
- Leak resulting from corrosion, cracks, defective piping.
- Spills during refilling and maintenance activities.

Contamination of soil and groundwater by fuel storage facilities carry direct and indirect risks to human health. Service stations pose significant risk on human health. Previous studies (Hassanvand et al., 2010; Kountouriotis et al., 2014) have proved that several Volatile Organic Compounds (VOCs) are produced and emitted in service stations. VOCs result from the evaporation of liquid fuels during car and storage tanks refueling (Hassanvand et al., 2010). Effect on human health from inhaling vapor varies from coughing, sore throat and eye irritation to death. It has been reported that exposure to petrol vapor increases the risk of acute myeloid leukemia, acute childhood leukemia, prostate cancer and other forms of cancer at various part of the body. These VOC emissions can be reduced by enforcing the installation of fuel vapor recovery systems (Kountouriotis et al., 2014). Moreover, a study conduct by Morales Terrés et al. (2010) has proved that small and medium size service stations have significant health impacts on their surroundings. Thus, service stations should not be located near vulnerable populations and activities such as schools and hospitals.

Moreover, service stations are also considered a fire hazard. The flammability of petrol vapors increase the fire risk in facilities. Fire that occurs in service stations results in significant environmental impacts and may lead to human fatalities (Ding, 2013). Hence, preventive measures such as checking tanks regularly, providing safety equipment and prohibiting smoking should be adopted to decrease the risk of fire.

Very little information is available on the environmental practices of the current (downstream) Lebanese oil and gas sector. The sector is mainly governed by two laws and one resolution:

- Law 5509 (11/8/1994) that set the general regulatory requirements for the establishment, construction and operation of installations for petroleum derivatives and liquid petrochemical products as well as for transport tankers and distribution stations for petroleum products.
- Law 444 (26/7/2002) that set the basic principles and general provisions to regulate the environmental protection and management in Lebanon.
- Resolution Number 5/1 (12/1/2001), defining the environmental guidelines for the establishment and/or operation of liquid petrol filling stations.

Moreover, a risk assessment study done by Renata et al. (2012), in the Jeita spring catchment identified that gas stations are potential source of environmental contamination. The study showed that the number of gas stations in the Jeita Spring catchment is relatively high, the majority of which were operating for more than 15 years, located in soils that represent a potential risk for underground water contamination. However no previous studies have investigated the environmental performance and management practices of the existing national and MNOCs oil companies operating (primarily storage and distribution) in the country.

D. International environmental agreements regarding the oil and gas industry

The oil and gas industry is a multidimensional sector governed by a series of politically, financially, economically, legally, and environmentally influenced laws and regulations. Currently, there are no international accords that govern upstream

petroleum activities, because issues concerning resource consumption and environmental exploitation are regarded as national matters. Resolution 1803, issued by the United Nations General Assembly, communicates that nations hold dominion over their natural resources and have the right to explore their naturally occurring raw material for the development of their country and its inhabitants (Hunter, 2015). The enactment of an international legal framework for the sector may be viewed as an infringement of sovereignty by several nations. Affirmed by the fact that international petroleum agreements regarding onshore and offshore upstream petroleum activities state that such operations are under the tutelage and jurisdiction of local governments. Consequently, the sector is administrated at the local level and is subject to the agreements, policies, and regulations that the national government undertakes with the employed international oil company. These agreements are typically influenced by the political ideology of the local government, the environmental concerns of the local populace, international commitments, and the policies of the commissioned oil company (Pickering et al., 2017, David et al., 2002; Miller, et al., 2003). Hence, it is up to each national government to enforce its own set of environmental legislation within its own borders in order to regulate the oil sector (Alba, 2010).

Nonetheless, international environmental agreements and protocols are applied in the oil industry if the environmental risks involved in an operation are deemed to be capable of transcending national borders and threaten the environmental safety of multiple nations or the international community. International regulations tend to tackle the process of transporting the fuel, since the operation is considered to have a transboundary effect. Moreover major accidents have occurred in the past, and continue to occur, while transporting fuel. Table 2 illustrates the most notable internationally

applied laws and regulations concerning the petroleum sector (UN, 1982; Anyanova, E., 2012; UNDP, 2017):

Table 2: International agreements that are applicable to the petroleum sector

International Convention for the Prevention of Pollution of the Sea by Oil (OILPOL) (1954) The treaty prohibited the discharge of petroleum and petroleum derivatives in certain areas of oceans, and is considered the first global effort aimed at protecting the environment.
The international convention relating to intervention on the high seas in cases of oil pollution casualties (1969) The Convention provides important powers to a contracting party to take such measures on the high seas as may be necessary to prevent, mitigate or eliminate grave and imminent danger to its coastline or related interests from pollution, or the threat of pollution, of the sea by oil following a maritime casualty and which may reasonably be expected to result in major harmful consequences.
Civil liability convention (1969) The International Convention on Civil Liability for Oil Pollution Damage, 1969 (CLC) lays down the principle of strict liability for ship-owners and provides for a system of compulsory insurance.
Stockholm Declaration (1972). It states that countries should comprise action plans that avert the risks of sea pollution by hazardous material, and stress on the need to develop laws that hold polluters responsible for any mismanagement.
International Convention for the prevention of pollution from ships (MARPOL)

(1973/197). The multiple oil spills that occurred during the 1960's and 1970's highlighted the need for an international protocol that responds to oil related disasters and the need for an international guideline that holds perpetrators liable and compensates the parties who are damaged by an incident. Thus the primary aim of this document was to reduce the likelihood of spills and marine contamination through the introduction of a new set of regulations.
United Nations on the Law of the Sea (UNCLOS) (1982) The convention issued a broad and generalized framework regarding the protection of the marine environment and stated that nations are obligated to protect their marine environment and are not permitted to endanger the ecosystems of other nations.
The international convention on oil pollution preparedness, response and cooperation (1990) The convention provides the international legal framework for establishing national and multinational response systems to oil pollution incidents.
Agenda 21 of the Conference on Environment and Development (1992) The document stresses on the dangers of coastal and ocean pollution, and emphasizes the need to minimize the risks involved in upstream petroleum activities.
Barcelona convention: Convention for the protection of the Mediterranean sea against pollution (1995) The convention stresses on the protection of the marine environment and the coastal region of the Mediterranean.
Sustainable Development Goals (2015) The document discusses the negative environmental impacts that the oil and gas

industry may have on the air, water, and soil; emphasizing the need to tackle the industry on all three fronts in order to minimize the damage resulting from petroleum related activities.

However, all of these declarations, except OILPOL, do not exclusively tackle the petroleum sector, nominally deal with the issue of pollution and marine pollution on a general basis, and several of which are not legally binding. Hence, as mentioned, petroleum is for the most part domestically regulated since international agreements continue to explicitly state that nations have the right to utilize and exploit their own natural resources. Despite the absence of international laws, the regulations that govern the petroleum sector tend to be similar across the globe giving rise to the term "*lex petrolea*" (Hunter, 2015). According to Alex Wawryk (2015) " '*lex petrolea' is a type of lex mercatoria, or international 'law of merchants'; the principles and norms, and their legitimacy as law, are derived from their use and acceptance by the members of the international petroleum industry, to serve its own needs, separately and autonomously from principles of customary international law derived from state practice."* These applied rules and regulations tend to be derived from internationally recognized standards, protocols, and agreements.

Furthermore, the laws and regulations adopted by national governments, with regards to the petroleum sector, tend to be similar throughout the world; which can be attributed to countries who had recently began excavating for oil adopting the laws and regulations enacted in petroleum exporting nations so that they may capitalize on the experience gained by these foreign oil exporting nations, such as having an Environmental Impact Assessment (EIA) being conducted before certain petroleum activities commence (Hunter, 2015, Johnstone, 2014). Additionally, according to

Mikulska (2010), the objectives of host countries tend to be similar to one another across the globe, with national legislative frameworks primarily targeting the following objectives (Cathrine B., 2010):

- Improve the nation's energy security
- Elevate the financial capabilities of the national government
- Preserve the integrity of the local environment
- Maintain the government's sovereignty over its natural resources
- Enhance the scientific and administrative proficiency of local inhabitants and advance the local infrastructure
- Begin petroleum related activities as soon as possible.

E-Environmental Management System (EMS)

Relying on the national governments and standards of developing countries is generally environmentally problematic since several of these countries are inexperienced, and lack the adequate financial and managerial capacity to implement and administer environmental regulations. All of which lead to further deterioration in local environments since the likelihood of environmentally damaging accidents occurring is much higher. However, the lack of a regulatory framework was not displayed as a hindrance since developing countries tend to adopt foreign policies and benchmarks for the management of the oil sector; the major issue lies in implementation (Alba, 2010). Accordingly, international oil and gas companies are left to regulate themselves, an issue advocated by scholars so that corporations may compensate for the administrative deficiencies that plague developing nations. This adds to the importance of multinational companies having an environmental management system (EMS), since

several authors reported that despite companies adopting codes of conduct, these newly found regulations are not always enacted. Companies continue to act for their own self-interest and may not implement regulations that would compromise their ability to compete in the international market. Academic authors' state that for self-regulatory policies to be properly implemented, a company needs to be subjected to a degree of surveillance and that company should also be transparent with all of the stakeholders involved, to ensure adopted laws and regulations are properly applied (Graham et al., 2006).

An environmental management system (EMS) is a regulatory organizational framework whose purpose is to develop an environmental strategy, for an institution, capable of adapting to an ever changing environment. The primary incentives for adopting an EMS is that it approaches environmental management in a holistic and systematic manner, enables an organization to continuously improve, and is typically integrated into the company's pre-existing operational model. Additionally, institutions that implement an environmental management system tend to(Borthwick et al., 1997 , Tinsley et al., 2012):

- Lower operational costs, since an EMS assists organizations in diminishing energy and resource consumption.
- Gain a competitive advantage, because the company would have an improved its image in the eyes of its.
- Reduce the environmental risks of accidents and disasters from occurring.
- Enhance the corporate social responsibility profile of the company.

The methodology by which an environmental management system operates is based on the Deming cycle, also known as the "Plan-Do-Act-Check" model, which is a four step systematic managerial model that emphasizes the need to constantly adapt and

improve implemented strategies or policies (illustrated in figure 3) (Jonas et al., 2015). The International Organization for Standardization (ISO) developed the ISO 14001 in order to guide and support companies that wish to improve their environmental practices. The purpose of the ISO 14001 is to facilitate the adoption of an EMS within organizations. However, the adoption of an environment management system, such as the ISO 14001, is marred with difficulties that discourage institutions from acquiring it, especially in developing countries. These include the lack of governmental policies that support the adoption of an EMS; the financial costs and investments required; the time and effort needed to train employees; and the fact that the certificate is not a legal requirement (Massoud et al., 2010).

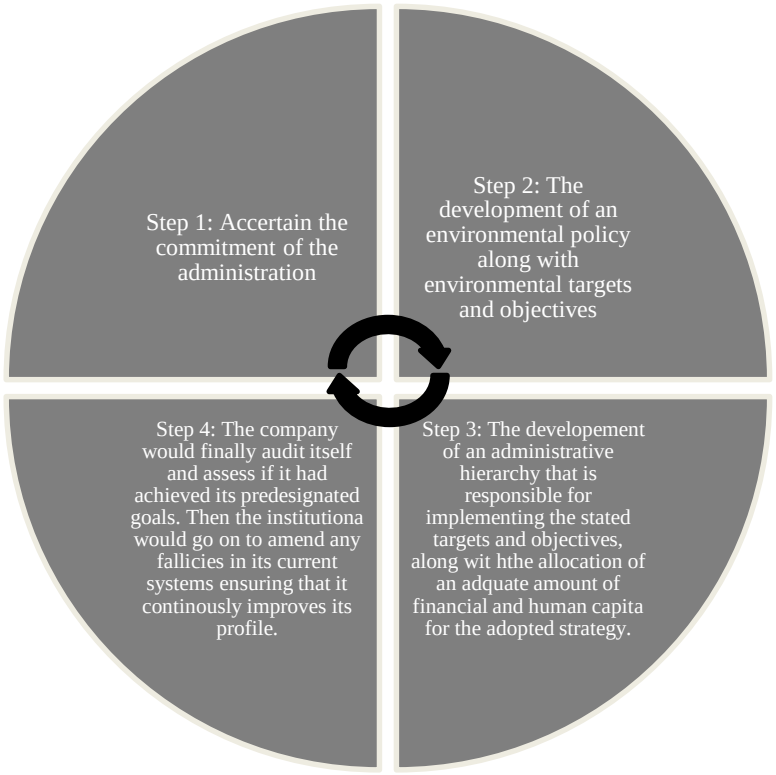

Figure 1: The structure of an Environmental Management System (Darnall, et al., 2006; Azilah K., 2015; Jonas et al., 2015)

However, several oil companies, which may not hold the ISO 14001 certificate, may already have the certificate's principles implemented through the application of certain standards or HSE managerial models such as those published by the American Petroleum Institute (API); especially that the API develops its standards in collaboration with the International Organization for Standardization (ISO) (Ian, 2012). The API's standard, which is entitled "API 75: Recommended Practice for Development of a Safety and Environmental Management Program for Offshore Operations and Facilities", also known as SEMP, is an example of an all-inclusive managerial program that tackles the environmental impacts of offshore petroleum activities. The program tackles issues such as safety limits, emergency planning, the need for an institution to be continuously audited, recordkeeping, documentation, risk analysis, legal requirements,

and stresses on the need for a company to reduce its energy consumption. The United States imposed several of the HSE standards in the API 75 document as legal requirements, in 2010, to encourage petroleum companies to improve their practices. Similar to incidents in the past, this decision came as a direct consequence of the British Petroleum Deepwater Horizon disaster, which resulted in the spillage of approximately 200 million gallons of oil over the course of 85 days (Matthew et al., 2011). The SMEP standard was modified and evolved to assimilate additional factors (illustrated in figure 4) in order to have a broader scope of implementation; becoming known as an SEMS (Safety and Environmental Management System) instead (Ian, 2012).

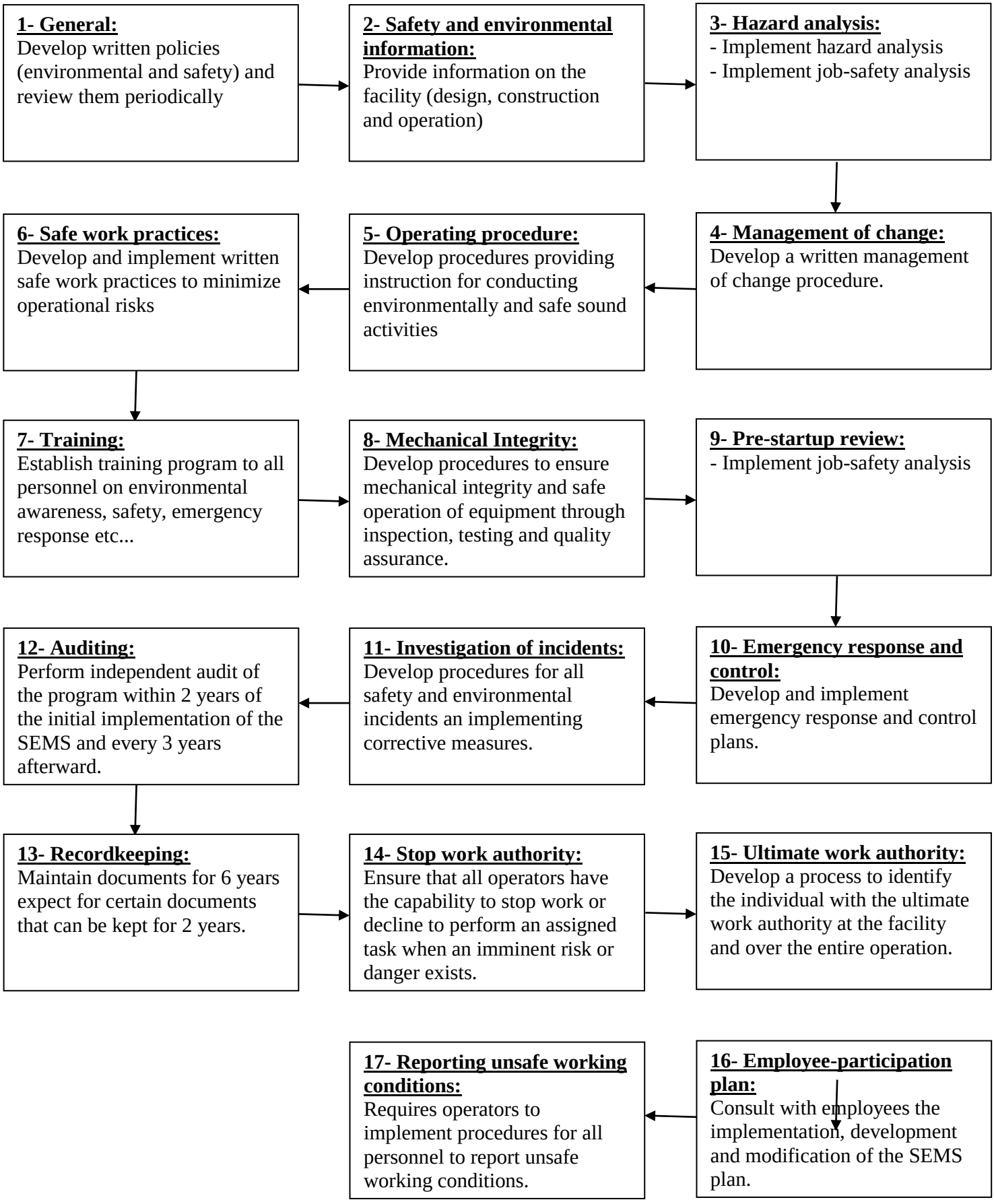

Figure 2: **SEMS elements (Taylor et al., 2013)**

The SEMS is regarded as an extensive and systematic approach to management; having a single managerial model capable of addressing several key dimensions within an industry, such as the issues of health, safety, environment, and quality, has been claimed to be more cost effective, as opposed to having to adopt multiple standards for each of the aforementioned factors; for it is said to increase communication within an organization (Wright T., 2000). However; despite the set of standards being called a "Safety and **Environmental** Management System", the protocols involved are primarily associated with safety rather than the environment. Benefits to the environment appear only as a byproduct of the improved safety regulations, under the assumption that there is a decreased likelihood of any disasters or hazards occurring; with the standard being comparable to that of OSHA's 29 CFR 1910.119 standard, which is primarily concerned with hazard analysis and risk prevention (Taylor et al., 2013).

A study conducted in Norway, a country that also imposes HSE legal requirements on petroleum companies, reported that most workers interpreted HSE practices as being primarily correlated to safety, with little emphasis given to occupational health and the environment. The study reported that there is a need to clarify the concept of an HSE program to the workers within a company, since the concept was understood in a different manner between several individuals; highlighting the need to disseminate information regarding the elements that comprise an HSE system or program, and the importance of having training programs. Furthermore, the study demonstrates the need to continuously audit and monitor a facility as several employees reported that health and safety procedures are constantly violated by

employees, which affirms that an HSE system cannot be implemented if a facility is not constantly scrutinized (Høivik et al., 2015).

CHAPTER III

METHODS OF INQUIRY AND ANALYSIS

A. Study Design

Primary data are the main source of information for the study; however, some secondary sources of data were used including books, published electronic and print journals and information from government documents and reports. The target population in our study is all the oil and gas companies registered in the general directorate of oil as well as the key stakeholders in the sector. The main petroleum companies that are active in Lebanon are gathered in the "Association of Petroleum Importing Companies APIC" which is a non-governmental association. Lebanon's distribution network consists of around 2,200 registered service stations, with a further 1,000 understood to be operating without the required permits. The market is dominated by 3 international companies that hold a combined market share exceeding 50%. The other remaining oil importers control roughly equal shares to complete the market.

B. Instruments

1- Survey questionnaire

For the acquisition of primary data a survey questionnaire was administered. The questionnaire addresses the first two objectives of the study. General Managers, quality and safety managers or plant operations managers were asked to complete the questionnaire. The questionnaire was pre-tested to check for ambiguity, misunderstanding and confusion over terms and questions and to ensure that the exact meaning of the questions was captured in the English-to-Arabic translation. The

estimated time needed to complete this questionnaire is approximately 20 minutes and was administered by the researcher. A cover letter was attached to the questionnaire to explain the background and purpose of the study. The questionnaire was comprised of a set of structured, standardized, closed-ended and coded set of questions (Appendix I). It was structured and developed to address the following:

- Information on the organization such as the ownership type, the service provided and the availability of an environmental department.
- The existing environmental management practices and their sustainability.
- The drivers and benefits to adopting the ISO 14001 environmental management system.
- The barriers and incentives to adopting ISO 14001.

2- Semi-structured interviews and recruitment of participants

In order to assess the third objective of our study, the qualitative research method, in particular the in-depth interview approach was adopted. This method provides a depth of information through the use of open-ended questions to examine a sensitive topic and collect nuanced information in a short period of time. It allows the respondent to talk freely about issues and does not constrain his/her responses with quantitative data and rigid numbers. This approach has a major advantage of allowing the interviewer to investigate and probe complex questions and answers directly from the respondent and to query specific differences and circumstances in more detail (Millard 2011).

An interview guide was formulated including both general and specific questions. The questions explore how the various stakeholders perceive the environmental management practices of the oil and gas companies and explore their

concerns regarding the environmental performance and prospects of the oil and gas sector in Lebanon. This interview guide helps focus the interview without locking it into a fixed set of questions in a rigid order and with specific wording. Table 3 summarizes the in-depth questions of the interview guide related to the study's objective. Any leading questions that could influence respondents' answers were carefully avoided or clarified during the interview. The interviews were conducted in Arabic, and all the data were documented by note-taking. Before carrying out the interview, the interviewees were informed that the name and data collected will remain anonymous, and that all confidential and specific information gathered will only serve the analytical purposes of this project. The list of key stakeholders interviewed includes a representative from each of the following governmental and non-governmental organizations:

- Association of Petroleum Importing Companies APIC
- Ministry of Energy and Water (MoEW)
- Lebanese Petroleum Administration (LPA)
- Ministry of Environment (MoE)
- Ministry of Industry (MoI)
- Ministry of Public Works and Transport (MoPW)
- Lebanese Ministry of Finance (MoF)
- Lebanese Standards Institution (LIBNOR)
- Disaster Risk Reduction Unit (RDU)
- IRI (Industrial Research Institute)
- Civil defense (CD)

Table 3: Summary of the in-depth interview questions linked to the study objectives

Objectives	**Questions**
Explore stakeholders' concern regarding the environmental performance of the existing national and multinational oil companies.	1- What do you think are the environmental impacts and risks of petroleum exploration, development, production, and decommissioning? 2- How do you evaluate the environmental practices of the existing oil and gas companies based in Lebanon? 3- What governmental body monitors the existing oil companies' environmental performance? Does your institution have a certain role regarding this issue? 4- In general, how do you find the implementation of environmental legislation in Lebanon? 5- What do you think are the major environmental risks once oil and gas production activities are commenced in Lebanon?
Explore stakeholders' prospects of the oil and gas sector in Lebanon.	6- Do you think the acquisition of an environmental management system (EMS) will enhance the organization's environmental performance? 7- Do you think that an EMS should be a requirement for the oil and gas companies? Please explain why? 8- What non-environmental benefits do you think the oil and gas sector would bring to the country?

3- Data Analysis

The collected data from the survey was numerically coded to facilitate the use of statistical programs, namely the Statistical Package for the Social Sciences (SPSS) software. Following the coding process, the data was subjected to statistical analysis. Frequencies of the various responses were worked out, interpreted, and explained in

terms of the general trends that emerged from the analysis. Relationships between the variables were explored. Analysis were carried out to investigate possible association between predictor variables or independent variables (i.e. size of company, ownership type, previous certifications and availability of HSE department) and the main outcome variables or dependent variables (e.g. drivers, barriers, incentives, etc.). The correlation tests were used to examine the relationship between the dependent variables and independent variables. To determine the correlation between the different categorical variables, statistical significance and strength of association were determined and analyzed. Bivariate cross tabulation matrices were conducted using SPSS to explore and present the patterns of associations between two variables.

The output were interpreted by comparing the column percentages across the matrices. To examine that the patterns and relationships observed in our selected sample are representative of the total population (i.e. not produced by random chance), the chi square significance value was used to determine the statistical significance of the results. A statistical significance value limit of p-value <0.05 is commonly used in the literature; therefore it was used in our analysis. Statistical significance alone is not a conclusive evidence of relationships; it is still possible that the relationship could still be weak. Therefore, measure of association was conducted to assess the strength of a relationship. The stronger the relationship, the larger the differences in the column percentage distribution observed. Cramer's contingency coefficient (V) was used to assess the strength of association between the two nominal variables compared. Cramer's V was selected because it is appropriate for any size contingency table. Most measures of association vary between 0.00 and 1.00. Generally, values less than 0.1 indicate “weak” and uninteresting relationship, between 0.1 and 0.3 indicates “moderate” and worth mentioning, whereas above 0.3 were regarded as “strong” and

evidence of a strong relationship. In conclusion, correlations showing statistical significance results and strong association values were selected and discussed in details.

For the qualitative section of the research, during the data analysis, all the acquired notes were combined, documented and organized. Then, and based on the stated objectives, appropriate and content analysis was performed to comprehensively evaluate and asses the respondents' transcripts. This type of approach ensures that all the scattered information is put together to achieve a complete review. Analyzing the data was performed using matrices and grids in order to organize and summarize the findings. To prevent the outcome from being subjective, data analysis was approached systematically. Furthermore, to support the findings of the study, direct quotations from the participants were used. The information that the various stakeholders provided was treated confidentially and the names were not mentioned. To ensure confidentiality, all collected data will be stored in a locked drawer that could only be accessed by the principal investigator. The scripts will be shredded after the retention period of 5 year.

CHAPTER IV

RESULTS AND DISCUSSIONS

A- Environmental governance and practices of the Lebanese oil and gas sector

The intricate task of governing the environmental dimension of the petroleum sector is further exasperated in the context of Lebanon, because of the prevalence of various environmental and administrative uncertainties. The lack of coordination between various stakeholders, the unconcise environmental legislature, the limited capacity of public organizations, the lack of accountability, the absence of sustainable environmental monitoring programs, and the presence of conflicts of interests among various stakeholders, distribution of tasks among Lebanese governmental institutions have impaired the adequacy at which environmental regulations are enacted in the existent Lebanese oil and gas sector.

These issues are exemplified by the fact that decree 5509, which is the legislation that tackles the technical, managerial, and environmental dimensions that govern the petroleum sector, was barely implemented until recently and has yet to be properly amended or updated since its inception in 1994. The uncertainty expressed by several stakeholders regarding the entities that will be responsible for governing the petroleum sector, once upstream operations have been initiated, since the future of some of the current stakeholders such as the LPA remains unresolved. An accurate record of all the petrochemical companies that operate within the country doesn't exist. The data sheets issued by the directorate of petroleum, which is under the MoEW, and the Ministry of Industry, contained companies that were not involved in field of petroleum and natural gas, had companies which have ceased to operate, contained several wrong

numbers and addresses, and excluded several key operators. The inability of the government to halt the operations of pre-established petroleum facilities, such as fuel stations, whose specifications violate some of the set laws and regulations hampers environmental remediation efforts. Moreover, the dependence on petroleum companies to regulate themselves, due to the lack of human and financial capita dedicated for the application of monitoring programs exacerbates the problem.

Overall three gaps in the Lebanese governmental work were identified: a jurisdictional gap, an information gap, and an implementation gap. The existence of a jurisdictional gap allows the infringements on the environment to go unpunished. Moreover, information on the oil and gas companies was not available unless requested officially. To add on, the instability of the political situation has forced the government to neglect environmental issues, and created an implementation gap. This was reflected by a lack of environmental monitoring, weak law enforcement system and a lack of technical knowhow.

Despite the involvement of a multitude of stakeholders within the petroleum sector (illustrated in table 1), the primary entities concerned with monitoring the environmental performance of petroleum companies were identified to be the MoE, the IRI, MoPW and the MoEW. In accordance to the responses provided by interviewed stakeholders, the MoEW was recognized as the principal public organization responsible for managing the sector. The environmental responsibilities of the MoEW include monitoring incoming petroleum shipments, by supervising the process of unloading imported fuel. It also supports the MoE by coordinating the process of setting environmental legislation of the sector. Nonetheless, the chief entity responsible for environmentally directing the sector within the country is the MoE, which was identified by several authorities, including the MoEW, as the public enterprise that is

primarily concerned with auditing the environmental practices of oil and gas companies. This statement was confirmed by one of the major stakeholders:

"MoE is the authority responsible for monitoring the implementation of environmental regulations, and this is the case not only for the petroleum sector, but for all industries in general. The MoE is the foremost authority responsible for anything that concerns the environment."

However, the lack of confidence of public entities in the ability of the Lebanese government in general, and the MoE in particular, to monitor the activities of petroleum companies highlights the limited institutional capacity that public entities, such as the MoE, possess. This point is substantiated by one of the interviewees who attests that companies are rarely, if ever, audited environmentally because governmental bodies do not possess the adequate capital to do so. Ministries rely on the companies themselves to report on their environmental practices, which raises the question of the validity of the submitted reports, because of the presence of a possible conflict of interest. Meanwhile, the IRI, which is affiliated with the MoI, provides technical services for ministries, performs inspections, calibrates equipment, and contributes to the development of standards and legislation. Previous studies (World Bank, 2010) targeting oil producing or potential producing developing nations revealed that most countries have established a clear environmental legal framework. However institutions that are in place for managing the environmental and social impacts of the oil and gas industry (i.e. ministries of environment) lack the sufficient organized administrative structure, are short on human and financial resources and lack the technology and the know-how to effectively implement their strategies and fulfill their regulatory mandate. Our findings entails that Lebanese government is facing similar challenges.

Despite the MoPW not being directly responsible for auditing the environmental activities of petrochemical industries, the ministry is tasked with the responsibility of monitoring fuel tankers with public licensed plates (red plates) and, along with the civil defense, is in charge of training truck drivers on proper health and safety practices. It has been reported that most petroleum companies transport their fuel using commercial license plates, which are only inspected once a year by internal security forces, and that the training program has thus far covered less than 20% of total truck drivers. Issues which further highlight inadequate efficacy of monitoring programs.

However, the aforementioned activities primarily target the downstream segment of the petroleum sector. The LPA, which is the governmental entity responsible for regulating upstream operations, will likely be a key stakeholder in governing the industry in future, once offshore activities commence. This governmental administration is involved in drafting legislation that tackles offshore related petroleum activities, will be responsible for overseeing upstream operations and, along with the MoE, will be accountable for auditing the environmental performance of offshore operators.

Table 4. Role and responsibilities of the different stakeholders in the Lebanese oil and gas sector

Stakeholders	Role and responsibilities
Industrial Research Institute (IRI)	– Monitors companies on behalf of ministries. – Develops rules and decrees alongside other governmental entities. – Coordinates with LIBNOR in issuing certificates. – Performs most of the scientifically technical matters on behalf of ministries.
Ministry of Energy and Water (MoEW)	– Primary entity involved in the sector – Coordinates with the ministry of environment, and other public entities, in the process of updating environmental legislation of the sector. – Requests permit for fuel carrying boats coming from abroad from the MoPW. – Monitors the process of unloading the fuel that is coming from abroad.
Minsitry of Environment (MoE)	– Highest authority in matters that concern the environment as per law 690 (2005) and law 444 (2002) – Will be involved in monitoring upstream operations in the future
Ministry of Industry (MoI)	– Issues license for companies that distribute gas (butane, propane, etc.)
Ministry of Public Works (MoPW)	– Monitors fuel tank trucks with public license plates (red licensed). – Issues permits to fuel carrying boats coming from abroad to dock in Lebanon – Provides safety trainings for public truck drivers.
Association of Petroleum Importing Companies (APIC)	– Association composed of the main 14 oil companies that import oil from abroad and distribute them within the Lebanese Market. – Ensures quality and safety of the imported fuel. – Improves coordination between public and private sector. – Participates in the development of new laws and standards.
Lebanese Civil Defense (CD)	– Responds in case of fire incidences. – Provides safety trainings for public truck drivers.
Lebanese Petroleum Administration (LPA)	– Responsible for regulating upcoming upstream the sector and will most probably monitors the upstream sector of the oil and gas industry, alongside the MoE. – Involved in the development of legislation concerning upstream petroleum activities
Lebanese Standards Institution (LIBNOR)	– Issues standards for ministries if requested.
Ministry of Finance (MoF)	– Monitors the financial dimension of the sector such as revenue generation, taxes, income statements or any other form of payment that companies need to submit to the government.

The jurisdiction of public institutions is not always clearly defined, which causes the responsibilities of ministries to overlap. For instance, the MoEW is the entity in charge of environmentally auditing the process of unloading fuel at Lebanese ports knowing that MoE is the legal entity entrusted to conduct these audits (figure 1). Moreover, laws governing the sector are considered outdated and vague, which causes their implementations to be challenging and difficult.

Our findings are consistent with the findings of Boadi et al. (2005) and Howes et al. (2017) that highlighted the undevelopment and the unenforcement of environmental laws under an unstable political climate as a main barrier to successfully implementing environmental legislations. Moreover the incomplete specifications (Devkota, 1999), the vagueness of environmental policies (Gilley, 2012), the lack of accountability (Howes et al., 2017) and the unclear chain of responsibilities (Baker et al., 1998) for implementing environmental policies were also recorded in other developing nations. In fact, expect in cases of environmental catastrophe (e.g. the recent waste crisis), all environmental issues have lagged behind other societal and economical concerns on the governmental agenda. Moreover, the huge political challenges that face Lebanon have driven the country to neglect environmental issues. This explains the low level of importance given to the laws regulating the sector.

The limited capacity of the MoE, the large number of stakeholders involved in the sector, and the vagueness of the Lebanese environmental legislation, have prevented the ministry from properly performing its duties, diminished its authority, and resulted in a deficiency in the sector's environmental governance. Several of the interviewees believed that if private operators adopt the ISO 14001, the expressed deficiencies would be diminished, especially in terms of environmental auditing.

When it comes to the practices of the existent Lebanese oil and gas companies, stakeholders' viewpoints were variants. Stakeholders, comprising APIC, CD, LIBNOR, LPA, MoF and DRDU, that are not involved in the environmental monitoring process did not comment on whether national laws and regulations are implemented, claiming that they did not know because they were not the responsible authority. However, the other group of stakeholders agreed that there is a huge deficiency when it comes to implementation. As mentioned by one of the major stakeholders:

"*Several violations are occurring in the sector, because there are conflicts of interest between the various stakeholders, the incomplete legislation, and the inability of governmental agencies to properly monitor companies*".

Stakeholders also stated that, before 2015, most companies were not abiding by law 5509 because there was no one to enforce it. The government was not monitoring these companies in any way, so petroleum industries were free to do as they please without any consequences. This highlights that the environmental aspect of the sector has been neglected by governmental agencies. Indeed, the inability of these agencies to properly monitor the sector will have negative implications on the environment. However, companies' environmental practices is also a critical factor to consider. Thus investigating the environmental awareness, approach and compliance of the existent Lebanese oil and gas companies is crucial to assess the practices of these companies.

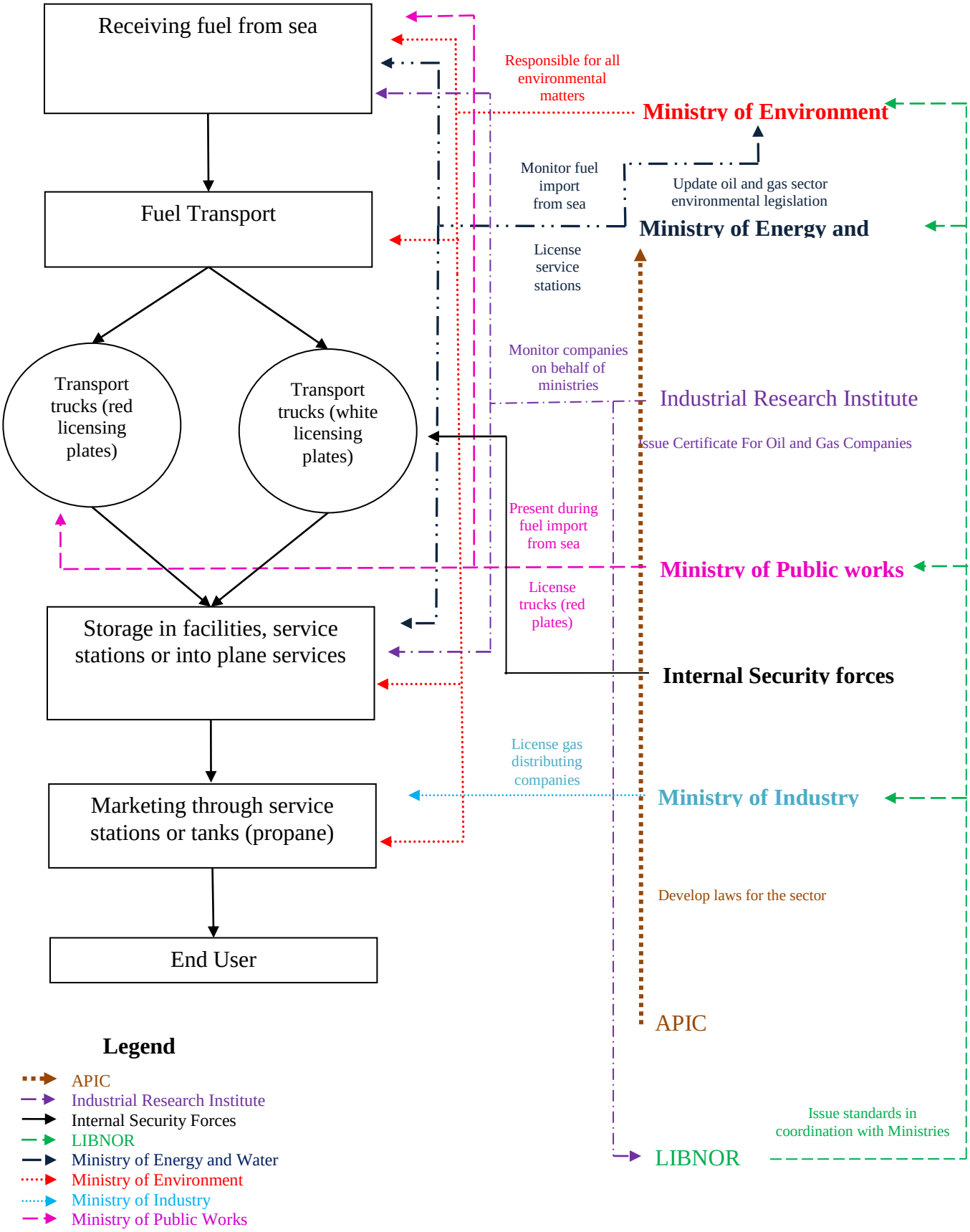

Figure 3. Stakeholders' role in environmental management of oil companies in Lebanon

B- Practices of the existing oil and gas sector

1. Profile of responding industries

Eighty-four percent of the 43 industries who responded to the survey were national corporations with the majority providing oil and gas storage and distribution services (51%). The size of the industries was predominantly medium-sized enterprise with more than 50 employees (60%) (Figure 1). The majority of the 43 industries do not have a dedicated HSE department or personnel dedicated to environmental issues (70%). Thus, our finding asserts the poor implementation of EMS within the oil sector in Lebanon. Moreover, such environmental positions were more strongly existent in MNOCs. This is due to the pressure that is mainly exerted by international mother companies on their sister companies forcing them to deal with their environmental issues. The absence of environmental departments or positions in locally-owned companies that do not have sister international organization is mainly attributed to the lack of enforcement by the government. These results are consistent with previous studies that targeted the Lebanese food sector (Massoud et al., 2010).

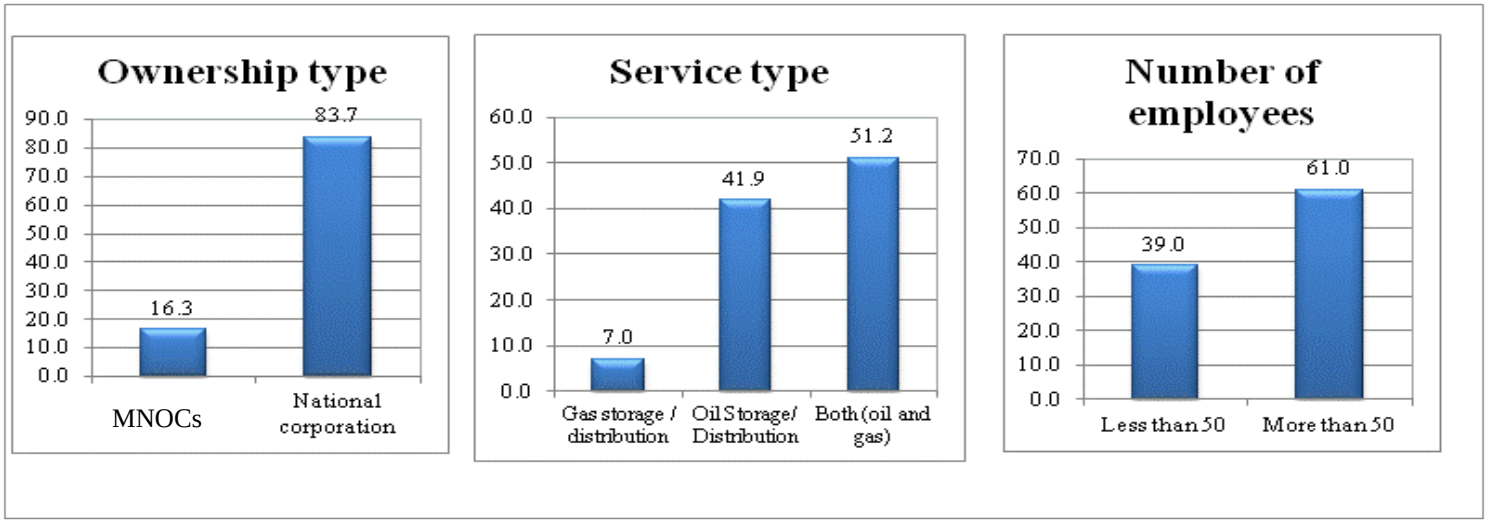

Figure 4. Description of the interviewed companies

2. Perception of environmental impacts and standards

The results showed that 67% considered that their practices have no impact on the environment while 62% claimed that their environmental performance is not a barrier to sustainable development. In fact, a large proportion of interviewees did not believe that the activities of the company they work in, or own, are environmentally damaging. They would claim that because their operations are limited to the context of Lebanon and because they do not operate any oil refiners, this impact that they have on the environment is limited. They conceived that they are simply selling a product. Meanwhile, smaller operators would add that because they do not have large petroleum storage containers (such as the ones found on the seaside road), their environmental impacts are negligible. Thus environmental considerations are only considered as financial burdens on the company. As one of them noted:

"We are a rather small company, so it is intuitive that we cannot place the environment as our priority. Moreover, we are incapable of making heavy investments."

Moreover, several gas companies believed that their environmental impacts were extremely limited because, in their opinion, natural gas was a clean form of energy.

Around 51% of respondents stated that they took initiatives (waste recycling, energy conservation measures, reuse of water) to improve environmental performance. Nevertheless, the majority of these initiatives are categorized under “safety measures” which include changing old containers, HSE trainings, installing valves and cleaning tanks. This is explained by the common misconception between safety and environmental management practices among respondents. Moreover, very few companies are addressing the waste and the wastewater generated from the liquid petrol filling stations. Contrary to the requirement of the decision No.5/1 (that sets the

environmental guidelines for the establishment and/or operation of liquid petrol filling stations) spills, wastes (e.g.: engine oil drained from generators and vehicles during servicing, oil filter etc.) and carwash water are being disposed directly in the nature, without any previous treatment. This was confirmed by one of the companies' representative:

"*We are well aware that we are environmentally damaging, especially that we, along with other petroleum companies, dump our wastes in the sea without treatment. Moreover, we acknowledge that we have played a role in severely polluting the soil in the area because of spills."*

As stated earlier, this is explained by the lack in the government ability to enforce environmental regulations. Moreover, law 5509 entails that gas stations should be sited away from places where people normally gather for any form of activities. However, this was not given due consideration in Lebanon, prior to 2015, because companies were not abiding by the law. Hence some residential building might be exposed to air pollution as vehicles move in and out of gas stations to take fuel (Mshelia et al., 2015).

When asked to compare environmental performance between the Lebanese oil and gas industry and their counterparts in the Middle East and in Europe, almost 63% of the respondents considered that the Lebanese companies lag behind those in the Middle East while 60% said that their performance was less than those in Europe. Companies are aware that their counterparts in other countries are abiding with the set of environmental laws and regulations imposed on their operations. However, environmental laws and regulations in Lebanon are characterized by low levels of

regulatory enforcement which is caused by the lack of precision in the law and unclear roles of responsibilities.

The survey revealed that only 28% of the firms had acquired an international management system and specifically the ISO 9001, with which they were more acquainted to than the ISO 14001 EMS standard. The results show that most of the oil companies that acquired ISO 9001 are interested in implementing ISO 14001 standard showing that they are willing to implement the EMS certification in the near future. This result about the oil and gas companies is consistent with the findings of Mzoughi (2006) and Curkovic (2001), who reported that firms with previous TQM are more willing to acquire ISO 14001. However, this finding is not in agreement with the findings of Shall (2000), who reported that Lebanese ISO 9001 certified industries are least interested in taking the next steps for pursing the EMS-ISO 14001 certification, compared to other management systems. In fact certified companies are already aware of the benefits of acquiring an international management system certificate. Thus ISO 14001 could improve the gaps in their environmental performance.

Only 1 company (2%) has obtained ISO 14001. Most of the respondents considered that acquiring the ISO 14001 certification is of "medium" difficulty (figure 2) and 40% had no idea about its cost. There was a large misconception regarding the procedure involved in attaining the ISO 14001. Several companies believed that the ISO 14001 primarily involved documentation and good record keeping, which may be attributed to the fact that the vast majority were not familiar with the ISO 14001 and were only familiar with the ISO 9001. This also explains why 40% of respondents are planning to acquire ISO 9001 certification in the future.

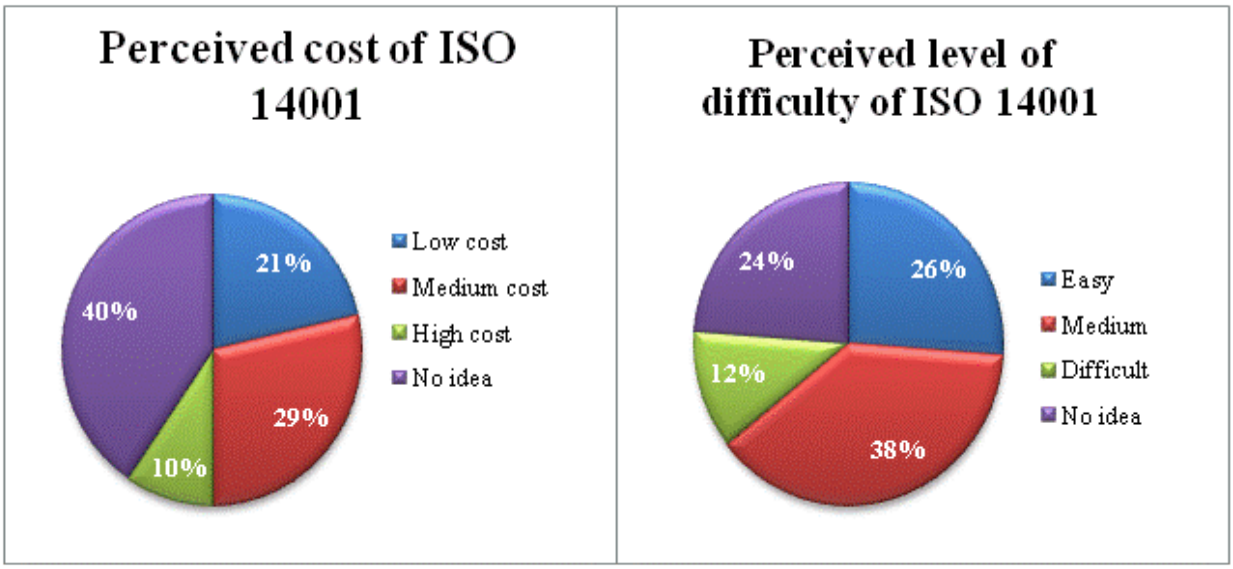

Figure 5. Perceived cost and difficulty of acquiring ISO 14001

A lack of environmental commitment is recorded among the respondents since only 34% stated having an environmental policy. An environmental policy is the basis of a good environmental management program. The policy reflects the support and the commitment of top management with regard the EMS. Even though 34% of the respondents claimed having an environmental policy, only the ISO 14001 certified company (2.3%) has diffused this policy to the public, on the company's website. This is explained by the lack of top management support and commitment to EMS adoption. When it comes to legal requirement most companies showed a sign of commitment since 81% of the companies affirmed having a procedure to identify all new legal requirements. The survey revealed that 44% of the companies are setting environmental objectives and targets while considering the financial, legal and operational requirements as the main factors. However, the vast majority of companies are not clearly documenting the defined environmental targets, or objectives. Moreover, smaller companies tend to be unconcerned with their environmental impacts, with the financial and legal implications of the sector being among their prime concerns. All these

findings stress on the lack of commitment to the EMS in the Lebanese oil and gas companies.

When it comes to staff training, companies seem committed since 83% of them are doing it. However, the topics tackled are mainly safety issues (80% tackling emergency situations like fire and oil leaks) therefore no importance is given to environmental topics. Only 35% of the companies have programs and procedures to conduct periodic environmental audits and 2 industries declared that their audits are executed by external parties. Moreover, many companies did not even have any emergency plans, while some believed that having their trucks and equipment insured is a form of emergency planning. This could be explained by the lack the environmental knowledge among respondent.

All companies agreed that no accidents or emergency have ever occurred during their operations. As stated by one of the representatives:

"No emergency has occurred in the company for the past few decades. Moreover the company cooperates with the civil defense in the case of an emergency".

This finding was not expected since previous studies have reported that accidents are frequent in gas station (park et al., 2006; Nouri et al., 2010). In addition, Strang et al. (2014) have proved that the probability of petroleum accidents in the oil and gas industry was almost six times higher than their occurrence in other industries, such as electricity generation, transportation, hospitals, universities, warehouses, government, businesses and residences. Thus companies may have preferred not to disclose their previous accidents and / or emergency situations.

The cross tabulations results show that international companies tend to adopt more environmental management initiatives as compared to national companies. This

could be explained by the pressure imposed by their mother companies. Medium size companies having a HSE department are more prone to having the characteristics of ISO 14001 than companies without a HSE department. Companies having an ISO 9001 certification are more likely to have set environmental objectives and targets as compared to uncertified companies. Certified ISO 9001 companies are more likely documenting environmental management practices compared to companies which do not have a quality management system certification. Lebanese oil and gas companies having a HSE unit are more ready to implement ISO 14001 compared to companies that have acquired ISO 9001 certification. Moreover, companies possessing an ISO 9001 certification can also be considered on a step further towards implementing ISO 14001 compared to companies that have neither a HSE unit nor an ISO 9001 certification (Table 5). It is interesting to note that the findings show that only medium sized companies have a HSE department. Our findings are consistent with previous studies that reported the existence of an environmental or a related department exhibits a positive effect on EMS adoption (Manuel et al., 2008). Moreover, companies with existing quality management system (ISO 9001) tend to spend less for EMS implementation, as a result of their more appropriate organizational capabilities. Knowing that the majority of the companies identified in our study are neither certified nor possess a HSE department then environmental initiative are inexistent in most of the companies. Such practices put the community at risks at all levels including environmental hazards condition and safety condition.

Table 5. Significance and strength of correlation between firm's characteristics and ISO 14001 components

ISO 14001 Components	Significance and Strength	Ownership type		Company size		Availability of HSE department		ISO 9001 certification	
		National	MNOCs	Small	Medium	Yes	No	Yes	No
Availability of environmental policy	Chi-square (P) Cramer's V		**0.038** **0.327**		**0.004** **0.452**	**0.004** **0.452**		0.057 0.300	
Availability of procedure to identify environmental aspects	Chi-square (P) Cramer's V		**0.001** **0.509**		**0.000** **0.563**	**0.000** **0.563**		0.057 0.300	
Availability of procedure to implement legal requirement	Chi-square (P) Cramer's V	0.167 0.292		0.631 0.076		0.631 0.076		0.85 0.03	
Availability of procedure to maintain environmental objectives and targets	Chi-square (P) Cramer's V		**0.01** **0.408**		**0.013** **0.392**	**0.013** **0.392**		0.064 0.293	
Objectives and targets periodically reviewed	Chi-square (P) Cramer's V		**0.02** **0.369**		**0.000** **0.574**	**0.000** **0.574**		**0.003** **0.475**	
Availability of environmental management program	Chi-square (P) Cramer's V	0.071 0.285			**0.012** **0.396**	**0.012** **0.396**		0.156 0.225	
Environmental management practices are documented	Chi-square (P) Cramer's V		**0.000** **0.630**		**0.04** **0.325**	**0.04** **0.325**		**0.000** **0.701**	
Availability of procedure to identify potential accidents and emergency situation	Chi-square (P) Cramer's V	0.256 0.180			**0.000** **0.627**	**0.000** **0.627**		0.066 0.290	
Availability of programs and procedure for conducting periodic environmental audits	Chi-square (P) Cramer's V	0.818 0.036		0.143 0.232		0.143 0.232		0.804 0.039	

Statistical significant correlation: P<0.05
Strong correlation: Cramer's V >0.3

3. Drivers

Lebanese oil and gas companies are willing to adopt ISO 14001 as they are motivated by a reduced operational cost, an improvement in environmental performance and meeting national regulations (Figure 6).

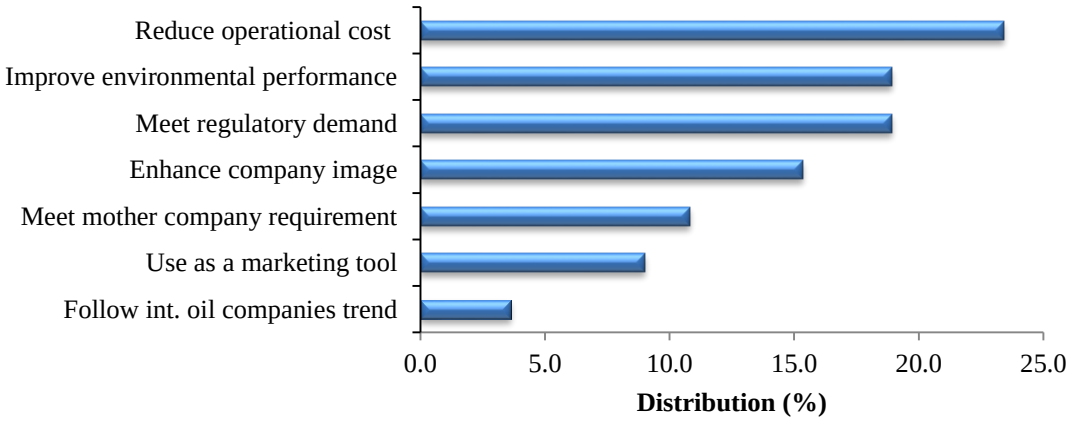

Figure 6. Perceived drivers to adopt ISO 14001 by the Lebanese oil and gas companies

The results of our study are in consistent with previous research (Chin et al., 1998; Gbedemah, 2004; Morrow et al., 2002) that identified cost reduction as the main driver for obtaining ISO 14001 certification. This finding suggest that oil companies are either fully aware of the financial benefits of acquiring ISO 14001 or most probably companies are only driven by projects with financial benefits. In consistent with our findings improving environmental performance was identified as a major driver by many authors (Florida et al., 2001; Flyxell et al., 2002; Morrow et al., 2002). This interesting finding could be attributed to the recent Lebanese waste management crises that increased awareness on sustainable environmental practices among the public. Meet regulatory demand was also perceived as one of the major drivers. This finding reveals that the enforcement of environmental legislation could drive companies to comply with their legal requirement.

The cross tabulations results reveal that international companies tend to perceive the improvement in the environmental performance as a driver to adopt ISO 14001 more prominently than national companies (table 6). This may be attributed to the pressure exerted by mother companies on local subsidiaries to address environmental issues. Oil and gas companies with a HSE department are more driven to adopt ISO 14001 by the improvement of the environmental performance compared to companies without HSE department that are mostly motivated by meeting regulatory demand. The result shows that the existence of a HSE department increase environmental awareness in the company by stressing on the need to improve companies' environmental performance. Companies having ISO 9001 certification are more likely to perceive consistency with Mother Company and enhancing their image as drivers to obtain ISO 14001 compared to uncertified companies. This finding point out the influence of mother companies on their subsidiaries.

Table 6. Significance and strength of correlation between firm's characteristics and drivers to adopt ISO 14001

Drivers	Significance and Strength	Ownership type		Company size		Availability of HSE department		ISO 9001 certification	
		National	MNOCs	Small	Medium	Yes	No	Yes	No
Meet regulatory demand	Chi-square (P)	0.731		0.837			**0.025**	0.558	
	Cramer's V	0.054		0.032			**0.350**	0.092	
Follow international oil companies trend	Chi-square (P)	0.339		0.110		0.408		0.337	
	Cramer's V	0.149		0.250		0.129		0.150	
Enhance company image	Chi-square (P)	0.077		0.422		0.075		**0.005**	
	Cramer's V	0.276		0.125		0.278		**0.438**	
Use as a marketing tool	Chi-square (P)	0.093		0.056		0.079		0.111	
	Cramer's V	0.266		0.303		0.277		0.252	
Consistent with mother company	Chi-square (P)	0.928		0.385		0.418		**0.05**	
	Cramer's V	0.014		0.137		0.128		**0.310**	
Improvement of environmental performance	Chi-square (P)		**0.007**	0.183		**0.042**		0.078	
	Cramer's V		**0.422**	0.208		**0.318**		0.275	
Reduce operational cost and improve profitability	Chi-square (P)	0.215		0.743		0.386		0.322	
	Cramer's V	0.194		0.051		0.135		0.155	

Statistical significant correlation: P<0.05
Strong correlation: Cramer's V >0.3

4. Barriers

Lack of governmental support, lack of top management commitment and the unclear benefits of ISO 14001 are the main barriers preventing companies from adopting ISO 14001 (figure 7).

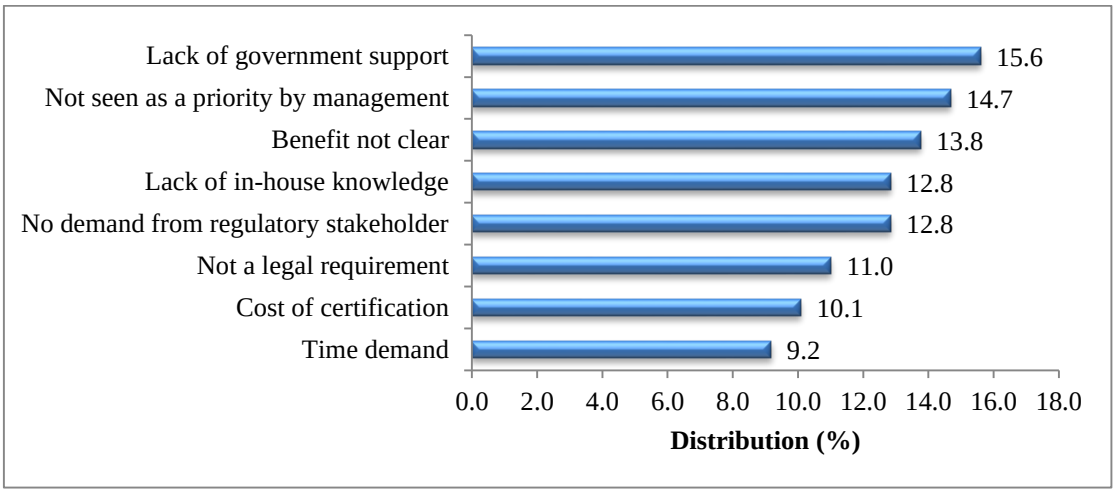

Figure 7. Perceived barriers hindering ISO 14001 adoption by the Lebanese oil and gas companies

The lack of government support and incentives is perceived as the most salient factor that hinders the Lebanese oil and gas companies from adopting the ISO 14001 EMS. This is consistent with previous findings reported in the Lebanese food and

pharmaceutical sectors (Massoud et al., 2009; Massoud et al., 2015). The barrier is not restricted to developing countries, a similar finding confirmed that the lack of cooperation between industry and regulatory agencies in the US accounts for the slow pace of adopting ISO 14001 (Curkovic etal., 2005). According to studies done by Massoud et al. (2009) and Mezher (2000), Lebanon faces many challenges regarding environmental performance, which include ineffective environmental regulations and unsound policies, overlapping roles and responsibilities among authorities and lack of government cooperation towards all economic sectors. This lack of government support includes, but is not limited to, the non-existent basic infrastructure such as improper sewer networks, lack of wastewater treatment plants, inaccessibility to sanitation services and power shortage; as well as the lack of financial incentives.

The results revealed that top management commitment can be a barrier to adopt ISO 14001. In fact, owner or managers of these oil and gas companies are not willing or likely to acquire the voluntary ISO 14001 standard as long as they are not exposed to any regulatory pressure or external demand. The ‘‘uncertainty of outcomes and benefits’’ is also perceived as a major barrier. This may be attributed to the respondent’s lack of knowledge with respect to environmental impacts. Additionally, the lack of professional advice, government support and resources further aggravate the uncertainty and skepticism (Chan, 2008). It is interesting to note that the “cost of certification” was not considered as a major barrier by the Lebanese oil and gas companies. Besides, 40% of the respondents have absolutely no idea or low perception regarding the cost of ISO 14001 (Figure 2). This would indicate that the majority of the Lebanese oil and gas companies are unaware of the real cost of ISO 14001 certification.

The cross tabulation results show that MNOCs find the certification cost and lack of governmental support as the main barriers in front of adopting ISO 14001 while national companies are more hindered by the lack of in-house knowledge. According to research (Bansal et al. 2002; Prajogo et al., 2012) the cost of implementing ISO 14001 EMS is considered significant, since major changes may be required and continuous environmental monitoring is needed in order to comply with the standard. Thus, MNOCs are more aware of this barrier. Moreover, governmental agencies should ensure that effective enforcement of applicable laws and legislations are coupled with financial incentives, education and increased awareness of environmental issues.

Small sized companies perceive the lack of top management commitment and lack of in-house knowledge as barriers to adopt ISO 14001 more significantly than medium sized companies. This could be explained by the fact that all small size companies doesn't have a HSE department thus environmental knowledge is very limited.

The results show that ISO certified companies are more aware of the benefits taken from international certification compared to uncertified companies that perceive the unclear benefits of acquiring ISO 14001 as a barrier to adopt the EMS.

Table 7. Significance and strength of correlation between firm's characteristics and barriers to adopt ISO 14001

Barriers	Significance and strength	Ownership type		Company Size		HSE unit		ISO certification	
		National	MNOCs	Small	Medium	Yes	No	Yes	No
Not a legal requirement	Chi-square (P)	0.380		0.859		0.228		0.791	
	Cramer's V	0.134		0.027		0.184		0.04	
Cost of certification	Chi-square (P)		**0.002**	0.093		0.608		**0.002**	
	Cramer's V		**0.463**	0.256		0.078		**0.467**	
No demand from stakeholders	Chi-square (P)	0.525		0.092		0.382		0.511	
	Cramer's V	0.097		0.257		0.133		0.1	
Lack of governmental support	Chi-square (P)		**0.006**	0.272		0.206		**0.003**	
	Cramer's V		**0.416**	0.167		0.193		**0.451**	
Benefits not clear	Chi-square (P)	0.211		**0.008**		0.285			**0.023**
	Cramer's V	0.191		**0.406**		0.163			**0.347**
Lack of in-house knowledge	Chi-square (P)	**0.045**		**0.021**			**0.022**	0.511	
	Cramer's V	**0.306**		**0.352**			**0.349**	0.1	
Not a top management priority	Chi-square (P)	**0.026**		**0.018**			**0.001**		**0.015**
	Cramer's V	**0.339**		**0.362**			**0.507**		**0.0372**
Time demand	Chi-square (P)	0.539		0.443		0.149		0.866	
	Cramer's V	0.094		0.117		0.220		0.026	

Statistical significant correlation: P<0.05
Strong correlation: Cramer's V >0.3

5- Incentives and supporting organizations

The top three organizations, as listed in figure 8, perceived to support Lebanese oil and gas companies to adopt ISO 14001 EMS standards and acquire the certification are:

1. Ministry of Energy and Water (MoEW) (33.7%)
2. Ministry of Environment (MoE) (30.8%)
3. Ministry of Industry (15.4%)

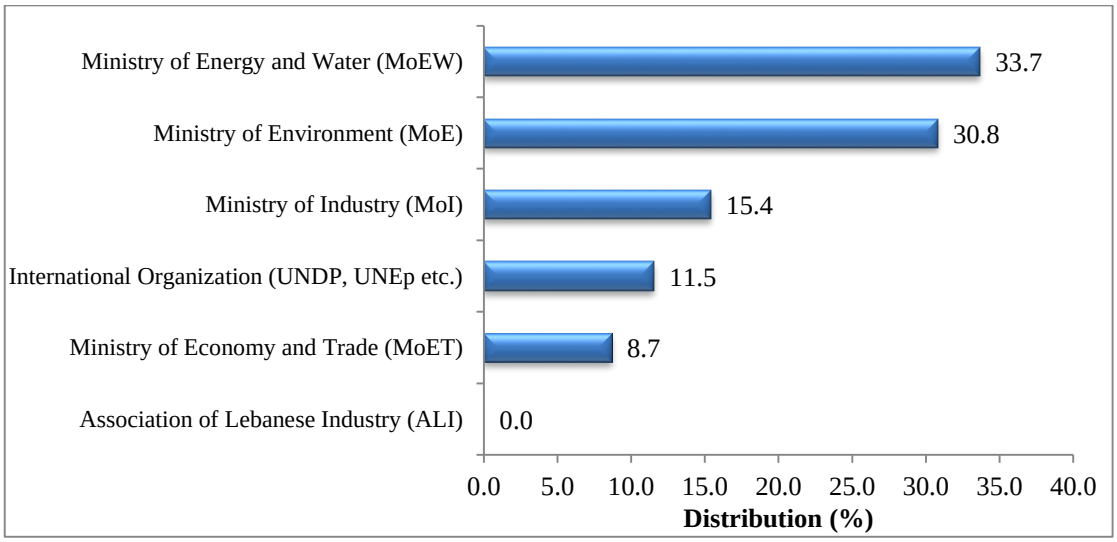

Figure 8. Organizations best perceived to support adopting ISO 14001

Given their formal and direct role in the sector, MoEW, MoE and MoI were identified as the key organizations to support oil and gas companies in adopting ISO 14001 EMS. However no serious encouragement to adopt EMS has been initiated from ministries. Moreover the lack of information in the public sector, the overlapping responsibilities among concerned ministries and the low coordination and communication between relevant stakeholders hinders the development of these initiatives. Moreover, the companies lack the technical know-how and the expertise for developing such programs. For these reasons an appropriate approach aiming to provide the necessary environmental knowledge, as well as the technical and financial assistance should be developed. Such approach should be provided in coordination with the MoEW, MoE and MoI.

Companies were mostly incentivized to adopt ISO 14001 (figure 9) by:

1. Establishment of regulations and policies to encourage adopting ISO 14001 24%
2. More collaboration programs between private and public sector 23.1%
3. Enhancing knowledge on ISO 14001 and its environmental, social and economic benefits (19.2%)

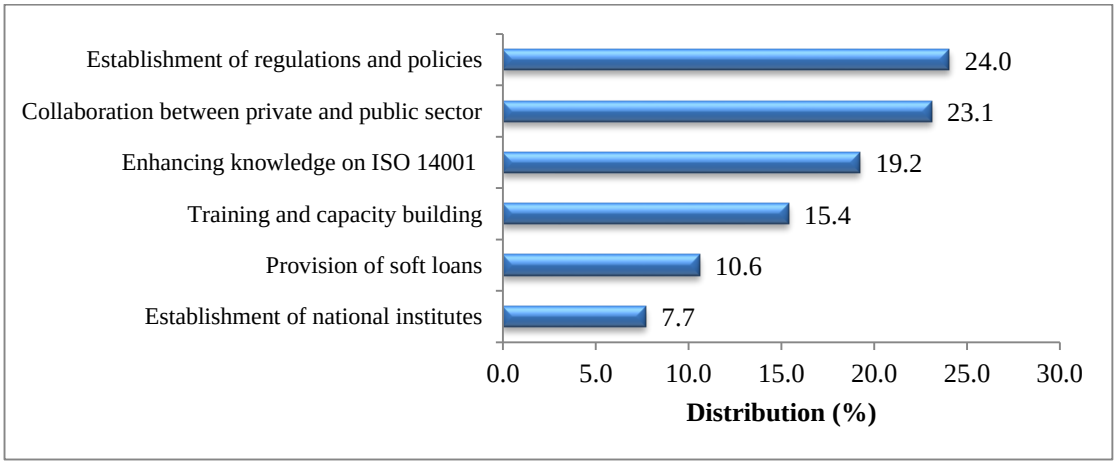

Figure 9. Perceived incentives to assist the Lebanese oil and gas companies adopt ISO 14001

The establishment of regulations and policies was perceived as an external incentive that would encourage the Lebanese oil and gas companies to adopt ISO 14001 EMS. This might indicate that ISO 14001 EMS would not be considered in the Lebanese oil and gas sector unless there is some kind of mandatory requirements (e.g. enforcement of laws and regulations) for improved environmental performance. In fact, as stated by several stakeholders, Lebanese government is planning to impose the adoption of EMS by the oil and gas companies. However, this obligation should be coupled with many incentives provided by the government in terms of financial, education, research and improved awareness on environmental issues.

Companies perceived financial incentives resulting from collaboration between public and private sector as an incentive to adopt ISO 14001. In fact, financial incentives were considered to be a great motivation for companies, as several institutes stated that they would greatly welcome a decrease in governmental taxes.

Enhancing knowledge was also perceived as an incentive to adopt ISO 14001. This may be attributed to the general lack of awareness in environmental issues among oil and gas companies.

The cross tabulation results (table 8) reveal that national companies perceive training and capacity building as an incentive to adopt ISO 14001 more strongly than MNOCs. However, MNOCs perceive more the provision of soft loans and the establishment of national regulations as incentives to adopt ISO 14001 than national companies. Companies with HSE departments are more incentivized by enhancing knowledge and provision of soft loans compared to companies without HSE unit. Hence, the provision of soft loans could be an option to promote ISO 14001 in MNOCs or companies having a HSE department. Moreover, enhancing knowledge and

establishment of regulations were both predominately perceived as incentives to ISO 9001 certified companies.

Our findings entail that institutional incentive factors (i.e. establishment of regulations to promote ISO 14001 EMS, collaboration programs between public and private sector and establishment of national institution) are perceived as the main incentives needed to promote ISO 14001 in the Lebanese oil sector. Thus, Lebanese government should work on strengthening human and institutional capacity through a combination of training, technical assistance, and public awareness programs. Moreover, government's strategy needs to be based on assisting companies and helping them interpret the standard, write documentation and conduct audits. Additionally, educational campaigns targeting the user and promulgating the impacts of environmental problems, and the necessity for conservation, should be established.

Table 8. Significance and strength of correlation between firm's characteristics and incentives to adopt ISO 14001

Incentives	Significance and strength	Ownership type		Company Size		HSE unit		ISO certification	
		National	MNOCs	Small	Medium	Yes	No	Yes	No
Enhance knowledge	Chi-square (P)	0.149			**0.002**	**0.08**		**0.020**	
	Cramer's V	0.220			**0.468**	**0.401**		**0.355**	
Training and capacity building	Chi-square (P)	**0.026**		0.207		0.834		0.303	
	Cramer's V	**0.339**		0.192		0.032		0.157	
Establishment of national institute	Chi-square (P)	0.459		0.351		0.620		0.839	
	Cramer's V	0.113		0.142		0.076		0.031	
Provision of soft loans	Chi-square (P)		**0.036**	0.335		**0.05**		0.957	
	Cramer's V		**0.319**	0.147		**0.426**		0.008	
Collaboration between private and public sector	Chi-square (P)	0.451		0.759		0.864		0.633	
	Cramer's V	0.115		0.047		0.026		0.073	
Establishment of regulations	Chi-square (P)		**0.019**	0.146		0.146		**0.001**	
	Cramer's V		**0.357**	0.222		0.222		**0.503**	

Statistical significant correlation: P<0.05
Strong correlation: Cramer's V >0.3

C- Challenges and prospects of the oil and gas sector

1. Environmental Challenges

Stakeholders stressed on the fact that environmental impacts from oil and gas production activities are broad, diverse and spread on all the oil and gas production process. The main risks that were identified by the various stakeholders are summarized in table 2. Water pollution, impacts on aquatic life, air pollution, oil leakages and spills were the most perceived impacts from the development of the upstream sector. Research shows that offshore exploration in developing countries has led to similar consequences (Seth, 2014; Gabaldón, 2013; Ogele, 2016). Moreover, stakeholders were only concerned with the direct impacts from the oil production activities. Indirect impacts such as impact on tourism were rarely invoked. Knowing that tourism is considered a major source of revenue to the Lebanese government then neglecting such aspect might be explained by the fact the government is not considering the integrated picture when assessing environmental impacts.

Additionally, inadequate environmental knowledge could be regarded as an environmental threat among several stakeholders. Several interviewees stated that their knowledge regarding the sector is rather limited. A key example is that the process of decommissioning the oil rig was rarely referenced as an environmental concern by interviewees although it is considered as one of the most environmentally challenging part in the upstream petroleum industry. In fact, most developing countries pay little or no attention to the decommissioning of oil and gas facilities (World Bank, 2010). This could be explained by the fact that government effort is directed at granting approval to proceed with oil and gas projects than to considering the long-term impacts and costs of these projects.

Stakeholders also agreed that the development of the upstream oil and gas sector in Lebanon will have a certain negative impact on the country's environment. Moreover, in order to detect, quantify, and control these impacts an environmental baseline assessment should be done and documented as recommended by the Strategic Environmental Assessment that was performed 5 years ago, in coordination with the LPA. This was also reflected by the literature (UNEP, 1997) and by one of the major stakeholders involved in the environmental monitoring process:

"The first thing that is needed is the formation of a baseline, whereby the state of the environment is compared to certain numerical values. For example, the amount of heavy metals in the water or the amount of particulates present in the air before and after any operation begins need to be documented. Consequently, we need to establish a baseline by which we can continuously compare the conditions of our environment."
However, conducting similar analysis is very technical and requires huge financial investments that are not so far met in Lebanon.

Table 9. Environmental risks of oil and gas production activities

Risks	APIC	CD	IRI	LIBNOR	LPA	MoEW	MoE	MoF	RRU	MoI	MoPW
Water pollution and impacts on aquatic life	√	√	√	√	√	√	√	√	√		√
Air pollution from green house gases emissions, acid rains etc..	√	√	√	√	√	√		√	√		√
Oil leakage and spills	√	√	√		√	√		√			
Hazardous waste production and improper waste management practices		√	√	√	√						
Natural resources consumption and utilization			√	√							√
Global warming		√	√								
Impacts due to political / geopolitical risks		√								√	
Impact due to weak environmental laws enforcement		√					√			√	√
Soil pollution		√	√								
Noise pollution					√						
Exposure to Naturally Occurring Radioactive Materials					√						
Impacts on tourisms					√						

Several stakeholders however, cited the possibility that the petroleum sector could yield a positive impact on our environment. It was argued that the fact that newly developed legislation concerning offshore oil exploration is being implemented, a knock-on effect is being created. This contradicts what was suggested in the literature (World bank, 2010) that countries with weak environmental regulatory system might transfer this deficiency to the upstream sector, once initiated and not the opposite. One

of the interviewees argues that the Lebanese government has in recent years began improving its environmental efforts within the sector in a bid to attract foreign investors within the field.

2- Environmental Management System

The stakeholders agreed that an EMS should be a requirement in the petroleum industry. Several interviewees believed that the major benefit derived from an EMS is that companies would be increasingly scrutinized, since several of the interviewed representatives believed that the government is incapable in its current state to properly monitor petroleum companies. In fact several stakeholders (such as the LPA, IRI, and MoE) stated that offshore operators are obligated to adopt an environmental management system, however, the installed EMS need not be the ISO 14001 and could be based on a different program such as that of the API. In consistent with our findings, EMS can help facilities ensure that their management practices conform to environmental regulations (Nicole et al., 2012). However, different types of EMS are related to varying type of environmental outcomes. Thus obtaining an EMS founded on ISO 14001 certification was associated with stronger environmental performance compared to other type of EMS (Nicole et al., 2012) such that of the API.
Other than being scrutinized, interviewees reflected that an EMS could be a tool to both ensure that laws and regulations are properly implemented and that a pro-active risk management approach is implemented. Table 2 represents the perceived benefits of the implementation of an environmental management system.

Moreover, relying only on voluntary approach in environmental regulation is considered a risky approach in country like Lebanon where environmental monitoring and enforcement are inexistent. Hence, the likelihood of success depends on the design

and deployment of the initiatives. Therefore, for a successful implementation of an EMS, the Lebanese government should ensure the following:

- A constant regulatory pressure for improved environmental performance.
- Availability of monitoring and enforcement mechanism with adequate penalties for noncompliance.
- Transparency by disclosing information about pollution and abatement options to firms and the public at large.

Table 10. Benefits of implementing an environmental management system

Benefits of EMS	APIC	CD	IRI	LIBNOR	LPA	MoEW	MoE	MoF	MoI	MoPW
Companies abide by the rules	√	√			√	√		√	√	√
Better risk management approaches				√			√	√	√	
Companies constantly monitored		√			√				√	√
Enhance company's image	√		√			√			√	
Decrease pollution	√			√		√				
Increase competition between companies	√			√				√		
Continual Improvement				√	√					
Decrease conflict of interest				√	√					
Improve the quality of the product		√							√	
Increase consumer trust	√									
Achieve sustainable development				√						
Improve workers health						√				
Better documentation									√	

3- Non-environmental benefits of developing the oil and gas sector

The stakeholders were able to point out several non-environmental benefits derived from the development of the oil and gas sector in Lebanon. Financial and economic benefits, diversification of income, reduce fuel import, and decrease the country's debts were among the most perceived benefits of developing the oil and gas

sector in Lebanon (table 3). In fact, with a hefty amount of debt and a complete dependency on oil imports for energy production, Lebanon is in desperate need for a source of income.

Moreover, consistently with our findings, Venables, 2016 has proved that significant financial impacts are foreseen after the extraction of oil and gas in developing countries. However oil wealth combined with a weak economy and poor governance was turned into what has been called the "resource curse": "*an extensive destruction of economic, social, and political structures, including the undermining of a country's institutional setup, leading to poverty rather than development.*" (Ross, 1999). Thus, countries with weak pre-existing institutional capabilities and already alarming levels of pre-discovery corruption are at higher risk of falling into the oil–corruption trap. Consequently, knowing the high level of corruption in Lebanon, government is highly advised to focus on maximizing transparency and accountability in the overall oil and gas sector.

Table 11. Benefits of the development of the upstream oil and gas sector in Lebanon

Non-Environmental Benefits	APIC	CD	IRI	LIBNOR	LPA	MoEW	MoE	MoF	RRU	MoI	MoPW
Financial and economic benefits	√	√		√	√	√	√	√	√	√	√
Diversification of income / source of income	√	√		√	√	√	√		√		√
Reduce fuel import	√	√		√				√	√		
Decrease the country debts		√					√	√		√	√
Source of funding for other sectors (infrastructure, industrial, agriculture, educational etc.)					√	√	√	√		√	
Improve social-well being						√	√	√		√	√
Increase the availability of energy including electricity	√				√	√		√			
Stabilize the political situation		√					√	√			
Reduce fuel cost	√		√								√
Ensure sustainable development							√	√			
Increase tourism						√		√			
Attract foreign investors	√							√			
Immigration reduction						√		√			

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

A- Conclusion

- Lebanon is experiencing regulatory failure in environmental governance of the oil and gas sector. Effective environmental regulations are completely lacking due to limited capacity of public organizations, lack of accountability, absence of suitable environmental monitoring programs, presence of conflict of interest and inadequate distribution of tasks among Lebanese governmental institutions.

- MoE was identified as the public enterprise that is primarily concerned with auditing the environmental practices of oil and gas companies. However, the limited capacity of the MoE, the large number of stakeholders involved in the sector, and the vagueness of the Lebanese environmental legislation, have prevented the ministry from properly performing its duties, diminished its authority, and resulted in a deficiency in the sector's environmental governance.

- The majority of the oil and gas companies consider that their environmental impacts are negligible. Moreover, the lack in the government ability to enforce environmental regulations has diminished the implementation of environmental liabilities in these companies. Such practices presents a potential threat to public health and to the environment.

- There exists a common misconception between environmental, safety and quality management practices. Considering that health, safety and the environment have much in common, they are being considered collectively, in oil and gas companies, largely at the expense of environmental issues.

- Lebanese oil and gas companies are willing to adopt ISO 14001 EMS as they are motivated by a reduced operational cost, an improvement in environmental performance and meeting national regulations.

- Lack of governmental support, lack of top management commitment and the unclear benefits of EMS are the main barriers preventing companies from adopting EMS such as ISO 14001.

- Institutional incentive factors (i.e. establishment of regulations to promote ISO 14001 EMS, collaboration programs between public and private sector and establishment of national institution) are the most salient incentives needed to motivate oil and gas companies to adopt the ISO 14001 EMS unlike economical and organizational factors.

- The development of the upstream oil and gas sector will have direct impacts (water pollution, impacts on aquatic life, air pollution, oil leakages and spills) and indirect impact (impact on tourism, global warming etc.) on the Lebanese environment. These impacts might be amplified by the weak regulatory regime and the lack in environmental knowledge among public authorities.

- The adoption of EMS will guarantee that oil and gas companies are increasingly scrutinized. EMS can help companies ensure that their management practices conform to environmental regulations.

- Financial and economic benefits, diversification of income, reduce fuel import, and decrease the country's debts were among the most perceived non-environmental benefits of developing the oil and gas sector in Lebanon.

B- Recommendations

- There is need to review, update, improve and enforce the environmental legislation governing the sector.

- The role of the MoE should be strengthened by setting a clear definition of the responsibilities of the MoE and other stakeholders in monitoring, auditing and inspecting the oil and gas sector.

- Government and companies are preferred to establish a separate program to address environmental issues since the emphasis placed on health and safety overwhelm environmental considerations.

- Developing and enforcing a convenient regulatory framework along with strengthening human and institutional capacity are key steps toward realizing effective environmental management practices in the oil and gas sector.

- Lebanese government is highly advised to focus on maximizing transparency and accountability in the overall oil and gas sector.

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APENDIX

SURVEY QUESTIONNAIRE

Interviewer Initials				**Questionnaire Serial #**		
Interviewer #						

I. General Information:

Section	**Question**	**Answer**	**Code**
GI1	What is your organization's ownership type?	National corporation	1
		International corporation	2
GI2	What kind of service does your organization provide?	Oil Storage/ Distribution	1
		Gas storage / distribution	2
		Both (oil and gas)	3
GI3	Does your organization have an environmental unit/department or designated staff to deal with environmental matters?	Combined HSE unit	2
		Yes	1
		No	0
GI4	What is the number of employees?	Less than 20	1
		Between 20 and 50	2
		More than 50	3
GI5	How much is average volume of the oil product handled by year?		
GI6	What are the companies' Years of operation?		

II. Environmental Performance and Sustainable Development:

Section	**Question**		**Answer**	**Code**
EPSP1	Do you think that your operation activities have negative impacts on the environment?		Yes	1
			No	0
			No idea	2
EPSP2	Have your organization taken any initiatives to improve its environmental performance?		Yes	1
			No	0
EPSP3	If yes, when was the date of the last environmental initiative taken by your company?		Current year	1
			Last year	2
			More than 1 year	3
EPSP4	If yes, please specify the type of initiative taken?			
EPSP5	Do you feel that the oil and gas industries' located in Lebanon lag behind their counterparts (i.e. oil and gas industry of similar size and sector) in other parts of the world on environmental issues?	European Union	Yes	1
			No	0
			No idea	2
		Middle East	Yes	1
			No	0
			No idea	2
EPSP6	Do you feel that the current environmental		Yes	1

	performance of the current Lebanese Oil and Gas companies could be a barrier towards environmental sustainability?	No	0
		No Idea	2
EPSP7	Please Rank your familiarity with one or more of the following international management systems	ISO 9001: 2008 [Quality Management System]	1
		ISO 14001: 2015 [Environmental Management System]	2
		OHSAS 18001 [Occupational Health and Safety Management System]	3
		ISO 50001 [Energy Management System]	4
EPSP8	Has your organization acquired one or more of these certifications?	ISO 9001	1
		ISO 14001	2
		OHSAS 18001	3
EPSP9	If not, do you have any plans in the future to apply for any of the above certification?	Yes	1
		No	0
		No idea	2
EPSP10	In case your organization decides to apply for any of these certifications in the future, please specify which one of these management systems you might consider pursuing.	ISO 9001	1
		ISO 14001	2
		OHSAS 18001	3
EPSP11	Do you think that current national regulation, policies or programs are sufficient to persuade or support your organization to acquire the ISO 14001 certification?	Yes	1
		No	0
		No idea	2

III. Environmental Practices

Section	Question	Answer	Code
EP1	Is there an environmental policy at your company, which is identified as such and documented?	Yes	1
		No	0
		No idea	2
EP2	Does the policy provide a framework for setting and reviewing environmental objectives and targets?	Yes	1
		No	0
		No idea	2
EP3	Is there a practice or procedure to communicate the policy to all employees, existing and new?	Yes	1
		No	0
		No idea	2
EP4	Is there a procedure to identify environmental aspects	Yes	1

	of activities, products and services?		No	0
			No idea	2
EP5	Does this procedure provide a method to quantify the environmental impacts of the environmental aspects?		Yes	1
			No	0
			No idea	2
EP6	Is it ensured that the aspects having significant impacts are considered in setting environmental objectives?		Yes	1
			No	0
			No idea	2
EP7	Is there a procedure to identify all the new implemented governmental environmental legal requirements?		Yes	1
			No	0
			No idea	2
EP8	Are there established and maintained environmental objectives and targets?		Yes	1
			No	0
			No idea	2
EP9	If yes can you specify the latest 3 objectives or targets			
EP10	Can you please rank the following issues from the most to the least important when setting the environmental objectives and targets? (multiple answers could be selected)		Legal requirements	1
			Environmental impacts	2
			Technological options	3
			Financial requirements	4
			Operational Requirements	5
			Business requirements	6
			Views of interested parties	7
EP11	Are these objectives and targets periodically reviewed and revised or updated?		Yes	1
			No	0
			No idea	2
EP12	Is there an environmental program developed for each objective and target?		Yes	1
			No	0
			No Idea	2
EP13	When there is a project involving new developments or new or modified activities, products or services, does the company consistently amend such programs where relevant to ensure that environmental management applies to that project?		Never	1
			Sometimes	2
			Always	3
EP14	Does management consistently provide resources essential to the implementation and control of the EMS?	Human resources	Never	1
			Sometimes	2
			Always	3
		Technology	Never	1
			Sometimes	2
			Always	3
		Financial	Never	1
			Sometimes	2
			Always	3
EP15	Does the company require that all personnel whose work may create a significant impact on the environment have received appropriate training?		Yes	1
			No	0
			No idea	2
EP16	Has the company established an environmental		Yes	1

	communications procedure relating to its environmental aspects?	No	0
		No idea	2
EP17	Are the environmental management practices documented in paper or electronic form?	Yes	1
		No	0
		No idea	2
EP18	Has the company established a procedure to identify potential accidents and emergency situations that may have an impact on the environmental?	Yes	1
		No	0
		No idea	2
EP19	If yes can you give an example of accident and emergency situation?		
EP20	Has the company established procedures to monitor and measure on a regular basis the key characteristics of its operation and activities that can have a significant impact on the environment?	Yes	1
		No	0
		No idea	2
EP19	Are there procedures for identification, maintenance and disposition of environmental records, including training records, results of audits and reviews, etc?	Yes	1
		No	0
		No idea	2
EP20	Are there programs and procedures for conducting periodic environmental audits?	Yes	1
		No	0
		No idea	2
EP21	If yes can you specify the frequency of these audits?		

IV. Drivers and Benefits to Adopt ISO 14001

Section	Question	Answer	Code
DBA 1	Please select the three (3) most perceived relevant drivers or benefits for your institution to obtain the ISO 14001 EMS certification from the list below	Meet regulatory demand	1
		Follow international oil companies trend	2
		Become competitive through enhancing company image recognition	3
		Use as a marketing tool	4
		Consistent with mother company corporate ethics / requirement	5
		Improve environmental performance	6
		Reduce operational cost and improve profitability	7

V. Barriers to Adopt ISO 14001

Section	Question	Answer	Code
BA1	What is your perception regarding the level of difficulty to obtain ISO 14001 certification?	Easy	1
		Medium	2
		Difficult	3
		No idea	4
BA2	What is your perception regarding the level of financial cost to obtain ISO 14001 EMS certification?	Low cost	1
		Medium cost	2
		High cost	3
		No idea	4
BA3	Please select the three (3) most relevant barriers that prevent your institution from adopting ISO 14001 EMS certification from the provided list:	Not a legal requirement	1
		Cost of ISO 14001 certification	2
		No demand from regulatory stakeholder	3
		Lack of government support and incentives	4
		Benefit for acquiring ISO 14001 certification are not clear or justifiable	5
		Lack of in-house knowledge / skills / resources	6
		Not seen as a priority by management / owner	7
		Time demanding to acquire certification	8

VI. Incentives to Adopt ISO 14001

Section	Question	Answer	Code
IA1	Please select the three (3) most relevant factors that would support your institution to acquire ISO 14001 EMS certification:	Enhancing knowledge on ISO 14001 and its environmental, social and economic benefits	1
		Training and capacity building	2
		Establishing national for technical advice and consultants services	3
		Provision of special soft loans to institutions that are planning to implement ISO 14001	4
		More collaboration programs between government body and educational institutions (e.g. workshops, greening courses)	5
		Establishment of regulations and policies to encourage adopting ISO 14001	6
		Others, please specify	7
IA2	Please select the three (3) most relevant governmental bodies, institutes or organizations that would likely be the most suitable to support your institution quest to acquire ISO 14001 EMS certification?	Ministry of Environment (MoE)	1
		Ministry of Energy and Water (MoEW)	2
		Ministry of Industry (MoI)	3
		International Organization (UNDP, UNEp etc.)	4
		Association of Lebanese Industry (ALI)	5
		Ministry of Economy and Trade (MoET)	6