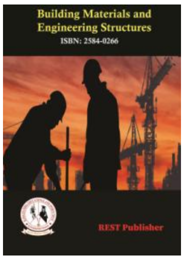
Building Materials and Engineering Structures
Vol: 1(2), June 2023
REST Publisher; ISSN: 2584-0266 (Online)
Website: https://restpublisher.com/journals/bmes/
DOI: http://doi.org/10.46632/bmes/1/2/1



A Comprehensive Analysis of Domestic Building Energy Efficiency Value Using VIKOR Method

***Prabakaran Nanjundan, M. Ramachandra, Chandrasekar Raja, Sangeetha Rajkumar**
REST Labs, Kaveripattinam, Krishnagiri, Tamil Nadu, India.
*Corresponding author Email: Prabakaranrsri@gmail.com

Abstract.*"What is a room's energy efficiency?" A facility's energy efficiency is determined by comparing its power usage per square meter to the energy demand standards set for that particular type of structure in a given climate. To evaluate the floor space of each room on each floor of your building in the warmest areas, measure the area of each room precisely and then sum those measurements to get the overall floor area. The more precise the measurement, the more accurately your energy waste will be displayed as oil used per square meter. The research significance is fairly long-term energy and expense savings. Buildings that use less energy and water also have lower maintenance expenses. They also have a lower total social impact since energy-efficient structures that do not use natural gas produce fewer greenhouse gas emissions. House efficiency, in general, refers to how effectively resources like electricity and freshwater are used to operate systems and equipment placed or used in the building, as well as to provide services like heating, cooling, and lighting. Alternative factors to consider include occupant density, lighting loads, computer equipment, and additional equipment. The assessment options are open plan offices, small offices, laboratories, open computer labs, meeting rooms, and circulation. The results based on circulation show that it has the highest rank, while the laboratories have the lowest rank. The value of the dataset for building energy efficiency in the VIKOR method shows that the circulation has the top ranking.*

Keywords: *Occupant density, Computer equipment, Additional equipment, Building Energy, Laboratories.*

1. INTRODUCTION

The very first step in creating energy optimization solutions is to conduct an energy analysis. The goal of this evaluation is to assess the system, compare energy usage, and identify potential areas for improvement [1]. Computer-driven energy simulation is a crucial aspect of designing and analyzing energy-efficient structures, as well as creating successful building energy indices. This technique is valid for evaluating the relationship between exterior climates, building materials, and heat pumps [2]. An objective way to assess a structure's efficiency is to provide it with a rating. Based on the amount of space inside the building and the effectiveness of the steam heating, ventilation, insulation, and lighting systems, homes can be assigned a rating from A1 to G. It is expected that higher ratings for a home's efficiency will result in lower energy costs [3]. Green building initiatives and the Energy Conservation Building Code (ECBC) both contribute to increasing building energy efficiency, although they do so in different ways. The ECBC establishes basic standards for energy efficiency, adding new office buildings and eliminating ineffective ones from the market. It promotes the market for buildings with increased energy efficiency [4]. Building applications and the associated tools were created to give designers access to such a method. There are over 400 home energy prediction models and applications available, according to the US Department of Energy [5]. Two-dimensional heat transfer effects have been added to Energy Plus, a technology that simulates the energy use of an entire building using co-simulation. Analyzing the results, the power load of solar heat from glass amounts to 2-8% of the overall house load, regardless of whether the facades are internally insulated or not [6]. Most studies evaluating the energy performance of buildings, both for new constructions, focus on energy use during operation. The amount of energy required to construct a building has also received considerable attention in another area of literature and is included in this one [7]. It is uncertain how improved productivity from optimum indoor conditions affects building energy efficiency. One possibility is that quantified and demonstrated productivity improvements could serve as a powerful impetus to employ a variety of energy-saving measures that also enhance indoor comfort

[8]. The opening of the energy services market in China provides an unprecedented opportunity for international energy applications and their energy service delivery subsidiaries, which specialize in improving energy efficiency [9]. In contemporary construction, energy conservation and enhancing building energy efficiency are crucial issues. Addressing this issue helps to increase the building's safety and environmental sustainability, reduce the use of fossil fuels, and enhance liability. At every point in the facility life cycle or at the design stage, the need for enhancing energy savings and building energy productivity should be taken into account [10].

2. MATERIALS AND METHODS

Since there are many research papers on network selection and vertical handover using the VIKOR method, it is worth reading the documentation to get an idea of how to use it in the context of network selection. [1] The VIKOR method was introduced to solve contradictory and sometimes conflicting problems in separate spaces with criteria. VIKOR stands for Multi-Criteria Optimization and Compromise Decision in Serbian abbreviation. [2] The TOPSIS and VIKOR methods also give better results to choose the best knowledge. They are best used with RF-MEMS switches and dielectric material, using the MADM approach for selection, which is the first time it has been used. [3] The VIKOR method provides the above five rankings for jurisprudence criteria and alternatives. This can help regulators in Iran and other Islamic countries to benefit from short-selling alternatives in the development of capital markets. [4] The VIKOR method is another MCDM method designed to improve complexity as there are several parameters in the settings. This approach centers on prioritizing and considering the proximity to the optimal choice, essentially selecting the most suitable option based on various criteria.[5] As usual in most MCDM techniques, the VIKOR method is subjective in a fuzzy environment and can be expanded to accommodate imprecise data in various fields. [6] A VIKOR method based on Hamming distance is proposed to sort PHESP sites. The translation of information and consistency in variable values are essential factors in decision-making, which vary depending on the type of decisions being made.This method is very useful for unspecified problems. [7] The VIKOR method introduces a ranking index based on a specified metric to determine how close a solution is to the best solution. On the contrary, the TOPSIS method is based on the principle that the chosen alternative is optimal if it is a "short distance" away from the solution, and "negative optimal" alternatives must be "away" from the solution. [8] An optimal model is proposed for determining attribute weights. Then, the joint interval is valued using an intuitive ambiguous decision matrix and MAGDM traditional VIKOR problems based on formal interval value resolution calculation steps. Intuitive fuzzy estimators and marginally known weight information are provided. [9] The VIKOR method is a unique MCDM method for decision-makers to arrive at a decision with conflicting criteria. [10]

Step 1.

Step 2. First, we need to identify the optimal and least favorable values

$$F_i^+ = Max\ (F_{ij})$$
$$F_i^- = Min\ (F_{ij})$$

Step 3. Normalization of S_j and R_j

$$S_j = \sum_{j=1}^{m} \left[\frac{w_j\,(f_i^+ - f_{ij})}{f_i^+ - f_i^-}\right]$$
$$R_j = Max \left[\frac{w_j\,(f_i^+ - f_{ij})}{f_i^+ - f_i^-}\right]$$

Step 4. Computation of Q_j for group of utility function

$$Q_j = \frac{v(S_j - S^+)}{(S^- - S^{+})} + (1 - v)\left(\frac{R_j - R^+}{R^- - R^+}\right)$$

Step 5. Ranking of the alternative

Sorting of R_j, S_j and Q_j are made from their minimum value. Hence the three ranking list is obtained.

Step 6. Acceptance of Rank choice

Case 1: Acceptable advantages

$$Q(a(2) - Q(a(1)) \geq D_Q$$

Where $D_Q = \frac{1}{j-1}$, where j is the number of alternatives.

Case 2: Choice of random acceptance stability, where Q_j is the best choice from S and R with $v \geq 0.5$

Condition: If any one of the conditions is not satisfied, then a set of compromise solution will be proposed and that is consist of:

1. Alternatives a1 and a2, if condition a2 is not satisfied

2. Alternative $a1, a2, a3, \cdots, am$, if condition case 1 is not satisfied $a(m)$ is determined by the relation $Q(am) - Q1 < D_Q$ for maximum M (the position of these alternatives is in closeness)

3. ANALYSIS AND DISCUSSION

TABLE 1. Building Energy Efficiency in Determination of best and worst value

	Determination of best and worst value			
	Occupant density	Lighting loads	Computer equipment	Additional equipment
Open plan offices	0.504	0.455	0.552	0.304
Small offices	0.421	0.631	0.707	0.591
Laboratories	0.309	0.719	0.803	0.779
Open computer labs	0.545	0.843	0.412	0.264
Meeting rooms	0.247	0.426	0.626	0.726
Circulation	0.766	0.732	0.821	0.936
Best	0.247	0.843	0.821	0.264
worst	0.766	0.426	0.412	0.936

Table 1, Building Energy Efficiency, shows that Meeting rooms have the best value for Occupant density, while Circulation has the worst value. For Lighting loads, Open computer labs have the best value, while Open plan offices have the worst value. In terms of Computer equipment, Circulation has the best value, while Open computer labs have the worst value. For Additional equipment, Open computer labs have the best value, while Circulation has the worst value. The assessment options are Open plan offices, small offices, Laboratories, Open computer labs, Meeting rooms, and Circulation.

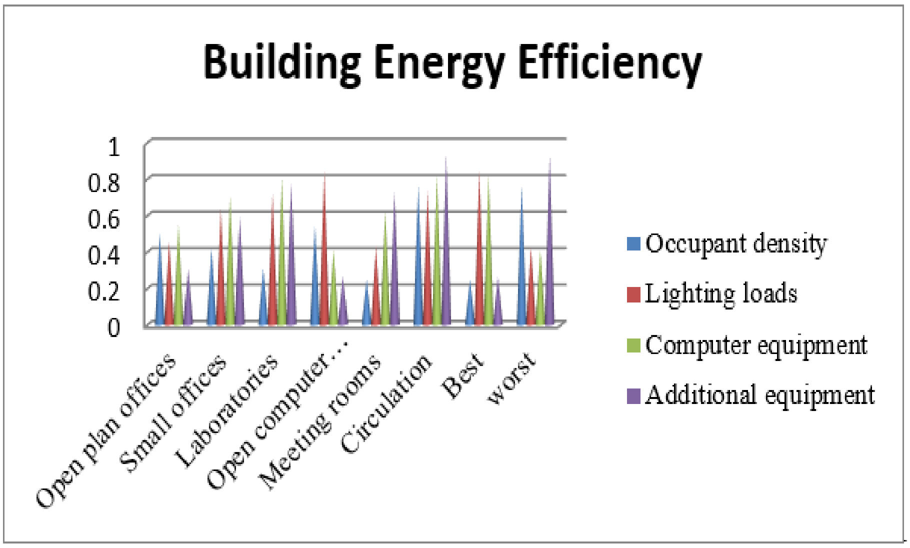


FIGURE 1. Building Energy Efficiency in determining the best and worst value

Figure 1 displays the following alternatives for assessment: occupant density, lighting loads, computer equipment, and additional equipment. The assessment options include open plan offices, small offices, laboratories, open computer labs, meeting rooms, and circulation.

TABLE 2. Building Energy Efficiency in Calculation Sj and Rj

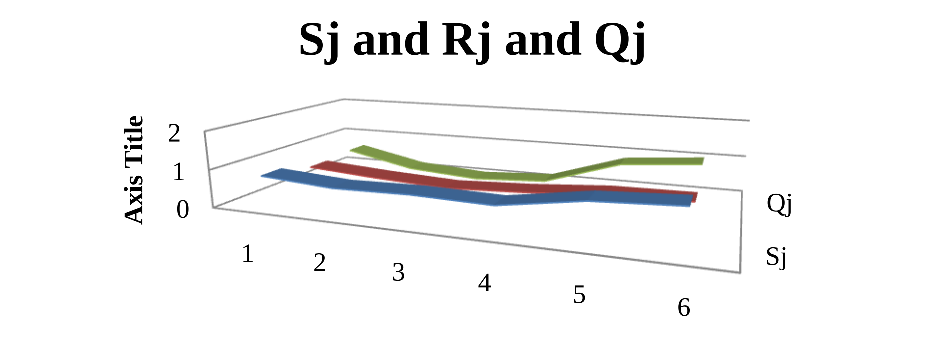
CalculationSj and Rj				Sj	Rj
0.123796	0.232614	0.164425	0.014881	0.535716	0.232614
0.083815	0.127098	0.069682	0.121652	0.402247	0.127098
0.029865	0.074341	0.011002	0.191592	0.3068	0.191592
0.143545	0	0.25	0	0.393545	0.25
0	0.25	0.119193	0.171875	0.541068	0.25
0.25	0.066547	0	0.25	0.566547	0.25

shows the table 2 calculation of the Sj and Rj, it is calculated.

TABLE 3. Building Energy Efficiency in Calculation Sj and Rj and Qj

	Sj	Rj	Qj
	0.783211	0.535716	0.605741
	0.650997	0.402247	0.19254
	0.689985	0.3068	0.054893
	0.643545	0.393545	0.16698
	0.962943	0.541068	0.828492
	1.066547	0.566547	1
S+ R+	0.643545	0.3068	
S- R-	1.066547	0.566547	

Table 3 shows the Sj, Rj, Qj by using the previous tabulation it is the sum of the value. Sj and Rj using the S+ R+ Minimum formula, S- R- Maximum formula.



	1	2	3	4	5	6
Sj	0.78321091	0.65099739	0.68998488	0.64354527	0.96294315	1.06654676
Rj	0.53571605	0.40224728	0.30680036	0.39354527	0.54106815	0.56654676
Qj	0.60574110	0.19253960	0.05489295	0.16698002	0.82849237	1

FIGURE 2. Building Energy Efficiency in Calculation Sj and Rj and Qj

Figure 2 shows the Sj, Rj, Qj by using the previous tabulation it is the sum of the value. Sj and Rj using the S+ R+ Minimum formula, S- R- Maximum formula.

TABLE 4. Building Energy Efficiency inRank

	Rank
Open plan offices	3
Small offices	4
Laboratories	6
Open computer labs	5
Meeting rooms	2
Circulation	1

Table 4 shows the final result of this paper the Open plan offices is the 3rd rank, small offices is the 4th rank, Laboratories is the 6th rank, Open computer labs is the 5th rank, Meeting rooms is the 2nd rank, Circulation is the 1st rank. The final result is done by using the VIKRO method.

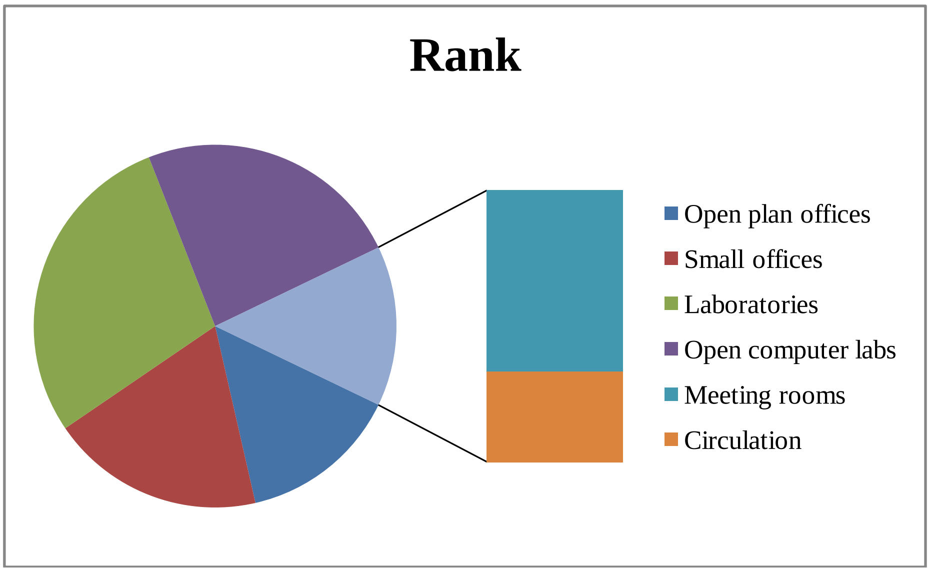


FIGURE 3. Rank

Figure 3 shows the from the result is based on Circulation are the result seen and got the first Rank, whereas the Laboratories got having the lowest rank.

4. CONCLUSION

"The results based on circulation showed that the first rank was obtained by those who had the highest results, whereas laboratories obtained the lowest rank. Buildings with cutting-edge technologies that consume very little operational energy are being constructed and could play a significant role in efforts to reduce fossil fuel consumption and CO2 emissions. In order to further encourage the use of energy-efficient construction materials, it is anticipated that building power standards would establish similar operational targets for future structures. Three proposed policy changes are further encouraging the development of China's energy capacity. There is a strong consensus that industry motivators are efficient and cost-effective instruments, and that government engagement is the most important and successful approach to increase energy efficiency, along with supports and information programs to help increase energy efficiency. Using thermal mass as a means of preserving energy works best where there are significant changes in atmospheric air temperature between day and night. Computer codes for building energy modeling are crucial in choosing the optimal energy-efficiency choices for a certain area. The journey towards promoting emission-free buildings has just begun, despite the lack of adequate local regulation and banking support, the challenges of financing building rehabilitation, the paradox of BEE's rollout in some regions, the slow progress of the heating systemic change, and the massive scale of boosting energy cost in rural areas.".

REFERENCE

[1]. Bakar, Nur Najihah Abu, Mohammad Yusri Hassan, Hayati Abdullah, Hasimah Abdul Rahman, Md Pauzi Abdullah, FaridahHussin, and MasilahBandi. "Energy efficiency index as an indicator for measuring building energy performance: A review." Renewable and Sustainable Energy Reviews 44 (2015): 1-11.
[2]. Lam, Joseph C., Kevin KW Wan, C. L. Tsang, and Liu Yang. "Building energy efficiency in different climates." Energy Conversion and Management 49, no. 8 (2008): 2354-2366.
[3]. Hyland, Marie, Ronan C. Lyons, and Seán Lyons. "The value of domestic building energy efficiency—evidence from Ireland." Energy economics 40 (2013): 943-952.
[4]. Yu, Sha, Qing Tan, Meredydd Evans, Page Kyle, Linh Vu, and Pralit L. Patel. "Improving building energy efficiency in India: State-level analysis of building energy efficiency policies." Energy Policy 110 (2017): 331-341.
[5]. Shi, Xing, Zhichao Tian, Wenqiang Chen, Binghui Si, and Xing Jin. "A review on building energy efficient design optimization rom the perspective of architects." Renewable and Sustainable Energy Reviews 65 (2016): 872-884.
[6]. Mustafaraj, Giorgio, Dashamir Marini, Andrea Costa, and Marcus Keane. "Model calibration for building energy efficiency simulation." Applied Energy 130 (2014): 72-85.
[7]. Copiello, Sergio. "Building energy efficiency: A research branch made of paradoxes." Renewable and Sustainable Energy Reviews 69 (2017): 1064-1076.
[8]. Fisk, William J. "Health and productivity gains from better indoor environments and their relationship with building energy efficiency." Annual review of energy and the environment 25, no. 1 (2000): 537-566.
[9]. Li, Jun, and Michel Colombier. "Managing carbon emissions in China through building energy efficiency." Journal of environmental management 90, no. 8 (2009): 2436-2447.

[10]. Korniyenko, Sergey Valeryevich. "The experimental analysis and calculative assessment of building energy efficiency." In Applied Mechanics and Materials, vol. 618, pp. 509-513. Trans Tech Publications Ltd, 2014.

[11]. Liang, Jing, Baizhan Li, Yong Wu, and Runming Yao. "An investigation of the existing situation and trends in building energy efficiency management in China." Energy and Buildings 39, no. 10 (2007): 1098-1106.

[12]. Dodoo, Ambrose, Leif Gustavsson, and Roger Sathre. "Building energy-efficiency standards in a life cycle primary energy perspective." Energy and Buildings 43, no. 7 (2011): 1589-1597.

[13]. Zhang, Yurong, and Yuanfeng Wang. "Barriers' and policies' analysis of China's building energy efficiency." Energy Policy 62 (2013): 768-773.

[14]. Sadineni, Suresh B., Srikanth Madala, and Robert F. Boehm. "Passive building energy savings: A review of building envelope components." Renewable and sustainable energy reviews 15, no. 8 (2011): 3617-3631.

[15]. Li, Jun, and Bin Shui. "A comprehensive analysis of building energy efficiency policies in China: status quo and development perspective." Journal of Cleaner Production 90 (2015): 326-344.

[16]. Maroua, Drissi, Oumsis Mohammed, and AboutajdineDriss. "VIKOR for multi-criteria network selection in heterogeneous wireless networks." In 2016 International Conference on Wireless Networks and Mobile Communications (WINCOM), pp. 82-86. IEEE, 2016.

[17]. Golfam, Parvin, Parisa-Sadat Ashofteh, and Hugo A. Loáiciga. "Evaluation of the VIKOR and FOWA multi-criteria decision making methods for climate-change adaptation of agricultural water supply." Water Resources Management 33, no. 8 (2019): 2867-2884.

[18]. Patra, Pritam, and Mahesh Angira. "Investigation on dielectric material selection for RF-MEMS shunt capacitive switches using Ashby, TOPSIS and VIKOR." Transactions on Electrical and Electronic Materials 21, no. 2 (2020): 157-164.

[19]. Ahmadvand, Maysam, and Hossein Tamalloki. "Using VIKOR method to prioritise sharia-compliant equivalents for short selling (based on evidence of Iran's stock market)." Afro-Asian Journal of Finance and Accounting 7, no. 3 (2017): 281-303.

[20]. Shahnazari, Arman, Hamed Pourdej, and MonaliDhondiramKharage. "Ranking of organic fertilizer production from solid municipal waste systems using analytic hierarchy process (AHP) and VIKOR models." Biocatalysis and Agricultural Biotechnology 32 (2021): 101946.

[21]. Afful-Dadzie, Eric, Stephen Nabareseh, and Zuzana KomínkováOplatková. "Fuzzy VIKOR approach: Evaluating quality of internet health information." In 2014 Federated Conference on Computer Science and Information Systems, pp. 183-190. IEEE, 2014.

[22]. Wu, Yunna, Lingyun Liu, Jianwei Gao, Han Chu, and Chuanbo Xu. "An extended VIKOR-based approach for pumped hydro energy storage plant site selection with heterogeneous information." Information 8, no. 3 (2017): 106.

[23]. Wu, Min, and Zhujun Liu. "The supplier selection application based on two methods: VIKOR algorithm with entropy method and Fuzzy TOPSIS with vague sets method." International Journal of Management Science and Engineering Management 6, no. 2 (2011): 109-115.

[24]. Xu, Chen Guang, Dong Xiao Liu, and Min Li. "Extension of VIKOR method for multi-attribute group decision making with incomplete weights." In Applied Mechanics and Materials, vol. 513, pp. 721-724. Trans Tech Publications Ltd, 2014.

[25]. Ramezaniyan, M., M. Kazemi, H. Jafari, and S. Elahi. "Application of integrated fuzzy VIKOR & AHP methodology to contractor ranking." Management Science Letters 2, no. 5 (2012): 1511-1526.

[26]. Rathor, Ketan, Keyur Patil, Mandiga Sahasra Sai Tarun, Shashwat Nikam, Devanshi Patel, and Sasanapuri Ranjit. "A Novel and Efficient Method to Detect the Face Coverings to Ensurethe Safety using Comparison Analysis." In *2022 International Conference on Edge Computing and Applications (ICECAA)*, pp. 1664-1667. IEEE, 2022.

[27]. Kumar, Ashish, Ketan Rathor, Snehit Vaddi, Devanshi Patel, Preethi Vanjarapu, and Manichandra Maddi. "ECG Based Early Heart Attack Prediction Using Neural Networks." In *2022 3rd International Conference on Electronics and Sustainable Communication Systems (ICESC)*, pp. 1080-1083. IEEE, 2022.

[28]. Chinnasami Sivaji, M. Ramachandran, Chandrasekar Raja, "Preference Analysis of Operating System Using PROMETHEE Method", Journal on Electronic and Automation Engineering, 1(1), December 2022, 1-8.

[29]. Khan, Imran, S. P. Maniraj, K. Santosh Reddy, V. Balaji, K. Kalaivani, and Mukesh Singh. "Congenital Heart Disease Prediction based on Hybrid Approach of CNN-GRU-AM." In *2023 7th International Conference on Intelligent Computing and Control Systems (ICICCS)*, pp. 613-618. IEEE, 2023.

[30]. Rathor, Ketan, Sushant Lenka, Kartik A. Pandya, B. S. Gokulakrishna, Susheel Sriram Ananthan, and Zoheib Tufail Khan. "A Detailed View on industrial Safety and Health Analytics using Machine Learning Hybrid Ensemble Techniques." In *2022 International Conference on Edge Computing and Applications (ICECAA)*, pp. 1166-1169. IEEE, 2022.

[31]. Manjunath, C. R., Ketan Rathor, Nandini Kulkarni, Prashant Pandurang Patil, Manoj S. Patil, and Jasdeep Singh. "Cloud Based DDOS Attack Detection Using Machine Learning Architectures: Understanding the Potential for Scientific Applications." *International Journal of Intelligent Systems and Applications in Engineering* 10, no. 2s (2022): 268-271.

[32]. Rathor, Ketan, Anshul Mandawat, Kartik A. Pandya, Bhanu Teja, Falak Khan, and Zoheib Tufail Khan. "Management of Shipment Content using Novel Practices of Supply Chain Management and Big Data Analytics." In *2022 International Conference on Augmented Intelligence and Sustainable Systems (ICAISS)*, pp. 884-887. IEEE, 2022.

[33]. Krishna, S. Rama, Ketan Rathor, Jarabala Ranga, Anita Soni, D. Srinivas, and Anil Kumar. "Artificial Intelligence Integrated with Big Data Analytics for Enhanced Marketing." In *2023 International Conference on Inventive Computation Technologies (ICICT)*, pp. 1073-1077. IEEE, 2023.

[34]. M. Mamatha, M. Ramchandran, Kurinjimalar Ramu, “Influence of Chemical Treatment of Natural Fibres Using the SPSS Method” Journal on Materials and its Characterization 2(1), March 2023, 28-39

[35]. Reddy, K. Santosh, V. KAVITHA, and VL NARAYANA. "Slow Increasing Functions and their Applications to some Problems in Number Theory." *ARPN Journal of Engineering and Applied Sciences* 8, no. 7 (2015): 33-44.

[36]. Tibadia, Rajkumar, Koustubh Patwardhan, Dhrumil Shah, Dinesh Shinde, Rakesh Chaudhari, and Kanak Kalita. "Experimental investigation on hole quality in drilling of composite pipes." *Transactions of the Canadian Society for Mechanical Engineering* 42, no. 2 (2018): 147-155.

[37]. Reddy, K. Santosh, and M. Rangamma. "Functions of Fast Increase which appears in some Limits and Formulae." *Telematique* (2022): 4978-4986.

[38]. Gandhi, Mohd Asif, Vusal Karimli Maharram, G. Raja, S. P. Sellapaandi, Ketan Rathor, and Kamlesh Singh. "A Novel Method for Exploring the Store Sales Forecasting using Fuzzy Pruning LS-SVM Approach." In *2023 2nd International Conference on Edge Computing and Applications (ICECAA)*, pp. 537-543. IEEE, 2023.

[39]. Sukumaran, C., and P. J. Sebastian. "Effect of Inclusive Games and Physical Exercises on Selected Physical Variables among the Intellectually Challenged Children." *Annals of the Romanian Society for Cell Biology* 26, no. 01 (2022): 1442-1450.

[40]. REDDY, K. SANTOSH, and M. RANGAMMA. "ON SOME FUNCTIONS OF FAST INCREASE."

[41]. Chaudhari, R., P. K. Loharkar, and A. Ingle. "Applications and challenges of arc welding methods in dissimilar metal joining." In *IOP Conference Series: Materials Science and Engineering*, vol. 810, no. 1, p. 012006. IOP Publishing, 2020.

[42]. Rathor, Ketan, Jaspreet Kaur, Ullal Akshatha Nayak, S. Kaliappan, Ramya Maranan, and V. Kalpana. "Technological Evaluation and Software Bug Training using Genetic Algorithm and Time Convolution Neural Network (GA-TCN)." In *2023 Second International Conference on Augmented Intelligence and Sustainable Systems (ICAISS)*, pp. 7-12. IEEE, 2023.

[43]. VENOTHA, A. SARLIN, and K. ALEX. "Women Entrepreneurs' Challenges in the Wake of the COVID 19 Pandemic." *Turkish Online Journal of Qualitative Inquiry* 12, no. 3 (2021).

[44]. Kalita, Kanak, Rakesh Chaudhari, and M. Ramachandran. "Mechanical characterization and finite element investigation on properties of PLA-jute composite." *International Journal of Computer Applications* 123, no. 13 (2015).

[45]. George, R., LJ, S., Alex, K., Mariadoss, S. and Venotha, A.S., 2021. A Study on the Scope of Implementation of Social Stock Exchange in India. *Turkish Online Journal of Qualitative Inquiry*, *12*(8).

[46]. Chaudhari, Rakesh, Asha Ingle, and Kanak Kalita. "Tribological investigation of effect of grain size in 304 austenitic stainless steel." *Transactions of the Indian Institute of Metals* 70 (2017): 2399-2405.

[47]. Sukumaran, C., B. Karpagavalli, R. Hariharan, and V. Parthiban. "Preclusive Strategies of Obesity to Lead a Healthy Life-A Review‖." *Pharmaceutical Sciences and Research* 1, no. 1 (2022): 42-45.

[48]. Mariadoss, S., A. SARLIN VENOTHA, and K. Alex. "The Role Of Women Entrepreneurs In Micro, Small And Medium Enterprises In Dindigul District." *PalArch's Journal of Archaeology of Egypt/Egyptology* 17, no. 10 (2020): 4245-4255.

[49]. Venotha, A. SARLIN, K. Alex, and S. MARIADOSS. "Women entrepreneurs: Making headway toward ownership by dint of effective leadership." *Journal of Xi’an Shiyou University, Natural Science Edition* 17, no. 1 (2021): 88-93.

[50]. Sukumaran, C., D. Selvam, M. Sankar, V. Parthiban, and C. Sugumar. "Application of Artificial Intelligence and Machine Learning to Predict Basketball Match Outcomes: A Systematic Review." *Computer Integrated Manufacturing Systems* 28, no. 11 (2022): 998-1009.

[51]. Chaudhari, Rakesh, and Asha Ingle. "Experimental investigation of dissimilar metal weld of SA335 P11 and SA312 TP304 formed by gas tungsten arc welding (GTAW)." *Transactions of the Indian Institute of Metals* 72 (2019): 1145-1152.

[52]. Sukumaran, C., and P. J. Sebastian. "Effect of Inclusive Games and Physical Exercises on Selected Physical Variables among the Intellectually Challenged Children." *Annals of the Romanian Society for Cell Biology* 26, no. 01 (2022): 1442-1450.

[53]. S. Siva Shankar, Vimala Saravanan, M. Ramachandran, R. Sangeetha, “A Tutorial on Optimization Automated Tracking Wireless Network System in SPSS Method”, REST Journal on Data Analytics and Artificial Intelligence, 2(2), (2023):100-108.

