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BARRIERS, DRIVERS AND STAKEHOLDERS OF ENVIRONMENTAL MANAGEMENT SYSTEMS IMPLEMENTATION IN EGYPT

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ABSTRACT:
The construction industry is an important sector that contributes to the Egyptian and global economies, but also causes considerable pollution, energy consumption, waste generation, and other environmental issues. The implementation of Environmental Management Systems (EMS) such as that of ISO 14001 can direct construction companies towards attaining a more sustainable construction sector. This paper aims towards identifying the key barriers, drivers and stakeholders that could facilitate the implementation of EMS in Egypt. A questionnaire survey was conducted on Egyptian contractors of various sizes that yielded over 100 responses. Findings were found in line with another synchronous survey on a different sample, thus adding validity to the research. Results were tested using t-test and Analysis of Variance (ANOVA) parametric tests. Most responses were not differentiated among five methods of categorizing the sample, except for a low-experienced respondents group that is thought to distort some of the responses. Findings showed financial issues to be major barriers and drivers of implementation, showing the need for financial/tax incentives and support. The method of awarding construction contracts and contract provisions need

to attend to environmental issues. Contractor top management requires awareness of the costs and benefits of EMS as they are the most influential stakeholder. Governmental and non-governmental organizations need to play a larger role such as the Egyptian Environmental Affairs Agency and the Egyptian Federation for Construction and Building Contractors, and The Egyptian Green Building Council can also have an orchestrating role. Finally, the research is limited to the data sample taken and by the research methods used and considerable research is required to facilitate EMS adoption and implementation and to achieve a more sustainable construction sector.

Conference Topic: Construction Management Methods and Practices
Keywords:
Environmental Management System, Egypt, ANOVA, t-test, Sustainability, Construction.

1. INTRODUCTION: (Font Time New Roman 12 Bold)

The world's environment is continually changing due to physical factors such as global warming, climatic changes leading to glacial erosion, pollution and depletion of natural resources. The construction industry has a major impact on the environment through its effect on each of these factors. Construction activities have raised serious concerns about their large environmental impacts, stemming from their consumption of materials, many of which are non-renewable. It is estimated that buildings account for about 40% of the materials entering the world's economy each year and for 25% of the world usage of wood (Kein et al., 1999). In the United States, buildings account for 36 percent of total energy use, 65 percent of electricity consumption, 30 percent of greenhouse gas emissions, 30 percent of raw materials use, 30 percent of waste output, and 12 percent of potable water consumption (EPA 2010). In Egypt, residential and office buildings account for 45% of electricity and the construction sector contributes a large amount of pollutants throughout the construction process and in the production of construction materials, such as noise, air, high-energy consumption, solid waste generation, global greenhouse gas emissions, environmental damage and resource depletion (ENCC, 2010). The construction industry has a particular importance in Egypt as it contributed to 4.6% of the GDP in 2009 (The Economist, 2010) and has been contributing between 4-6% of GDP and 7-8% of total employments throughout the previous years (ENCC, 2010).

In recent years, many industrial sectors have developed various types of Environmental Management Systems (EMS) for identifying and managing the impacts that the commercial, industrial, and service operations have on the environment. Although the use of the EMS is becoming more common among other industries, its use by the construction industry is less common. Proper implementation of EMS can enhance efficiency, lower costs, reduce resource use and waste, help to ensure compliance with regulatory requirements, and improve relationships with customers (Krages, 2007 and Perry, 2007, and Whitelaw 2004). If Egyptian environmental laws are to be applied stringently, construction companies will face great challenges, as with the increased awareness of environmental issues, the construction industry can be exposed to increased attention by regulators and stakeholders.

This paper aims to investigate the barriers, drivers, and stakeholders (BDS) of implementing EMS in the Egyptian construction industry. This objective was researched through a questionnaire survey on a varied sample with over 100 responses in Egypt. The remainder of the paper reports on the survey and its findings in four further sections, namely;

Environmental Management Systems, Questionnaire Survey, Results Analyses and Discussion, and Conclusion.

2. ENVIRONMENTAL MANAGEMENT SYSTEMS:

An EMS involves the formal system and database, which integrates the procedures and the processes for training of personnel, monitoring, summarizing, and reporting of specialized environmental performance information to internal and external stakeholders of the company. The documentation of this environmental information is primarily focused on design, pollution control and waste minimization, training, reporting to top management, and setting goals (Melnyk et al., 2003). With the goal of continual improvement, EMS provides organizations of all types with a structured system and approach for managing environmental and regulatory responsibilities to improve overall environmental performance, including areas not subject to regulation such as product design, resource conservation, energy efficiency, and other sustainable practices (Lesourd et al., 2001). A typical and globally adopted EMS is the ISO 14001 system (http://www.iso.org) which contains five main sections:

1. Environmental policy.
2. Planning.
3. Implementation and operation.
4. Checking and corrective action.
5. Management review

The EMS structure can be viewed in light of Deming's Plan-Do-Check-Act (PDCA) cycle, as illustrated in Fig.1 (Whitelaw, 2004). Typical benefits of EMS implementation include cost savings such as that of reduced consumption of natural resources, improved community outcomes, and improved staff efficiency and satisfaction (Krages, 2007 and Perry, 2007, and Whitelaw 2004).

Fig.1 EMS Structure in Light of Deming's PDCA Cycle.
Source: (Whitelaw, 2004)

3. QUESTIONNAIRE SURVEY:

The objective of the questionnaire survey was to gather and analyze relevant data to evaluate the BDS of EMS implementation using appropriate statistical techniques. Therefore, the opinions of managers and owners of construction companies towards EMS implementation were investigated through the questionnaire survey. The following sub-sections discuss the design of the questionnaire and the survey and sampling approaches.

3.1 Questionnaire Design:

The questions of the questionnaire were derived from the literature review. Every attempt was made to design the questionnaire attractively and neatly. An introductory letter was included to explain the objective of the questionnaire and assure confidentiality. The first section of the questionnaire contained definitions, overview of environmental impacts in the construction and of EMS, and method of filling the questionnaire. The second section of the questionnaire collected general information about the company and respondents. The third section asked specific questions about barriers, drivers and stakeholders using a five-point Likert scale with 5 being strongly important, 3 being undecided, and 1 being strongly unimportant. A portion was always added for respondents to add whatever they felt missing or to comment.

3.2 Survey and Sampling Approaches:

The sampling frame was obtained from a list of contractors registered with the Egyptian Federation for Construction and Building Contractors (EFCBC). Discussions with EFCBC personnel let to considering the first three grades, as defined by EFCBC, large companies and grades four to six considered small and medium enterprises (SME). Grade seven was neglected as they are usually beginner contractors whose work volume is small and rarely have experience with advanced management systems.

A random sampling approach was undertaken in the first instance of the survey, where the questionnaire was posted to 257 companies and a depressing 5 responses were obtained. A non-random snowballing technique was then followed with questionnaires personally administrated, where the researcher would recruit future subjects from current participants, thus building up the sample in a snowball manner (Bernard, 2000).

The minimum sample size was calculated according to the following equation (Easterby-Smith et al., 2002):

$$n = \frac{ń}{1 + \left(\frac{ń}{N}\right)}$$

Where;
n = sample size,
N= total population,
S is the maximum standard deviation in the population elements, (total error assumed 0.1 at confidence level of 95%) and,
P is the proportion of population elements that belong to the defined class, the maximum value is chosen at P = 0.5
V is the standard error of sampling distribution = 0.05

$$\acute{n} = \frac{S^2}{V^2} = \frac{0.25}{(0.05)^2} = 100$$

$$S^2 = p\,(1 - p) = 0.5 * 0.5 = 0.25$$

$$n = \frac{\acute{n}}{1 + \left(\frac{\acute{n}}{N}\right)} = \frac{100}{1 + \left(\frac{100}{\infty}\right)} = 99$$

The sample size collected was 107 responses which is greater than the minimum sample size of 99.

4. RESULTS ANALYSES AND DISCUSSION:

The reliability of the measuring instrument (i.e. the questionnaire) was evaluated, then the results of the questionnaire survey for each of the Barriers, Drivers, and Stakeholders are presented. Results and compared to the outcomes of a recent PhD study conducted in Egypt (Hassan 2009) and whose data gathering was nearly synchronous to that of this research. The sample of this research included both large companies (grades 1 to 3 of EFCBC classification) and SME (grades 4 to 6 of EFCBC), while the sample of Hassan (2009) is mostly comprised of what is considered here as large companies. This can explain some of the differences among results.

4.1 Reliability of Measuring Instrument:

The questionnaire as a measuring instrument was tested for reliability of responses and internal consistency. The reliability of a scale indicates how free it is from random error. The reliability is assessed via internal consistency, that is the degree to which the items that make up the scale that are measuring the same underlying. The most common statistic used to measure internal consistency is Cronbach's coefficient alpha (α), which provides an indication of the average correlation among all of the items that make up the scale. Values for (α) range from zero to one, with higher values indicating greater reliability. A minimum level of 0.7 Cronbach's coefficient alpha values are recommended depending on the number of items in the scale (Fellows et al., 2003).. The values of (α), are shown in Table1, were calculated using SPSS software, and since values of alpha are more than 0.7, then this scale is considered reliable.

Table.1 Values of Cronbach's Coefficient (α) for Scale Reliability

Scale items	Cronbach's coefficient (α)
Internal barriers	0.7808
External barriers	0.7772
Driving forces	0.8809
Stakeholders	0.8375

4.2 Barriers:

The barriers to EMS implementation in the construction industry were ranked according to importance. The rank was based on the mean scores obtained by respondents.

4.2.1 Internal barriers:

Responses pertained by the total sample for internal barriers to EMS implementation are illustrated in Fig. 1. The results show that the lack of financial resources was ranked first with an average score of 4.17, high implementation cost was second with an average score of 4.02, and the difficulty to provide the required documentation was ranked as least with an average score of 3. 64. Although the results analyses in Hassan (2009) was for internal and external barriers combined, in what was termed as difficulties and obstacles, the two top barriers were high costs of environmental measurements and implementing EMS, which is in line with the outcome of this paper. These findings are also in line with the challenges identified by ENCC (2010) facing green construction including capital cost, insufficient fiscal incentives, and the lack of finance.

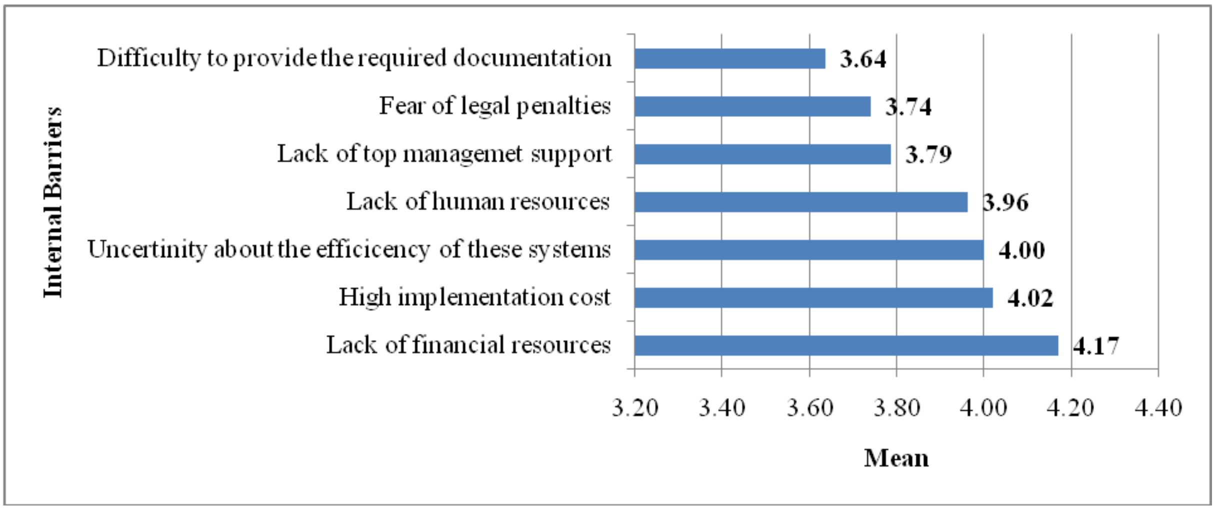

Fig.1 Internal Barriers to EMS Implementation

4.2.2 External Barriers:

The ranking of external barriers to the EMS implementation is shown in Fig. 2, where the lack of customer awareness was ranked first with an average score of 4.28, and bids being awarded to the lowest price bidder was ranked second with an average score of 4.26. The least affecting factor was the lack of a central source of information with a score of 3.49. In Hassan (2009), the lack of information related to environmental management in the construction sector was what can be considered as the top ranked external barrier, which is in line with the lack of environmental awareness of customers in this paper.

4.3 Drivers:

The drivers affecting EMS implementation in the construction industry were defined as factors that could be contributed to the development of the company's environmental performance. As shown in Fig. 3, the provision of financial support to companies was conceived as the highest ranking factor with a score of 4.04, and the second ranking factor was the competitive advantage gained by companies complying with environmental laws with an average score of 3.74. Contract conditions containing specific environmental requirements was the least driving factor with an average score of 3.50. The top ranking driver in this paper, provision of financial support, was not included in the survey of Hassan (2009). However, the second highest ranking driver in this paper was the competitive advantage for complying companies which is similar to the top two ranking drivers of Hassan (2009) where are EMS as a means of distinguishing organizations for their competitors and improving the public image.

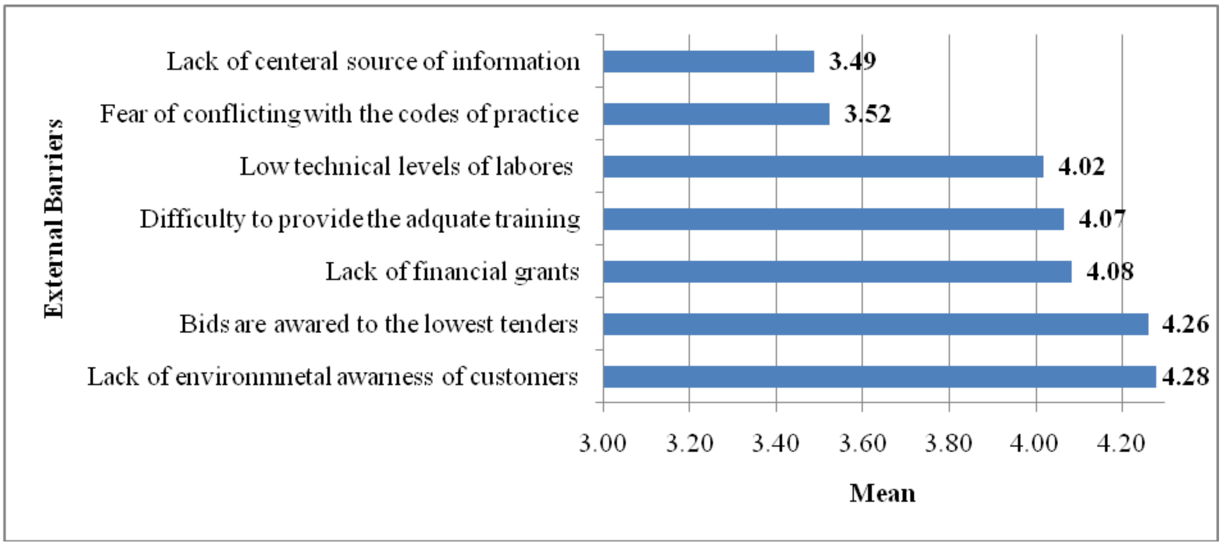

Fig.2 External Barriers to EMS Implementation

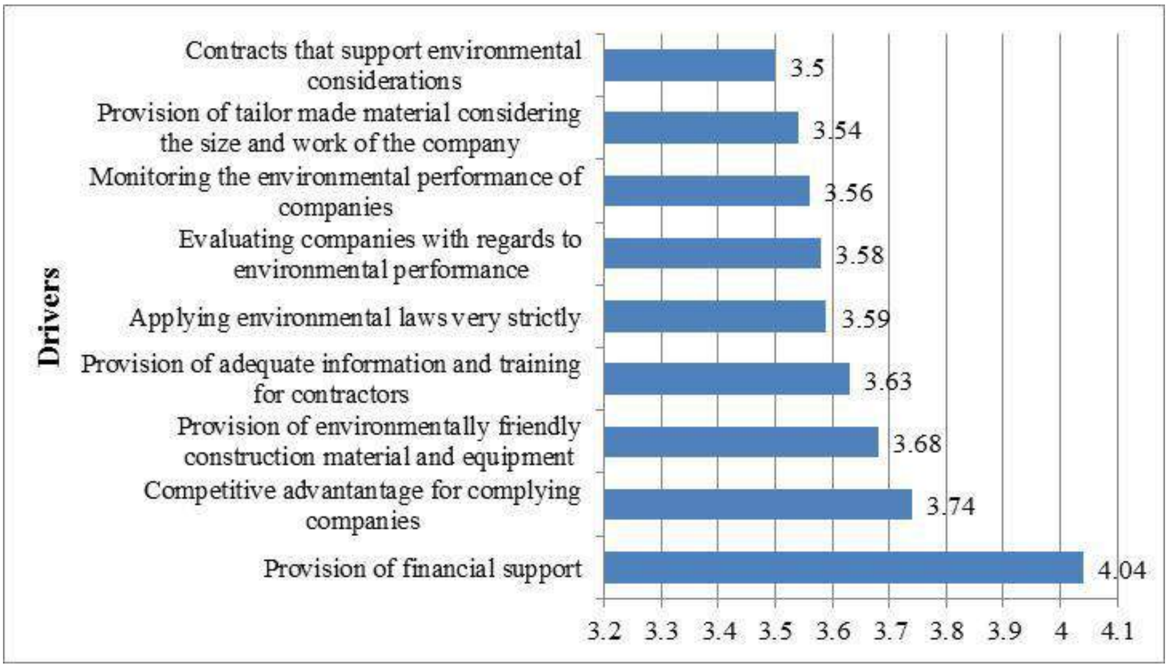

Fig.3 Drivers to EMS Implementation

4.4 Stakeholders:

The stakeholders affecting EMS implementation were defined as the parties which might exercise pressure/have influence on the companies to implement an EMS. In Fig. 3, it can be seen that most important stakeholder was top management with a score of 4.36. The bid awarder of public projects was seen as secondly important with an average score of 4.33. The Egyptian Environmental Affairs Agency (EEAA), EFCBC, and companies' suppliers had a same following importance with an average score of 4.32. In Hassan (2009) the client was seen as the top ranked stakeholder. This is similar in meaning to the bid awarder in this paper. Top management was ranked third in Hassan (2009).

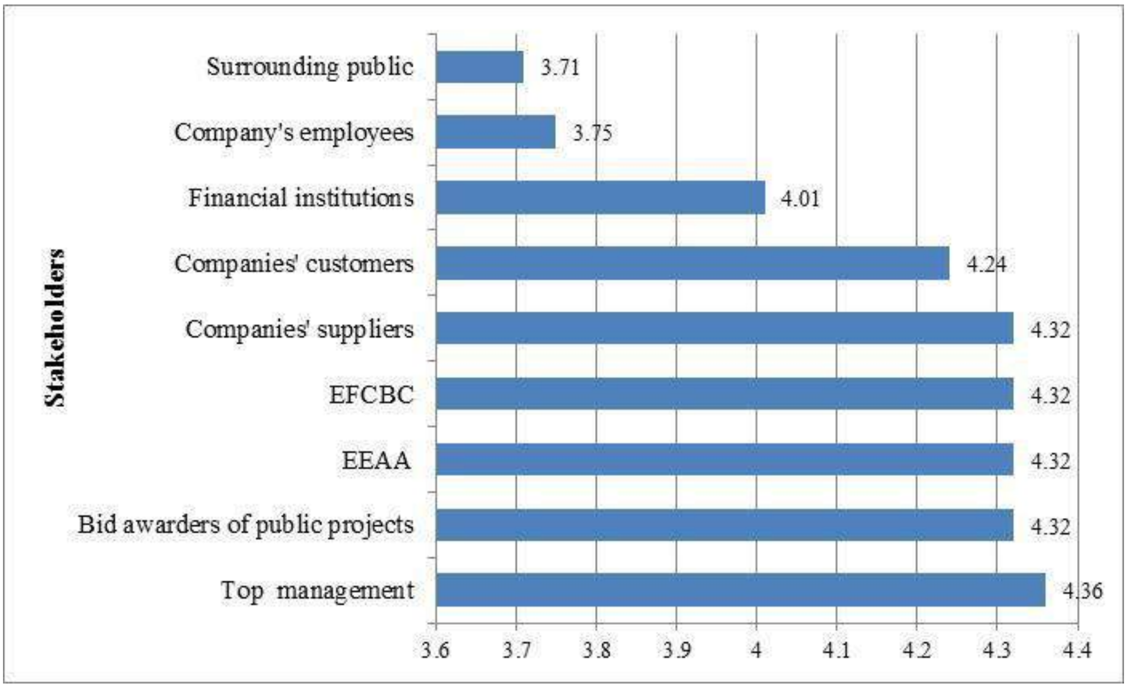

Fig.4 Stakeholders to EMS Implementation

4.5 Differentiation of Results:

The sample was categorized in different ways: according to company size into large companies and SME; according to contracting type as main contractors and companies working as both main and subcontractors (the group of companies working as only subcontractors was very small and thus neglected); according to project type as companies working in public projects only, and working in both public and private projects (the group of companies working in private projects was very small and thus neglected); and according to work scope of respondents working as site engineers or working as both site and design engineers (other groups were very small and thus neglected). These four ways of categorizing the sample had only two groups and were thus all tested for differentiation of results using the t-test. Normality was assumed for the sample and as per Gravetter et al., (2000) and Stevens (1996) in such a large enough sample size the violation of the parametric tests are robust against the violation of the normality assumption.

An independent samples t-test was conducted using SPSS software to compare the mean scores of barriers, drivers and stakeholders for each of the four categories described above, and the results thereof are shown in Table 2. It can be concluded that at the 0.05 level of significance no differences were found for categorization of results by company size, there was no significant difference for the categorization of contracting type for external barriers and stakeholders, while internal barriers and drivers showed significant differences of responses. As for differentiation using the project type groups, internal barriers, external barriers and stakeholders were not significantly different in results while a significant difference was found in drivers to EMS implementation. In the case of work scope of respondents, a significant difference was detected in scores of external barriers and drivers between groups, while differences among internal barriers and stakeholders were insignificant.

Table.2 Differentiation of Results using T-Test

Categorization	Factors	Mean	Standard Deviation	Significant value (2-Tailed)
1. Company Size	Internal Barriers	27.214	5.044	0.846
	External Barriers	27.179	5.071	0.243
	Drivers	32.945	7.898	0.966
	Stakeholders	38.214	6.649	0.170
2. Contracting Type	Internal Barriers	26.672	5.156	0.017
	External Barriers	27.597	4.896	0.350
	Drivers	31.896	7.572	0.018
	Stakeholders	38.033	7.600	0.579
3. Project Type	Internal Barriers	26.710	4.793	0.228
	External Barriers	27.000	4.950	0.092
	Drivers	31.580	7.301	0.036
	Stakeholders	37.246	6.805	0.751
4. Work Scope of Respondent	Internal Barriers	27.915	5.312	0.219
	External Barriers	26.333	5.235	0.037
	Drivers	29.571	5.819	0.014
	Stakeholders	38.857	4.509	0.247

The sample was categorized also by years of work experience, whereas, the sample is grouped as 0-10 years of experience, 10-20 years of experience, and more than 20 years of experience. The Analysis of Variance (ANOVA) was used to evaluate differences among means. Normality of the variables was assessed via the skewness and kurtosis of each variable. Low values of skewness and kurtosis, mostly less than one in the case of these variables, indicates (Curran et al. 1998). A one-way between-groups Analysis of Variance (one-way ANOVA) was conducted using SPSS software to explore the impact of the respondents work experience on the scores of the BDS. The test of homogeneity assumption showed that 2 out of 4 variables were significant at the 0.05 level, namely: internal barriers and drivers were found to be significant at the 0.003, 0.015 levels, respectively. Stevens (2002) suggested that ANOVA is reasonably robust to violations of this assumption provided the sizes of groups are within 1.5 of one another. Table 3 shows the results of conducting ANOVA to the survey sample results.

The F statistic was found to be non-significant in all variables at the 0.05 level, except for ‘stakeholders’ that was non-significant at the 0.006 level. The post-hoc Tukey HSD test revealed the differences in ‘stakeholders’ was due to significant differences at the 0.05 level between the (0-10) years of experience group and each of the (10-20) years of experience group. This is the least experiences group, showing it is responsible for most of the differences in results, and except for this group the results are mostly non-different.

Table.3 Differentiation of Results using ANOVA according to Grouping by Work Experience

Factors	Degrees of Freedom		Test Of Homogeneity of Variances		ANOVA	
	Between Groups	Within Groups	Levene Statistic	Signific-Ance	F Statistic	Signific-Ance.
Internal Barriers	2	104	6.111	0.003	2.413	0.095
External Barriers	2	104	1.558	0.215	1.172	0.314
Drivers	2	104	4.389	0.015	1.836	0.165
Stakeholders	2	104	2.077	0.131	5.425	0.006

It can be generally concluded that the majority of groupings did not show differentiation of results in the five different methods of categorization using the t-test for four of them and ANOVA for the firth. Furthermore, post-hoc Tukey HSD test in ANOVA pointed out the group of lowest experienced respondents (0 – 10 years of experience) was responsible for a good part of the differentiation in answers, and possibly affecting the unexplained differentiation in other categorizations.

5. Conclusion:

5.1 General Findings and Outcomes:

The construction industry is of particular importance to economy in Egypt and globally. However, the industry is responsible for a considerable amount of the energy consumption, pollution and other environmental issues. The adoption of Environmental Management Systems (EMS) such as that of the ISO 14001 standard can enhance efficiency, lower costs, reduce waste and increase employee productivity. This paper investigated the barriers, drivers and stakeholders of EMS implementation to facilitate its adoption and use. A questionnaire survey was conducted on Egyptian construction contractors to research the issue. Results of the survey were found to be in line with contemporary literatures/studies conducted almost synchronous to this paper, thus indicating validity of the research. The main internal barriers were the lack of financial resources and high implementation costs. The top external barriers were the lack of customer awareness and bids being awarded to the lowest price bidder. The main drivers of EMS implementation were the provision of financial support to companies and the competitive advantage gained by companies complying with environmental laws. Top management was the major stakeholder influencing EMS implementation, followed by the bid awarders of public project. Results' differentiation was tested among groups of respondents using t-test and ANOVA on SPSS software. The majority of groupings did not show differentiation of results, and the ANOVA test pointed out the group of lowest experienced respondents being responsible for a good part of the differentiation in answers, and possibly affecting the unexplained differentiation in other categorizations.

5.2 Recommendations:

The adoption of EMS in construction companies requires the attention of governmental and non-governmental agencies. For example, financial incentives or tax reduction schemes could be used to encourage EMS implementation. The inclusion of environmental issues in selecting bids or at least in contract conditions or technical qualification can be very effective as well. Organizations such as EFCBC and EEAA can play a significant role and coordination of efforts is required among organizations, with the Egyptian Green Building Council with its ministerial and institutional backing in position to play such a role. Further research in this topic is required, where the costing, benefits, and problems of implementation need to be researched, probably through in-depth case studies or action research. In general, this area requires considerable research that is inclined towards implementation and is of a pragmatic/practical nature to facilitate EMS adoption/implementation.

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