



The Influence of Technological Factors on Environmental Management Accounting Adoption in Libyan Oil Firms

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Abstract

This study investigates the extent influence of technological factors on the environmental management accounting (EMA) adoption. Technological, Organizational and Environmental (TOE) framework with Diffusion of Innovation (DOI) Theory is employed. The data in this study is collected by 44 questionnaires delivered to both of environmental and financial managers in Libyan oil firms. The findings show that most firms have a great intention and willingness to adopt EMA practices. The study found that both of technological characteristics (perceived benefits/ perceived importance) are significant factors for adopting EMA and therefore, more attention for enhancing employees' awareness towards the importance and benefits of EMA adoption should be increased by top management in Libyan oil firms.

Keywords: Environmental Management Accounting; DOI Theory; TOE Framework; Libyan Oil Firms.

1. Introduction

With the end of the twentieth century, EMA has emerged as a response to the failure of conventional accounting systems in relative to environment-related activities (Ferreira , Moulang , & Hendro 2010). EMA is defined by Jasch (2003, p. 668), as an effective tool that help organizations to manage environmental activities, by increasing material efficiency, and reducing environmental impact and its related costs. Pressures increased by many parties on traditional accounting systems for providing required information to both internal and external stakeholders in order to reduce environmental impacts and related costs, have led substantially to the appearance of EMA (Chang, 2007; Gale, 2006; Jasch, 2006). Commonly, most the environmental costs under the conventional accounting systems being allocated as overhead costs, and thus these costs are invisible and cannot be identified (Ditz, Ranganathan, Banks, & Beloff, 1995). According to several studies, EMA can provide beneficial information for firms to manage environmental costs, improve both of economics and environmental performance, and then achieve the sustainability (Gibassier & Alcouffe, 2018; IFAC, 2005; Pratiwi, Meutia, & Syamsurijal, 2020). In spite of the importance and benefits

of EMA, adoption and implementation level of EMA in organizations is still low in several countries, particularly in developing countries, such as Libya. As referred by IFAC (2005), most managers do not recognize the importance and benefits of reducing environmental impacts and improving environmental performance. Thus, this will led to lost many opportunities and benefits in regard to reduce environmental impacts and its related costs, and improve environmental performance (Chang, 2007; UNDSO, 2001). This is due to low the environmental awareness in firms. This weakness is more obvious in firms in developing countries, like Libya as mentioned by Burritt (2004); where the knowledge of the firms on the innovation and new techniques in accounting field is less likely to exist. Although, the importance and need of diffusion EMA practices in many countries for improving environmental performance (Schaltegger, Hahn, & Burritt, 2000), this topic has not received enough attention by researchers (Ambe, 2007; Chang, 2007; Greig, Lord, & Shanahan, 2006). Therefore, this represents a significant gap in EMA field, and there is still a lack of exploration on the situation of EMA practices and its adoption and implementation within many corporations.

2. Literature Review

2.1 The Benefits and Importance of EMA

EMA, in relation to a specific organizational context, can provide several benefits, as indicated by a number of researchers (Beer & Friend, 2006; Bennett, Rikhardsson, & Schaltegger, 2003; Burritt, Hahn, & Schaltegger, 2002; Ferreira et al., 2010; IFAC, 2005). These benefits represent in helping on reduce the environmental impacts, improve an organization's performance, better utilize resources, reduce total costs, improve product pricing, attract human-resources, improve an organization's reputation, and offer useful information for decision making at different levels (Burritt et al., 2002; Ferreira et al., 2010; IFAC, 2005; Jasch, 2003, 2006).

In addition, the adoption and use of EMA can provide useful and important information to assist firms to expose hidden opportunities, offer more choices to manage wastes, reduce material consumption and energy, recycle materials, and achieve eco-efficiency, leading to the reduction of environmental costs and impacts. Despite of the benefits and importance of EMA, however its adoption is still weak and in early stage within firms in several countries around the world, as indicated by Ferreira et al. (2010). Several studies argued that, it is crucial for organizations to adopt and implement EMA practices due to its importance and benefits which can be gained, as well as in order to maintain its legitimacy and survival (Burritt, 2004, 2005; Fuzi, Habidin, & Effendy, 2016; Jamil, Mohamed, Muhammad, & Ali, 2015). Thus, this study argues that, it is crucial for Libyan oil firms to adopt EMA to improve environmental performance and realize sustainability.

2.2 The TOE Framework and DOI Theory

The TOE framework by Tornatzky and Fleischer (1990) is commonly used in the technological context based on the DOI theory by several studies (Alatawi, Dwivedi, Williams, & Rana, 2012; Oliveira & Martins, 2011). DOI theory perspective is mainly based on the influence of characteristics and perceptions of individuals on the innovation adoption

(Rogers, 2003). TOE framework with DOI theory explores how the behavioral intention of firms shaped by characteristics of technology such as the perceived benefits and perceived importance that related to innovation. Tornatzky and Fleischer (1990) noted that individuals' perceptions and attitudes on the importance and benefits of an innovation or technology can play important role to influence on the intention behavior of individuals to adopt this innovation.

Perceived benefits refers to the level to which organizations or individuals perceive that system is beneficial or useful, to improve their performance (Twati, 2007). Perceived benefits of any innovation, technique or system impact the behavioral intentions of individuals to adopt and use of this innovation, technique or system (Malhotra & Galletta, 1999). Perceived importance is explained as the degree to which people perceive that system is necessary and important to enhance performance (Cohen, 1990). According to Chau and Tam (1997), the adoption of a new technology is based on perception, specifically if it is perceived as better than current technology used in an organization, and this is closely related to the degree of perceived importance. Thus, people who do not see much gain from having information technology will not be enthusiastic to adopt such technology. Chau and Tam (1997), further argue that the degree of perceived importance will not be identical, due to different opportunities and constraints facing each organization.

2.3 The Influencing Factors to the Study

Literature related to the adoption of innovations, information technology (IT) and information system (IS) (e.g. Alatawi et al., 2012; Grover, 1993; Twati, 2007) indicates that factors in technological context that normally explain attributes of innovation would influence the adoption of organizational practices and innovations. Based on the TOE framework by Tornatzky and Fleischer (1990), technological context focuses on how the characteristics of technology themselves can affect the propensity and intention of firms to adopt technical and administrative innovations. The technological variables are many and varied, for example, perceived benefits, perceived importance, perceived barriers and the ability to adopt. They have been examined in the diffusion of innovations context (Chau & Tam, 1997; Oliveira & Martins, 2011; Tornatzky & Fleischer, 1990). These factors can facilitate or constrain adoption of innovations. Previous studies have provided evidence to show the relationship between technological factors and innovations adoption (Oliveira & Martins, 2011).

Building on the literature related to the adoption of IT/IS, two main variables in the technological context were selected and assumed to be the most suited for analyzing the EMA adoption process in oil sector in Libya. Technological variables, the focus of present study, are perceived benefits and perceived importance. These variables were chosen due to their importance and have been found to be among influencing factors on organizations' behavior to accept, adopt and use new techniques and information systems, as shown in several previous studies (e.g. Chai, Bagchi-Sen, Morrell, Rao, & Upadhyaya, 2006; Chau & Tam, 1997; Janvrin, Bierstaker, & Lowe, 2008; Kuan & Chau, 2001; Oliveira & Martins, 2011; Tsai & Tai, 2003; Twati, 2007).

Therefore, it is expected that both of the perceived benefits and perceived importance of EMA can play an important role in the adoption of EMA. To date, few studies have

incorporated explicit characteristics on innovation, such as perceived benefits and perceived importance in modeling the adoption of EMA. Thus, current study attempts to examine the impact of two technological variables (perceived benefits/ perceived importance) on firms' intentions to adopt EMA practices.

As explained in Figure 1, in the theoretical framework of the study it was referred to TOE framework and DOI theory in its investigation of two technological factors which include perceived benefits and perceived importance, and EMA adoption within Libyan oil firms.

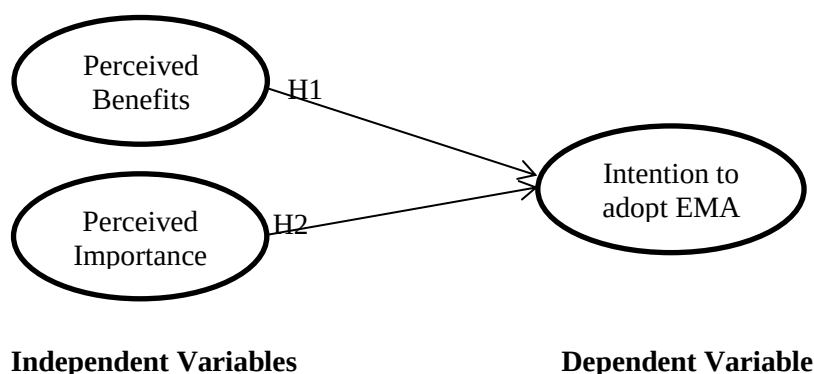


Figure 1. Research Framework

2.3.1 Perceived Benefits of EMA

Perceived benefits represent one of most important characteristics of innovation. According to Chau and Tam (1997), perceived benefits are mainly concerned with benefits capture, specifically, the extent of agreement with claimed benefits. According to Twati (2007) perceived benefits (usefulness) refer to the level to which the organizations or individuals perceive that system is beneficial or useful, to improve their performance. Perceived benefits of usefulness impact the behavioral intentions of individuals in the adoption and use of the technique or system (Malhotra & Galletta, 1999). Several empirical research has consistently shown that perceived benefits have a significant influence on the adoption and use of IS/IT (e.g. Beatty, Shim, & Jones, 2001; Chau & Tam, 2000; Iacovou, Benbasat, & Dexter, 1995; Kuan & Chau, 2001; Oliveira & Martins, 2008; Twati, 2007).

Therefore, it can argue that the motivation of the organizations to adopt EMA practices will be enhanced if they believe that practices are beneficial for improving the environmental and economics performances. As result, it is expected that perceived benefits of EMA will be have a significant influence on intention behavior of organizations to adopt EMA practices. Thus, the relationship between perceived benefits and EMA adoption can be worded in the following hypothesis:

H1: Perceived benefits will have a significant positive direct influence on firms' intention to adopt EMA practices.

2.3.1 Perceived Importance of EMA

Perceived importance is another important characteristic of the innovation. The impact of perceived importance on the adoption of innovation has been suggested in IS/IT literature. Perceived importance refers to the degree to which people perceive that system is necessary and important to enhance performance (Cohen, 1990). According to Chau and Tam (1997), adoption of a new technology is based on perception, specifically if it is perceived as better than current technology used in an organization, and this is closely related to the degree of perceived importance. Thus, people who do not see much gain from having information technology will not be enthusiastic to adopt such technology. Chau and Tam (1997), further argue that the degree of perceived importance will not be identical, due to different opportunities and constraints facing each organization. Few studies have examined the influence of perceived importance in decision making and behavior intentions of individuals concerning IT adoption and use (Chai et al., 2006; ChanLin, 2007; Chau & Tam, 1997; Janvrin et al., 2008; Leonard, Cronan, & Kreie, 2004; Oliveira & Martins, 2011).

The findings of previous studies showed that perceived importance had a significant impact on behavioral intention, in turn would affect adoption behavior. This supports an argument that the adoption of new technologies is closely associated with the perceived importance of technology, as proposed by Chau and Tam (1997). In other words, if individuals believe that the technology, program or practice is beneficial and important, their motivations to adopt it will increase. However, further evidence is required in order to confirm such claims and results.

Building on the above discussion, it is argued that the motivation of organizations to adopt EMA practices will be enhanced if they believe that practices are necessary or beneficial for their legitimacy and survival. Therefore, it is expected that perceived importance will be a vital factor in enhancing the intention of organizations to accept and adopt EMA practices. Thus, the relationship between perceived importance and EMA adoption is worded in following hypothesis:

H2: Perceived importance will have a significant positive direct influence on firms' intention to adopt EMA practices.

3. Methodology

The data in this study is collected by personally survey. Firms are derived from the Libyan National Oil Corporation's directory (NOC) 2020. Out of 44 samples of questionnaires delivered to both of financial and environmental managers who work in 22 firms in Libyan oil sector, only 43 (97.7%) were returned and found to be usable. The response rate of 97.7% was considered satisfactory when compared to other studies in the Libyan context (Hokoma, Khan, & Hussain, 2008a, 2008b, 2010; Sayeh, 2006; Twati, 2007, 2008; Twati & Gammack, 2006; Youssef, 2006). For example, the study of Twati (2007) reported a response rate of 66%. Thus, the response rate of this study is considered acceptable. The descriptive and regression analysis are used to analyze the data collected in this study.

4. Data Analysis

4.1 Firms' Profile

The findings reveal in Table1 that the majority of the respondents are from large firms (69.8) and respondents from small and medium firms constitute only 30.2 %. The firms sizes in this study were as follows: 9.3% had less than 300 employees; 4.7%, less than 400, 9.3%, less than 500, and 76.7%, had more than 500 employees. The results also show that 55.8% of the firms were surveyed in this study fully owned by the government and 44.2% were mixed, jointly owned by the government and private sector, and none were from the private sector. The figures in Table 1 provide insight into the EMA adoption status of the firms surveyed. The result below shows that the all of the Libyan oil firms did not adopt any EMA practices. It could be due to they are not viewing EMA as a significant tool, and therefore they will to be less likely to adopt.

Table 1: Profile of Firms (N =43)

Profile	Classification	Frequency	Percentage
Size of Firms	Small and Medium	13	30.2
	Large	30	69.8
Number of Employees	201-300	4	9.3
	301-400	2	4.7
	401-500	4	9.3
	>500	33	76.7
Property	Government	24	55.8
	Mixed	19	44.2
Status of EMA Adoption	Yes	0	0%
	No	43	100%

4.2 EMA Adoption

According to Ferreira et al. (2010), EMA practices involve twelve items reflect EMA related activities, which were selected and derived from various resources (e.g. IFAC, 2005; UNDSO, 2001). These items focused on two monetary and physical aspects of EMA, as suggested by Burritt et al. (2002). Adapting from Ferreira et al. (2010), respondents were asked to measure the extent of intention to adopt EMA practices within Libyan firms, on a scale of 1 “not intent at all” to 5 “intent to a great extent” . The results in Table 2 show that the mean scores ranged from 3.30 to 3.60 with the maximum score of 5 and the minimum score of 1. The highest mean score on the practice of product life cycle cost assessments (3.60) than the remaining items. On the other hand, the lowest mean score was (3.30) for the practice of identification of environmental costs, and classification of environmental costs. The highest variability with a standard deviation of 1.044 was also related to the sixth item. These results imply that the Libyan oil firms have a great intention and willing to adopt product life cycle cost assessments than the other EMA practices.

Table 2: Descriptive Statistics Result for EMA Adoption (N =43)

	Items	Mean	Std.dev	Min	Max
1	Identification of environmental costs.	3.30	.914	2	5
2	Estimation of environmental liabilities.	3.40	.877	2	5
3	Classification of environmental costs.	3.30	.989	2	5
4	Allocation of environment-related costs to production processes.	3.33	1.040	2	5
5	Allocation of environment-related costs to products.	3.51	.960	2	5
6	Introduction of improvement to environment-related costs management.	3.35	1.044	1	5
7	Creation and use of environment-related costs accounts.	3.37	.952	2	5
8	Development and use of environmental key performance indicators (KPIs).	3.47	1.032	2	5
9	Product life cycle cost assessments.	3.60	.929	2	5
10	Product inventory analyses.	3.53	.909	2	5
11	Product impact analyses.	3.58	.982	2	5
12	Product improvement analyses.	3.44	.983	2	5

4.3 Factors Influencing EMA Adoption

In Table 3, perceived benefits of EMA (PBEMA) items have the highest mean (3.5705), followed by perceived importance of EMA (PIEMA) items (3.4167). The results of the descriptive statistics for each item of the two technological factors influencing EMA adoption are informed in Table 4 and 5. Although, these results show the mean score of both PBEMA and PIEMA is high, however, Libyan oil firms are not adoption of EMA yet, as mentioned earlier in Table 1. This finding compatible with the study of Ferreira et al. (2010), which reports the adoption of EMA is still weak and in early stage within firms in several countries around the world despite its benefits and importance.

Table 3: Overall Result of Descriptive Statistics for Influencing Factors (N =43)

EMA adoption influenced by	Mean	Std. dev	Min	Max
PBEMA	3.5705	.87883	2.00	5.00
PIEMA	3.4167	.97658	2.00	5.00

4.3.1 Perceived Benefits of EMA (PBEMA)

According to Ferreira et al. (2010), the EMA benefits involve fifteen items. These items are selected and adapting to reflect perceived benefits of EMA (PBEMA) factor. The respondents were asked to determine the extent to perceive the benefits of EMA adoption within Libyan oil firms, on a scale of 1 “strongly disagree” to 5 “strongly agree”. Table 4 show the results of each item of PBEMA, where the mean scores ranged from 3.42 to 3.86,

with the maximum score of 5 and the minimum score of 2. The highest mean score in PBEMA is on the practice of improvement in reputation (3.86). Conversely, the lowest three mean scores are on the practice of increase in customer satisfaction (3.42); cost of capital reduction (3.42); and identification of new opportunities (3.42). The highest variability with a standard deviation is 1.074 for third and fifth items. The results show that all items received high mean values, this imply that Libyan oil firms have a good perceiving of EMA benefits.

Table 4: Results of Descriptive Statistics on PBEMA (N =43)

	PBEMA Items	Mean	Std. dev	Min	Max
1	Increased demand for green products.	3.51	1.055	2	5
2	Increase in product margins.	3.56	1.053	2	5
3	Increase in customer satisfaction.	3.42	1.074	2	5
4	Cost of capital reduction.	3.42	1.006	2	5
5	Insurance cost reduction.	3.47	1.008	2	5
6	Operating cost reduction.	3.65	.973	2	5
7	Identification of new opportunities.	3.42	.982	2	5
8	Generation of process innovation.	3.56	.959	2	5
9	Generation of product innovation.	3.65	.973	2	5
10	Attraction of better quality staff.	3.51	1.032	2	5
11	Improvement in productivity.	3.49	1.055	2	5
12	Improvement in reputation.	3.86	.915	3	5
13	Improvement in decision making.	3.77	.947	2	5
14	Product costing improvement.	3.70	.964	2	5
15	Production process improvement.	3.58	1.074	2	5

4.3.2 Perceived Importance of EMA (PIEMA)

Based on Ferreira et al. (2010), twelve items are selected and adapting to reflect the perceived importance of EMA (PIEMA) factor. The respondents were asked to assess the degree of importance of EMA practices within Libyan oil firms, on a scale of 1 “not important at all” to 5 “very important”. Table 5 show the results of each item of PIEMA, where the mean scores ranged from 3.16 to 3.70, with the maximum score of 5 and the minimum score of 2. The highest mean score in PIEMA is on the practice of product impact analyses (3.70). While, the lowest mean score is on the practice of classification of environmental costs (3.16). The highest variability with a standard deviation is 1.206 related to the eleventh item. These findings suggest that the product impact analyses is the most important practice of EMA, while the classification of environmental costs is the least important for Libyan oil firms.

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Table 5: Result of Descriptive Statistics on (PIEMA) (N =43)

	PIEMA Items	Mean	Std. dev	Min	Max
1	Identification of environmental costs.	3.51	1.055	2	5
2	Estimation of environmental liabilities.	3.49	1.055	2	5
3	Classification of environmental costs.	3.16	1.022	2	5
4	Allocation of environment-related costs to production processes.	3.35	1.131	2	5
5	Allocation of environment-related costs to products.	3.30	1.103	2	5
6	Introduction of improvement to environment-related costs management.	3.40	1.178	2	5
7	Creation and use of environment-related costs accounts.	3.19	1.118	2	5
8	Development and use of environmental key performance indicators (KPIs).	3.56	1.140	2	5
9	Product life cycle cost assessments.	3.49	1.121	2	5
10	Product inventory analyses.	3.47	1.182	2	5
11	Product impact analyses.	3.70	1.206	2	5
12	Product improvement analyses.	3.40	1.072	2	5

4.4 The Influence of PBEMA and PIEMA on EMA Adoption

The results of the regression equation in Table 6 show that the regression model is significant R² is 0.741 and (F=57.290, p<0.01). The findings indicate that PBEMA has a positive significant influence on EMA adoption. Table 6 shows the standardized coefficient (Beta) for PBEMA and EMA relationship is 0.391 and significant at p<0.05. Therefore, hypothesis H1 is supported. Similarly, when examining PIEMA to EMA, the results show that PIEMA has a positive significant influence on EMA adoption, and standardized coefficient (Beta) for PIEMA and EMA relationship is 0.550 and also significant at p<0.05. Hence, hypothesis H2 is supported. This finding consistence with past literature (e.g. Alatawi et al., 2012; Davis, 1989; Ferreira , Moulang , & Hendro 2008; Ferreira et al., 2010; Oliveira & Martins, 2011; Tornatzky & Fleischer, 1990; Tsai & Tai, 2003; Twati, 2007), which indicate that the perceived benefits and the perceived importance are important factors in facilitating the adoption of technology and management information systems in particular.

Table 6: Regression Analysis of PBEMA and PIEMA and EMA (N =43)

Variables	Standardized Coefficients (Beta)	t	Sig.
PBEMA	.391	3.632	.001
PIEMA	.550	5.118	.000

R²= 0.741, F=57.290, P<0.001

5. Discussion and Conclusion

The previous results revealed that technological factors (PBEMA and PIEMA) have a positive significant influence on EMA adoption, meaning that as the PBEMA and PIEMA increasing, Libyan oil firms are more likely or willing to adopt EMA practices. Such results are in line with DOI theory that focuses the impact of perceptions of potential users of innovation on adoption and the spread of technology and new ideas through societies, and degrees of willingness to adopt innovations. Based on the DOI theory, the innovation adoption process can be affected by individual characteristics, internal and external characteristics of the firms (Rogers, 2003). These findings also assert the assumption of TOE framework as outlined by Tornatzky and Fleischer (1990), who noted that individuals' perceptions and attitudes on the importance and benefits of an innovation or technology can play important role to influence on the intention behavior of individuals to adopt this innovation.

As well as, The findings concur with past studies (e.g. Alatawi et al., 2012; Davis, 1989; Ferreira et al., 2008, 2010; Oliveira & Martins, 2011; Tornatzky & Fleischer, 1990; Tsai & Tai, 2003; Twati, 2007), which showed that the perceived benefits and perceived importance had an important influence on decision-making, intention and behavior of individuals toward many issues. For instance, Twati (2007) found that the perceived benefits play a significant role in the adoption of management information systems in the Libyan organizations. Also, Chau and Tam (1997), found support for the positive relationship between the perceived importance of open systems properties and open systems adoption.

With respect to EMA, this study represents an important addition to the literature through highlight on the technological factors specifically (perceived benefits/ perceived importance), and their role in enhancing EMA adoption. As well as this study provides a significant contribution in evaluating the state of EMA practices in Libyan firms. This study has a number of implications. Although, the findings of this study showed that most of the managers who were surveyed expressed their intention and willingness to adopt EMA practices. However, the Libyan firms have not adopted and implemented EMA yet. Thus, there is a need to make further research for exploring other factors which might to be have influence on EMA adoption within Libyan firms. In conclusion, the pursuit to address environmental issues, improve environmental performance and achieve the sustainability requires greater attention and responsibility by firms to enhance environmental awareness and promote EMA adoption.

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تأثير العوامل التكنولوجية على تبني المحاسبة الادارية البيئية في شركات النفط الليبية

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ملخص البحث

تبحث هذه الدراسة في مدى تأثير العوامل التكنولوجية على اعتماد المحاسبة الإدارية البيئية. وقد تم استخدام الإطار التكنولوجي والتنظيمي والبيئي مع نظرية نشر الابتكار، وتم جمع البيانات عن طريق 44 استبانة الذي تم ايصالها للمدراء الماليين ونظرائهم البيئيين في الشركات العاملة في قطاع النفط الليبي. حيث أظهرت نتائج هذه الدراسة أن معظم الشركات لديها نية كبيرة واستعداد لاعتماد ممارسات المحاسبة الإدارية البيئية. وجدت الدراسة أن كلا من الخصائص التكنولوجية (الفوائد المتصورة والأهمية المتصورة) عاملان مهمان لاعتماد المحاسبة الإدارية البيئية. ذلك يتطلب من الإدارة العليا في شركات النفط الليبية زيادة الاهتمام لتعزيز وعي الموظفين بأهمية وفوائد المحاسبة الإدارية البيئية والترويج لتبنيها.

الكلمات المفتاحية: المحاسبة الإدارية البيئية؛ نظرية نشر الابتكار؛ الإطار التكنولوجي والتنظيمي والبيئي؛ شركات النفط الليبية.