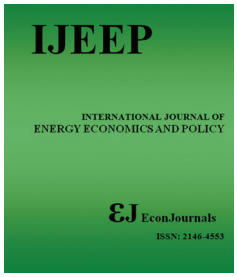

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Barriers Involve in the Energy Efficiency in the Manufacturing Industries of Pakistan

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ABSTRACT

The industrial sector is consuming 35% of the total energy production in Pakistan. Furthermore, many emphases are given in this domain during the past few decades. Energy crises have incredibly influenced the industrial sector which affects the country's economy directly. Electricity saving is possible in the industrial sector by using techniques of energy management (EM). By using this technique, we can save enough energy that will offer financial and conservational help in upcoming. We cannot accomplish energy efficiency due to numerous blockades that we see in industries on regular basis. Few pieces of research have observed the barriers that impact the EE. Here is a lack of emphasis on the necessities for energy efficiency and suitable administration. The clear purpose of this study identifies the barriers that create the problem in the improvement of energy efficiency in manufacturing industries. We collected information about the barriers from various small and large industries through Interviews and research articles. We collected the data by the questionnaire technique by using a 5 Likert scale. And these responses were collected from energy representative. The outcome of this study identifies a significant relationship is existing between technical skills, poor information regarding energy management and inappropriate technology with energy efficiency improvement. There are partial mediation, training, and education that show a mediating effect between Lack of technical skills and energy efficiency improvement. Therefore, future research might be investigated other possible mediation factors in energy efficiency improvement.

Keywords: Energy Efficiency, Improvement in Energy Efficiency, Barriers to energy Efficiency
JEL Classification: N75

1. INTRODUCTION

Worldwide, growing population, innovative industrial development, and emerging nations cause in rising the waste of Energy. The manufacturing sector is one of the most intensive areas according to energy consumption, all over the world. The industrial sector is consuming 35% of the total energy production in Pakistan. Furthermore, many emphases are given in this domain during the past few decades. Energy crises have incredibly influenced the industrial sector which affects the country's economy directly. Electricity saving is possible in the industrial sector by using techniques of energy management (EM) (Tahir Hassan et al., 2017). Energy inefficiency in a great portion of the existing building standard is an extensive contributor to environmental change (Jensen, 2013) and, also, in various states to oil deficiency (Steve, 2015). Enhanced EE is known as an important approach in energy and environment variation extenuation rules (IPCC, 2014). Higher struggle, changeable energy marketplaces, energies industries to accomplish their energy needs sensibly and use it proficiently (Sa, 2015) (Ikram, 2018) EE discusses using less energy to manufacture the similar quantity of facilities or beneficial production. E.g., in the manufacturing area, EE can be calculated by the volume of energy essential to produce a ton of goods (Lawrence, 2018). Furthermore, past studies show that EE in industrial measures

may not generally sufficiently applied due to the occurrence of a variety of obstacles, Hence, there is a gap in EE in manufacturing Industries Invalid source specified. Research in different states shows that the nature of barriers to improving EE relies upon the hindrances which are mentioned (SPRU, 2011) (Backlund, 2013) and these barriers look more different in the developing countries.

The clear purpose of this study identifies the barriers that create the problem in the improvement of energy efficiency in manufacturing industries. Many studies have been conduction which describes the types of barriers: Technical barrier i.e. lack technical skills, inappropriate use of technology (David, 2018), Political barriers influence the EE (Langlois-Bertrand, 2015). Organizational barriers which describe the culture of the organization in the way of decision-making processes (Lalk, 2016). From past few decades as energy crises has incredibly influences the industrial sector which effect the country economy directly. Thus, in this study we are going to explore the followings: I What are the serious blockades need to be measured for effective execution of EE Improvement? II which barriers is to prioritize for effective execution of EE management? In many Studies have found that the magnitude of a corporate takes an important outcome on its implementation of conservational investments. Furthermore, study has attentive on large energy-intensive firms, with less consideration given to SMEs. Large corporations have superior inducements to improve EE and can save extra money (SPRU, 2011). Therefore, the barriers they face may differ from those faced by small- and medium-sized companies. Small and medium enterprises (SMEs) usually practice bigger problems in improving energy EE than bigger firms. These problems challenged by SMEs have several reasons. Initial, they have less related statistics about EE procedures or the technical skills to execute those procedures (Fredrik, Barriers to Energy Efficiency in Swedish Non-Energy-Intensive Micro- and Small-Sized Enterprises – A Case Study of a Local Energy Program, 2017).

2. LITERATURE REVIEW

The importance of investment priorities is the awareness of skills (Chen, 2018). Some companies desire to pay penalties and are disinclined to endorse energy efficiency (Wang et al., 2018). Therefore, more consideration must be paid to such problems, encompassing procedures from manufacturing users to all corporations providing enterprises with investment, technologies, services, technologies, information, and competences (Cagno, 2014). Renewable energy is endorsed for industrial applications (Richardson, 2018).

The most prominent delaying reasons–the non-existence of technical assistances (Hanna, 2018) lack of government policies, higher cost of capital, and deficiency in information and consciousness are the most serious blockades to the enhancement of energy efficiency in the manufacturing in Ukraine (Timilsina, 2016) suitable new technologies can support to overcome the barricades in Colombia's manufacturing industry (Raiza, 2017) the connected blocks/drivers to energy management. A review of energy procedures strategies, standards an investigation of the administrative practices (Noel, 2018). The study not only highlights the convergence inside European Union (EU) to the mutual purposes for Renewable energy efficiency (RE) and energy safety but also the technical diffusion (Gökgöz, 2018), investigation find that the procedure and regulatory (PR) and technical barrier (T) barriers have the maximum position (Kumar, 2018) which implies that WEEE management.

The fundamental reasons for the EE gap are identified as barriers (Schleich, 2000). (Lukas, 1997) was a beginner to discourse the construction of EE barriers, suggesting a blockade frame according to the operational queries: "What is a problem to whom accomplishment what in energy protection?" EE strategies can design poorly in the development countries (Kivimaa, 2017).

Energy can be a chance of pay for businesses that have progressed toward becoming "Mechanical Prosumers" which implies creating and expending sustainable power sources (Vienna, 2015). In Pakistan an approach producer should focus on that kind of assets which is preposterous in the up and coming brief time, for example, atomic vitality and so on so this paper is essential preparation the structure of assembling enterprises, obstructions and vitality emergency and steps taken to conquer the issues looked by the nation (Munir, 2017).

Hindrances to modern vitality effectiveness change though the possibilities of expanding vitality productivity are immense, they are typically ignored since the possibility to actualize financially savvy vitality proficiency arrangements are either covered or repressed by some basic components. These essential components are insinuated as limits. In this one of a kind circumstance, a limit can be portrayed as a guest segment that controls interests in signs of progress that are both essentialness viable and (clearly) monetarily accomplish (Schleich, 2000) (Rohdin, 2006). The costs utilized in the vitality enhancement forms specifically identifies with the financial states of the nation. The budgetary obstructions are viewed as the essential hindrances inside the ICS esteem chain involving providers, makers, and wholesalers (Weber and Gerbaulet, 2018). Pakistan has positioned as the fourth biggest cotton fabricator and viewed as cotton's third powerful customer. The textile division is classified as the greatest while holding the extensive chain of manufacturing, making it huge Pakistan's assembling segment. The textile business comprises of 1221 spinning units, 425 little units, 442 turning units, and 124 huge turning units (Statistics, n.d). Applied obstructions contain imperfect technical assistance (Pugliese, 2013) and skill to recognize (Tobias, 2011) and implement energy redeemable plans (Pugliese, 2013), as well as difficulty in gathering external skills and lack of time (Sala, 2013). We develop this theoretical model based on literature. By barriers to energy efficiency (EE) progress, its argument toward the problems in the system of EE methods' growths and their convention. We can be stunned by presenting new strategies or agendas or technical improvements (Sena, 2017). Lack of information regarding Energy management, budget funding, energy audits, limited internal skills (Johannes, 2017), Lack of information, split incentives, time/other priorities (Fredrik, Barriers to Energy Efficiency in Swedish Non-Energy-Intensive Micro- and Small-Sized Enterprises – A Case Study of a Local Energy Program, 2017) the LTS that hinder energy effciency improvements (Lazarevic, 2018). Additional barriers are deficiency of skilled staff and information (Alireza, 2013)

(Tobias, 2013). The necessity of expert staff with training in EE is one more problem here. Assistances to work and maintain EE is very important to make an EE project running effectively. This is a key barrier in developing nations. Training the staff and define that they have appropriate opportune to access the replacement parts necessity new substructures (Sena, 2017). Small and medium organization's energy managers having lower technical skills. Furthermore, an organization should work on their education (Tahir Hassan et al., 2017).

3. DATA ANALYSIS

In this research, we used the positivism research philosophy because positivism presents the research questions and the hypotheses can demonstrate. The research approach of this study is inductive because they pass from the data to the theory or from the specific to the general. The research strategies of this research are survey method. This strategy allows us to collect huge data to answer the question of this study. We gathered rich and reliable data through this method. The time horizon is cross-sectional as it is conducted at one point in time, in a non-contrived setting with minimum interference of the respondents.

3.1. Data

This is the exploratory study supported by the use of questionnaires. An assessment was directed among the different types of manufacturing industries situated in Punjab the most industrialized and the biggest region of Pakistan, both in the population and in the economy (Khan, 2012). A total of 6 manufacturing organizations were randomly selected from different types of Industries. We collected information about contact and addresses of different companies by using the web-based approach of Small Medium Enterprises Development Authority (SMEDA, n.d.) Pakistan. The Data was collected from energy managers and representatives of companies.

The methodology that is applied for research has been selected in order to get factual and assume conclusions about the Energy Efficiency Improvement. Using the literature, we identify the variables that influence energy efficiency. We are using a quantitative approach to analyze the result. Furthermore, we are using the questionnaire (close Ended) to collect the data and using the conventional technique. The study of literature and the interviews with industrialists help me to understand the barriers and in the adoption of the questionnaire.

We collect the data through questionnaires. All responses were rated on a five-point Likert-scale which ranging from 1 (Extremely Important) to 5 (Not important). Data were collected from 200 energy representatives of different manufacturing industries and we receive the 156 valid responses from the representatives. The theoretical framework of this study contains 5 different extrinsic variables. All these variables are the aspects of Energy Efficiency Improvement and other variables.

3.2. Proposed Framework

We develop this theoretical model based on literature. By barriers to energy efficiency (EE) progress, its argument toward the problems in the system of EE methods' growths and their convention. We can be stunned by presenting new strategies or agendas or technical improvements (Sena, 2017). Lack of information regarding Energy management, budget funding, energy audits, limited internal skills (Johannes, 2017), Lack of information, split incentives, time/other priorities (Fredrik, Barriers to Energy Efficiency in Swedish Non-Energy-Intensive Micro- and Small-Sized Enterprises – A Case Study of a Local Energy Program, 2017) the LTS that hinder energy efficiency improvements (Lazarevic, 2018). Additional barriers are deficiency of skilled staff and information (Alireza, 2013) (Tobias, 2013). Necessity of expert staff with trainings in EE is one more problem here. Assistances to work and maintain EE is very important to make an EE project running effectively. This is a key barrier in developing nations. Training the staff and define that they have appropriate opportune to access the replacement parts necessity new substructures (Sena, 2017). Small and medium organization's energy mangers having lower technical skills. Furthermore, organization should work on their education (Tahir Hassan et al., 2017).

3.2.1. Hypothesis

H_1: Lack of technical skills is positively related to Energy efficiency Improvement.

H_2: Poor information of EM is positively related to Energy efficiency Improvement.

H_3: Inappropriate Use of Technology is positively related to Energy efficiency Improvement.

H_4: On the Job Training and Education is positively related to Energy efficiency Improvement.

H_5: Training and Education shows mediating effect between Lack of technical skills and Energy efficiency Improvement.

H_6: Training and Education shows mediating effect between Poor information of EM and Energy efficiency Improvement.

H^7: Training and Education shows mediating effect between Inappropriate Use of Technology and Energy efficiency Improvement.

3.3. Statistical Analysis

The data in analyzed by using partial least squares structural equation modelling (PLS SEM). Structure model is used for testing the hypotheses. We are using the PLS algorithm to check the Validity and Reliability of the Variables and check the discriminant Validity. We also check the loading values. We also run the Bootstrapping test. In this test we check the total effects of variables, Total indirect effects, specific indirect effect and path coefficient.

3.3.1. Evaluation of the measurement model

The hypotheses used in this paper described on a responsive measurement model because indicators linked with a specific concept remained highly correlated. Additionally, all objects were identical, and the meaning of concept would be same if any solo item would leave out, if the concept would have enough consistency invalid source specified. Table 1 and Figure 1 shows the reliability and validity of all Variables. The acceptance range for loadings 0.4 the below range of loading is not valid for your variables. Therefore, you can see the loading values in the table which is higher than 0.4, if there is any value that is lower than 0.4 then we eliminate that value but in our case all the values are greater than 0.4 so they all are support the content validity. For the Internal consistency reliability, Composite reliability is taking

Table 1: Measurement of model

Variables	Indicators	Loadings	Cronbach's alpha	Composite reliability (CR)	Average variance extracted (AVE)
Lower technical skills	LTS1	0.946	0.956	0.964	0.819
	LTS2	0.922			
	LTS3	0.874			
	LTS4	0.903			
	LTS5	0.899			
	LTS6	0.883			
Poor information regarding energy management	PIEM1	0.845	0.931	0.946	0.744
	PIEM2	0.861			
	PIEM3	0.852			
	PIEM4	0.845			
	PIEM5	0.860			
	PIEM6	0.909			
Inappropriate use of technology	IUT1	0.839	0.930	0.945	0.741
	IUT2	0.911			
	IUT3	0.836			
	IUT4	0.900			
	IUT5	0.864			
	IUT6	0.809			
Energy efficiency improvement	EE1	0.793	0.858	0.898	0.639
	EE2	0.848			
	EE3	0.833			
	EE4	0.710			
	EE5	0.807			
Training and education	T&E1	0.951	0.957	0.969	0.886
	T&E2	0.934			
	T&E3	0.945			
	T&E4	0.934			

on Cronbach's Alphas, because it is assumed more appropriate. The Higher the value the higher the reliability. For checking the discriminant validity Fornell-Larcker criterion was used, which is presented in table Bold values in table show the square-root of AVE, which is higher than the estimated correlation values, thus demonstrating the discriminant validity of constructs involved in the proposed measurement models are satisfying all requirements for establishing the validity and reliability of measurement models. Table 1 shows the reliability and validity of all Variables.

3.3.2. Discriminant validity

Discriminant validity is the degree to which a hypothesis is truly different from other hypotheses by empirical values. Thus, developing discriminant validity infers that a hypothesis is unique and captures phenomena not characterized by other hypotheses in the model. Two measures of discriminant validity have been proposed. (1) examining the cross loadings (2) Fornell-Larcker criterion (Joseph, 2014).

A test for discriminant validity of models was achieved by the evaluation of all cross-loading values. Complete list of cross loading values of all indicators involved in the constructs of measurement models is shown in Table 1. As per the findings presented in Table 1 all indicators (measurement scale items) of measurement models have a higher loading on their respective underlying latent construct, as related to loading on any other construct involved in the model. Hence, these findings meet the cross loadings evaluation criteria and provide a satisfactory evidence for discriminant validity of the model as in Table 2.

3.3.3. Total effects

The Table 3 shows that the direct relationship between the variables (hypotheses) were investigated/analyzed and conformed. Our results show that Lower technical skills (LTS), Poor information regarding Energy Management (PIEM) and Training and education have positively influence the Energy efficiency (EE). On the other hand, Inappropriate Use of Technology (IUT) is negatively associated with Energy Efficiency (EE) and Training and Education (T&E) which means IUT have not affected EE. Hence, all hypothesis has positively direct impact on project success as these findings meet the evaluation criteria and provide a satisfactory evidence for direct hypothesis of the proposed models.

Table 2: Discriminant validity

	EE	IUT	LTS	PIEM	T&E
EE	0.799				
IUT	0.814	0.861			
LTS	0.847	0.851	0.905		
PIEM	0.863	0.873	0.903	0.862	
T&E	0.848	0.826	0.911	0.878	0.941

3.3.4. Specific indirect effects

The specific indirect Effects the indirect relationship between the variables (hypotheses) were investigated/analyzed and conformed. As in the frame work Figure 2, we take the training and education as the mediator, the results show that Training and Education does not have mediating effect between Inappropriate Use of Technology and Energy efficiency Improvement. And Training and Education also doesn't have mediating effect between Poor information of EM and Energy efficiency Improvement. But there is only one mediation that is proved: Training and Education shows mediating effect between Lack of technical skills and Energy efficiency Improvement. As shown in Table 4.

Table 3: Total effects

Hypothesis	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T Statistics (|O/STDEV|)	P-values
IUT -> EE	0.171	0.176	0.132	1.297	0.195
IUT -> T&E	0.090	0.095	0.082	1.093	0.275
LTS -> EE	0.312	0.303	0.109	2.869	0.004
LTS -> T&E	0.608	0.608	0.078	7.799	0.000
PI(EM)->EE	0.432	0.436	0.129	3.337	0.001
PI(EM) -> T&E	0.251	0.246	0.080	3.148	0.002
T&E -> EE	0.284	0.282	0.123	2.303	0.022

Table 4: Specific indirect effects

Hypothesis	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T Statistics (|O/STDEV|)	P-values	Decision
IUT -> T&E -> EE	0.025	0.025	0.026	0.981	0.327	Against
LTS -> T&E -> EE	0.173	0.173	0.083	2.083	0.038	Supported
PI(EM) -> T&E -> EE	0.071	0.069	0.038	1.853	0.064	Against

Figure 1: Structural model

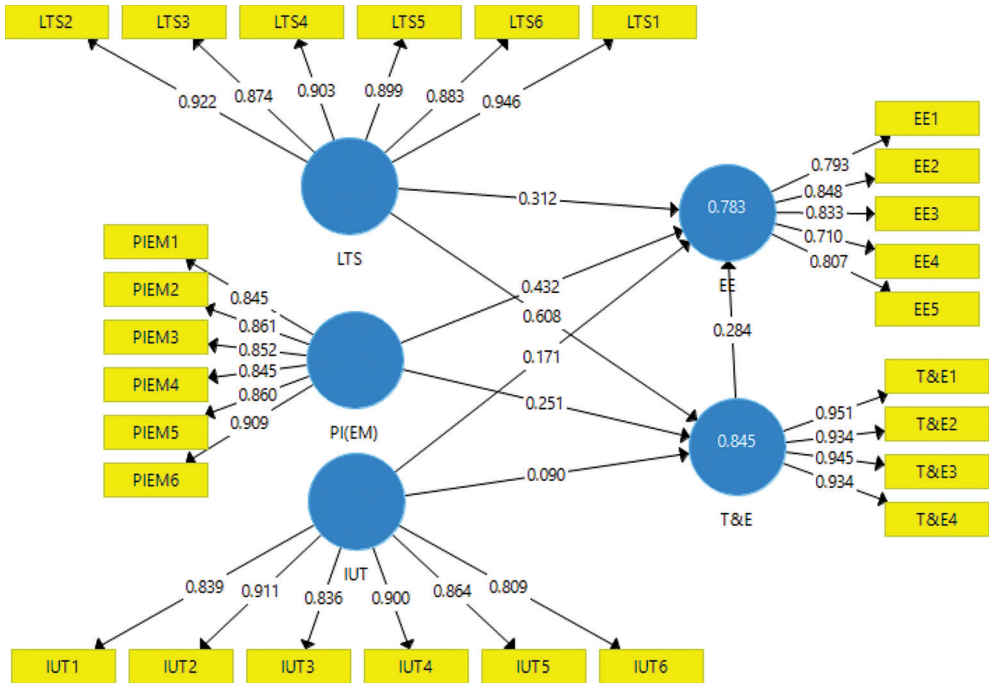
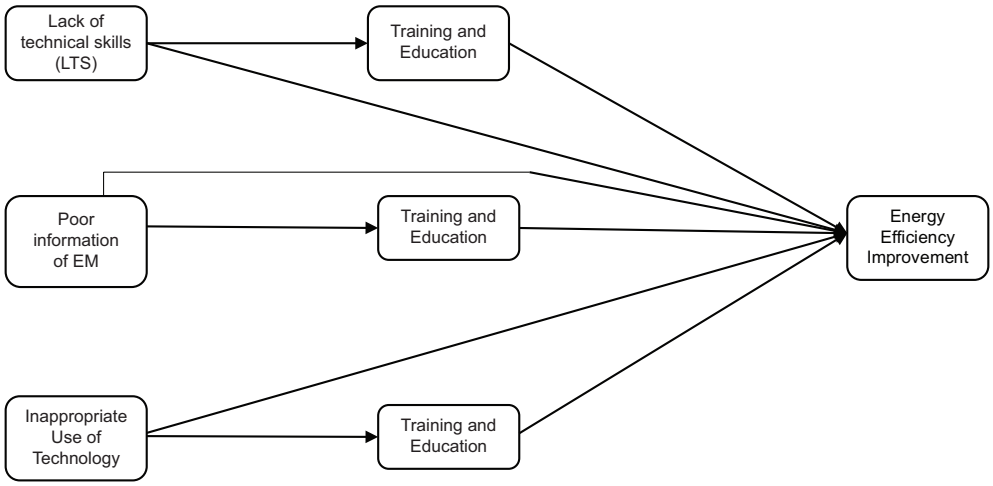


Figure 2: Conceptual framework



4. CONCLUSION

The existing work recommends and empirically observe a mediation model that clarifies the role of training and education of employees play as mediator between Lower technical skills (LTS) and Energy Efficiency Improvement (EE). The (Smart PLS) has been applied to inspect the facts. The data from a variety of manufacturing companies have been collected by questionnaires. The observed results propose some exciting facts clarifies the role of training and education of employees play as mediator between Lower technical skills (LTS) and Energy Efficiency Improvement (EE). Thus, the Manufacturing industries should give the training and education to their employees. Therefore, that they work well and adopt the technology well and helps to improve the energy efficiency in the manufacturing Industries.

The research is not complete without limitations which shows the direction for future research. Initially, it must be noted that the conclusions of this study supported the proposed theoretical framework. There may be other fundamental models also dependable with the same design of covariances. Therefore, future research might be investigated other possible mediation factors in the energy efficiency improvement. Furthermore, data are collected from only 2 to 3 cities of Pakistan; hence, one ought to be careful when put on the finding to other locations. Its challenging the future model to other locations (country) would be a favorable future way to study. 4th, the study doesn't emphasis on any sort of businesses, furthermore it can become a good future direction to work on particular/specific organization as hyper modest and requires a flexible and fast answer from firms (Felipe, 2016)

Finally, the research shows sign of causality but cannot examine causality. A forthcoming research might implement a longitudinal method to test the evidence of causality.

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