Journal of Information Systems Engineering and Management
2025, 10(28s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Impact Assessment of Environmental Management System Instrument of ISO 14001

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ARTICLE INFO

Received: 30 Dec 2024

Revised: 12 Feb 2025

Accepted: 26 Feb 2025

ABSTRACT

Application of ISO 14001-EMS standard in construction firms is used and being studied in different countries. In the Philippines, the province of Palawan, declared as the last frontier, considers environmental protection as its culture where constructions firms are being established through various and vast construction projects. This study aims to develop environmental management system assessment model instrument standard for construction firms in Palawan based on the ISO 14001:2015 – Environmental Management System. The survey questionnaire was constructed by the certified internal audit of ISO 14001:2015 EMS standard and distributed to the population of the construction firms in Palawan. The analysis of data includes descriptive statistical analysis such as mean and frequency. The results revealed that most of the construction firms in Palawan are private owned and did not apply ISO 14001:2015 in their construction firm. Most issues contraries and self-implication of assessment model are it requires more stable worker cost and most of the indicators in their firm has most criterion met but need more improvement. The assessment model instrument of ISO 14001:2015 EMS was further revised and analyzed using the principal component analysis and further its reliability using Cronbach alpha. The assessment model instrument was developed through data reduction using the Pincipal component analysis. It undergoes evaluation by as ISO certified individual.

Keywords: ISO 14001, Environmental Management System (EMS), Construction Firm, Palawan, Pincipal Component Analysis

INTRODUCTION

Construction firms are involved in the process of managing the construction of vertical or horizontal structures. The ongoing projects that the firms are involved, produce waste material through air, water and soil. Thus, some of the construction firm have efficient management system that they incorporate in their company to minimize and eventually prevent pollution they may cause in the environment [1].

The International Standardization of Organization had introduced and revised the ISO 14001 to ISO 14001:2015 namely Engineering Management System standard. This standardization had become applicable to construction firms and companies [2]. It allows the company to incorporate in their management system the environmental checklist and policy which result to reduction of products of environmental pollutants[3]. Every step of their company and management are related in the continuous improvement of management system which involved the environment [4]. Studies had also shown that not only on the environmental reduction impact of the company it continuously support but also to the marginal profit of the company [5].

The ISO 14001 which has been revised to ISO 14001:2015– Environmental Management System standard is implemented to some selected countries of construction firm, where its effect also depends in the area or topography of application where it is implemented [6]. Researches had identified that the benefits of ISO 14001-EMS on construction firm are improved public image and improved regulatory relations. The ability to increase the price, gain protection against negligence of the environmental effects and promote management control are also some of the potential benefits of ISO 14001 certification [7]. The environmental issues cannot be addressed by the construction firms separately because they had built up a system that requires planning, implementation, monitoring and continuous improvement which was the key elements of implementing Environmental Management System. As

it is stated, the environmental management at the project, structure and organization level at construction firm are important [8]. Thus, the International Standardization Organization had implemented the ISO 14001-EMS to the firms.

ISO 14001:2015 is a process of providing companies with framework in order to protect the environment and respond to balance the changing environmental conditions with socio-economic needs [9]. Allowing a balance between the environment, society and the economy is considered necessary to meet the needs of the present conditions without compromising the future generations needs which leads to achieving the sustainable development [10].

The ISO 14001:2015 specifies the requirements needed by the construction firm in order to achieve the intended outcomes its sets for its environmental management system [11]. An environmental management can provide information to the top management in a systematic way to create the long term options in order to contribute to the sustainable development. It can be done through the firms contribution by giving attention to the preventions or mitigation of adverse environmental impacts thus promoting environmental protection [12]. It can helped the construction firm to mitigate the potential adverse effect of environmental conditions within the firms and it couls assist them to fulfill the compliance obligation [13].

ISO14001:2015 assessment model is a self-managed procedure, and so its achievement is contingent mainly on the organization's promise inside the group. Numerous governments might fail to attain the areas of ISO14001:2015 owed to an organization assembly's absence of the pledge obligatory in terms of time and money [14].

There is no hesitation that ISO14001:2015 has assisted countless organizations to decrease their impression on the surroundings. This achievement bounces worldwide from an extensive variety of commercial subdivisions and extents; though it is clear that there are chances to advance ISO14001:2015 to encounter the tests for the approaching years [15]. Moreover, requirements to completely decrease the danger of government's misusing the accomplishment of ISO14001:2015 guarantee for their individual improvement when they create negligible developments and then receptive stakeholders such as patrons and stockholders [16].

The province of Palawan in the Philippines, was proclaimed the last frontier, thus environmental issues are growing interest in some studies that demand the enterprises to implement policies, techniques and procedure on managing the environmental impact of their activities [17]. The construction firms are one of the enterprises that are tackled by the local government units and the provincial government to have in their managerial system on environmental awareness [18].

In this context, there is a need for helping the construction firms of Palawan to comply the specific requirements in composing their present environmental management system in accordance to the ISO 14001:2015 standards [19]. Thus, this study was conducted to create a assessment model instrument based on ISO 14001:2015 Environmental management system in order to assist the construction firms in Palawan to comply with the foregoing standards and in order to assess their construction firms environmental management system so that they can contribute to the Philippine Agenda of sustainable development [20].

METHODS AND METHODOLOGY:

The study was both qualitative and quantitative in data collection in determining the main objectives of the study which are to develop environmental management system assessment model instrument based on the ISO 14001:2015 (environmental management system standards) in construction firms in Palawan. The assessment model instrument where first constructed at the beginning of the study. The researcher attended the internal audit course to produce a questionnaire and internal audit assessment model instrument. The assessment model instrument was distributed to the population of the construction firms in Palawan.

The data was gathered in the different construction firms in Palawan and it presented in the form of table and had been analyzed. Data representation was in the form of graph this was used for discussion of the analysis. Descriptive statistics was used in analyzing the implication of the answers of the respondents as basis of refining the model instrument that was produced. Furthermore, the model instrument has been tested for reliability using Cronbach Alpha and finally it was produced and develop through the use of extracting tool principal component analysis.

Phase I. Development of idea on ISO 14001:2015-EMS

This phase of the study includes compilation of information of the ISO 14001 which serves as the standard for developing Environmental Management System in different parts of the world in its application in construction firms. This phase includes gathering information used in the studies on developing the assessment model instrument on environmental management system of different construction firm in Palawan. In this phase the elements of environmental management system standard which is the management tool that enables a certain construction firm of any size to control the impact of its activities, products or services on the environment was determined as the basis for drafting and formulating of survey questionnaires to be used in the study. The result of this phase has produced a guideline in the formulation of questionnaires that has been used in the study. The development of assessment model instrument on environmental management system for construction firm in Palawan was conceptualized in this phase with the use of Principal component analysis as a tool.

Step 1. Compilation of information and related studies about ISO14001-EMS in construction firms

Information about ISO 14001 in construction firms was obtained from the published studies, journals and websites. Recent literatures that can support the need for construction firms to consider developing and implementing the environmental management system standards. These related literatures and information were compiled as source of the development of the idea on producing the assessment model instrument of ISO 14001 in construction firms in Palawan. The related studies about ISO 14001-EMS in construction firm was provided information of the effects and benefits of study that has already been conducted in the construction firms in other countries.

Step 2. Accumulation on evidences on Palawan, Philippines as environmental protected area

Research on the information about the mainland Palawan as environmentally protected area through readings of books, journals, pamphlets and other information paraphernalia regarding Palawan was done. Data on the number and size of construction firms in main land Palawan were gathered. These information about Palawan particularly its policies and laws on environmental protection was compiled as basis of describing Palawan as the research setting of the study.

Step 3. Development of idea on coverage of ISO 14001:2015-EMS on assessment model instrument and the used of analytical hierarchy process as a tool

The elements to be included in the questionnaires was based on the ISO 14001:2015 environmental management system standards. According to the related studies through this research instruments implementation of ISO 14001-EMS can be applied to different organizations like construction firms but will differ only in the application and condition unto different topographies that it will be applied. The elements of ISO 14001:2015 are each defined in the questionnaire that has to be monitored and serves as guidelines and framework. The analytical hierarchy process has been used as a tool for decision making and a method of mathematically and tested as stated on the related literature. It has been a tool in developing various complex items and ISO 14001 was one of the parts.

Phase II. Development of Data

In this phase, the researcher has attended the internal audit course at the beginning. The survey questionnaire and assessment model instrument were formed in this phase. The knowledge that has been acquired in the training on internal audit course was applied to develop a self-survey assessment model instrument and survey questionnaire. The survey questionnaire was distributed to the construction firms located to the different parts of the main Palawan for confirmation. After a week and several days the survey questionnaire and the assessment model instrument was gathered. The result of this phase has then produced a data presented through graph and tables for analysis and discussion.

Step 4. Attend internal audit course on ISO 14001:2015-EMS Standard

The ISO 14001:2015-EMS standard has been applicable in some areas and companies. The researcher attended a particular internal audit course conducted by SGS Philippines company which has help to improve and modify the questionnaires to be determined and to be analyzed in this study. The Internal audit course involves assessing the company or the construction firms' environmental management system through the elements of the ISO 14001:2015 EMS standard.

Step 5. Develop an ISO 14001:2015 EMS survey questionnaire and assessment model instrument

The researcher has established a particular questionnaire that can assess the environmental management system of each construction firms in Palawan. This survey questionnaire also involves identifying the demographic profile of the construction firms. The assessment of each construction firm in each of the elements of ISO 14001:2015 can help improve and will serve as a tool in producing the assessment model instrument for construction firms in Palawan in developing its framework in the managements system regarding the ISO 14001:2015 EMS standard.

Step 6. Distribute and gather the survey questionnaire and assessment model instrument throughout Palawan

The survey questionnaire has been distributed to different parts of the main land of Palawan particularly Puerto Princesa City, Roxas, Aborlan and Brooke's Point. The survey questionnaire and assessment model instrument were distributed to the construction firms using motorcycle, hired tricycle and van. The engineer or the employee of the construction firm was asked to answer the survey questionnaire and assessment model instrument for the status of their construction firm. The engineer has accepted the questionnaire and was ask for contact numbers for the follow up for the collection of questionnaires. The list and location of the construction firms in Palawan were provided by 2nd District of the Department of Works and Highways.

The questionnaire was gathered through contact numbers of the engineer or the employee on what date the questionnaire was finished. Some of the questionnaire that has been gathered were gathered a week after or more. The questionnaire was gathered and were open each for the input process of data. The data was encoded first into frequency of the data and furthermore into a graph form and into summary form. The data came from the population of construction firms in the main land of Palawan as 18 respondents.

Step 7. Preparation of data for analysis

The data are arranged and encoded through a table. Each element of the ISO 14001:2015 have enlisted 18 respondents. Each data represents the respond of construction firm in a table form. There are 141 items of elements on the data of Assessment model Instrument. The demographic profile was also encoded in table form to express and easy to analyze each. The importance and constraints of applying of the elements of ISO 14001:2015 in each of the construction firm are put also in table form and also for easy analysis.

Phase III. Analysis of Assessment model instrument

In this phase of the study, the data gathered was analyzed and discussed in line with the main objective of the study which is to produce an assessment model instrument on environmental management system. The data were described using descriptive analysis such as mean and frequency. The demographic profile of each construction firms of the main land Palawan was described as basis for the limitation of the assessment model instrument that was produced.

Descriptive analysis was also used to describe how important the issues on environmental management system and constraints on each construction firm in the application of ISO 14001:2015 EMS. Descriptive analysis was also used to describe the items on assessment model instrument based on ISO 14001:2015. The Cronbach Alpha was used to test the reliability and validity of the assessment model instrument.

Step 8. Descriptive statistics to discuss the demographic profile of construction firms

Descriptive statistics such as frequency and mean were used to describe the demographic profile of the respondents of construction firms in Palawan. The data gathered were then summarized using graphs and table and described through the use of percentage. The discussion base was limited only to the construction firm that where the refining of the assessment model instrument that was produce in the later of the study was based. The responds of the 18 respondents serve as the basis for analyzing and describing of data.

Step 9. Descriptive statistics to relay the importance, constraints and self-implication of assessment model instrument

Descriptive statistics were also used to discuss the importance of some of the important issues in environmental management system of the construction firms in the application of ISO 14001:2015 EMS. The frequency of the data was encoded and formed into summary of the data. The mean rating of each of the items of the issues for application of ISO 14001:2015 EMS were summarized and also the descriptive rating of each of the mean rating. The following

are the range of rating: the mean rating of 1 to 1.49 would implicate of “not important”, 1.5 to 2.49 mean rating would indicate “somewhat important”, 2.5 to 3.49 mean rating would implicate the mean rating of “importance”, 3.5 to 4.49 mean rating would implicate “quite important”, and finally, 4.5 to 5 mean rating would implicate “very important”. The constraints on application of ISO 14001:2015 or assessment model instrument has been also analysed using descriptive statistics such as frequency and mean. The same scale of mean rating was applied to the description if they would agree or not as descriptive rating.

The assessment model instrument was further discussed on the present application of construction firm in their company. Descriptive analysis also was used to describe the rating of the respondent or the construction firm on their company in the application of ISO 14001:2015 EMS internal audit. Each of the item was described as for their involvement in particular. This implies that each of the construction firms has different knowledge on ISO 14001:2015 EMS and application of the items or indicators were used in their construction firms. The assessment model instrument was assessed by each of the construction firm or respondent that they had already been applied to their company. The assessment model was also assess based on the parts as context of the construction firm on environmental management system, leadership, planning, support, operation, performance evaluation and improvement. Contained in the ISO 14001:2015 each item was discus through system-input process, implementation and outcome.

Step 10. Principal component analysis for reduction of unnecessary data for assessment model instrument

The data where further develop through a table. Each of the elements of assessment model instrument based on the ISO 14001:2015 EMS undergo principal component analysis. At the beginning there are 141 items of questionnaire each subdivided to 18 elements of assessment model instrument based on ISO 14001:2015 EMS standard. Each of the 18 categories undergo the Principal Component Analysis. Then each of elements of 18 of the assessment model instruments were reduce.

Step 11. Reliability test for assessment model instrument using Cronbach Alpha

The assessment model instrument was further test and refine through the application of the reliability test using the Cronbach Alpha. The assessment model instrument used in this statistical tool for confirmation and test. The assessment model instrument fail and it has item return to the revision of making the assessment model instrument and will undergo again the process from step 5 which is develop an ISO 14001:2015 EMS survey questionnaire and assessment model instrument until the assessment model instrument pass the test of the reliability.

Phase IV. Develop Assessment Model Instrument

In this phase, the assessment model has produced. Using the Principal Component analysis with the verdict of critics which determine the best choice in each item of indicator such as context of the construction firm on environmental management system, leadership, planning, support, operation, performance evaluation and improvement.

Step 12. Develop of assessment model instrument of EMS through critic of experts

After the assessment model instrument had pass the reliability test, the assessment model instrument were further applied of the through critics of a construction firm which determine the best item that is applicable to it. The data of critics are further analyzed through application of principal component analysis. Then, the assessment model instrument are ready for the application in construction firms.

The assessment model instrument was developed and has been applicable only to the limits of the demographic profile in which the construction firm has answer the questionnaire or the respondents. The assessment model instrument can be further developed through developing of idea again.

Theoretical Framework

The ISO 14001:2015 is a standard with the definition of environmental management system is a system that incorporates the elements and indicators of a construction firm based on standards. It will provide a framework that incorporates to management system to prevent the environmental impact of construction firm in a particular area. Palawan is an island with an environmental law of Republic Act 7611 which is the strategic environmental act which serves as environmental policy. Construction firms which produce waste and pollution during the process of building had been growing in the land of Palawan.

In this study the researcher has develop a framework which serves as guidelines of the construction firm to lessen the environmental impact and then eventually help the management system of each construction firm especially in the land of Palawan. Using the pincipal component analysis the data gathered and the elements of ISO 14001:2015 EMS standard based on the construction firms in Palawan has produce an assessment model instrument which can help and be a basis of construction firms in implementing and in the management system of each construction firm in Palawan.

RESULTS AND DISCUSSIONS:

1. Profile of the Respondents

This section presents the profile characteristics of the construction firm and Training Programs participated and conducted.

A. Number of years of existence of the Construction firm

Half (50%) of the construction firms in Palawan existed for 16 years and above and the rest existed for 15 years and below as shown in figure 1. It can be noted from these data that some of the construction firms are still in their early stage of existing.

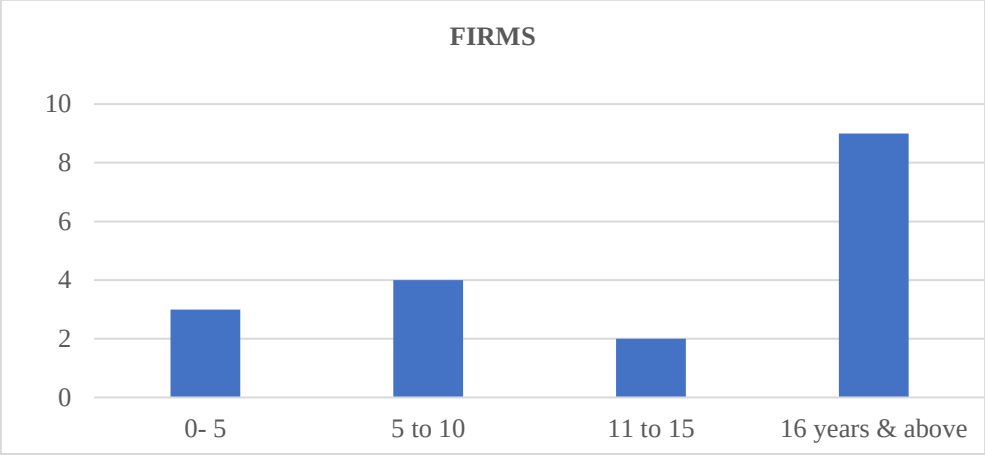

Figure 1. Number of years of existence of the construction firm

B. Characteristics Profile of the Respondents

Table 1 shows the respondents' characteristics profile. Respondents have construction firms which are privately owned (56%) and 44% family owned. More than half of the respondents have 1 to 30 number of employees (67%), (17%) have number of employees within the range of 31 to 60 and same percentage with 61 to 90 number of employees. However, the average size of employees in construction firms is 28. In terms of location of the headquarters, (61%) of the construction firms are located within the Urban and only 31% of them from Rural. As to the classification of works undertaken, mostly (39%) are in the infrastructure projects, 33% are into general buildings while, 28% are into general engineering.

Moreover, according to number of engineers present in the construction firm, 78% of the respondents confirmed that they have at least 1 to 5 engineers, others (17%) said that they have 6 to 10 engineers and only 6% of them have 11 to 15 engineers. The results show that most of the construction firm in Palawan are privately owned with a mean number of employees of 28.33 and 1 to 5 engineers, and mostly are in the seat of the city. Generally, they engaged into general buildings and infrastructure projects.

Table 1. Characteristics profile of the respondents.

Characteristics	Frequency (n=18)	Percentage
Ownership		
Family-owned	8	44%
private	10	56%
public	0	0 %
Size (number of employees)		
1 -30	12	67%
31-60	3	17%
61-90	3	17%
Mean Size	**28**	
Location of headquarter		
Rural	7	39%
urban	11	61%
Classification of works undertaken		
General buildings	6	33%
Infrastructure projects	7	39%
General engineering	5	28%
Number of Engineers		
1-5	14	78%
6-10	3	17%
11-15	1	6%

C. Awards, Training conducted and participated in, by employees in relation to Environmental Management System

Most of the respondents **(56%)** affirmed that they did not conduct trainings for their employees on environmental management system while, **44%** of the respondents conducted trainings as shown in table 2. Only **39%** of the respondents confirmed that their employees participated in training programs in environmental management system and **61%** of them did not participate in. Only **6%** of the respondents said that they have received an award the rest did not obtained an award. The results show that most of the construction firm did not involve themselves in the conduct and participation of the employees to trainings on environmental management system though some of them received some award.

Table 2. Involvement of Employees of Construction Firm in Training Programs and awards

Involvement in Trainings	Frequency (n=18)	Percentage
Conducted Trainings		
yes	8	44%
no	10	56%
Participating In Training Programs		
yes	7	39%
no	11	61%
Received awards		
yes	1	6%
no	17	94%

2. Important Issues, Constraints and self-implication on applying assessment model instrument based on ISO 14001: 2015 Environmental Management System of the Construction Firms.

A. Implementation and Familiarity on Environmental Management System (ISO 14001;2015)

Table 3 presents how the construction firm in Palawan are familiar and has implemented the ISO 14001: 2015 the conformity to environmental management system standards. There are 83% of them responded that they did not still implemented the environmental management certification and only 17% implemented it. Only 50% of the respondents said that they are familiar with ISO 4001:2015 and 33% are not familiar, however there are (17%) still seems somewhat familiar. In terms of the understanding on the benefits the construction firm will get after applying for ISO 14001: 2015 only 44% of the respondents knew the benefits. Some 39% of them "somewhat" knew the benefits but others (17%) did really clear to them the benefits of ISO 4001:2015. These results implies that there are still construction firm in Palawan did not aware about the standards (ISO 4001:2015) on environmental management system.

Table 3. Implementation and Familiarity on the Environmental Management System (ISO 4001:2015)

Criteria	Frequency (n=18)	Percentage
Implemented EMS Certification		
yes	3	17%
no	15	83%
Familiarity with ISO 4001:2015		
yes	9	50%
somewhat	3	17%
not	6	33%
Clear about the Benefits after applying for ISO 4001:2015		
yes	8	44%
somewhat	7	39%
not	3	17%

B. Important Issues About Environmental Management system within the Construction Firm

The respond of the respondents to the important issues about environmental management system is shown in Table 4. It can be deduced as shown that in terms of the issue on the environmental performances they regard "reduce pollution", reduce environmentally liability and risk", reduce energy and natural resources consumption" and improve management of environmental impacts" as important issues to be considered in the management of environment on their ongoing projects. As to "management effectiveness" the respondents regarded the "improve among operation staff" as quite important. While, the rest on management effectiveness issues are important to the construction firm.

On the other hand, on the issue of "competitive advantage" the respondents regarded "greater market shares" as important but the issue on "better company image", access to new markets" and "enhance competitiveness" are quite important issue in the environmental management system. Moreover, in terms of regulatory effectiveness, the respondents assessed it as important issue. But when it comes to financial impact the "greater access to capital" is quite important to them and the "decreased insurance cost", "fewer regulatory fines", "decreased permit costs" are important issues. Lastly, according to the issue on the aspect of stakeholder "client/customer requirement" is quite important and other aspects like 'pressure group/community member requirements", "buyer requirement" and "lender requirement" regarded as important issue in the environmental management system. This result indicates that issues on environmental management system is considered as important area of giving emphasis by the construction firms.

Table 4. Important Issues on Environmental Management System within the construction firms

Issues	Mean Rating	Descriptive Rating
Environmental Performances	3.26	important
Reduce pollution	3.22	important
Reduce environmental liability and risk	3.39	important
Reduce energy and natural resources consumption	3.22	important
Improve management of environmental impacts	3.22	important
Management Effectiveness	3.36	important
Improve communication among operation staff	3.89	quite important
Streamline the operation on environmental management	3.06	important
Demonstration of environmental stewardship	3.00	important
Effective marketing opportunities	3.39	important
Cost reduction	3.44	important
Competitive Advantage	3.57	quite important
Better company image	3.78	quite important
Access to new markets	3.50	quite important
Enhance competitiveness	3.89	quite important
Greater market shares	3.11	important
Regulatory Effectiveness	**3.26**	**important**
Revised approach to regulatory inspections	3.06	important
Greater permit flexibility	3.33	important
Improved compliance with government regulations	3.39	important
Financial Impact	**3.31**	**important**
Decreased insurance cost	3.00	important
Fewer regulatory fines	3.44	important
Decreased permit costs	3.11	important
Greater access to capital	3.67	quite important
Stakeholders	**3.15**	**important**
Client/customer requirement	3.94	Quite important
Pressure group/community member requirements	3.22	Important
Buyer requirement	2.78	Important
Lender requirement	2.67	important

C. Constraints of Applying for ISO 14001:2015 in Construction Firms

The respond of the construction firm to the constraints of applying for ISO 4001:2015 is presented in Table 5. In terms of management difficulties, excessive paper works for documentations, regulatory difficulties and financial difficulties, the respondents are undecided on this matter, they are not yet sure about these constraints based on the results.

Table 5. Constraints of Applying for ISO 14001:2015 in Construction Firms

Issues	Mean Rating	Descriptive Rating
Management Difficulties	2.78	undecided
Lack of top management support	2.67	undecided
Lack of operation staff support for implementation	2.78	undecided
Lack of time to implement a quality EMS	2.89	undecided
Excessive paper works for documentations	3.00	undecided
Lack of knowledge in understanding ISO 14001: 2015 requirements	3.00	undecided
Regulatory Difficulties	3.26	undecided
Uncertainty on environmental management system information	3.22	undecided

Potential legal penalties from voluntary disclosure	3.33	undecided
Lack of regulatory flexibility	3.22	undecided
Financial Difficulties	**3.24**	**undecided**
High initial or registration cost	3.22	undecided
High maintenance cost	3.17	undecided
Design cost of ISO 4001: 2015 EMS	3.06	undecided
More staff work hours = overtime costs	3.50	agree

CONCLUSION

Based on the results of the study the researcher concludes the following: most of the construction firm of Palawan are private owned and include 1 to 5 engineers. On the other hand, they have limited source of leaders who can apply and use the ISO 14001:2015 although some have implemented their environmental protection. Some were not active in conducting and participating in training leading to ISO applications.

They mentioned that one of the reasons that they were not be able to apply the ISO 14001:2015 EMS, because it will require them more stable workers and they perceived it will cost them. On the other hand, they agree that if this can be applied in their firm, it will improve communication and operation of staff, better company image, access to new market, enhance competitiveness and will have greater access to capital.The assessment model instrument produced would imply that some of these indicators had been applied to their construction firm and they are evaluated through these questionnaires and they help in modifying this assessment model instrument through the use of principal component analysis and test of reliability. A new assessment model instrument has been produced for self-evaluation of their firms in relation to a particular International Organizational Standard of 14001:2015 Environmental Management system.

Acknowledgement

This thesis would have remained a dream had it not been for the guidance, support and unending help of several individuals who is one way or another contributed and extended their valuable assistance in the preparation and completion of this study, the researcher extends her deepest appreciation and utmost gratitude to the following: To engineers of construction firm in Palawan, for allowing the researcher to conduct and answer the survey questionnaire of the researcher; It is with great pleasure to acknowledge the support of Dr. Noel L. Gauran and Miss Sharon Rose P. Anunciado, who helped in the statistical analysis. To her friends Amyr Lien V. Miranda, Chira Mae Anadon, Fatima Janoras and the Life Group Family of the church in helping her in prayers and support morally.

To her cousins Davis John C. Hilario, Dennis C. Hilario, Dianne C Hilario and all cousins to my mother side for the encouragement, help and support morally for the researcher to continue this study. To her grandma Felecitas F. Suerte and Concolacion A. Canilla, for support and encouragement to pursue this study. To her tita and tito Thelma C. Hilario, Virgilio Hilario, James Suerte, Marivic Suerte, Nemrod Suerte, Mila Suerte, Jessie Suerte, Alfredo Suerte and Ester Suerte for their love to share in the researcher and in morally support her in the conduct of the study.

To her brothers, John Karl S. Canilla, Kevin S. Canilla, Klint S. Canilla, and o her parents Lea Linda S. Canilla and Edmundo A. Canilla for unending love, care and support in the conduct of the study; To her friends, 30th batch of ASHS, to Lea Untalan, Fatima Palad for their moral support and help on the researcher; The researcher is grateful to her professors, roommates and classmates in the graduate school for sharing their knowledge, expertise, educational information, ideas and for the inspirations; Above all, her utmost appreciation and thanks to the Almighty God for the love and care and for making her life wonderful despite of struggles and difficulties and for the divine intervention in this academic endeavor.

K.C.S.C.

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