Environmental Performance: Drivers and Measures

A Case Study of Ras Lanuf Oil Company

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Abstract

The purpose of this study is to shed light on the reality of the experience of measuring environmental performance as experienced by one Libyan oil and gas company. The aim of the exploratory case study is to extend prior empirical research by investigating possible drivers of the adoption of ISO 14001 EMS and measures of environmental performance amongst managers in RASCO.

The exploratory single case study methodology was adopted since a case study provides a deeper understanding of the nature of management practice, especially when the issues under investigation have not yet been studied. To achieve this, method of data collection was conducted, namely, questionnaire,. Qualitative methods of data analysis, namely, descriptive analysis was adopted.

The study findings revealed that environmental performance measurement at RASCO is still in its infancy and has obvious teething problems, such as setting indicators for measuring environmental performance since it difficult to quantify**.** It appears that the process of measuring environmental performance is still in the development stage since there is insufficient information about EPIs due to ISO 14031 EMS unknown in RASCO. The study found that the most important drivers to adopt ISO 14001 EMS in RASCO are to follow international oil and gas sector trends, to enhance RASCO's image, and to improve its environmental performance.

Keywords: Environmental performance, Environmental performance measurement, Environmental Management System, Environmental performance indicator.

1. Introduction:

Companies spend large amounts on environmental costs and have to respond to environmental issues. Some companies obtain environmental standards such as ISO 14001 and Eco-Management and Audit Scheme (EMAS) certifications; others use them as a major management tools to achieve their environmental performance due to the pressures for companies to act and adopt strategic environmental practices (Wagner, 2003; Sumiani et al., 2007).

2.1 Research Aim, Objectives and Questions:

The purpose of this study is to extend prior empirical research by investigating possible drivers of the adoption of ISO 14001 EMS in RAS LANUF OIL & GAS PROCESSING COMPANY (RASCO). In other words, the aim of this study is to investigate drivers and measures of environmental performance in RASCO.

In order to satisfy this aim two objectives are identified as the following:

1- To identify the motivational factors that drives the adoption of Environmental Management System (EMS) in RASCO.

2- To identify the current state of environmental practices for measuring environmental performance within RASCO.

In order to meet these two objectives, the following specific research questions were investigated:

1- What are the factors which influence Environmental Management System (EMS) adoption in RASCO?
2- Why and how is the environmental performance of RASCO determined and measured?

3.1 Importance of the Study:

this study is important for several reasons. Firstly, this study extends environmental performance studies in academic accounting and management research in a developing country. This extension allows scholars to compare results from other countries,

especially developing countries, with the results found in developed countries. Secondly, the examination of the study can provide insights into the field of corporate environmental performance, investing particularly in oil and gas companies. The current study can encourage oil companies to certify their EMS at ISO 14001 standard and inform them about the benefits of implementing EMS compliant with ISO 14001 standards and convince them to implement such systems.

4.1 Research Methodology and Method:

The choice of the exploratory case study method comes from the research questions and the fact that a case study is appropriate when searching for answers to 'why', 'how' and 'what' questions. Also, when the focus is on contemporary phenomena, a case study can explain the causal links in real-life situations. In these circumstances, a case study is considered the most appropriate research method (Yin, 1994). This study covered a single case study regarding a refining and manufacturing company in the oil and gas sector in Libya.

The methods of data collection was questionnaires these were distributed only to the heads of divisions in the case company;

5.1 Scope of the Study:

This study has a number of boundaries. Some important aspects are necessary to state to understand the boundaries of this study. First, the major field of this study is linked to environmental performance. Second, it is limited to the oil and gas industry, specifically, in the context of the ISO-certified industry in a Libyan petrochemical company (RASCO). Third, this study applies a single case study analysis to the data in order to address the questions of the study and to identify possible factors influencing the adoption of EMS such as ISO 14001 by RASCO. Fourth, previous studies were conducted in developed countries, namely U.S.A, EU and Australia and in different industries, but this study is applied to a developing country, namely Libya. Fifth, this study does not compare Environmental Performance Measurement (EPM) in developed countries with developing countries. In contrast, the current study was conducted within one country, one industry, one company, and in one cultural setting in the Libyan oil and

gas sector. Sixth, the time period investigated was after 2007, when RASCO was awarded ISO 14001 certificate. Questionnaires were distributed only to the heads of divisions in the case company in March 2019. Seventh, this study considers the measures of environmental performance from the perspective of quality (the total quality of environmental performance) and from the perspective of internal management tool. Eighth, this study is concerned with environmental performance, especially its drivers and measurement from pragmatic viewpoint and only discusses the use of indicators such as those derived from the model of Freedman and Jaggi (1992). Therefore, measurement techniques such as accounting and financial are not considered.

2. Theoretical Framework and Previous Studies:

2.1 Historical Background:

Drivers of the Adoption of ISO 14001 EMS:

In the latter half of the 1990s, ISO 14001 adoption was attractive to many companies in the world especially in Japan (Nishitani, 2009). Although ISO 14001 compliance is not legally required, ISO 14001 has been adopted by numerous companies due to its external and internal advantages. The fact that ISO 14001 is the most recognised EMS certification in the world provides a strong and well-recognised signal to stakeholders of the company's commitment to environmental management. This is considered as an external advantage, whereas the internal advantage of ISO 14001 is that it brings achievement of environmental objectives and cost reductions, since it reduces environmental impact and improves aspects such as operational efficiency and effectiveness (Boiral and Sala, 1998; Rondinelli and Vastag, 2000; Bansal and Bogner, 2002; Jiang and Bansal, 2003; Nishitani, 2009; Rotterdam 2012).

The drivers for ISO certification can be classified into internal and external drivers. Internal drivers include five items, namely reinforcing the corporate structure, enhancing quality, creating standardized procedures, improving corporate image, and enhancing

management effectiveness. External drivers include four items, namely meeting customer demand, complying with the trend (current thinking), pressure from competitors, and expansion of market share. In addition, the main drivers for ISO certification are improving the corporate system and customer and market demands to promote globalisation of products (Liu and Wu, 2010).

Nishitani (2009) found that the firms of larger size and with lower debt ratios were more likely to adopt ISO 14001. Companies that had higher export ratios, higher proportions of stock held by financial institutions, higher proportions of stock held by other corporations, larger size, and better economic performance were more likely to adopt ISO 14001.

Henriques and Sadorsky (1996) identified various drivers of adopting an environmental plan such as pressure groups, financial status, firm size, and sectoral classifications. Nakamura et al. (2001) examined the determinants of the companies being certified ISO 14001. The results showed that the company size and advertising expenditures play a significant and positive role.

Previous studies have indicated that the stakeholders' environmental pressures and company characteristics are the most common drivers of the adoption of EMS. The literature shows that the company characteristics such as company size are the most important drivers of company adoption EMS such as ISO 14001 (Henriques and Sadorsky, 1996; Nakamura et al., 2001; Nishitani, 2009; Jesús Valero-Gil, et al., 2017). Patten (2002), Adams et al. (1998), Cormier and Magnan (2003), Welch et al. (2002), Nakamura et al. (2001), Hibiki et al. (2003), Arimura et al. (2005), Mori et al. (2008) and Wagner (2014) all have found that firm size has a positive effect on the likelihood of environmental actions. Specifically, with respect to ISO 14001, previous studies have consistently found company size is an important drivers of certification (King et al., 2005; Potoski and Prakash 2005; Mori et al., 2008; Ying Li et al., 2019). In this respect,

some characteristics of the firm such as size influence the firm's environmental behaviour (Motta, 2003).

Mori et al. (2008) have found five constructs to explain the adoption of ISO 14001 certification in Japan: facility size and resources, attitude and perspective, economic benefits and competitiveness, regulation and oversight, and environmental activity. According to Matuszak-Flejszman (2009, p. 412) several reasons for implementing the EMS such as ISO 14001 can be listed as followings:

- care for the environment,
- accepted development strategy of the company,
- development guidelines for the quality management system in use,
- influence of any third parties on the activity of the company,
- possible growth in exports of company products,
- compliance with legal requirements,
- raising pro-ecological awareness of the employees,
- interest of the local community in the activity of the company,
- improving environmental impact,
- planning to increase market share.

3.7 Drivers of Environmental Performance Measurement:

Various empirical studies in the economics literature offered a better understanding of the key determinants of environmental performance and as well as a company's environmental behaviour. These determinants reflect both internal and external pressures that drive companies to improve their environmental performance (Sangle, 2010). Empirical studies have identified the determinants of environmental performance as follows:

1- government regulation and the public (local communities);
2- financial markets and consumer markets;
3- involvement of the company's higher level management;

4- environmental education of employees.

Several different drivers for companies to adopt EMS have been recognized in the previous studies. The drivers are divided into two groups, institutional drivers and performance drivers which in turn are divided into economic/competitive drivers and ethical/environmental drivers. From the review of the literature it seems there is prevalence of economic drivers over environmental performance.

First, concerning EMS and economic performance, (Schaefer, 2007, p. 519) states there is "an economic benefit from having ISO certificate as large number of customers demanded it and it is necessary when bidding for competitive contracts". With environmental performance, if there is no environmental culture in the company, EMS will not improve environmental performance and environmental performance would have improved by changing people's attitudes.

Secondly, on the issue of EMS and legitimacy, the positive image, external legitimacy and recognition can be gained from having a good environmental reputation is related to environmental management. For internal legitimacy, institutional factors are, in fact, more prevalent and more important in the adoption of EMS and standards. Thus, Institutional force shapes the adoption of management innovations (Schaefer, 2007). .

In general, there are number of factors driving companies towards environmental management. Roome (1992 cited in Hocking and Power, 1993) has suggested a number of factors which may drive a company toward environmental management. These factors include internal management objectives, external reporting, marketing and compliance with legislation. In specific, there are certain factors which make companies concerned about environmental issues; there are several reasons which make companies care about measuring their environmental performance from both business and economic policy perspectives (Azzone et al. 1996; Tyteca, 1997; Young, 1998a):

- companies are subject to strict environmental legislation (external constraint);
- companies realise the benefits of being proactive;
- companies realise that a better brand image will be obtained in terms of environmental performance;
- companies recognise that there will be regulatory risk, market risk and stakeholders risk if they do not take any proactive actions on the environment;
- companies are under pressure (from public opinion and regulators) to quantify their environmental performance;

James and Bennett (1994) classified five drivers, namely: sustainable development; buyers; employees' company; and financial and non financial stakeholders. Drivers of environmental performance measurement can be divided into external and internal drivers. External drivers are legislation, international standards, customer requirements, shareholder concerns, attracting investment, pressure from consumers and the supply chain, pressure from environmental groups and associated media influence. On the other hand, internal drivers are monitoring improvement, management expectations, employee and community concerns, making business decisions and setting priorities (Bennett and James 1994; Steger, 1996). The drive to measure corporate environmental performance is the product of several factors, in particular compliance with legislation, image and reputation enhancement and stakeholder pressure (Ramos et al., 2007). Additionally, customer requirements drive environmental measurement Wells et al. (1992, p. 315) stated that "we do not measure for the sake of measuring; we measure because the customers we serve- internal customers, end customers, host communities, regulators, or stockholders- demand environmental performance".

The Importance of Environmental Performance Measurement (EPM):

The purpose of measuring environmental performance is to understand its impacts on the environment. Some authors have pointed out the importance of environmental performance measurement as follows: "environmental performance measurement can

provide the tools to study the effectiveness of environmental regulation and taxes from an economic policy viewpoint to improve the quality of the environment" (Young, 1998a, p. 150). The information derived from environmental performance measurement can provide policy makers with meaningful guidelines (Tyteca, 1996). The measurement and monitoring of environmental performance is important for controlling a company's compliance with the requirement for continuous improvement of environmental performance (Jacsh, 2000).

Information gained from the measures will lead to the formation of priorities which will deal, primarily, with the worst environmental performance area in the company (O'Reilly et al., 2000). "Measures can be used to monitor a company's progress in reducing its environmental effect" (Young, 1998a, P.172).

Tools of Environmental Performance Measurement (EPM):

There is little available literature on tools for measuring environmental performance in the public sector (Lundberg et al., 2009), compared with the available literature on evaluation of environmental performance in the private sector.

Some companies have adopted certain tools for measuring their environmental performance as a result of the internal and external pressure which has impelled them to improve their environmental performance concerning the production processes and products (Welford and Gouldson, 1993; Azzone and Berteli., 1994; Porter and van der Linde, 1995; Azzone et al., 1996).

There are four environmental performance measurement tools (Welford, 1998; Young and Richard, 1999):

- Framework to select indicators; described by James and Bennett (1994) and ISO 14031. The advantage of this is that the indicators selected relate to the company's individual environmental aspects.

- Different types of indicators; select indicators according to type (physical or efficiency or customer measures).
- Performance measurement frameworks, which include all the company's activities. The advantage of this is that the company does not spend resources and time selecting indicators.
- Mathematical measurement models; difficult for the manager to implement and the complexity of the results may be difficult to communicate.

There are other tools for measuring environmental performance as pointed out in the literature on this subject; for example:

- Contributor measures (process improvement indicators): This is defined by Welford and Gouldson (1993) and Wolfe and Howes (1993), the following are some examples of process improvement indicators: environmental investment, training, management commitment, employee awareness, and systems (Young, 1998a, b).

- External relation measures: The term 'environmental-related performance measurement' which James and Bennett (1994) used includes the measurement of the impact of environmental action beside environmental performance measures, customer perceptions and profitability. Welford and Gouldson (1993) provide examples of measures of external relations performance which translate into three areas: impact measures such as the number of prosecutions; positive measures including public awareness programmes; and risk measures which need to be used in conjunction with contributor, qualitative and quantitative measures.

- Customer satisfaction measure: Wells et al. (1992) addressed three perspectives on environmental measurement: process improvement; environmental results; and customer satisfaction. The latter is an important measure of an effective environmental measurement system.

Azzone et al. (1996) identify how different measures can be aggregated to achieve environmental performance objectives. They define the following: the company's environmental aims; the environmental objectives; the environmental policy; the principles of operational and management activities; and the company's operating procedures and its processes.

Moreover, the BSC can be a tool for measuring environmental performance since it is a valuable tool for linking environmental performance with the strategic performance of the company, and selection and development of EPIs which drive performance toward the company's strategic goals (Johnson, 1998).

Examples of frameworks for evaluating environmental and sustainability performance with particular focus on the company level (profit or not-for-profit, private or public) are to be found in studies conducted by Ramos et al. (2007), Global Reporting Initiative (GRI) (2002), Melo and Pegado (2002), Tyteca et al. (2002), Dias-Sardinha and Reijnders (2001), Wehrmeyer et al. (2001), Bennett and James (1999b), Young and Welford (1998), Epstein and Young (1998), Johnson (1998), Ditz and Ranganathan (1997) and Azzone et al. (1996).

Azzone et al. (1996, p.70) pointed out some limitations of environmental performance measurement as follows: The environmental impact expressed by a number of non-compliance measures (e.g. pollutants, solid wastes, energy consumption and waste water) require distinct measurement units; there is a "lack of clarity in identifying how information should be structured and presented"; and there is "the complexity associated with the measurement of the company's environmental performance".

2.2 Previous studies:

Relevant Previous Studies on Drivers of the Adoption ISO 14001 EMS:

In the early 1990s, there are many studies that have focused on the drivers for adoption ISO 14001 EMS. The findings of the main studies relating to drivers of corporate environmental performance can be summarised in this section.

The following points can be concluded from a review of these previous studies:

First: Many empirical studies analyse the drivers of the adoption of certified EMS such as ISO 14001(Nakamura et al., 2001; Welch et al., 2002; Bansal and Hunter, 2003; Hibiki et al., 2003; Yiridoe et al., 2003; Anton et al., 2004; Arimura et al., 2005; Nishitani, 2009). Most of these studies were conducted at the sector level, and examined the drivers at the sector level, centred on an EMS, whereas very few studies conducted in the public sector examined the drivers at company level.

Second: The drivers of performance management particularly EPM in public companies could be quite different for private companies. Since public companies must provide responses to the needs of society, thus, public companies pursue political and social goals rather than commercial and profit objectives.

Third: In general, the literature introduced knowledge about environmental management. In particular, the literature provided some knowledge on EMS, but it leaves some gaps, one of which is that previous studies have focused on the performance referring to EMS aspects, with less focus paid to institutional factors. Previous studies were based on various theories to examine the drivers of environmental actions. Theories such as economic theory (Nakamura et al., 2001; Arimura et al., 2005), regulatory influence theory (Nakamura et al., 2001; Neumayer and Perkins, 2004).

Empirical Previous Studies on EPM:

As outlined in the previous sections, there are a number of studies which attempt to examine EPM whether directly or by using indicators as a way of measuring environmental performance. Table (1) summarises the relevant prior studies on EPM.

Table (1): Summary of Empirical Previous Studies on EPM

Study	Applied on	Features	Methodology
Metcalf & Williams (1995)	33 companies in utility, paper, consumer products, & chemical	Developing programs to measure environmental performance (benchmark study)	Survey (telephone interview)
Melcalf et al. (1996)	Georgia Power Company	Develop EPM system	A case study (pilot studies)
Tyteca (1997)	U.S. fossil fuel-fired electric utilities	Define standardised, aggregate environmental performance indicators	Three linear programming models
Jung et al. (2001)	39 firms' voluntary EHS reports in petroleum and refining industry.	Addresses EPM and its application	Framework called 'Gscore'
Johnstone, et al (2004)	2000 firms in 9 European countries	Determine the effects of firm characteristics on EMS	Survey/ Logit analysis
Vivian et al. (2005)	377 construction in Hong Kong	Implement performance measurement indicators	Questionnaire survey and interviews
Xie & Hayase (2007)	68 companies from electrical machinery and instrument manufacturing sector in Japan	Develop EPM model for third-party organisation	Questionnaire survey
Styles, et al (2009)	35 pharmaceutical-manufacturing installations & 18 power stations holding IPPC (*)	Applying the Environmental Emissions Index	Database of emissions

	licences in Ireland.		
Lundberg et al. (2009)	Swedish Rail Administration in public sector	Develop EPM framework	A case study, focus group interviews, direct observation and analysis of internal documentation by thematic content analysis (Triangulation).

(*) Integrated Pollution Prevention Control

As can be seen from Table (1), many studies have addressed the measures of environmental performance in Europe and the USA, as well as in Japan. These studies are not consistent in methodology; the focus on EPM was in a broad sense and there is a lack of agreement on what, how and where to measure. Most of the studies were concerned with the 'greening' and 'benchmarking' of the businesses, whereas only a few studies described EPM. Most of the EPE frameworks do not include performance criteria to guide the evaluation process. The previous studies on EPM focus on Operational Performance Indicators (OPIs) such as BOD and TSS (Freedman and Jaggi, 1992; Bennett and James, 1999a).

Moreover, previous studies on EPE showed a variety of specific indicators used to measure performance; there were also differences in the method of data collection and the sources and origin of the information, and a lack of agreement on what, how and where to measure (Azzone and Manzini,1994; Wehrmeyer, 1995; Epstein, 1996; Azzone et al., 1996; Eagan and Joeres,1997; Ilinitch et al., 1998; Thoresen, 1999; Bennett and James, 1999a; Young and Welford, 1999; ISO,1999; GRI, 2000; Kolk and Mauser, 2002; Nawrocka and Parker, 2009). There is confusion between the use of the term 'sustainability' and the term 'environment'. Measuring environmental performance is a difficult task due to the lack of a sufficient set of indicators (Lober, 1996). Methods and tools for EMS in the public sector are still in their infancy and there is a lack of experience and measurement (Lundberg et al., 2009). Companies achieve benefits through adopting EMS in all areas but they have to tailor measures to their own needs.

EPM relies on the accounting system and gathers both external and internal information, some of which is extraordinary information (Eckel et al., 1992). Most of the debate on environmental performance measurement is about standards and how to set environmental indicators for companies (Tyteca et al., 2002).

From reviewing the literature, it can be seen that the drivers of performance management particularly EPM in public companies could be quite different from private companies. Since public companies must respond to the needs of society, they pursue political and social goals rather than commercial and profit objectives (Ramos et al., 2009).

In the literature, environmental performance measurement is provided as a consistent theme of reporting, while some reports include quantitative performance data. The debate in the literature about environmental performance measurement focuses on the standard and process through which environmental indicators may be set up for companies. The analysis of the measurement and reporting of environmental performance of companies is still in its infancy in the literature. The principles of the construction of EPIs have not been described and discussed comprehensively. To date, however, environmental performance as the responsibility of government has not been given sufficient attention in the literature of Libyan studies.

In conclusion, there are no absolute rules on what to measure, and there are no absolute standards for what constitutes good performance or for what objectives to set. The inconclusive results of previous studies are due to the lack of agreement on what environmental performance is or how to measure it.

3. Methods and Procedures:

3.1 Research Methodology:

Qualitative research is defined by Bryman (1995) as an "approach to the study of the social world which seeks to describe and analyse the culture and behaviour of humans and their groups from the point of view of those being studied" (p. 46).

According to Silverman (2006) the nature of the research problem is the most valid reason for doing qualitative research. For instance, the current study attempts to understand real environmental practice, which has difficulties such as how to measure environmental performance and how to discover what motivates people to conduct these measurements; this could only be conducted using qualitative methods.

Qualitative methods can be used to explore an area that has not been studied or about which little is known, for example the subject of EPM in the Libyan context, particularly in the oil and gas sector, was unexplored before this study was conducted.

Therefore, the research approach for the current study is qualitative and pragmatic in nature, and includes a single case study (a Libyan oil and gas industrial company). This allowed the collection of data of sufficient richness to capture significant details about the company's background in general and its EPM in particular.

A qualitative approach was chosen for this study as it is best suited to exploring the underlying attitudes and behaviour of individuals via an open-ended approach. Hence it is appropriate to the current study, which explores the motivational factors for adopting ISO 14001 and the current practice of environmental performance in meeting the requirements of ISO 14001 EMS. Thus, qualitative research is the most appropriate approach for a single case study (RASCO) within the Libyan context since RASCO has a short historical background on environmental performance, which means that very little is known.

3.2 Research Design (Case Study):

Since there is no absolute method that is suitable for all research (Denzin and Lincoln, 1998), the selection of methods depends on the nature of the research, data collection and the research objectives (Bailey, 1982).

To answer the research questions of the current study and to meet its objectives, this study employs the following research strategy, which is a single exploratory case study**.** The case study is considered essential in building up a comprehensive understanding of environmental performance measurement tools within the context of the oil and gas/ petrochemical industry, the subject of the current study. In other words, it will provide the answers to the how and what research questions that led the researcher to adopt a single case study.

3.3 Analyzing Questionnaire Data

Questionnaire data analysed by using quantitative analysis software Statistical Package for the Social Sciences (SPSS) data base, via entered the responses to the questions into SPSS. Descriptive analysis was then carried out using frequency and cross tabulation calculations. Descriptive analysis enabled the researcher to obtain a general overview of issues under investigation.

3.3.1 Results of the Questionnaires (Descriptive Analysis):

Data concerning Heads of Divisions' perceptions in RASCO and their attitude towards environmental was collected in order to performance measurement to discover what measurement tools are being used in RASCO to measure environmental performance and to find out whether there were some factors which influence the adoption of ISO 14001.

To facilitate the discussion of the results, this chapter is divided into three main sections, namely: descriptive analysis (descriptive statistics) of questionnaire data, statistical analysis, and chapter summary.

3.3.2 Descriptive Analysis of Questionnaire Data:

Descriptive statistics is a branch of statistics that sets out to summarise data that has been collected. Typically, they are mainly based on the calculation of the mean, median, mode frequency distribution, percentage distribution, rank and standard deviation.

The questionnaire was designed and formulated to explore the environmental issues related to measuring environmental performance. Questions concerning "topics such as the adoption of an environmental management system, the certification according to a standard, the existence and content of a follow-up system as well as the use of environmental objectives or indicators" (Lundberg et al., 2005, p. 437) were included.

3.3.3 Respondents' Background Information:

The educational background could be an important factor which influences the practice of Heads of Division and make them more likely to adopt innovation and become proactive. Therefore, the first section of questionnaire concentrates on background information of respondents. Table (2) provides background information of Heads of Divisions respondents as illustrated below.

Table (2): Background Information of Heads of Divisions Respondents

Res.	Occupation	Experience	Years of present occupation	Qualification	Place of qualification
7KH	Head of polymer division & operation monitor	12	3	BSc Chemical Engineering	Libya

	in management of polyethylene plant				
8FH	Head of operation refinery division & operation specialist in management of refinery plant	20	7	MSc Development Manufacturing Systems	UK
9TR	Monitor of environmental measurements unit in management of loss prevention and protection environment	23	2	BSc Environment Science (postgraduate student)	Libya
10AR	Monitor of utility operation in management of utility plant	16	1	MSc Environmental Operation Design	UK
12HR	Monitor of environmental programs and improvement unit in management of loss prevention and environmental protection	14	4	MSc Environmental Science	UK
13BH	Head of Division of effluent treatment plant(ETP)	25	4	BSc Electronic Engineering and MSc Environment.	UK
14AB	Head of Division of Ethylene	21	8	BSc Chemical Engineering	Libya
6AS	Operation specialist in ETP	35	4	High diploma in Polymer Technology	UK

As shown in the previous table, the vast majority of the respondents have professional experience exceeding twelve years working in RASCO and most hold Masters Degrees.

In addition, half of the respondents qualifications are in an environmental area, which gives a good indication about their knowledge in this scope, whereas the rest of respondents have knowledge of chemical science, which gives an indication of their familiarity with the harmful and hazardous material they are dealing with and its impact on the environment. Moreover, five of them (62.5%) graduated in the UK. This educational background and experience can be an important determinant in the respondents' perception of environmental performance measurement.

3.3.4 The Perception of Heads of Divisions on Environmental Performance:

This section presents the results of the questionnaire survey. The use of perception measures due to there is limited publicly available data on environmental practices in RASCO and non-availability of publicly data in Libya. Therefore, it only concentrates on the perception of Heads of Divisions in the RASCO Company on environmental performance. It is divided into three sections namely; an overview of environmental performance in the oil and gas industry in Libya in general; the current environmental performance practice; and the factors that influenced the adoption of ISO 14001 in RASCO in particular.

3.3.5 Environmental Performance in the Libyan Oil and Gas Industry:

In section two of the questionnaire survey there was a list of statements provided to the respondents to discover their attitude toward the statements. There were 11 statements which were rated on a 1-6 scale: 1 mean very strongly agree…6 means disagree.

To facilitate data analysis of this section, 'very strongly agree' and 'strongly agree' were combined with 'agree', 'very strongly disagree' and 'strongly disagree' were combined with 'disagree' as well. Table (3) provides Perception of Heads of Divisions on Environmental Performance in the Oil and Gas Industry in Libya in General and the frequencies of the responses. Moreover, the Mean is provided.

Section two of the questionnaire also provides some interesting issues on the oil and gas industry, such as the importance of the oil and gas industry. This category includes statements one, two and three in Table (3) which indicate that all the respondents agree with these statements which provide the suggestions that "the oil and gas industry is very important for the Libyan economy and employs a large number of skilled people" since the Libyan economy relies on oil and gas revenue. Oil represents 93% of government revenues and 95% of export earnings.

On the other hand, the majority of all respondents disagree with statement three, which suggested "the oil and gas industry employs mostly unskilled people".

However, Table (3) indicates that the majority of the respondents tended towards agreeing with the statement that the oil and gas industry is a good corporate citizen. This result supports the responses of statement two.

Concerning environmental performance in the oil and gas industry, Table (3) shows that the vast majority of respondents believe that environmental performance is acceptable in the oil and gas industry. None of the respondents demonstrated disagreement with this view. This result introduces strong evidence that the respondents are satisfied with the environmental performance in their company. This gives a clear indication that companies are dealing well with the environment, based on this result which reflects a positive picture of Heads of Divisions' attitudes to environmental performance. The mean responses for statement (9) rise above 3, which was supported by the majority of the respondents who agreed with this statement. In addition, the vast majority of the respondents agree with the statement which provides the suggestion that "the environmental performance in the oil and gas industry is detrimental to the health of the neighbouring communities".

The analysis of the perceptions of the respondents is related to the improvement of environmental performance in oil and gas industry; the majority of respondents agree that in the last ten years ago the oil and gas industry has witnessed improvements in environmental performance in oil and gas companies. This result is supported by the results of the content analysis where LNOC has made agreements with some companies to clean up waste (especially sludge) and has a contract with the Garthage Company to measure the environmental performance of RASCO, for example.

In relation to the analysis of factors which influence companies to adopt EMS as ISO 4001, the result in Table (3) showed the frequencies of the respondents for statement eleven which indicated that the majority of the respondents agree with this statement suggesting that "the existing laws to protect the environment are not sufficiently enforced". However, only one respondent had no clear view in this respect. It appears that this refers to the absence or low level of external pressure from government bodies. This argument is also supported by the results of the content analysis.

Table (3): Perception of Heads of Divisions on Environmental Performance

STA	V.SA	STR	AGR	V.SD	SDA	DIS	NOA	MEA
The oil and gas industry: is very important for the Libyan economy.	7	1	-	-	-	-	-	1.13
employs a large number of people.	-	4	3	-	-	1	-	2.88
employs mostly unskilled people.	-	-	1	2	-	5	-	5.12
is a large consumer of natural raw materials?	2	2	3	-	-	1	-	2.62
consumes a large amount of electrical energy, made from non-renewable fossil fuels.	1	3	4	-	-	-	-	2.38
consumes a large amount of thermal energy, from non-renewable fossil fuels.	1	3	3	-	-	1	-	2.75
is detrimental to the health of the neighbouring communities.	1	-	6	-	-	1	-	3.25
is a good corporate citizen.	-	1	4	-	-	-	3	5.13
The environmental	2	-	5	-	-	-	1	3.88

performance of the oil and gas industry: is acceptable.								
has improved in the last 10 years.	1	1	5	-	1	-	-	2.88
The existing laws to protect the environment are not sufficiently enforced.	-	3	4	-	-	1	-	3.00

Table Key:
STA: statement; V.SA: very strongly agree; STR: strongly agree
AGR: agree; V.SD: very strongly disagree; SDA: strongly disagree
DIS: disagree; NOA: no answer; MEA: Mean

3.3.6 The Perception of Heads of Divisions on the Current Environmental Performance Practice in RASCO:

As can be seen, Table (3) provides frequencies of the responses in the following categories:

Environmental impact: the respondents agree on statement five in Table (3), it seems the respondents are familiar with the environmental impact of their plants, which is caused by the activities of the company. About half of respondents consider that their operation does not have any impact on the environment while two of the respondents have no idea.

Measurement: this category contains questions four and twelve. The respondents provided answer for question four, that is "does your plant have measuring and monitoring systems in place to assess actual performance against the company's environmental objectives?" A majority of the respondents indicated their plants have measuring and monitoring systems, similarly the respondents who provided an answer for question twelve, that is "does your plant measure the emissions associated with both the use and disposal of your products?" indicated that for the majority of respondents their plants do measure for emissions.

Improvement: this category contains question thirteen that is "does your plant have an emission reduction programme?" The majority of the respondents indicated that their plants have an emissions reduction programme.

3.3.7 The Perception of Heads of Divisions on the Factors Influencing the Adoption of ISO 14001 in RASCO:

The drivers of the adoption of ISO 14001: from Table (4), as illustrated below, it can be seen that when asked the question "does your plant have regulatory compliance and comply with wastewater regulation; chemical handling and storage requirements; hazardous waste regulations and storage tank regulations". All the respondents answered the same; their plants comply with regulations and the frequencies indicated that.

Table (4): Requirement of ISO 14001

STA	YES	NO	DOK	NOA	MEA
Does your plant: have an environmental policy?	7	1	-	-	1.12
produce an environmental report?	6	1	-	-	2.12
operate or plan to implement an environmental management system, e .g. ISO 14001?	8	-	-	-	1.00
have measuring and monitoring systems in place to assess actual performance against the company's environmental objectives?	6	1	1	-	1.38
have any environmental issues which have any impact on the way your company conducts its business?	3	-	3	2	3.75
has considered the wider implications of sustainability for its business?	4	2	2	-	1.75
operate under any legal consents or permits for discharges to air, land or water?	5	1	1	1	2.38
use or store hazardous substances on site?	7	1	-	-	1.12
operate under an ISO 14001 certified environmental management system?	6	2	-	-	1.25
report any environmental achievements?	7	-	1	-	1.25
operate under an EMAS certified environmental management system?	3	2	3	-	2.00
measure the emissions associated with both the use and disposal of your products?	5	2	-	1	2.25
have an emission reduction programme?	5	1	1	1	2.38
Does your plant/unit have regulatory compliance and comply with: wastewater regulation.	6	1	1	-	1.38
chemical handling and storage requirements.	6	1	1	-	1.38

hazardous waste regulations.	6	1	1	-	1.38
storage tank regulations.	6	1	1	-	1.38
air reporting regulations.	5	1	2	-	1.62
Table Key: STA: statement; YES: yes; NO: no DOK: do not know; NOA: no answer; MEA: mean					

Specific impact: as can be seen from Table (5) below a majority of all respondents indicated there are positive impacts of environmental measures on their plants, on costs as well as overall economic performance, and on water pollution in the environment respectively. However, half of the respondents showed there is a positive impact of environmental measures in their plants on revenues.

The impact of emissions on the environment: all the respondents mentioned there is a negative impact as a result of carbon monoxide; sulphur dioxide and ozone. On the other hand, the respondents indicated unclear respondents on the impact of air pollutants.

The impact of environmental measures: out of all the respondents indicated that there is a positive impact of environmental measures on cost; revenue; overall economic performance and water pollution.

Table (5): Environmental Impacts

STA	NOI	POI	NEI	NOA	MEA
Impacts of environmental measures of the plant on: costs	1	5	1	1	2.88
revenues	1	4	-	3	4.50
overall economic performance	1	5	1	1	2.88
water pollution in the environment	-	5	3	-	2.38
Impact of pollutants air: carbon monoxide	3	1	3	1	2.88
carbon dioxide	3	1	4	-	2.13
sulphur dioxide	2	3	3	-	2.12
nitrogen dioxide	3	2	3	-	2.00

Impact of these emissions on the environment: sulphur oxides	1	2	5	-	2.50
ozone	1	2	5	-	2.50
carbon monoxide	1	1	6	-	2.62
hydrocarbon	1	3	4	-	2.38
nitrogen oxide	1	2	5	-	2.50
Table Key: STA: statement; NOI: no impact; POI: positive impact; NEI: negative impact; NOA: no answer MEA: mean					

Table (6) provides information about some environmental issues in RASCO, and its method of dealing with them, for example, performance measures and methods of disposal of treated waste, as shown in Table (6) and interpreted below.

Sources of emissions: the respondents indicated that the main sources of emissions in RASCO are furnace and boiler emissions. In addition, all of the respondents indicated that the most obvious environmental aspect of RASCO is industrial wastewater, whereas the majority of the respondents indicated that the waste in RASCO is petrochemical industry waste.

Methods of waste treatment: a majority of the respondents wrote that the most common methods used in RASCO to dispose of waste are incinerators and industrial wastewater treatment, while half of the respondents indicated that the most common method used in RASCO to treat waste are reducing and reuse methods. Moreover, vast majority of the respondents indicated that the plants in RASCO recycle oil and hydrocarbons and also the majority of the respondents indicated that the plants in RASCO measure report and improve the performance of waste management and industrial wastewater.

Table (6): Environmental Aspects and Methods of Treatment

STA	YES	NO	MEA
What are environmental impacts of the goods, works and services you intend to supply, include an assessment of: use of raw material or nature of resources	2	6	.25

emissions to air	4	4	.50
releases to water	4	4	.50
energy and water consumption	3	5	.38
waste management, including recycling programmes	4	4	.50
Which the sources of emissions in your plant: furnace emissions	7	1	.88
gas turbine emissions	4	4	.50
boiler emissions	5	3	.62
ozone depletion compounds	1	7	.12
Which of these air pollutants does your plant emit? carbon monoxide	6	2	.75
carbon dioxide	7	1	.88
sulphur dioxide	4	4	.50
nitrogen dioxide	3	5	.38
Which kind of waste does your plant produce? petrochemical industry	6	2	.75
industrial wastewater	5	3	.62
industry hazard waste	3	5	.38
sanitary wastewater	4	4	.50
Which of these environmental aspects does your plant apply? Industrial wastewater	8	-	1.00
Sanitary wastewater	5	3	.62
Sea water cooling system	5	3	.62
Which method does your company use to dispose of waste? incinerators	5	3	.62
bio solids	-	8	.00
land filling	5	3	.62
W.W testament	5	3	.62
reuse	3	5	.38
Which one of these R4 golden rules does your plant follow: recycle	3	5	.38
reuse	4	4	.50
recover	3	5	.38
reduce	5	3	.62
Do the plants separate and recycle the following solid wastes: oil & hydrocarbons	6	2	.75
metal (existing iron)	3	5	.38
plastic & bags	2	6	.25
polyethylene	2	6	.25
hazard barrels & cans	3	5	.38
Table Key: STA: statement; YES: yes; NO: no; MEA: mean			

3.4 Statistical Analysis:

To assist the results of descriptive analysis, it is necessary to identify appropriate statistical analysis tools. It is worth mentioning that the analytical statistic considered the most appropriate tools to aid the descriptive analysis was chi-square, since the sample size is small. As a non-parametric test, it is suitable for dealing with data shown in frequencies, as in this case.

The chi-square was conducted and calculated using SPSS. The results of the chi-square test were insignificant, due to the sample size being too small. Tests such as Fisher's exact test are also suitable for analysing data which are in categories (Neave and Worthington, 1988) this test was conducted manually, but the result was insignificant. Other non-parametric tests, such as Mann-Whitney and Wilcoxon test, which are designed to analyse data that is organized by rank (Miller et al., 2002) were also conducted, but the result was insignificant, since the sample size was too small (only eight participants). The failure of statistical (Mann- Whitney and Wilcoxon) test to detect any significant difference between that may will be due to the small sample size. The relatively small number of participants did not allow for rigorous statistical assessment.

4. Results:

A number of results were reached, the most important of which were:

1- RASCO has already adopted ISO 14001 EMS (at the end of 2007, the ISO 14001 EMS programme was launched in RASCO).

2- The most important drivers to adopt ISO 14001 in RASCO are to follow international oil and gas sector trends, to enhance RASCO's image, and to improve environmental performance.

3- RASCO is doing its best to comply with the laws and regulations. Clear evidence for this is that they obtained the ISO 14001 EMS, set up their own internal

regulations to comply with the law, and launched their monitoring department, the General Loss Prevention Department.

4- Reasons led RASCO to implement the IMS system: To enhance its total quality management and to enhance performance measurement.
5- The major change in RASCO was after 2007 when it adopted an Integrated Management System (IMS).
6- Its proactive environmental attitude allowed RASCO to be the first company in Libya to obtain IMS certifications in the oil and gas sector.
7- This is a significant indication of the interest of RASCO in the environment since it is aware that its operations and activities affect the environment.
8- RASCO focuses on non-financial performance measurement.
9- RASCO uses Environmental Condition Indicators (ECI). It focuses on Operational Performance Indicators (OPIs) for measuring its environmental performance.
10- There is insufficient information about indicators to implement measures of environmental performance in RASCO.
11- ISO 14031 and environmental indicators are almost unknown in RASCO, it does not seem to practise formal EPM.
12- There is no standard format or benchmark available since environmental performance measurement is still in its relative infancy.
13- There is a general lack of environmental performance indicators against which to assess overall environmental performance. It appears that the process of measuring environmental performance is still in the development stage in RASCO.

6. Recommendations:

1- The EPM of RASCO has been presented, discussed and analysed to be a model for other oil and gas companies in Libya.

2- RASCO as a proactive company can guide reactive companies adopting ISO 14001 EMS which provides benefits for both the company itself by allowing it to develop its environmental performance, and the Libyan government by facilitating the comparison between oil and gas companies in terms of performance evaluation.
3- RASCO should develop indicators to measure improvements in its operational environmental performance, which are needed to achieve its environmental policy, objectives and targets to prevent pollution or to minimise negative environmental impact on the environment.
4- RASCO would be better if it designs indicators for all operational processes; however, the priority must be given to waste, such as solid waste. The indicators should provide a clear idea of what data is needed to allow effective decision-making.
5- RASCO's activities must be evaluated and audited, which is supposed to lead to a good base for achieving continual improvement. Based on these audit procedures, measures should be taken continually to improve the product-related environmental performance.
6- RASCO can enhance its environmental performance after adopting the ISO system by improving total quality, competitiveness, satisfying customers' needs, achieving sustainable management, and enhancing its corporate image.
7- A comprehensive environmental legislation must be drawn up, covering environmental protection with considerable powers allocated to the Libyan Ministry of the Environment and the LEGA. There should be an environmental policy with planning and legislation at the government level.
8- Adopting adequate research and development programmes within Libyan oil and gas companies to facilitate the process of any managerial innovation such as ISO 14001 EMS and the BSC.

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