ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

OPTIMIZATION OF ENERGY CONSUMPTION IN AN INDUSTRY BY USING EP-OP AND TOPSIS METHOD

Amit Yadav*, Prof. Ravi Nagaich, Dr. S.C. Solanki
***** Ujjain Engineering College, Ujjain
Ujjain Engineering College, Ujjain

ABSTRACT

Maintenance of good indoor environment condition in buildings requires increased investment and possible higher energy consumption. To reduce the cost of the indoor environment of axes metrology is focused on the relation between investment cost for HVAC equipments as well as decreased energy consumption and improved performance of occupants in office building. For this, EP-OP method is applied to collect the data and then TOPSIS method is applied on the collected data which is the technique for order preference by similarities to ideal solution. To obtain the best possible result in which, the energy consumption cost is reduced without reducing the Illumination Efficacy with fare employee satisfaction. TOPSIS analysis is a practical application to verify the collected data. First the initial data is collected with the help of EP-OP method, and then the data collected is analyzed by TOPSIS analysis. After completion of successful TOPSIS analysis, data processing is being done. By using TOPSIS method, energy consumption cost will be decreased up¬-to Rs. 16000 per year of the present investment on the improvement of the indoor air quality and light illumination without any retrofitting and financial investment.

KEYWORDS: EP-OP METHOD,Topsis method & Initial data which is measured from visited company.

INTRODUCTION

EP-OP method in which we collect the data and utilizing those data we will apply TOPSIS method in which we have used technique for order preference by similarities to ideal solution to obtain the best possible result in which we have reduce the cost without reducing the efficiency much and also with fare employee satisfaction. Using this method we have decreased the cost up to 17% of the present investment on the improvement of the indoor air quality. The financial losses due to decreased office work performance compared to energy saved are much higher and thus the efficiency of the organization is decreased. Cost benefit analysis is a method in which we try to reduce the expenditure on any occupants. CBA is a quantitative analytical tool to aid decision-makers in the efficient allocation of resources. It identifies and attempts to quantify the costs and benefits of a program or activity and converts available data into manageable information. The main objective of cost benefit analysis is to select the best possible alternative which provides maximum satisfaction with least cost. The project is all about selecting the alternative which not only reduce the cost but also give employee satisfaction increase in productivity.

CBA is a tool which allow entrepreneur to utilize their resources efficiently and extract maximum from their limited available resources. here we have applied CBA for the efficient use of electricity so that costing related to that must be reduce and at the same time environment condition must also remain same , what is desired. We have used EP- OP method and TOPSIS method. To collect data we have used EP-OP method and on the basis of that data we found certain factor which we have applied on TOPSIS for selecting out the best alternative which will well suited for the given condition. TOPSIS method only gives us the best alternative and to apply that is all depend on the practical arrangement and application.

PROBLEM STATEMENT

Now a day most of the organization and firms are facing problems with regards to cope-up with the maintenance of indoor air quality. It has been also found that due to improper energy balance and due to improper structural arrangement it was investigated that a lot on improving indoor air quality hence on the basis of this analysis a general look over this aspect so that organizations can get fare benefit with least possible investment.

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

I have done inspection in a firm named axes metrology where indoor air quality is of great importance. It is also found that by simply adjusting or rearranging some structural arrangements it can reduce a lot of energy without losing the efficiency of the firm.

This research is about to give generalized view to all our industrial firms that how it can reduce the energy consumption and thereby cost by simply applying simple mathematical operation which is not only energy saving but also maintains the desired type of environment.

METHODOLOGY

The energy performance and occupant productivity assessment method(EP-OP) for complex assessment of office building refurbishment in consideration of existing indoor environmental conditions ,predicting increased office work performance ,energy consumption and technical state of the building envelope as well as HVAC equipment was developed.

EP-OP METHOD

It is possible to evaluate office work performance according to thermal sensation vote as well. Measurements of air temperature are not sufficient for the EP-OP method as thermal sensation depends on the seasonal conditions, physical activity and clothing level of the occupants. It could only be used for comparison with the results of questionnaire survey.
The main step of the procedure is grouped into:-

1. Initial data collection.
2. Data analysis.
3. Data processing

Initial data collection

In initial data collection we collect the information about the office. Data like indoor environment condition, the shape and size of the building, the type of work, the economic condition of the organization where we have to establish the set-up, surrounding climatic condition of the office etc.

Data analysis

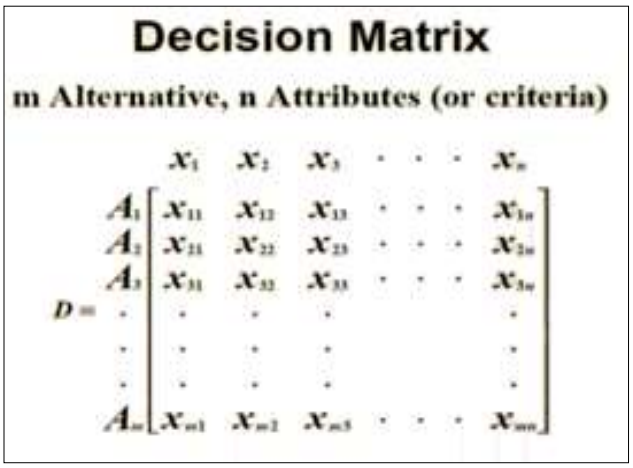
Now we have obtain the details about the data and we will now analyse the best possible way in order to obtain the maximum productivity and in turn increase the net profit in least cost possible.
To analyse this we will frame various charts and graph on the basis of temperature, performance, ventilation, health rate etc.

Data processing

This phase include implementation of the analysis that we have done on the basic inputs. In this process we will final design data to the organization. After the implementation of the design we will get certain result or feedback from the organization which will decide the effectiveness of our analysis.

Topsis method

The Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) was developed by Hwang and Yoon. This method is based on the idea that the selected alternative should have the shortest distance from the ideal solution and the farthest distance from the negative solution .The ideal solution may be defined as an imaginary action leading to the best possible results from all of the analyzed alternatives.



DESIGN OF EXPERIMENTS

Initial data which is measured from visited company

WEIGHTAGE →	0.3	0.4	0.2	0.1
Condition	Temp °C	Energy consumption KWH	Cost RS/h	Error
C_1	19	1.675	15.07	3.963
C_2	20	1.58	14.22	4.007
C_3	21	1.52	13.95	4.051
C_4	22	1.48	13.32	4.406
C_5	23	1.42	12.78	4.460

Rating data out of 10

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

WEIGHTAGE →	0.3	0.4	0.2	0.1
Condition	Temp ^{0}C	Energy consumption KWH	Cost RS/h	Error
C_1	7.6	8.37	7.53	7.92
C_2	8.0	7.9	7.11	8.0
C_3	8.4	7.6	6.97	8.10
C_4	8.8	7.4	6.66	8.80
C_5	9.2	7.1	6.39	8.92

Calculate $(\sum x^2_{ij})^{1/2}$ for each column and divide each column by that to get r_{ij}

$(\sum x_{ij}^2)^{1/2}_{temp} = (7.6^2+8.0^2+8.4^2+8.8^2+9.2^2)^{1/2}$

Condition	Temp ^{0}C	Energy consumption KWH	Cost RS/h	Error
C_1	0.120	0.192	0.097	0.0423
C_2	0.121	0.180	0.0916	0.0428
C_3	0.133	0.176	0.0898	0.0433
C_4	0.140	0.172	0.0858	0.0470
C_5	0.146	0.164	0.0822	0.0477

$=18.82$

$(\sum x_{ij}^2)^{1/2}_{ec} = (8.37^2+7.9^2+7.6^2+7.4^2+7.1^2)^{1/2}$

$= 17.18$

$(\sum x_{ij}^2)^{1/2}_{cost}$

$= (7.53^2+7.11^2+6.97^2+6.66^2+6.39^2)^{1/2}$

$= 15.52$

$(\sum x_{ij}^2)^{1/2}_{eff}$

$=(7.92^2+8.0^2+8.10^2+8.8^2+8.92^2)^{1/2}$

$=18.69$

Condition	Temp ^{0}C	Energy consumption KWH	Cost RS/h	Error
C_1	0.403	0.480	0.485	0.423
C_2	0.425	0.450	0.458	0.428
C_3	0.446	0.440	0.449	0.433
C_4	0.467	0.430	0.429	0.470
C_5	0.488	0.413	0.411	0.477

Multiply each Column by wj to get Vij.

WEIGHTAGE →	0.3	0.4	0.2	0.1

WEIGHTAGE →	0.3	0.4	0.2	0.1

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

Condition	Temp ^{0}C	Energy consumption KWH	Cost RS/h	Error
C_1	0.120	0.192	0.097	0.0423
C_2	0.121	0.180	0.0916	0.0428
C_3	0.133	0.176	0.0898	0.0433
C_4	0.140	0.172	0.0858	0.0470
C_5	0.146	0.164	0.0822	0.0477

Determine Ideal Solution A^+

A^+ = {0.120, 0.164, 0.0822, 0.0477}

Calculate the relative closeness to the ideal solution $C_i^+ = S_i^-/(S_i^+ + S_i^-)$

Condition	$S_I^-/(S_I^+ + S_I^-)$	C_I^+	Result
C_1	0.026/0.058	0.448	← WORSE
C_2	0.028/0.0472	0. 593	
C_3	0.021/0.0352	0.595	← BEST
C_4	0.024/0.0458	0.524	
C_5	0.032/0.0580	0.551	

According to TOPSIS method we have selected C3 condition is best For organization.

RESULT

According to the initial arrangement of axis metrology we found that the total investment done by them on indoor air quality are as follows:

Real amount = 88.88*9

Initial data = 799.9 Rs/day

= 23997.6 Rs/month

After applying our mathematical method and by rearranging the cabin structure we have reach the solution which is as follows

Amount by our = 73.92*9

Calculation = 665.28 Rs/day

= 19958.4 Rs/month

Through our analysis we have reduce the cost about 4000 Rs. Which is 18% of initial cost.

CONCLUSION

The EP-OP method for office building refurbishment analysis considering both energy efficiency and office work performance is presented in the paper. The method involves a set of procedures which include technical and energy consumption data collection, a questionnaire survey as well as measurements of the indoor environmental conditions. The TOPSIS technique is used in order to identify most efficient intervention scenario for decision makers.

Study of axis metrology site we found that cost of energy consumption can be reduced a lot without much reduction in the efficiency. After collecting data we have selected certain factor in our consideration and applied TOPSIS method taking temperature and efficiency in consideration.

After getting the best alternative which maintains the temperature about 230c at the least expanse that is Rs20023.2 which was initially Rs 23997.6 their-by decreasing the cost about Rs 4000 at the same time the efficiency remain about 83 to 85%.

Condition	Temp ^{0}C	Energy consumption KWH	Cost RS/h	Error
C_3	21	1.52	13.95	4.05

FUTURE SCOPE

The main characteristics of three different thermal protection levels are dealt with in the following list. Taking no action will be much more expensive than carrying out insulation measures here and now! This is shown by the feasibility study. Good insulation saves money – and the better the level of insulation, the more money will be saved. The other features are also positively affected by good insulation:

- The risk of mould formation is reduced,
- Thermal comfort is increased and there are better options for effective heating.
- These are the advantages of good insulation which can be enjoyed by the owner and

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

occupant themselves.The European community will also benefit if energy is saved through better thermal protection:

- Investment in thermal protection measures creates more employment in Europe and
- The reduced energy consumption will slow down climate change.

REFERENCES

1. Joost van Hoof1, Mitja Mazej2,(2010),Jan L.M. Hensen3" Thermal comfort: research and practice" frontiers in bioscience, 15(2), 765-788
2. Mohammad S. Al-Homoud *, Adel A. Abdou, Ismail M. Budaiwi(2009), "Assessment of monitored energy use and thermal comfort conditions in mosques in hot-humid climates", Energy and Buildings 41 (2009) 607–614.
3. Keramatollah Akbari1, Robert Oman2(2013), "Impacts of Heat Recovery Ventilators on Energy Savings and Indoor Radon in a Swedish Detached House", WSEAS Transactions On Environment And Development, E-ISSN: 2224-3496, Issue 1, Volume 9, January 2013.
4. Vivian Loftness1, Volker Hartkopf2, Beran Gurtekin3 (2003) " Evaluating the Cost-Benefits of High Performance Building and Community Design for Sustainability, Health and Productivity" Linking Energy to Health and Productivity in the Built Environment, 2003 Green build Conference.
5. G. S. Brager, R. de Dear (2001), "Climate, Comfort, & Natural Ventilation: A new adaptive comfort standard for ASHRAE Standard 55" Center for Environmental Design Research Center for the Built Environment, Oxford Brookes University, Windsor, UK, April 2001.
6. Steven Emmerich, H.E. Burroughs, William Fisk(2014), " Indoor Air Quality" 1791 Tullie Circle, NE. Atlanta, Georgia 30329-2305.
7. Ksenia Chmutina(2010) "Building Energy Consumption And Its Regulations In China" The University of Nottingham, Paper 67.
8. Rokas Valancius, Andrius Jurelionis * and Viktoras Dorosevas(2013) "Method for Cost-Benefit Analysis of Improved Indoor Climate Conditions and Reduced Energy Consumption in Office Buildings" Energies 2013, 6, 4591-4606; doi:10.3390/en6094591, ISSN 1996-1073.
9. A.J. Marszala,∗, P.Heiselberga, J.S.Bourrelleb, E.Musallc, K.Vossc, I.Sartori d, A.Napolitanoe (2011)" Zero