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Study of the relationship between the performance of medical centers and the establishment of environmental management system

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Abstract

Introduction: In recent years, many organizations have used management system certification such as the Environmental Management System (EMS). The purpose of present study is to assess the effect of Environmental Management System (ISO14001) on hospital performance. This is an applied (regarding the purpose of the study) and descriptive research and data are gathered through secondary (library) and primary (questionnaires) sources. This is applied and causal. After confirming the validity and reliability of the questionnaire, it was used for data collection. The research population includes hospital staff. This community was considered limited and therefore all the staff were studied. The results were analyzed using structural equation methods with Smart-PLS software. In addition, the results indicate that three variables of environmental management system, environmental training of human sources and environmental management program have a direct and significant effect on hospital performance.

methods: Gas cogeneration systems have been studied in terms of pollution and noise produced for residents. Due to the multiplicity of primary actuators, only natural gas actuators that can be implemented in residential buildings are considered here. All calculations have been done for residential buildings with EES software and after analyzing the gas cogeneration system,

Results: The results have been compared with the solar cogeneration system. The initial cost of the systems, the pollution created and the amount of noise in the various prime mover of the cogeneration systems have been examined and the cogeneration system with the solar collector has been described as the cleanest, quietest and the most expensive cogeneration system.

Conclusion: It is possible to use the cogeneration cycle in all areas and in any weather conditions, while the use of the cogeneration cycle is suitable in areas with high hours of solar radiation, which is one of the weaknesses of solar systems.

1. Introduction

Today, the implementation of efficient management principles in hospital administration is necessary more than ever. Most hospitals have recognized the significant role of system in coordinating their activities to lead them toward organizational goals. They try to implement effectively and

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efficiently the new management tools that the system provides to achieve goals such as providing employee and customer satisfaction and continuous improvement with proper planning.

In recent years, many organizations have used management system certification such as the Environmental Management System (ISO 14001). Although, in the past, the implementation of these systems was considered the pride of an organization; today, it is necessary in order to survive an organization and may be in the near future it will become to an inseparable part of an organization. This International Standard can be used by internal and external parties, including certification bodies, to assess the organization's ability to fulfill customer requirements, regulatory requirements, and applicable rules for service delivery and organizational requirements. In the present study, the effect of environmental management system (ISO 14001) on the performance of hospital.

The environmental management system is one of the most prominent tools for protecting the environment in the world. All human activities have environmental consequences, and health-care services, including hospitals, are no exception. Hospital services improve health and save lives. At the same time, the activities of hospitals produce hazardous and non-hazardous wastes (such as pharmaceutical, infectious, toxic and radioactive wastes) and a large amount of natural resources are also consumed. Today, observance of environmental criteria in terms of legal requirements as well as stakeholder satisfaction, including health care employees, is one of the management principles. To meet these demands, environmental management systems such as the ISO 14000 series have been developed.

Despite the growing interest in the implementation of optional management systems, there is little empirical evidence of the impact of these systems on the environmental performance of organizations(Heras-Saizarbitoria, Dogui, & Boiral, 2013; Ryan-Fogarty, O'Regan, & Moles, 2016) . A number of studies have highlighted the lack of information resources for further analysis(Hertin, Berkhout, Wagner, & Tyteca, 2008). In addition, the results of the research conducted in this case are different and in some cases contradictory(Daddi, Magistrelli, Frey, & Iraldo, 2011; Wagner, 2002).

Another research is conducted to show whether the implementation of Environmental Management System (EMS) has a positive impact on eco-friendly performance of companies. There are several tools to assess the performance of organizations and to measure the success rate in achieving the goals, which are chosen according to the nature of the organizational system and its way of success. The purpose of this paper is to measure the effect of environmental management system (EMS) on the performance of hospital.

Research hypotheses:

The main hypothesis 1: The implementation of an environmental management system (ISO14001) is effective on hospital performance.

Sub-hypothesis 1.1: Implementing an environmental management program based on ISO 14001 is effective on hospital performance.

Sub-hypothesis 1-2: The training of human resources based on the ISO 14001 influences hospital performance.

According to the definitions given and the previous researches, the following conceptual model (Figure 1) is presented to study the effect of the implementation of an environmental management system on hospital performance:

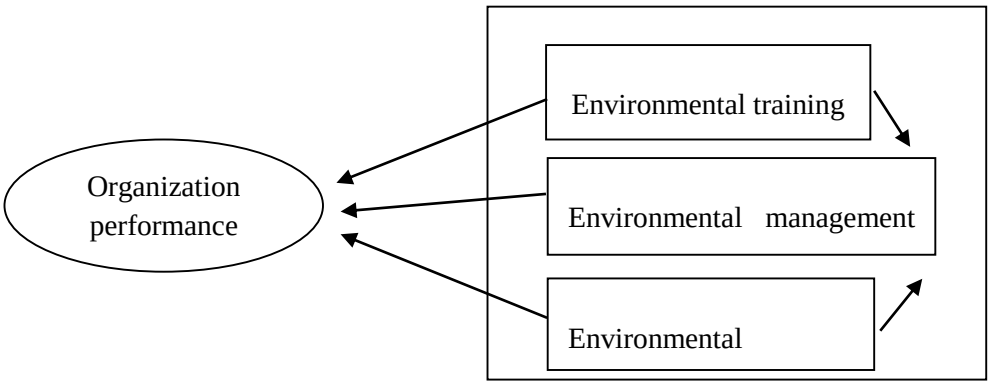

Figure 1: Conceptual Model of EMS Research

Definitions:

- ISO 14001: This international standard specifies the requirements for an environmental management system to enable the organization to identify and implement its policy and objectives, with considering legal requirements and the relevant environmental information(Zilahy, 2017).

- Performance: The measurable result of an organization management compared with its taken actions is called performance(Herrmann, Kearney, Röger, & Prahl, 2017).

- Environment: An environment, including air, water, and soil, where the organization operates(Rino & Salvador, 2017).

2. Methods

This is an applied research based on the purpose of the study, and its method is applicable to those organizations and institutions that are related to its statistical population. Structural Equation Modeling (SEM) is a multi-variable, strong and general technique of analysis, which belongs to multivariate regression family; more precisely, it is a general linear model expansion, which allows the researcher to test a set of regression equations and to examine the relationships between different variables, simultaneously.

The importance of this technique in the management and health care sciences and medicine is that, typically, the researcher in these fields examines the relationships between different variables in the form of a network of relationships and presents its general idea in the form of a conceptual model(10). At this stage, the researcher estimates the size of latent variables or factors by using observable variables. For example, the researcher estimates the performance of a hospital, which is a latent variable, through observable variables such as training and planning that are specified by the questionnaire, and structural equation modeling can be used for this purpose. The first generation of modeling of structural equations with a covariance-based approach had high sample size. Soft wares such as Lisrel, Amos, EQS and M-Plus are four commonly used soft wares in this approach and the first generation of structural equation modeling. Due to some limitations of this method, another approach was introduced that became well-known as the second generation of structural equation modeling (PLS-SEM). The ability of this approach to use little data, the lack of sensitivity to data normalization, the ability to predict and support sophisticated models, and its ability of formative and reflective measurement made it well known among the researchers. Subsequently, a variety of software was introduced to implement this approach; software such as Visual-PLS, PLS-Graph, Warp-PLS, XLSTAT and Smart-PLS. The last software is the most widely used one, which is also used in this research. The data needed for analysis in the form of model parameters is provided to the software. The software uses observed variables provided by the

researcher to estimate the latent variables. The observable variables include those variables that the researcher collects from the samples, and the latent variables are the ones that the researcher expects the designed model to show them.

The relationships between latent and observable variables in the model are called factor loadings that include regression coefficients used for predicting observable variables by latent ones. Output of the analysis is an estimated parameter which is the result of fitting the input data to the model specified by the researcher. Since the parameters of the model (or latent factors) are estimated based on the observed parameters (the result of the initial analysis of the raw data by the software), the number of observed factors must be more than the number of latent factors.

The general steps for implementing the structural equation modeling method are:

A) Description of the study,

B) Drawing the outline of the research model (latent variables, observable variables, and relationships between them) and controlling requirements of implementing the structural equation model,

C) Calculating the designed model and fitting and modifying it

D) Proper interpretation of the findings

The main question of the study is whether this model, which is proposed and designed, based on the hypotheses of the relationship between variables fit into the data collected from the study population; in other words, is the model supported in that society statistically? For this purpose, it is necessary to draw diagrams and specify the expected relationships between the variables (which represent the hypotheses of the research). In the diagram, usually latent variables are represented by geometric forms of elliptic or circle, and observed variables or indices are represented by squares or rectangles.

A structural equation model consists of two parts: the first part consists of a measurement model that defines the relationship between explicit (measured) variables and estimated variables or factors. The second part also includes a structural model that shows how factors are interconnected (Fig. 1). After specifying the proposed model and entering the relevant data into the software, the researcher will run the SEM in order to perform the fit test.

In this research, a field study has carried out to collect information regarding testing hypotheses. On the other hand, in the current research, the literature and theoretical background are based on valid scientific sources. The data collection tool is a questionnaire, which has 15 questions designed in two sections: The first part covers the demographic variables of the respondents, and the second part includes questions related to the main variables of the research - the environmental management system, the environmental training of human resources, the environmental management program and the performance. In this regard, there are nine questions about the environmental management system, three questions for the environmental training of human resources, six questions related to environmental management and six questions for measuring the performance of the hospital.

In order to measure the indices in the questionnaire, the 5-point Likert scale was used which is one of the most common measurement scales. Scoring the questionnaire is as follows (Table 1):

Table 1: scoring method based on the questionnaire

Completely agree	Agree	undecided	disagree	Completely disagree	answer
5	4	3	2	1	score

By giving questionnaires to each staff member, they were asked to carefully read the questions and, according to the given scale, mark the closest response to their status in the questionnaires.

The number and structure of research questions based on the research variables are presented in Table 2.

Table 2: the structure of questions based on research variables

Variable	Question numbers	Number
Environmental management	1-9	9
HR training	1-3	3
Environmental Management program	4-9	6
performance	10-15	6

The statistical population of this research included hospital staff, which is considered limited by the size of the population of 220 people. A questionnaire was distributed among all staff. Finally, 189 questionnaires were collected. Therefore, the analyses were performed based on the output of these questionnaires.

Data analysis method

In the present study, the collected data was analyzed using descriptive statistics and inferential statistics methods. Frequency distribution table, central tendency and dispersion index were used for descriptive analysis and SPSS24 software for graphs. Also in statistical analysis we used structural equation modeling (verification path analysis) based on partial least squares method through Smart software. Structural modeling through the partial least squares method is a variance-based approach that requires less conditions in comparison with similar structural equations techniques such as Lisrel. For example, this type of modeling is more appropriate than true linear modeling in Laser software for real applications, especially when the models are more complex or the distribution of data is abnormal. In this approach, two models are considered simultaneously: a measurement model that examines the relationship between observed variables and latent variables, and a structural model that measures the relationship between latent variables. In this step, it is determined whether theoretical concepts are correctly measured by the observed variables. For this purpose, their validity and reliability are investigated. To verify the validity of the construct, a confirmatory factor analysis is used. This model is based on pre-empirical information about the data structure, and a confirmatory factor analysis (measurement model) must be performed before conducting path analysis (structural model).In fact, it is assessed whether the selected questions provide appropriate factor structure for measuring the dimensions in the research model. In confirmatory factors analysis, the more factor loading is closer to number one, the stronger is the relationship between questions of the questionnaire and latent variables. And if the factor loading is zero, it means that there is no relationship between the questionnaire questions and the latent variable. Negative factor loading suggests a negative linear association between the questionnaire and the latent variable. In confirmatory factor analysis, factor loading less than 0.3 is considered negligible and should be omitted from the model. Also, if the value of t is greater than or equal to +1.96 or less than-1.96, at 95% confidence level, the indicators are appropriate factor structures for measuring the dimensions under study in the research model.

Fit test of model

After the model is determined, its goodness of fit is assessed. Goodness of fit is the suitability and adequacy of data for the model under study. In general, if the fit indices indicate that the model is acceptable, the data is considered appropriate and sufficient to analyze the relationships among the variables. In modeling structural equations with partial least squares methods (PLS-SEM), due to the

predictive nature of this approach, fit indices show the adequacy of the model in predicting dependent variables. In this research, communality and redundancy indices have been used. These indices indicate that in the structural model how and to what extent the exogenous variables can predict the endogenous variables of the model.

3. Results

The goodness of fit of a structural model using coefficients t is such that these coefficients should be greater than 1.96 to be confirmed at 95% confidence level. Results showed that the coefficient of all variables is greater than 1.96 that indicates the significance of this path and the suitability of the structural model. In addition, if the values are more than 2.58, they are significant at level 0.01.

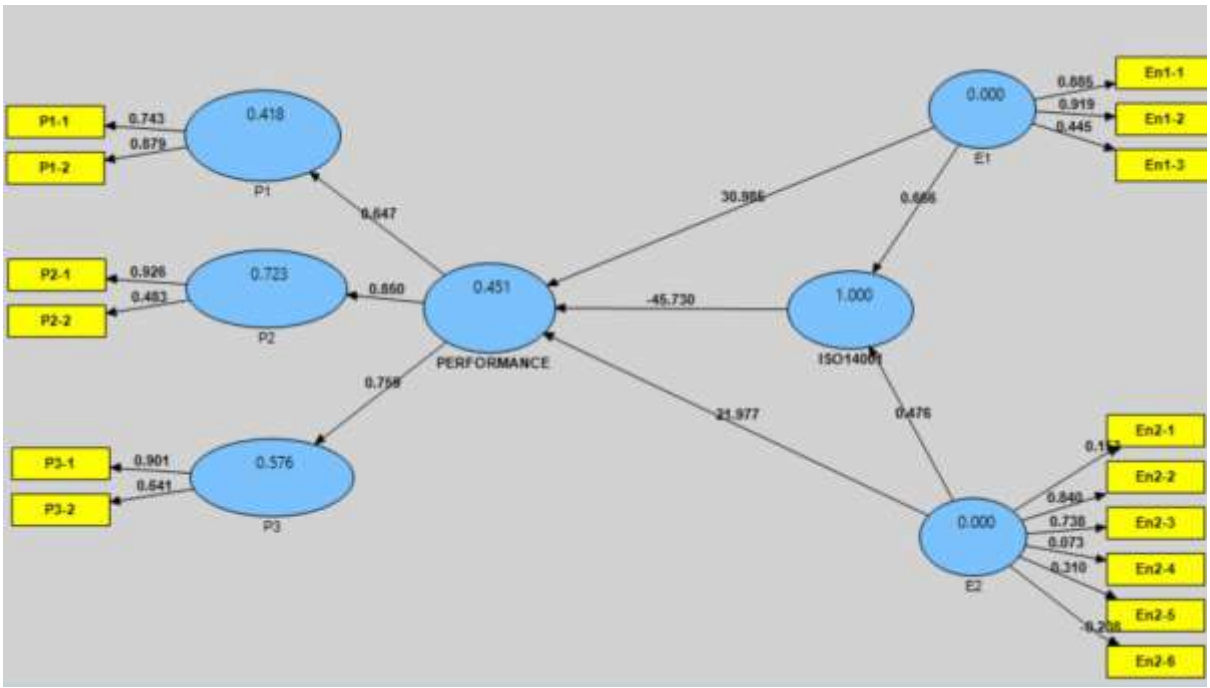

Figure 2: Output of Structural Equation Model

Regarding the values obtained from Fig. 2, and the value criterion for the coefficients of factor loadings is 0.3. As can be seen, the majority of factor loadings of questions are greater than 0.3, which indicates that these criteria are appropriate.

Coefficient of determination

The second criterion for examining the structural model in a research is the index of determination coefficient (R2 coefficients) associated with the latent endogenous (dependent) variables of the model.

The coefficient of determination is the main criterion for assessing the latent variables in the confirmatory path model and the three values of 0.19-0.33-0.67 are considered as the value criteria for the weak, moderate, and strong R2 values, respectively. The value of R2 for performance is 0.451, which, according to the three criterion variables, confirms the goodness-of-fit of the structural model at the moderate level. Also, regarding the next three variables (0.418) p1, (0.723) p2 and (0.576) p3, the average and strong level is confirmed.

Cv-red is the index of or redundancy that shows the quality of the structural model, and cv-com shows communality index. Positive numbers indicate the desired quality of the model.

The hypotheses were tested using structural equations modeling. Structural equation modeling is a suitable statistical technique which is based on hypotheses related to causal relationships between variables and tests causal models using the linear equation system. Therefore, structural equation modeling evaluates the theoretical relationships between certain and expected structural conditions and estimates the casual relationship among latent variables as well as relationships among measured variables (observed).

The main hypothesis 1: implementing an Environmental Management System (ISO14001) is effective in hospital performance in 2015.

The results of the model and the standard estimation value (-46.730) which is greater than (0.3), indicate the suitability of the model. Also regarding the factor, which are more than the expected value of 1.96, the third hypothesis is confirmed, and we conclude that the implementation of ISO 14001 environmental management system had a positive impact on the performance of the hospital, so the above hypothesis is confirmed.

Sub-hypothesis 1.1: Human resource training based on ISO 14001 is effective in hospital performance

The results of the model and the standard estimation (30.986) which is greater than (0.3), indicates that the proposed model is suitable. Also, According to the factor loading which are higher than the expected value of 1.96, the first hypothesis is confirmed and one can conclude that human resources training based on the ISO 14001 was effective on the performance of the hospital in 2015, so the first hypothesis is confirmed.

Sub-hypothesis 1.2: The implementation of the environmental management program based on ISO 14001had positive effect on the hospital performance

According to the results obtained from the model and the standard estimation value (21.977) which is greater than (0.3), this model is suitable. Regarding the factor loading, which exceeds the expected value of 1.96, the above hypothesis is confirmed and it is concluded that the implementation of the environmental management program based on ISO 14001 had a positive impact on the performance of the hospital in 2015. So, the second hypothesis is confirmed.

4. Conclusion

In the present study, data were collected by a questionnaire. The validity and reliability of the questionnaire was confirmed and structural equation modeling and partial least squares technique were used to analyze the data with Smart-PLS statistical software.

To study the non-experimental causal relationships between variables in the form of multivariate analysis and statistical hypothesis testing, structural equation modeling was used. Accordingly, the conceptual model of research was modeled in Smart- PLS software. All variables are input into the structural equation model at the same time and in one-step, and with regard to the standardized coefficients, significant levels and numbers of the software output the hypotheses on the path coefficients among the variables of research were confirmed/rejected. Software outcomes related to the estimationof model parameters are presented in two standardized and non-standardized formats, and considering the differences between them in the conclusion is important. In standardized solutions, the measures of latent variables and observed variables are standardized (with a mean of zero and standard deviation of 1); therefore, factor loads can be interpreted as standardized regression coefficients. For example, if the factor loading of the performance (latent variable) on the observed variable is equal to 765/0, one can say that an increase of 1 point in the performance factor leads to an increase of 765/0 points in the training index.

The changes resulting from the implementation of management systems in an organization (and in this research, the environmental management system) from the perspective of human resources has multiple causes, and studying them needs the consideration of multiple variables and structures and investigating the complex relationships among them. The results showed that the use of structural equation models could be useful and valuable. Confirmation of this hypothesis "environmental management (ISO14001) affects the performance of the organization" suggests that this management system has been able to improve the performance of the organization's processes in a way that is less harmful to the environment.

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