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Critical Success Factors for Implementation of (ISO 50001)

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***Abstract*—** Energy is the main problem of the world. The rapid growth in the industrial sector contributes to the production of harmful gases. According to the Ministry of Planning and Development (IEP report) the consumption of Electricity in the Industrial sector has increased from 26% to 28% from (FY 2022 to FY 2023). The need for energy is enormously increasing with Economic escalation and Population Growth. Owing to the above facts/problem, Industries may adopt standards like Energy Management Systems (ISO 50001). The Research is conducted on the Different Manufacturing Industries in KPK, Pakistan. Energy Management Systems can improve the service quality of industry and reduce Electricity bills. In this study, the Critical Success Factors of Energy Management systems will be analyzed to help Industries implement more sustainable Energy Management Systems. In Critical Success factors the indicators identify the success of the Industries performances. Four main factors and twelve sub-factors have been adopted for the (Regression and Correlation) analysis and their impact on the Implementation of EMS.

***Keywords*—** Critical Success Factors, Energy Management Systems, Regression Analysis, Organizational Policies, Top Management Commitments, Government Support and Regulation, Employees Training and Education.

I. INTRODUCTION

Rapid Industrial expansion is a reliable sign of progress in the economy but the utilization of energy in the industrial sector contributes to the production of harmful gases. In Pakistan, the consumption of energy by the industrial sector is 28% of the total energy consumption [1]. The need for energy will be increased with the increase of economic growth and increase in population [1]. This problem will need the adoption of industrial standards, like energy management systems [4].

The Critical Success Factor (CSF) is a technique for evaluating an organization's performance to accomplish business objectives [2]. Critical Factors might serve as an indicator to make sure a system or process of the organization has been operating optimally [4]. In this study, the Critical Success factors of Energy Management Systems have been analyzed for the Industries to be able to implement the necessary corrective measures.

Energy Management Systems is implemented in all industries in developed countries but according to the United Nations Industries Development Organizations report Energy Management Systems is implemented in a few industries in Pakistan (5). EMS is not implemented in any industry in KPK, Pakistan. The manufacturing industries have been selected for this study among the different clusters in KPK, Pakistan. These industries consist of Cable Industries, Steel mills, Floor mills, Automotive Industries, Tobacco Industries, food and beverages Industries, Pipe and pumps Industries, Textile Industries, Defense and weapons Industries, Chemical Industries, Fertilizer Industries etc. The total consumption of energy by the Industrial sector in Pakistan is 32,708.48 GWh in 2022 [1]. An estimated 99% of total industries did not implement the Energy Management Systems, Which is the biggest problem for the rapid growth of industries.

This study identifies which factor is reliable and has an impact on the Implementation of Energy Management Systems. The factors will be analyzed by the correlation and regression analysis for the impact of 4 main factors and 12 sub-factors on the Dependent Factor.

II. LITERATURE REVIEW

In 2011, the International Organization for Standardization (ISO) introduced ISO 50001, a standard that focuses on energy management systems [3]. The standard is designed to assist organizations in developing systems and processes that enhance performance, efficiency, and energy consumption [3]. The main objective of ISO 50001 is to assist organizations in establishing and executing a thorough energy management system, while continuously enhancing their energy performance [3]. Through a thorough examination of legal obligations, a thorough assessment of energy-related factors, and a comprehensive analysis of energy transparency, cost reduction, and reduction in harmful gas emission, ISO 50001 assists organizations in systematically and comprehensively achieving energy-related goals that are oriented towards sustainability and objectives [3]. Various aspects of the organization will undergo improvements, including overall management, legal requirements, sales and marketing, operational controls, and finances [3]. Through the successful implementation of EMS, the organization will enhance their environmental reputation,

comply with legal requirements, optimize energy usage, improve operational control and streamline procurement procedures [4]. The greater investment for the organization is to implement energy management systems (ISO 50001), which will intern be recouped after the successful implementation of this system [4].

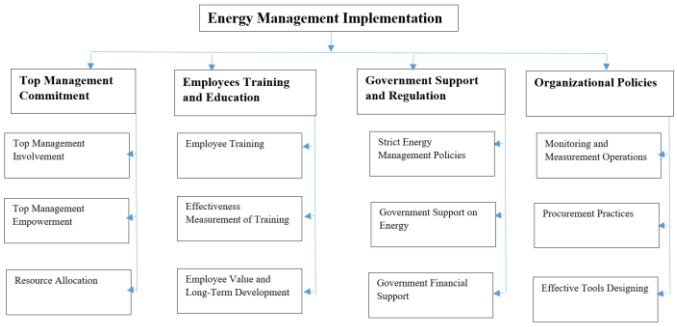


Figure 1

John F. Rockart and MIT Sloan School of Management introduced Critical Success Factors in 1979 to help senior executives define information needs for effective organizational management. An essential aspect to consider is an area that determines the success of an organization's performance [7]. This CSF's area explores managerial preferences by examining important financial and non-financial variables in specific circumstances [7]. Critical Success Factors may operate as performance indicators or be utilized to set work performance indicators. CSF is categorized into different levels of management, including Industrial CSF, Organizational CSF, Divisional CSF, Operational Unit CSF, and Individual CSF [7]. Upon reviewing the publications of Sir Francis Galton and Karl Pearson, it became evident that Galton's research on the hereditary traits of sweet peas played a pivotal role in the development of linear regression [8]. Further advancements made by Galton and Pearson led to the development of more comprehensive methods such as multiple regression and the product-moment correlation coefficient [8]. Current textbooks usually cover correlation before diving into prediction problems and the use of linear regression [8].

III. METHODOLOGY

The stages of Research are as follows:

- The study is based on a quantitative research design approach, while a Structured Survey is used for primary data collection.
- The questionnaire was distributed to the Production Engineers, Production Managers, QA/QC Engineers, QA/QC Managers, Energy Managers, Internal Energy Auditors and External Energy Auditors with a Likert Scale (1-5) to different manufacturing Industries in KPK, Pakistan.
- Initially 279 questionnaires were collected, refined to 270 after data cleaning through SPSS, however, the response rate was 46%.
- Cronbach's Alpha test has been used to ensure the validity of the questionnaire.
- Correlation Analysis was performed to explore relationships between factors.
- Multiple Regression Analysis was used to investigate the impact of factors on EMS effectiveness.
- The regression equation is derived from putting values in the equation 1.

$$Y=b_0+b_1X_1+b_2X_2+b_3X_3+\ldots+b_kX_k \quad (1)$$

where:

- Y is the dependent variable,
- b_0 is the constant (intercept),
- $b_1,b_2,b_3,\ldots,b_k$ are the coefficients for the independent variables $X_1,X_2,X_3,\ldots,X_k$ respectively.

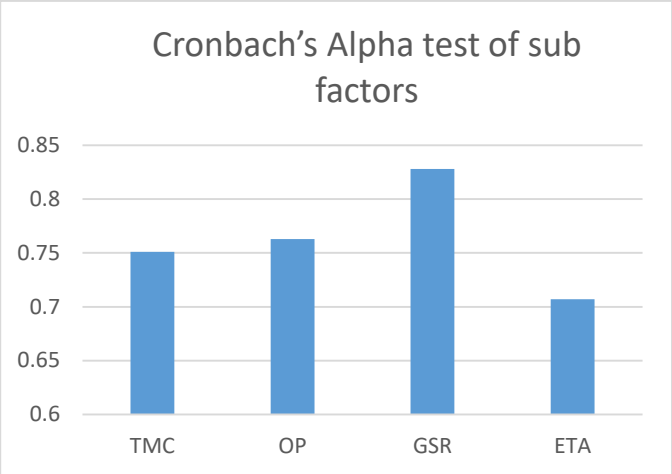
IV. RESULT AND DISCUSSION

A. *Cronbach's Alpha Test*

Cronbach's Alpha verifies that the data gathered through the questionnaire is valid because the result of all variables is above 7. The data is given in Table 1 and Graph 1.

Serial Number	Number of Items	Variables	Cronbach's Alpha	Remarks
1	3	Top management Commitment	0.751	Valid
2	3	Organisational Policies	0.763	Valid
3	3	Government Support and Regulations	0.828	Valid
5	3	Employees Training and Education	0.707	Valid

Table 1 Cronbach's Alpha



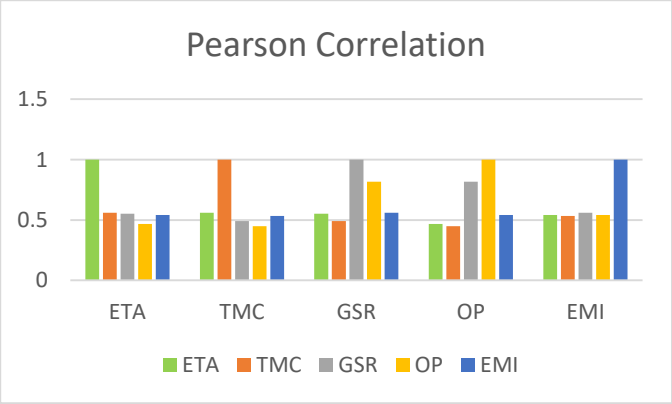
GRAPH 1

B. *Pearson Correlation*

Tables 2 and Graph 2 show that Energy Management Implementation has strong Positive Correlations with employee training and Education, Top Management Commitment, Organizational Policies and Government Support and Regulation [9]. The improvement in any Independent factors can improve the Implementation of Energy Management Systems.

		ETA	TMC	GSR	OP	EMI
ETA	Pearson Correlation	1	.559	.552	.466	.541
TMC	Pearson Correlation	.559	1	.491	.449	.533
GSR	Pearson Correlation	.552	.491	1	.818	.559
OP	Pearson Correlation	.466	.449	.818	1	.540
EMI	Pearson Correlation	.541	.533	.559	.540	1

Table 2



GRAPH 2

C. *Multiple Regression and Anova*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.680[a]	.462	.454	.48053

a. Predictors: (Constant), OP, TMC, ETA, GSR

Table 3 Model Summary

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	51.233	4	12.808	55.468	<.001[b]
	Residual	59.575	258	.231		
	Total	110.808	262			

a. Dependent Variable: EMI

b. Predictors: (Constant), OP, TMC, ETA, GSR

Table 4 ANOVA

Coefficients

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	.861	.207		4.163	<.001
	ETA	.203	.056	.216	3.624	<.001
	TMC	.192	.051	.219	3.783	<.001
	GSR	.172	.079	.181	2.188	.030
	OP	.200	.071	.218	2.808	.005

a. Dependent Variable: EMI

Table 5 Multiple Regression

To analyze the Multiple Regression Analysis with a 95% confidence Interval, the model shows a significant model summary: $F_{(1,2)}$=55.468, P< .001, Adj R^2 = 0.454, R^2 = 462. The analysis shows that employee training and Education have a positive effect on the Implementation of Energy Management Systems (β = 0.216, t = 3.624, p < 0.001), the Top Management Commitment also have a positive effect on the Implementation of Energy Management Systems (β = 0.219, t = 3.783, p < 0.001), the Government Support and Regulation also have a positive effect on Implementation of Energy Management Systems (β = 0.181, t = 2.188, p = .030), the Organizational Behavior also have a positive effect on Implementation of Energy Management Systems (β = 0.218, t = 2.808, p = 0.005). The regression equation based on the unstandardised coefficients is:

EMI=0.861+(0.203×ETA)+(0.192×TMC)+(0.172×GSR)+(0.200×OP)

DISCUSSION

Before implementing Energy Management Systems the organization had to train employees on Energy concepts while taking care of their needs and developing their competencies. The organization have to measure the effectiveness of training and its impact on employees concerning energy performance. Top Management actively participates in the energy management and improvement process, empowers employees to solve Energy management problems and provides resources necessary for Energy management. The organization should adopt strict policies regarding Energy management and utilization. The government should support renewable energy-related policies and provide financial support for the

implementation of an Energy Management System. The organization should implement monitoring and measurement operation gadgets for energy management, design effective tools for energy management and adapt procurement of goods and services that consider energy efficiency. The organization should ensure the effective implementation of energy management.

CONCLUSION

In conclusion, the critical success factors play a pivotal role in successfully Implementing Energy Management Systems (ISO 50001). The Correlation of all factors has been developed and Regression analysis has been performed to improve the Implementation of Energy Management Systems. The results of the questionnaire data suggest activities should be prioritized. These include identifying, reviewing, evaluating, and documenting facilities, systems, processes, equipment, and employees that impact the consumption of the Organization's energy. Appropriate corrective actions can be implemented to improve the process.

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