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**CASE STUDY**

# Validation of performance of ISO 14001 through developed model

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**ABSTRACT:** The case study is based on ISO 14001 and compares the validation with other certified industries. In view of the above, response has been collected to have further improvements through developed model which was prepared based on the factorization of various input and output variables which is linked to the clauses of ISO 14001. The developed model has represented almost all the clauses of ISO 14001 considering main content of the all the clauses. Response is collected from the industries where input and output variables were sent earlier and also those involved in the implementation of the system. Evidences arrived out of case study suggests that the model questionnaire improves the environmental performance of an organization and bringing effectiveness in the system. This study will give better results after implementation of the model in any sector. Due to the implementation of model, the study has brought the improvements in ISO 14001and surrounding environment as well. The study on validation stated that by implementing the model, the industries where survey took place have achieved almost 30% improvement in environmental performance.

**KEYWORDS:** *Clauses; Implementation; Input and output variables; Performance; Response*

## INTRODUCTION

Organizations today are increasing their use of predictive analytics to more accurately predict their business outcomes to improve business performance, and to increase profitability. Common and *yet also* highly strategic predictive modelling applications include fraud detection, rate making, credit scoring, customer retention, customer lifetime value, customer attrition/churn, and marketing response models. As the number of these models increases to support more and more business objectives, so does the requirement to manage these models reliably and securely as valuable corporate assets (Chu *et al.*, 2007).With this increasing awareness comes the realization that the potential impacts of proposed development activities need to be assessed and understood so that appropriate management and control strategies can be adopted (Chavan, 2005). Over the years, worldwide concern for the environment has been gaining much attention. Industrial activities which lead to environmental pollution have raised the concern on promoting more environmentally friendly production in order to mitigate the impacts of pollution (Nee and Wahid, 2010).ISO 14001 certification/implementation is certainly proved to be an important driver for the enhancement of

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environmental performance (Fei-Baffoe *et al*., 2013). The efficiency of the ISO 14001 standard and environmental management overall probably depends less on explicit technical and managerial aspects than on the way these practices are implemented on a daily basis and the true resolve of managers and employees to improve environmental performance (Boiral and Henri, 2012).

The most recognized of these approaches, ISO 14001, has demonstrated mixed performance outcomes, with some prior studies indicating that certification increases environmental performance while other studies show no effect (Arimura *et al*., 2015). Environmental performance should therefore be measured against the organization's control of its operations and how these are tied into and comply with any relevant environmental legislation along with the recorded reduction and minimization of overall environmental impact to enhance environmental performance while applying such mitigation measures. In theory, an adequately scoped EMS should encompass all impacts. Finally, that will evaluate the extent of compliance with the applicable legislative measures with respect to environmental pollution (Kumara and Weerasinghe, 2017). EMS implementation is increasingly seen as essential due to a perceived link between a company's impact on the environment and profitability. Process-based strategies to improved environmental performance can be adapted from traditional just-in-time and total quality management techniques (Watson *et al.*, 2004).

A growing consensus is developing among world-wide industry that environmental protection and compliance are best achieved when environmental factors are integrated into industrial operations in a systematic way (Diamond, 1999). A useful guideline for companies to ensure that their ISO 14001 certification attempt is successful and that they build a system that will produce value for the company, is to (1) begin with an auditing service that focuses on environmental aspects and has personnel qualified to evaluate the environmental engineering and science–related components of the EMS; and (2) drive the initiative through internal personnel that are genuinely interested in improving the current system and decreasing the environmental impact of the company on its surroundings (Godshall, 2000). A properly implemented EMS will help to control environmental impact, improve environmental performance, improve training, improve communication, and improve data collection. There is also the potential for an EMS to save money through process change or product selection (Christini *et al*., 2004). Environmental Management Systems (EMSs) have become an important tool for those organizations looking to manage their environmental issues such as pollution prevention, legal compliance, and minimizing the impacts their activities cause to the environment. It considers a company's organization through a thorough review of operations, and analyzes how a company's actions affect the environmental issues (Campos, 2012). Environmental management systems based on ISO 14001 was developed to evaluate and improve the environmental behaviour of organizations, thus establishing measurement, evaluation and monitoring processes for all relevant environmental aspects. Most of these environmental aspects, when imported to the management system, are translated to metrological requisites, that is, they are defined as quantitative variables that need to be measured to evaluate their compliance by comparing those measurements with the specifications previously established for the requisites (Beltran *et al*., 2010). Numerous studies have been conducted around the world on the implementation of EMS and their benefits. Melnik *et al*. (2003) have presented studies which have shown that organizational improvements in environmental performance are beneficial not only for the environment, but also for a positive relationship between improved environmental and corporate performance (Campos, 2012).If the indicator results from the transformation of model outputs, its validity will logically depend on the validity of the model. This approach is applied by Pussemier (in Reus *et al.*, 1999) for one part of his pesticide indicator. Some authors follow the approach currently used in modeling and restrict validation of their indicators to a visual procedure based on the comparison with measured data. This is the case of Brown *et al*. (1995) for the GUS index (indicator of pesticide leaching risk) or Sharpley (1995) for the Phosphorus index. The criticisms pointed out by Kirchner *et al*. (1996) to this procedure can also be made to those examples (Bockstaller and Girardin, 2003). Despite the significant role production workers play in improving the companies' environmental performance there have been relatively few studies that have investigated shop floor reactions to EMS via survey questionnaire. Further studies in this area are

now required (Kaur, 2011). As a result, the aim of this research is to validate the model through ISO 14001 certified organization and subsequently to know about the improvements through implementation or applying the model for managing environment management system and getting required improvements through various case studies in Indian context. Earlier studies on ISO 14001 implementations have not addressed core elements of all the clauses and relationship between various clauses for improving the environmental performance along with development of model and validation the model in any manufacturing or service sector. The present research work from model development to its validation have been carried out in ISO 14001 certified industries mostly in power sectors and some of the other manufacturing and service sectors from the year 2015 to 2017 in mostly in Maharashtra State, India.

## MATERIALS AND METHODS

### *Model development*

The current methodology has been adopted for model development and validation as given in (Fig.1). Primary Data collection was done by using a standardized research instrument, which was developed in the present research work. A pilot study was also carried out for validating and bringing further improvement in the research instrument. Secondary data was collected from research articles published national and international journals, reputed books, proceedings, thesis, internet and other relevant sources etc.

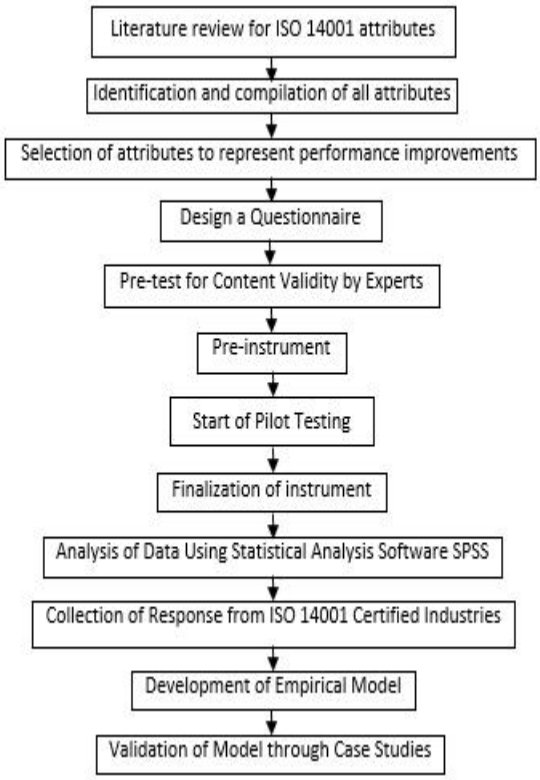


Fig.1: Flow chart for research methodology

### *Sampling Procedure for model development and validation*

This case study for validation is based on the data collection from 50 respondents of ISO 14001certified organizations which was collected using developed model (The model was developed through 76 independent or input variables and 12 dependents or output variables from 146 respondents from ISO 14001 certified organizations). The organizations involved in this process were mainly power sectors and other manufacturing and service sectors as discussed below in detail. Afterwards, response was obtained for validation of model for present research work. Proper instructions were given to respondents only those were involved in the implementation or management of the ISO 14001 (EMS) in their respective organizations based on the earlier response obtained for input and output variables of the study for development of model. Response obtained through mail and/or email attachment/personal interactions for development of model and later validation as well. In this particular study, the majority of the respondents are found to be male from different sectors of ISO 14001 certified organizations. The average age of the respondents is 40 years. Most of respondents are ISO 14001 managers or management representatives those are qualified internal auditors and they are having good knowledge on the system as well as manufacturing process of their respective organizations. The current study was carried out using questionnaires and the selection of measurements items i.e. attributes were based on exhaustive review of literature. The dependent variable, performance was measured in through output variables those are based on each ISO 14001 clause. All responses were measured using five-point likert type scale with scale ranging from “strongly agree” (1) to

"strongly disagree" (5) for model development through questionnaire survey of 45 input variables and 12 output variables. Before the actual survey were conducted, the questionnaires were pre-tested and reviewed for structure, readability, ambiguity and completeness, and the survey instrument was refined in light of comments from the respondents. The respondents were asked to rate the answer of each question on a 5-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree) to what extent the statement fits the situation in their organization (Haslinda and Chan, 2010).

It can also claim that the application of EMS would provide competitiveness advantage which improve performance and decrease costs. Thus, more conscious entrepreneurship and success show that the compliance of ISO 14001 EMS standards from the beginning would lead to the high performance (Muhsin Halis and Mine Halis, 2016).

The departments were chosen based on their involvement in the procurement process. Since the targeted respondents are only 100, all the respondents were involved in the study. Primary data was collected using structured questionnaires. The filled questionnaires were then collected after one week; this gave respondents enough time to answer the questions promptly. Each item in the questionnaire was developed to address a specific objective or research question (Vincent *et al.*, 2015). As to the last stage of the EMS model, Management Review, Podkarpackie enterprises should pay more attention to the improvement in minimizing the negative influence on the environment (4.09) and to the procedure of conducting the management review (4.26). The average levels of these determinants showed that the examined enterprises were aware of their significance (Fura, 2013).

## RESULTS AND DISCUSSION

Response to input and output variables and model validation

A total of 50 input and output variables model were mailed and response collected from the respondents of the various ISO 14001 organizations which were mostly received within the timeframe given to the respondents. The response rate through email and personal interaction were observed 9.73% and 90.27% respectively for model validation. The model consisted of 45 input variables and 12 output variables have been sent to the various ISO 14001 certified organizations and response was collected for validation. The field workers had established prior to administering the questionnaire whether these businesses had indeed implemented any green business practices. Only 298 questionnaires were returned, giving an effective response rate of 93.13% (Smith and Perks, 2010). For instance, Tan (2005) conducted study on ISO 14001 firms in Malaysia which give a 47.4% of response rate. On the other hand, Samat *et al*. (2006) conducted their study among service organizational in the northern region of Malaysia also achieved a response rate of 57.71 % which is significantly higher than the standard 20% acceptable mail survey response rates (Nee and Wahid, 2010). A total of 174 questionnaires are distributed to managers in a wide range of firms from different sectors of activities. Those firms have been classified into three categories; private manufacturing, private service and public firms. The researcher collected 156 questionnaires (about 89.7% response rate) out of which, 143 found to be usable for analysis which represents 91.7% of collected questionnaires (Kadasah, 2013). In October 2004, 31 questionnaires were distributed to the companies. The primary data used in this thesis consists of questionnaire responses from quality managers of selected companies. Finally 63.3 percentage of responses were obtained (Inno M, 2005).

*Factor analysis for model development*

The Cronbach's Alpha is 0.971 which means values are very much reliable and contributing more for the present research work. Overall mean score of 3.95 was recorded indicating employees viewed EMS adoption as a long term affair and there must be a will to continually improve it. Crobanch s alpha for this scale is 0.87 signifying reliability in this scale (Low *et al.*, 2015). Schuessler (1971) stated that a scale is considered reliable if it has an alpha value greater than 0.60. Hair *et al.*, (1998) added that reliability estimates between 0.60 and 0.70 represent the lower limit of acceptability in quantitative research studies. The reliability was checked by examining the Cronbach's á coefficient. As shown in Table II the values of Cronbach's alpha value ranges from 0.81 to 0.94 which is greater than the minimum value (i.e. 0.60) suggested by Hair *et al.*, (2006) and Nee (2011).

KMO measure of sampling adequacy for the items was 0.770. Thus, the sample size of 76 is adequate and satisfactory which means the study has got strong

and required interrelationship. The KMO measure of sampling adequacy for the items was 0.869 (that is, > 0.7), indicating sufficient inter-correlations of the Bartlett's Test of Sphericity, which was found to be significant (Chi-square = 1263.085, p < 0.005) (Chenand Chai, 2010). Final Cronbach's alpha is more than 0.79, which means that the items/variables of all the performance measures are highly reliable (Digalwar and Sangwan, 2007). This indicates that the sub-criteria have common factors. It is recommended KMO value more than 0.5 as optimal. Final Cronbach's alpha value and range of correlation coefficients is calculated using reliability analysis.

The Bartlett's test of sphericity should be significant (p < 0.05) in the factor analysis to be considered appropriate (Samadhan and Deshmukh, 2013). Overall, the first-stage model discriminates well among firms subscribing to ISO 14001: the chi-square statistic for the first stage only is 212.58, significant at p<.001 (Potoski and Prakash, 2005). Bartlett's Test of Sphericity is significant (0.000). Significance is less than 0.05 i.e. the significance level is small enough to reject the null hypothesis. The next item from the output is communalities which show how much of the variance in the variables has been accounted for by the extracted factors. For instance over 90% of the variance in "Input variables" is accounted for. In research, factor analysis with varimax rotation reduced the independent variables almost by 50 %. In, rotation sums of squared loadings, the first factor accounts for 35% of the variance. In present research work, factor analysis indicated that three significant factors with eigenvalues greater than 1 contributed 36.104%. The outcome of component matrix is the extracted values of each item under 3 variables of the 76 input variables on the five factors extracted. Five variables were extracted wherein the 76 items are divided into five variables according to most important items. Later, rotated component matrix is performed.

*Regression analysis for model development*

In the current study, linear egression coefficient R= 0.833 which indicates strong correlation between independent and dependent variables. In terms of variability, the value amount of $R^2$= .694 or 69% which explains the variability within the population. A new model was estimated and the assumptions underlying the regression model were tested again. The adjusted $R^2$ of 0.900 is acceptable for this type of analysis and the model is statistically significant (p value = 0.025) (Chan and Wong, 2006).The predictive power of the model was analyzed using $R^2$. The $R^2$ value of success in implementation of EMS was respectively 0.69, which is greater than the acceptable threshold of 0.3 (Morovati-Sharifabadi *et al.*, 2014).

The result of ANOVA test (Table 1) provides the F-test value for the null hypothesis. However based on the analysis, we can reject the null hypothesis where F= 31.363 and p=0.001 (P< 0.01) wherein confidence interval is by default set at 99%. A high value of F means that there is more chance of the null hypothesis being rejected and alternate accepted. Here it is 31.663 which mean that the values are high. The significance value of 0.004<0.005 indicates that the correlation is statistically significant (Vincent *et al.*, 2015).

Table 1: Analysis of Variance*

| Model | Sum of Squares | df | Mean Square | F. | Sig. |
|---|---|---|---|---|---|
| Regression | 53.296 | 5 | 10.659 | 31.363 | 0.000[b] |
| Residual | 23.451 | 69 | 0.340 | - | - |
| Total | 76.747 | 74 | - | - | - |

a. Dependent variable: Output-2
b. Predictors: (Constant), Input factor-5, Input factor -3, Input factor -1, Input factor -4, Input factor -2
*ANOVA

The difference in overall significance between Model A and Model C also is highly significant. In Model D, I test Hypothesis 2 by adding a variable for the years under ISO 14001 certification. Its coefficient is positive and significant, indicating that, at least for the period under study here, the greater the experience with ISO 14001, the lower were a facility's emissions. The change in overall fit also represents a significant improvement between Models C and D (Russo, 2009). Here the Sig is 0.000 for all models, which means the alternate hypothesis is accepted. It is understood that both the F value and the Sig. value that the two variables are indeed different from each other and that they affect the output in a different manner. For example, Table 2 tells us about the structure of the model. The analysis of the same is as under:

Input factor-1 and 3 have a negative relationship with output factor-2 and input factor-2, 4 and 5 are having positive relationship with output factor-2.

Table 2: Estimation of regression coefficients

| | Unstandardized Coefficients B | Std. Error | Standardized coefficients Beta | t | Sig. |
|---|---|---|---|---|---|
| (Constant) | -0.192 | 0.454 | - | -0.422 | 0.674 |
| Input-Factor-1 | -0.157 | 0.309 | -0.125 | -0.507 | 0.614 |
| Input-Factor-2 | 0.508 | 0.330 | 0.415 | 1.539 | .128 |
| Input-Factor-3 | -0.130 | 0.272 | -0.088 | -.476 | .635 |
| Input-Factor-4 | 0.189 | 0.292 | 0.128 | .650 | .518 |
| Input-Factor-5 | 0.627 | 0.126 | 0.545 | 4.956 | .000 |

*Model validation*

The following ISO 14001 certified industries organizations are covered from different sectors and response has been collected based on the developed model which consisted of 45 input variables and 12 output variables. The model addresses about the performance of the organization in the form of input and output variables. The model is validated and found satisfactory and significant improvement in the following ISO 14001 certified organizations. The input variables have been extracted and reduced to five factors i.e. 45 variables which is the outcome as model questionnaire. The total degree of emphasis of the input variables is 225.

The feedback collected based on the model input variables and output variables from the 12 organizations. The feedback is collected from mainly management representatives, core groups and engineers involved in the implementations of the system from various ISO 14001 certified organizations. Most of the attributes have become agree and strongly agree and changed from undecided to agree or strongly agree as mentioned above. Earlier input and output variables were representing almost all the contents of clauses. After formation of model, the input and output variables has resulted into most important and significant variables. The case study analysis of the ISO 14001 model is described in detail as given below.

*Case study: Power plant no.1*

Input variables:

a) Input variables total score has come down from 96 to 61

b) No. of attributes became disagree to strongly agree – 6

c) No. of attributes became disagree to agree – 3

d) No. of attributes became agree to strongly agree – 10

e) No. of attributes became undecided to strongly agree – 1

f) No. of attributes became undecided to agree – 2

g) No. of attributes became strongly agree – 21

h) Total improvement in score – 36%

Output variables:

Out of 12 output variables 7 have become strongly agree and 5 are agree.

Degree of emphasis is not improved on corrective and preventive action, integrated system, annual budget etc. Efficiency of employees and legal compliances are required to be improved further. Whereas output variables availability of documents, competency, legal compliances, objectives achievement and control of documents are observed as agree.

*Case study: Power plant no. 2*

Input variables

a) Input variables total score has come down from 74 to 45

b) No. of attributes became agree to strongly agree – 29

c) No. of attributes became strongly disagree to strongly agree – 1

d) No. of attributes became disagree to strongly agree – 2

e) No. of attributes became undecided to strongly agree – 2

f) No. of attributes became strongly agree – 39

g) Total improvement in score – 39%

Output variables

Out of 12 output variables 11 have become strongly agree. Annual planning, budget and operations and its activity required and also safety aspect to be covered and more thrust required to be given upon the above input variables. In line with the above, output variable are almost observed strongly agree. Involvement of outside parties i.e. degree of emphasis is observed to be undecided.

*Case study: Power plant no. 3*

Input variables

a) Input variables total score has come down from 124 to 54

b) No. of attributes became disagree to strongly agree – 10

c) No. of attributes became disagree to agree – 5

d) No. of attributes became agree to strongly agree – 14

e) No. of attributes became undecided to strongly agree – 2

f) No. of attributes became strongly agree – 30

g) Total improvement in score – 56%

Output variables

Out of 12 output variables 8 have become strongly agree. Budget, auditing cycles and operation and its activities requires further improvement and output variable at s. no. prevention of pollution, 6 operation and activities, competency, control on documents also did not change the scale which are observed as agree. Prevention of pollution is needed to be improved further.

*Case study: Power Plant no. 4*

Input variables

a) Input variables total score has come down from 98 to 67

b) No. of attributes became undecided to agree – 5

c) No. of attributes became disagree to agree – 6

d) No. of attributes became undecided to strongly agree – 10

e) No. of attributes became strongly agree – 27

f) Total improvement in score – 31%

Output variables

Out of 12 output variables 11 have become strongly agree. Display of environment parameters, operations and its activities, identification of aspects etc are coming under scope for improvements. Hence, it is concluded that the above input variables have not changed the scale for survey through model. At the same time, output variables are almost observed as strongly agree.

*Case study: Power plant no. 5*

Input variables

a) Input variables total score has come down from 93 to 54

b) No. of attributes became undecided to agree – 5

c) No. of attributes became disagree to agree – 3

d) No. of attributes became undecided to strongly agree – 8

e) No. of attributes became strongly agree – 22

f) Total improvement in score – 41%

Output variables

All 12 output variables have become strongly agree. Annual cycle, budget, communication of policy, resources and identification of aspects are coming under scope for improvements. Hence, it is concluded that the above input variables did not change the scale for survey through model. Output variables are almost observed strongly agree.

*Case study: Copper manufacturing*

Input variables

a) Input variables total score has come down from 104 to 69

b) No. of attributes became undecided to agree – 5

c) No. of attributes became disagree to agree – 2

d) No. of attributes became undecided to strongly agree – 5

e) No. of attributes became strongly agree – 21

f) Total improvement in score – 34%

Output variables

Out of 12 output variables 8 have become strongly agree. Budget, compliances, trainings, auditing cycles and safety aspects etc. needs further improvement. Output variable as specified above did not change the scale which are observed agree.

*Case study: Waste water treatment plant*

Input variables

a) Input variables total score has come down from 86 to 55

b) No. of attributes became agree to strongly agree – 24

c) No. of attributes became undecided to strongly agree – 4

d) No. of attributes became strongly agree – 30

e) No. of attributes became disagree to agree – 1

f) Total improvement in score – 36%

Output variables

Out of 12 output variables 10 have become strongly agree.

The input variables such as compliances, resources, communication of policy, operations and its activities etc are inviting for further scope of improvements. Output variables are almost observed strongly agree.

*Case study: Tower manufacturing*

Input variables

a) Input variables total score has come down from 77 to 53

b) No. of attributes became agree to strongly agree – 18

c) No. of attributes became strongly agree – 21

d) Total improvement in score – 31%

Output variables

Out of 12 output variables 9 have become strongly agree. Annual planning, compliances, corrective and preventive actions, safety, budget and operations and its activity require some thrust. Hence, it is concluded that the above input variables have not changed the scale for survey through model. Likewise, output variables are almost observed strongly agree.

*Case study: Pharmaceutical industry*

Input variables

a) Input variables total score has come down from 76 to 51

b) No. of attributes became agree to strongly agree – 24

c) No. of attributes became undecided to strongly agree – 1

d) Total improvement in score – 33%

Output variables

Out of 12 output variables 10 have become strongly agree. The input variables such as operation and its activities, training and integration of documents are coming under scope for improvements and output variables are almost observed strongly agree.

*Case study: Cement industry*

Input variables

a) Input variables total score has come down from 92 to 70

b) No. of attributes became agree to strongly agree – 10

c) No. of attributes became undecided to agree – 6

d) Total improvement in score – 24%

Output variables

Out of 12 output variables 10 have become agree.The input variables such as identification of aspects, non-conformities, corrective and preventive action, resources, display of environment parameters, job responsibilities, operation and its activities etc. are coming under scope for improvements. Likewise, output variables are almost observed agree except waste management and achievement of objectives.

*Case study: Paper industry*

Input variables

a) Input variables total score has come down from 54 to 70

b) No. of attributes became agree to strongly agree – 26

c) No. of attributes became undecided to agree – 5

d) Total improvement in score – 30%

Output variables

Out of 12 output variables 5 have become agree.

The input variables such as non-conformities, resources, communication of policy, EMS audits, job responsibilities, operation and its activities, safety audits, placement of fire extinguishers etc. are coming under scope for improvements. Likewise, output variables are observed agree except waste management, compliance, internal communications and document controls.

*Case study: Shipbuilders*

Input variables

a) Input variables total score has come down from 108 to 87

b) No. of attributes became disagree to agree – 4

c) No. of attributes became undecided to agree – 10

d) Total improvement in score – 19 %

Output variables

All output variables have become agree. The input variables such as interested party role on setting objectives, safety at work place, updation of legal and other requirements, awareness, involvement of stakeholders, corrective and preventive action, annual budget, and resources are coming under scope for improvements. Likewise, output variables are observed agree and need to be improved further to strongly agree.

## CONCLUSION

After implementation, application and validation of developed model in ISO 14001 certified industries, it is considered to be a successful research work. This current study has validated and proved significant improvements through implementation of developed model in Indian context as observed above almost 30% further improvement. Through implementation of ISO 14001 model, the industries are found complying with the legal and other requirements and reducing the non-compliances as against the clause i.e. legal and other requirements. During implementation and validation of developed model, it has resulted into significant improvements through achievement of an objective and availability of resources, management of waste and effective process of implementation. The research work would have major influence on future efforts to inculcate positive environmental approach among employees of ISO 14001 certified organizations while implementing the present model.

It has been observed that input variables related to safety, budget, annual cycle, corrective and preventive actions, legal compliances, operations and its activities etc. requires further improvements. In view of the output variables such as efficiency of employees, objectives and targets and control of documents needs some improvements.

Mostly input and output variables are observed as agree and strongly agree which are changed from strongly disagree to disagree or undecided to agree and strongly agree.The author hope that the case studies presented in this paper will not only encourage EMS managers or management representatives to apply the developed ISO 14001 model in ISO 14001 and Non-ISO 14001 certified industries for achieving further improvements.

The following conclusions can be made, based on the analysis of variance and coefficients arrived due to input and output variables. The above developed model is distinctively important as it is solely based on all the clauses of ISO 14001 in Indian context which is entirely different from previous studies.The research work is beneficial to researchers in validating the case studies based on developed model that will influence environmental management system implementation which could lead to required reductions in environmental impact of various processes of the activities and further improvement in environmental performance of the ISO 14001 certified organizations.

*Future research needs and recommendation*

In India, the developed model can be applied specially in the service sector and manufacturing sectors with large sample size of 100 or more from the various organizations for model validation. It is also suggested to conduct study for validation of the ISO 14001 certified industries i.e. more polluted industries in India. It is also desired that models can be validated in three sectors such as small, medium and large sectors and then improvements can be compared and validated based on the response. ISO 14001 managers or management representatives or employees involved in the implementation need to give more thrust for improvement of ratings for respectable outcome of developed model.

In addition to the above, the present research work is based on the ISO 14001:2004 (EMS) which is valid up to September 2018. This study can be performed for ISO 14001:2015 standard for further validation through developed model.

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## CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

## REFERENCES

Arimura, T.H.; Darnall, N.; Ganguli, R.; Katayama, H., (2016). The effect of ISO 14001 on environmental performance: Resolving equivocal findings, J. Environ. Manage., 166: 556-566 (**41 pages**).

Beltrán, J.; Muñuzuri, J.; Rivas, M.; González, C., (2010). Metrological management evaluation based on ISO10012: an empirical study in ISO-14001-certified Spanish companies. Energy, 35(1): 140-147 (**8 pages**).

Bockstaller, C.; Girardin, P., (2003). How to validate environmental indicators. Agric. Syst., 76(2): 639–653 (**15 pages**).

Boiral, O.; Henri, J.F., (2012). Modelling the impact of ISO 14001 on environmental performance: A comparative approach. J. Environ. Manage., 99: 84-97 (**14 pages**).

Campos, L.M., (2012). Environmental management systems (EMS) for small companies: a study in Southern Brazil. J. Cleaner Prod., 32: 141- 148 (**8 pages**).

Chan, E.S.; Wong, S.C., (2006). Motivations for ISO 14001 in the hotel industry. Tourism Manage., 27(3): 481-492 (**12 pages**).

Chavan, M., (2005). An appraisal of environment management systems: A competitive advantage for small businesses. Manage. Environ. Qual.: An Int. J., 16(5): 444 – 463 (**20 pages**).

Chen, T.B.; Chai, L.T., (2010). Attitude towards the environment and green products: consumers' perspective. Manage. Sci. Eng., 4(2): 27–39 (**13 pages**).

Christini, G.; Fetsko, M.; Hendrickson, C., (2004). Environmental management systems and ISO 14001 certification for construction firms. J. Constr. Eng. Manage., 130(3): 330-336 (**7 pages**).

Chu, R.; Duling, D.; Thompson, W., (2007). Best practices for managing predictive models in a production environment. In Proceedings of the 2007 Midwest SAS Users Group Conference. 1-10 (**10 pages**).

Deshmukh, S.P.; Sunnapwar, V.K., (2013). Validation of performance measures for green supplier selection in Indian industries. Int. J. Model. Eng. Resour., 3(3): 1617-1622 (**6 pages**).

Diamond, (1999). An Introduction to IS0 14000 and environmental management systems. Geomatrix Consultants, Inc.

Digalwar, A.K.; Sangwan, K.S., (2007). Development and validation of performance measures for world class manufacturing practices in India. J. Adv. Manuf. Syst., 6(01): 21-38 (**18 pages**).

Fei-Baffoe, B.; Botwe-Koomson, G.K.; Mensa-Bonsu, I.F.; Appiah Agyapong, E., (2013). Impact of ISO 14001 Environmental Management System on Key Environmental Performance Indicators of Selected Gold Mining Companies in Ghana. J. Waste Manage., 1-6 (**6 pages**).

Fura, B., (2013). Improving ISO 14001 Environmental management systems, Polish J. Environ. Stud., 22(6): 1711-1721 (**11 pages**).

Godshall, L.E., (2000). ISO 14001: A Case Study in Certification at Bayer Pharmaceuticals in Berkeley, California. In 2nd POSTI meeting and the ESST Annual Scientific Conference, Strasbourg (**16 pages**).

Hair, J.F.; Black, W.C.; Babin, B.J.; Anderson, R.E.; Tatham, R.L., (1998). *Multivariate data analysis* (Vol. 5, No. 3, pp. 207-219). Upper Saddle River, Prentice hall, NJ.

Haslinda, A.; Chan, F.C., (2010). The Implementation of ISO 14001 Environmental Management System, Asian Soc. Sci., 6(3): 100-107 (**8 pages**).

Inno, M., (2005). Assessment of the ISO 14001 implementation process in Estonian certified construction companies. Master's Dissertation in the international master's programme applied environmental measurement techniques, Department of civil and environmental engineering water environment technology, Chalmers University of Technology, Göteborg, Sweden, 1-66 (**66 pages**).

Kadasah, A., (2013). Attitudes of managers towards the potential effects of ISO 14001 in Saudi Arabia: Factor analysis. Int. Bus. Res., 6(7): 91-101 (**11 pages**).

Kaur, H., (2011). Impact of human resource factors on perceived environmental performance: An empirical analysis of a sample of ISO 14001 EMS companies in Malaysia. J. Sustainable Dev., 4(1): 211-224 (**14 pages**).

Kumara, K.M.S.C.; Weerasinghe, T.K., (2017). The effectiveness of implementing environmental management system-ISO 14001 in food manufacturing companies: A case study of a Sri Lankan food manufacturing company. Environ. Manage. Sustainable Dev., 6(2): 240-249 (**10 pages**).

Low, H.H., Tan, O.K., Choi, S.L. and Rabeatul Husna, A.R., (2015). The adoption of environmental management system in Malaysia s manufacturing organizations, J. Econom. Bus. Manage., 3(1): 93-97 (**5 pages**).

Morovati-Sharifabadi, A.; Naser Sadrabadi, A.R.; Namakshenas-Jahromi, M., (2014). Evaluation of the effective factors on organizational success in implementation of environmental management system (EMS) (A case of Iranian tile and ceramic industry). Int. J. Econ. Manage. Soc. Sci., 3(12): 816-821 (**6 pages**).

Halis, M.; Halis, M., (2016). Relationship between environmental management systems implementation and environmental performance: Findings from Turkish EMS certificated businesses, Int. J. Organ. Leadersh., 5(2): 137-150 (**14 pages**).

Nee, G.Y., (2011). Determining factors for ISO14001 EMS implementation among SMEs in Malaysia: a resource based view. World Acad. Sci. Eng. Technol., 59(1): 1294-1299 (**6 pages**).

Nee, G.Y and Wahid, N.A., (2010). The effect of ISO 14001 environmental management system implementation on SMEs performance: An empirical study in Malaysia. J. Sustainable Dev., 3(2): 215-220 (**6 pages**).

Potoski, M.; Prakash, A., (2005). Green clubs and voluntary governance: ISO 14001 and firms' regulatory compliance. Am. J. Political Sci., 49(2): 235-248 (**14 pages**).

Reus, J.; Leenderste, P.; Bockstaller, C.; Fomsgaard, I.; Gutsche, V.; Lewis, K.; Nilsson, C.; Pussemier, L.; Trevisan, M.;van der Werf, H., Alfarroba, F.; Blu¨mel, S.; Isart, J.; McGrath, D.; Seppa¨la¨, T.; (1999). Comparing environmental risk indicators for pesticides. Results of the european CAPER project. Centre for agriculture and environment, Utrecht, 90(2): 177-187 (**11 pages**).

Russo, M.V., (2009). Explaining the impact of ISO 14001 on emission performance: a dynamic capabilities perspective on process and learning. Bus. Strategy Environ., 18(5): 307-319 (**15 pages**).

Samat, N.; Ramayah, T.; Mat Saad, N., (2006). TQM practices, service quality, and market orientation: Some empirical evidence from a developing country. Manage. Res. News, 29(11): 713-728 (**16 pages**).

Savely, S.M.; Carson, A.I.; Delclos, G.L., (2007). An environmental management system implementation model for US colleges and universities. J. Cleaner Prod., 15(7): 660-670 (**11 pages**).

Schuessler, K, (1971). Analyzing social data, Boston, MA: Houghton Mifflin.

Singh, M.; Brueckner, M.; Padhy, P.K., (2015). Environmental management system ISO 14001: effective waste minimisation in small and medium enterprises in India. J. Cleaner Prod., 102: 285–301 (**17 pages**).

Smith, E.E.; Perks, S. A., (2010). Perceptual study of the impact of green practice implementation on the business functions, South. Afr. Bus. Rev., 14(3): 1-29 (**29 pages**).

Tan, L.P., (2005). Implementing ISO 14001: is it beneficial for firms in newly industrialized Malaysia?. J. Cleaner Prod., 13(4): 397-404 (**8 pages**).

Vincent, O.; Benard, M.; Nyariki, B.; Ndungu, M., (2015). Reuse, remanufacturing and environmental performance: Analysis of timber processing firms in nakuru county, Sci. Innovation, 3(3): 32-38 (**7 pages**).

Watson, K.; Klingenberg, B., Polito, T.; Geurts, T.G., (2004). Impact of environmental management system implementation on financial performance: A comparison of two corporate strategies. Manage. Environ. Qual.: An Int. J., 15(6): 622-628 (**7 pages**).