Carbon Emission of Global Construction Sector Using Grey Relational Analysis (GRA) Method

*Chinnasami Sivaji, Prabakaran Nanjundan, M. Ramachandran, Jaganathan Rajamanickam

REST Labs, Kaveripattinam, Krishnagiri, Tamil Nadu, India.

*Corresponding Author Email: chinnasami@restlabs.in

Abstract. *Construction industry is wide products of scale creates, and more companies equally different. However, involved in on-site construction most companies smaller and local. Globalization and internationalism balance of construction department despite that, construction most of the activities are carried out by local companies. Required in the manufacturing process goods and services outsource in construction of the doing (among other companies like businesses) a there is a trend. Construction materials, plant and equipment usually from other companies purchased or purchased hired. Special services by subcontractors are provided, and labor by labor agents. Design and engineering services are separate professional provided by companies. Construction industry in india by 2025 it would reach $ 1.4 tn expected. Cities driving growth - total 75% of domestic production% urban people to contribute to the contributing amount (63% currently), and 68 cities more than 1 mn contains the population. Construction industry in india market 250 sub-sectors with links to departments works. Environment and substantial in society global for outcomes the construction industry is responsible. Of our built environment construction and use global greenhouse gas 39% of emissions. Built environment year global co2 makes 40% of emissions. In those total emissions, building activities annually 27% cause, same building and infrastructure at the time materials and construction (generally packed carbon) they are referred to as 13% of the year's addition responsible. Working in the country about 16 percent of the population for people to live for its livelihood depends on construction. Indian construction industry 30 more than millions use people and ₹ 200 billion makes more assets. This is the country's gdp for 5 percent of the product, for total capital formation contributes more than 78 percent. Gray related analysis related to ash calculation degree and measurement or between computer factors the main behavior of the organization the level of contribution influence decides to be once. Between factors or between action for two systems of relationship two gray contact size called. G.mr. The basic of a method the principle is that, selected alternative in a positive-body solution from "large-scale ash relationship" and "small gray" of the relationship must have negative- the physical solution. Gray related huashong analysis science and technology deng of the university created by julang. This gray system theory very widely used one of the models. G.mr.a a specific information concept uses. It's black no information as situations and proper those who contain information defines white. Alternative taken as Unrenewable, Renewable, Nonenergy. Evaluation preference taken as China, European, India, Russia, US. From the result it is seen that US is got the first rank where as is the Russia is having the lowest rank. US is ranked first and Russia is ranked lowest.*

Keywords: Global Construction, Construction market, Gray correlation analysis (GRA).

1. INTRODUCTION

Construction department infrastructure and buildings to the community highly non-renewable provides energy through consumption. As a result, this consumption causes large emissions of co2. World environmental input-release table 2009 by using by construction activities worldwide the amount of co2 emissions caused this article examines and comparing. It is in 40 countries co2 of the construction department analyzes emissions, 26 types of energy use and non-energy considering the use [1]. The construction industry is very much energy, dangerous and challenging business one of the fields. More there are waste, it is myopic issues caused by control facing. In the field previous research, construction department from switching to reaction very effective switching and stable promote practices suggests that to be required. England construction industry £ over 100 billion has income and the country's gdp it accounts for nearly 10% of the product. Construction industry uk very much within the economy in diverse and unstable sectors one, and it is wide suitable dying demand cycles, project specific product needs facing, uncertain products conditions and geographically scattered within short-term project environments a variety of specialized skills connect. World construction for the economy the size and importance of the sector

and its environmental impact considering the contribution, growing "sustainability" to use the agenda as a lens recommended any construction performance can be measured [7].

Department of global construction total co2 emissions 5.7 in 2009 billion tons, which is global by economic activity total co2 produced contributed 23% of emissions. 94% global construction in total co2 from the department indirect emission. Gasoline, diesel, other petroleum products and light fuel oil global construction for direct co2 emissions of the sector four are major energy sources. Indirect co2 emissions are mainly hard coal, natural gas and non-energy originates from the application. Emerging economies department of global construction almost in total co2 emissions 60% are due. China the largest contributor is. Moreover, in developing countries direct of the construction department and indirect co2 emissions the intensities of developed countries greater than value. So, low body carbon construction materials and development of services and promoting the app, construction machines energy efficiency, as well as renewable energy use construction carbon emissions of the sector three key to reducing key opportunities identified [2]. Construction department, agriculture or like manufacturing, the level of growth of a country reflective change adopting the method this article does so suggesting to do so-mode often by short term hidden fluctuations. Early after lagging in growth, in middle income countries ($ 350- $ 900 individual) construction accelerates, then it falls. This time description of the description and its some effects will be provided. In a construction and production for forms of change more detailed in between comparison is made. A more than millions all with population simple for a sample of countries resilience analysis is used construction and production, employment and labor revenue data were available in 1955-64. [2]. our community buildings it is ubiquitous, but inevitably they are in the eyes of the environment negative effects causes. They're during life expectancy, they are plenty of resources consuming energy, occupation of land, eventually they are demolished. Environment in the construction industry interest on issues as fast growing, sustainable home technologies and with regard to construction methods more attention is paid. This general growing awareness leading to kyoto-ethics, this is greenhouse gases reducing emissions international agreement and leading to global warming [3]. The growth of a country operation in the construction industry the relationship between size one, it's been for years at the economic level subject to study. Such a major obstacle to studies, especially in developing countries, appropriate regarding this secto lack of information. Construction structural change in the field current paradigms on, a national economy as it develops over time, time-series of a country based on statistics longitudinal studies cross-sectional in countries rather than data based [4].

Department of malaysian construction bad performance is bad in its communications contains the source. Construction in malaysia communication within organizations it is necessary to investigate issues. This study is at construction sites for bad communication factors leading up analyzes and the associated challenges provides strategies to face.80 site workers involved cross-sectional survey based on the questionnaire, results for poor communication key reasons: for superiors between workers lack of shared language, workplace stress, superiors and colleagues' site workers approach to attitude, mechanisms misunderstanding and among the workers poor communication skills [6]. Construction market in alberta moderate for years. In 2003, the province new projects $ 90.5b (£ 45b) (alberta advantage, 2004) this includes oil and gas 66 of the project's workload percentage (alberta economic development, 2004). Multiple ebc companies' revenue oil and greatly the gas sector depends. Industry the current boom is huge oil and gas construction of facilities due to improvement, more professional construction staff and efficient severely of activists leading to scarcity. This worst in the industry has had an impact, which biggest, primary projects large cost and time exceeds. Of skilled operators lack and inexperienced enough due to staff due to construction planning because of poor workmanship it is said to be lack of capacity [7]. Construction department world economic across exceptional in development having an impact. Will be done by the construction department enough buildings and infrastructure is a country social development, industrialization, freight transport, standard growth and urbanization getting into some goals like that ensures.

This study economy and total much to domestic product construction department with other sectors through contributing complex links determining the link the aim is (gdp). Statistical from 1970 to 2019 department malaysia and the world data from the bank was collected, more pearson contact test, integration testing, and granger causal test conducted. Vector error correctional model (vecm) short periodic and long-term balance analysis and impulse for response function created (irf) construction performed to study occupational behavior [9]. Human buildings and industrial activities due to natural today context 2 is widely degraded considered. In the natural environment reducing the impact on the impact in developing a built environment there is tension. Individuals full size for systems social and industrial a move structured environment required, but natural environment structured support the environment and maintain. So, prevent unnecessary degradation green during construction design of raw materials and clever connect sensitivity to the application there is a need to need [10]. The age of information has already come it is obvious. Many like writers, earl (1989) currently we are an information that we live in the community instructions, where the main is source knowledge and information technology it activation the mechanism is. Information some of the workers have improved the largest of the

economies creating type employees because of that, technology is some capital creation in sectors contains the highest rate this is also avoided. Pioneer for this dawn conditions are technological defacement, commercial globalization and in social progress three parts of the dynamic change the earl advises that [11]. Since the mid-1990s arrival studies, developing countries ' informal ' in many areas construction operations describe rapid expansion. This is in the interpretation of the concept increasing diversity the way to considerable confusion leads. Literature discussion through broad review to bring some clarity the effort is being made. The essence of informal character that is the absence of regulation is argued. Construction function different types because the rules are subject to the terms, information in the construction industry various explanations inevitable [12].

2. MATERIALS & METHODS

Unrenewable: An unrenewable one resource limited resource is a natural resource is, with consumption nature quickly to continue immediately by means can't change. Carbon-based fossil fuels are an example. Original organic material, heat and pressure with help, oil or gas-like fuel switching. In some waters earth minerals and metal minerals, fossil fuels coal, petroleum, natural gas and groundwater not all is renewable are considered resources, however, nuclear reactions except individual elements always protected, nuclear decay or atmospheric escape. Rather, in a sustainable manner when harvested resources such as wood and for energy conversion systems the air used as renewable resources considered, often their localized filling for humans may occur within meaningful time limits.

Renewable: Renewable energy is from renewable resources energy is, they are naturally completed in human time scales. Clarification to clarify demand in renewable resources solar, air, water movement and geothermal heat these include. Most renewable energy sources although stable, some are no. For example, some bio sources present to last at exploitation rates are considered impossible. Renewable energy is often electric production, heating and used for cooling. Renewable energy projects generally large, but they are rural and distant areas and developing very relevant to countries, energy in human development there often important. Renewable energy is often with more electrification used, it is many contains benefits: electricity heat or supplies can move efficiently, and the consumption phase is clean. In addition, renewable electrification with energy very efficient, so in primary energy needs leads to significant reductions.

Nonenergy: For drivers of energy management between its benefits there is an inseparable link. Without one without the other can't discuss it. Energy management end users, energy companies, countries and widespread for society has benefits, many of them are energy use and distribution controls with some major drivers growing turn directly, environmental impacts, and policies and regulations and increasing with these problems energy costs that come. Energy management activities and calling projects is this driving to alleviate and mitigate the forces can, at the same time, energy various including non-profit benefits kind of additional benefits offering. Non-energy non-benefits impacts, supplemental benefits, co benefits and benefits "beyond the meter," energy non-benefits energy management plans important but often unattended value referring to the proposal.

Grey Relational Analysis (GRA): Gray correlation analysis (GRA), this type of problem to solve data envelopment analysis facility analyzed. Layout and dispatch rules both cases of selection problem are gra's to illustrate the application, gra procedure were analyzed using gra's core process is first of all compare the performance of alternatives sequential translation. This step ash is called associated formation. Then, compare all gray between rows and reference row the correlation coefficient is calculated. Finally, this gray is related in terms of coefficients, reference sequence and for each comparison sequence the gray in between relative quality is calculated [13]. The surface roughness and bur of the work piece drilling process parameters for height gray related analysis to improve application introduced. An orthogonal sequence to the experimental design was used. Many performances characteristics surface gray for hardness and burr height ash obtained from corresponding analysis machining parameters optimized by relevant standards are determined. By the author of this work for better knowledge, gray is related drilling down using analysis optimization and in the process effect of cutting parameters on several performance characteristics there is no published work to evaluate [14].

Deng (1989) is a gray relational proposed the analysis. Gray relational analysis is gray relational approximate rows using grade a method of measuring quantity. Some other researchers of process parameters optimization has also been studied. Die-sinking EDM machining parameters related to gray to shape analysis. In polycarbonate composites of yield stress and elongation injection molding for mechanical properties to obtain optimum parameters of the process gray relational analysis. The simulation used the taguchi method and presented an ash-related analysis. Taguchi method and gray related analysis with several performance characteristics improve turn functions. Particle with multiple performance properties wire of reinforced material is electric to optimize the extrusion process gray relational analysis. Taguchi method and gray relational analysis final grinding dry for high purity graphite in process improve machining parameters [15]. Gray correlation analysis, a weighted average in practice depends on several criteria. Several criteria have been proposed decision making for ordering goods. Gray

correlation analysis (GRA) is commonly used in asia. It's an impact assessment model, which is relational two in terms of quality similarity between rows or measures the degree of difference. A global comparison to a local comparison is done by measuring the distance between two data sets between two points. Gra has the merit of point set topology therefore, it is subjective to the parameters in the model avoids side effects of the system. Using the ordered pair concept available products and eol the two result domains of the strategy are linked this article is going to provide the method. To apply this domain-combination method the gra model is obviously appropriate [16] Istanbul stock exchange (ISE) some funds in the financial sector index order shares of companies do gray correlation analysis (GRA) is used. Gra has become a benchmark of global comparability contains and to instead, it does not change any hierarchical structure. To retain eligibility, all criteria are also the means of decision are equally distributed. The original decision model was multilevel if in a multilevel hierarchical structure, multiple a level from levels weighting for performance characteristics a change must be made [17] Gray correlation analysis (GRA) based on the use of optimization of wastewater treatment alternatives gray is related to selection analysis. Bad, incomplete and to deal with uncertain information it has been proven to be effective. The main directions gray relational analysis (GRA) is in current applications one of gray system.

Gray relationship grades multiple performance by optimizing complexity between characteristics gra can be used to effectively resolve correlations [18]. Gray relational analysis is used with many performance characteristics to solve the turning functions. As a performance index gray relative quality using the taguchi method optimum cutting parameters by can be determined. Ash taguchi by relational analysis multiple performance characteristics by method an overview of optimization first is given. Then, cut select and turn parameters evaluation of machine performance in operations is discussed. Gray communication of taguchi method by analysis basically turn functions the upgrade is described in detail [19]. In gray correlation analysis, electrode wear, material removal rate and surface roughness test results are initially zero, in the normalized range, it is gray, also known as correlation formation. For determining optimum machining parameters gray relational analysis, it is reported step by step. Many considering performance characteristics optimum machining parameters are obtained [20]. The following conclusions on the benefits of using the Gra method are based on original data, a gray area in multi-attribute decision making (MADM) problems is correlation analysis (GRA) method. The calculations are simple and easy to understand. In a business context helps in making management decisions this is one of the best methods [21] multi-functional properties surface removal rate and maximum surface area all 203 particles with hardness for machining reinforced material optimized wire electrical discharge machining (WEDM) gray to determine the parameters correlation analysis. Gray relational analysis method material removal rate using the tool abrasion, surface roughness and specific shear stress of multi-functional properties including basically cutting speed, feed rate, turning parameters such as depth of cut and machining time [22].

3. RESULT AND DISCUSSION

TABLE 1. Carbon emission of global construction sector

	Unrenewable	Renewable	Non energy
China	49.98	69.53	19.15
European	34.32	72.97	33.69
India	39.70	89.58	49.18
Russia	34.12	68.28	34.60
US	80.04	86.41	27.96

Table 1. shows the Carbon emission of global construction sector for Alternative: Unrenewable, Renewable, Nonenergy. Evaluation preference: China, European, India, Russia, US. Unrenewable US the highest value Russia showed the lowest value. Renewable India the highest value Russia the lowest value. Nonenergy India the highest value China showed the lowest value.
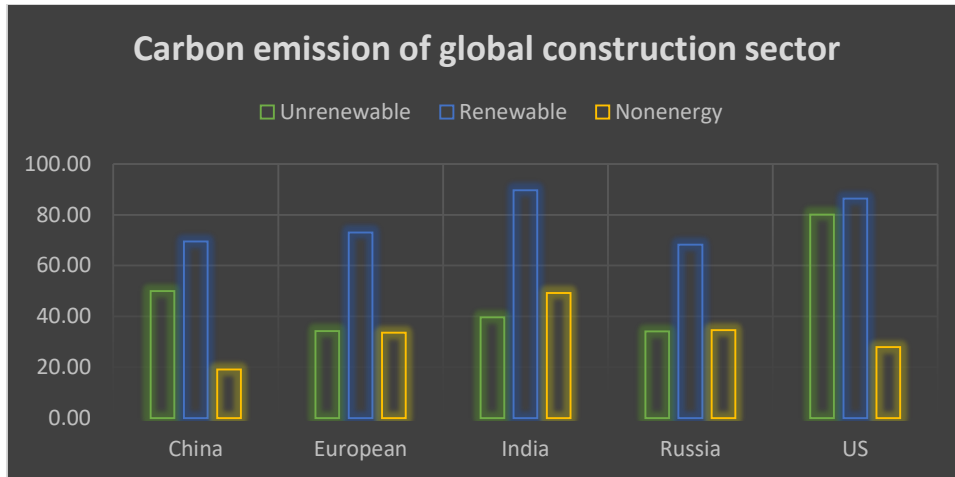
FIGURE 1. Carbon emission of global construction sector

Figure 1 shows the graphical representation in Unrenewable US the highest value Russia showed the lowest value. Renewable India the highest value Russia the lowest value. Nonenergy India the highest value China showed the lowest value.

TABLE 2. Normalized Data

Normalized Data		
Unrenewable	Renewable	Nonenergy
0.3454	0.0587	1.4152
0.0044	0.2202	0.7300
0.1215	1.0000	0.0000
0.0000	0.0000	0.6871
1.0000	0.8512	1.0000

Table 2 shows the Normalized data for Alternative: Unrenewable, Renewable, Nonenergy. Evaluation preference: China, European, India, Russia, US show in figure 2.
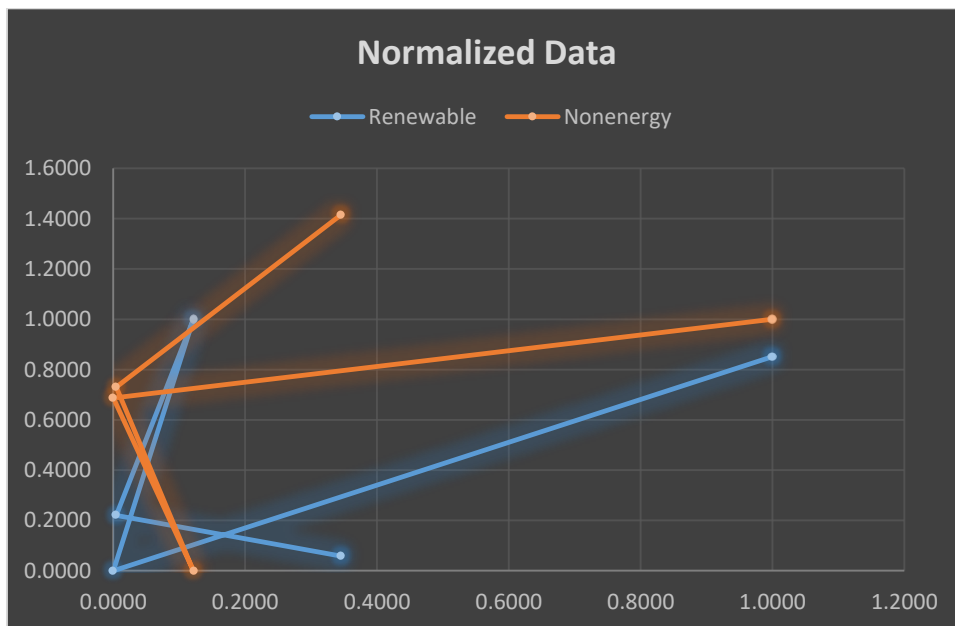
FIGURE 2. Normalized Data

TABLE 3. Deviation sequence

Deviation sequence		
Unrenewable	**Renewable**	**Nonenergy**
0.6546	0.9413	0.0000
0.9956	0.7798	0.6852
0.8785	0.0000	1.4152
1.0000	1.0000	0.7281
0.0000	0.1488	0.4152

Table 3 shows the Deviation sequence for Alternative: Unrenewable, Renewable, Nonenergy. Evaluation preference: China, European, India, Russia, US.

TABLE 4. Grey relation coefficient

Grey relation coefficient		
Unrenewable	**Renewable**	**Nonenergy**
0.4330	0.3469	1.0000
0.3343	0.3907	0.5080
0.3627	1.0000	0.3333
0.3333	0.3333	0.4929
1.0000	0.7706	0.6302

Table 4 shows the Grey relation coefficient for Alternative: Unrenewable, Renewable, Nonenergy. Evaluation preference: China, European, India, Russia, US.
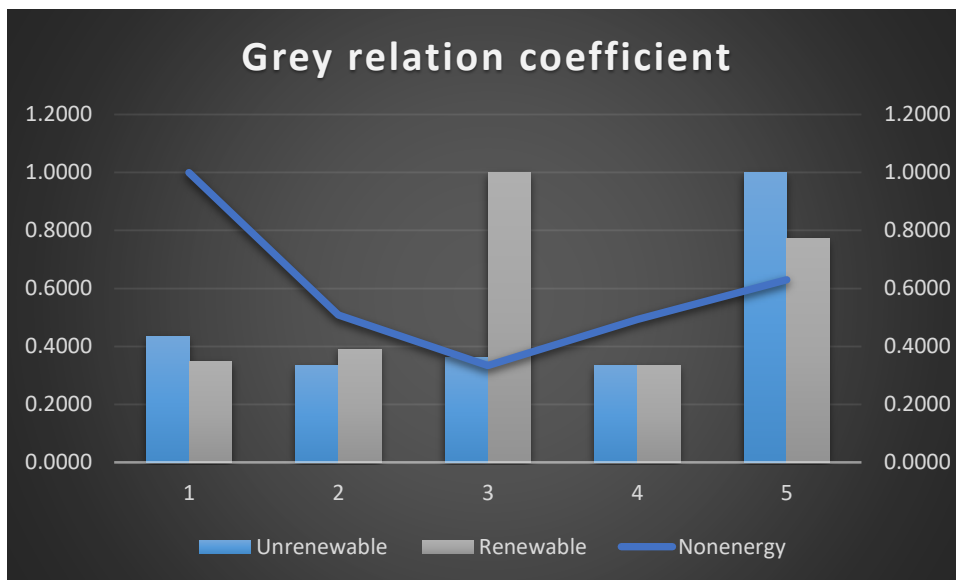
FIGURE 3. Grey relation coefficient

TABLE 5. GRG & Rank

	GRG	Rank
China	0.593317	2
European	0.411007	4
India	0.56535	3
Russia	0.386509	5
US	0.800281	1

Table 5 Shows the GRG values for Alternative: Unrenewable, Renewable, Nonenergy. Evaluation preference: China, European, India, Russia, US. Final rank China are ranked Second, European are ranked Fourth, India is ranked Third, Russia are ranked Fifth, US is ranked First. The GRA technique is used to generate the outcome.
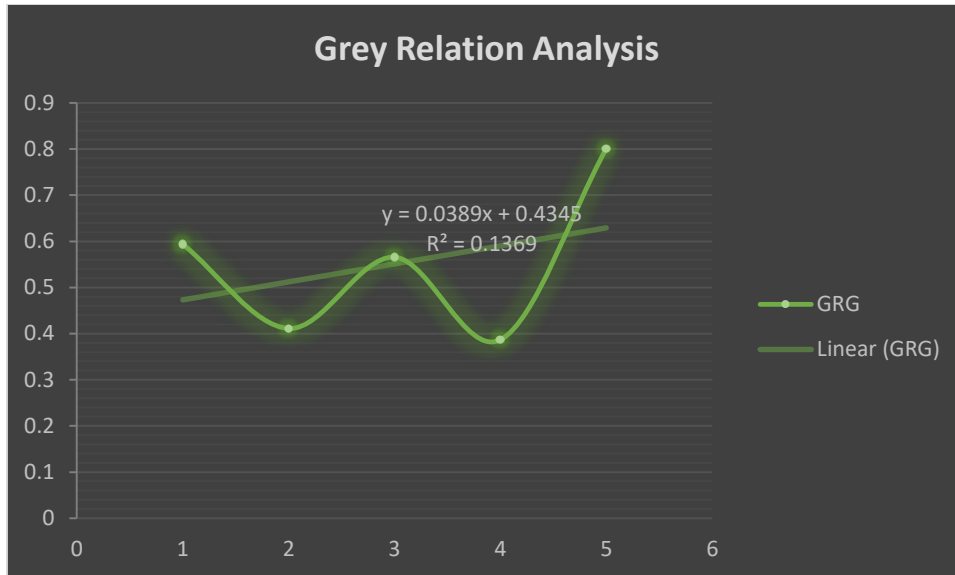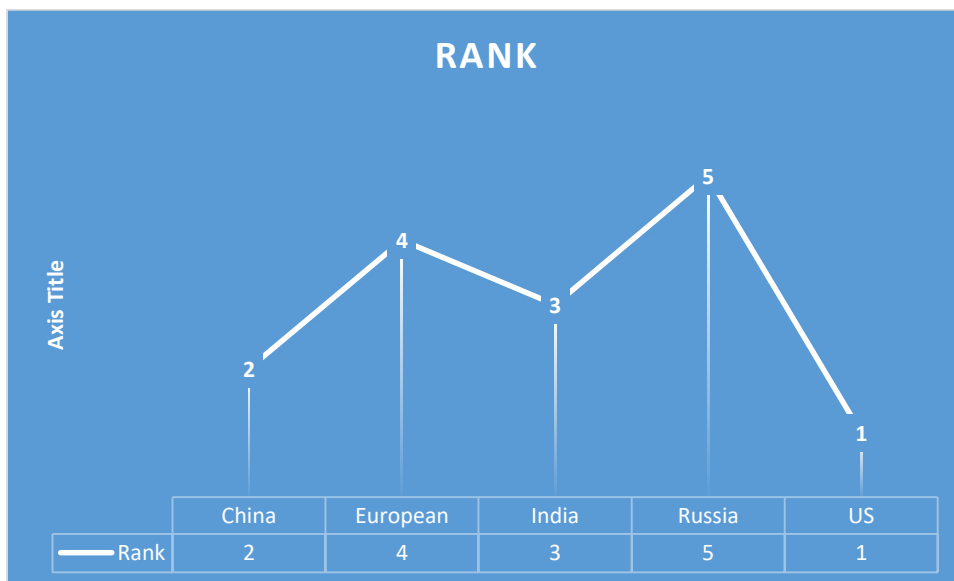
FIGURE 4. Grey Relation Analysis

FIGURE 5. Rank

Figure 5. shows the graphical representation in Rank the final result of this paper the China is in 2nd rank, the European is in 4th rank, the India is in 3rd rank, the Russia is in 5th rank and the US is in 1st rank.

4. CONCLUSION

Technology in the industry changes have occurred, especially environmentally friendly technologies the application is growing. In accordance with such change's skill training for workers and management for companies training is needed. Related to construction the decentralization of government actions new for local authorities gains demands, direct management and / or agreement with private companies' high volume by doing engaged in construction activities. Continuing, labor in construction ocal on issues develop the capacity of the authorities there is a need to be taken. Construction industry is more for a number of people creating jobs. Labor conditions world the whole varies widely. Departmental policies department (sector) growing up in the construction industry the coming labor issues has done research on, i.l.o's tripartite social among members facilitated the conversation, technical consultations presented and practical created tools, policy recommendations and headquarters and field used by offices training modules. Buildings and including infrastructure-built environment economic and the basis of social development the component. Naturally, high size in the built environment material and energy consumption these include. For example, building industry primary energy uses about 40% of the application. Life of the environment to create rotational energy consumption is two can be divided: function occupation / used for

operation energy (heating / cooling, ventilation, hot water, etc.); packing energy – built environment construction, maintenance, renovation and used for demolition energy. Occupied built for the environment, the total amount of operating energy about 80% of energy use% is. Therefore, functional analysis of energy and related carbon emissions are packed with the analysis of energy for years compared to in building energy research dominated. Very much recently, packed energy and significant of emissions the stock is recognized. It's just two facts. First, more energy efficiency building technologies because of implementation, the function percentage of energy and withit related carbon emissions that will decrease in the future expected, very much advanced and effective insulation materials, and more energy capacity equipment and equipment. Second, road, bridges and other 'instital' like infrastructure for an unmade' built environment, physical emissions are more than 90 life cycle emissions contains. World input release table 2009 41 countries and regional with energy of the construction industry related carbon emissions input-release using the analysis, this article reveals this. 5.7 billion tonnes of co2 emissions (23% global economic activite) global construction in 2009 includes field. Indirect co2 emission is the total of this total dominating area (94%) is. Construction is global the most important carbon is fiery one of the fields unreasonable. Gasoline, diesel, othpetro and l.f.oh global construction for direct co2 emissions of the sector four are major energy sources. Indirect co2 emissions are mainly hcoal, natural gas and from non-energy use is formed. Global construction total packing energy in the field renewable less than 6 resource response. Emerging economies department of global construction almost in total co2 emissions 60% are due. China the largest contributor is. Moreover, in developing countries direct from the construction department and indirect co2 emissions the intensities of developed countries greater than value. Turkish construction department of direct carbon the biggest intensity of emissions contains. Likewise, chinese construction department indirect carbon the biggest intensity of emissions contains. Life cycle low packing in sight carbon building material and creating services and use, construction energy efficiency of machines increasing, renewable energy promoting the app carbon of the construction industry three to reduce emissions key key opportunities identifies. In particular, growing economies are their too much less in construction carbon technologies creating, promoting and implement / more to make purchases efforts should be made.

REFERENCES

[1]. Huang, Lizhen, Guri Krigsvoll, Fred Johansen, Yongping Liu, and Xiaoling Zhang. "Carbon emission of global construction sector." *Renewable and Sustainable Energy Reviews* 81 (2018): 1906-1916.

[2]. Strassmann, W. Paul. "The construction sector in economic development." *Scottish Journal of Political Economy* 17, no. 3 (1970): 391-409.

[3]. Sreedhar Raju, Balaguru S 2020, 'Mechanical and Tribological Behavior of Al 7075 Hybrid MMNCs Using Stir Casting Method', International Journal of Mechanical and Production Engineering Research and Development, vol. 10, pp. 391-400. (H-index 26, IS: 0.744, Scopus) www.tjprc.org

[4]. Bawa, Surjit Singh. "Implement gamification to improve enterprise performance." *International Journal of Intelligent Systems and Applications in Engineering* 11, no. 2 (2023): 784-788.

[5]. Buyle, Matthias, Johan Braet, and Amaryllis Audenaert. "Life cycle assessment in the construction sector: A review." *Renewable and sustainable energy reviews* 26 (2013): 379-388.

[6]. Aswini, S., S. Tharaniya, R. J. Joey Persul, B. Avinash Lingam, and P. Kogila. "Assessment of Knowledge, Attitude and Practice on Immunization among Primi Mothers of Children." *Indian Journal of Public Health Research & Development* 11, no. 3 (2020).

[7]. Bawa, Surjit Singh. "Implementing Text Analytics with Enterprise Resource Planning." *International Journal of Simulation--Systems, Science & Technology* 24, no. 1 (2023).

[8]. Ruddock, Les, and Jorge Lopes. "The construction sector and economic development: the 'Bon curve'." *Construction Management and Economics* 24, no. 7 (2006): 717-723.

[9]. Fuladipanah, Mehdi, H. Md Azamathulla, Ozgur Kisi, Mehdi Kouhdaragh, and Vishwandham Mandala. "Quantitative forecasting of bed sediment load in river engineering: an investigation into machine learning methodologies for complex phenomena." *Water Supply* 24, no. 2 (2024): 585-600.

[10]. Dainty, Andrew RJ, Alan Bryman, and Andrew DF Price. "Empowerment within the UK construction sector." *Leadership & Organization Development Journal* 23, no. 6 (2002): 333-342.

[11]. Bawa, Surjit Singh. "Enhancing Usability and User Experience in Enterprise Resource Planning Implementations."

[12]. Olanrewaju, AbdulLateef, Seong Yeow Tan, and Lee Foo Kwan. "Roles of communication on performance of the construction sector." *Procedia engineering* 196 (2017): 763-770.

[13]. Bawa, Surjit Singh. "How Business can use ERP and AI to become Intelligent Enterprise." *vol* 8 (2023): 8-11.

[14]. Bal, Menoka, David Bryde, Damian Fearon, and Edward Ochieng. "Stakeholder engagement: Achieving sustainability in the construction sector." *Sustainability* 5, no. 2 (2013): 695-710.

[15]. Carrillo, Patricia. "Lessons learned practices in the engineering, procurement and construction sector." *Engineering, construction and architectural management* 12, no. 3 (2005): 236-250.

[16]. Bawa, Surjit Singh. "Automate Enterprise Resource Planning with Bots."

[17]. Balaguru S and J. Venkataramana, 2020, 'Experimental Study on Tyre Dynamics and Properties of Heavy Load Transporting Vehicle', Lecture Notes in Mechanical Engineering, vol. 1, pp. 179-190. (H-index 24, Scopus, Springer) https://doi.org/10.1007/978-981-15-3631-1_17

[18]. Akshaya, V., Vishwanadham Mandala, Chunduru Anilkumar, P. VishnuRaja, and R. Aarthi. "Security enhancement and attack detection using optimized hybrid deep learning and improved encryption algorithm over Internet of Things." *Measurement: Sensors* 30 (2023): 100917.

[19]. Palanimuthu, Kogila. "Birhanu Gutu, Leta Tesfaye, BuliYohannis Tasisa, Yoseph Shiferaw Belayneh, Melkamu Tamiru, and Desalegn Shiferaw." Assessment of Awareness on COVID-19 among Adults by Using an Online Platform: 26 Countries View."." *Medico-legal Update* 21.

[20]. Sangeetha Rajkumar, M. Ramachandran, Vimala Saravanan, Prabakaran Nanjundan, "Environmental Impact Assessment United States of India Using GRA Method", Aeronautical and Aerospace Engineering, 1(2), June 2023, 35-42

[21]. Alaloul, Wesam Salah, Muhammad Ali Musarat, Muhammad Babar Ali Rabbani, Qaiser Iqbal, Ahsen Maqsoom, and Waqas Farooq. "Construction sector contribution to economic stability: Malaysian GDP distribution." *Sustainability* 13, no. 9 (2021): 5012.

[22]. Ponnada, Venkata Tulasiramu, and SV Naga Srinivasu. "Efficient CNN for lung cancer detection." *Int J Recent Technol Eng* 8, no. 2 (2019): 3499-505.

[23]. Tasisa, Yirgalem Bekele, and Kogila Palanimuthu. "Psychosocial Impacts of Imprisonment among Youth Offenders in Correctional Administration Center, Kellem Wollega Zone, Ethiopia." *Medico-legal Update* 21, no. 2 (2021).

[24]. Sridharan, Sujatha. "Assimilating Novel Perspectives of Complimentary Feeding among Mothers of Infants." *Indian Journal of Public Health Research & Development* 11, no. 4 (2020).

[25]. Zutshi, Ambika, and Andrew Creed. "An international review of environmental initiatives in the construction sector." *Journal of cleaner production* 98 (2015): 92-106.

[26]. Betts, Martin, Lim Cher, Krishan Mathur, and George Ofori. "Strategies for the construction sector in the information technology era." *Construction Management and Economics* 9, no. 6 (1991): 509-528.

[27]. Wells, Jill. "Informality in the construction sector in developing countries." *Construction management and economics* 25, no. 1 (2007): 87-93.

[28]. Jisha, L., P. Jayaprabha, S. Gnanawel, K. Gowtham Kumar, and P. Kogila. "Assessment of the Prevalence of Febrile Seizure and Associated Factors among Children: A Retrospective Study." *EXECUTIVE EDITOR* 11, no. 03 (2020): 3179.

[29]. Diwakar N and Balaguru S, 2020, 'Experimental Study on Vibration Control of Transportation Trailers Used for Spacecraft', Lecture Notes in Mechanical Engineering, vol. 1, pp. 143-151. (H-index 24, Scopus, Springer) https://doi.org/10.1007/978-981-15-3631-1_14

[30]. Sellamuthu, Suseela, Srinivas Aditya Vaddadi, Srinivas Venkata, Hemant Petwal, Ravi Hosur, Vishwanadham Mandala, R. Dhanapal, and Jagendra singh. "AI-based recommendation model for effective decision to maximise ROI." *Soft Computing* (2023): 1-10.

[31]. Gharehbaghi, Amin, Redvan Ghasemlounia, Ehsan Afaridegan, AmirHamzeh Haghiabi, Vishwanadham Mandala, Hazi Mohammad Azamathulla, and Abbas Parsaie. "A comparison of artificial intelligence approaches in predicting discharge coefficient of streamlined weirs." *Journal of Hydroinformatics* 25, no. 4 (2023): 1513-1530.

[32]. Krishna Kumar TP, M. Ramachandran, Chinnasami Sivaji, "Supplier Selection Analysis using Multi criteria Decision Making VIKOR Method", /Data Analytics and Artificial Intelligence 1(1) 2021, 48-52.

[33]. Kuo, Yiyo, Taho Yang, and Guan-Wei Huang. "The use of grey relational analysis in solving multiple attribute decision-making problems." *Computers & industrial engineering* 55, no. 1 (2008): 80-93.

[34]. Ponnada, Venkata Tulasiramu, and S. V. Naga Srinivasu. "Edge AI system for pneumonia and lung cancer detection." *Int J Innov Technol Exploring Eng* 8, no. 9 (2019).

[35]. Tosun, Nihat. "Determination of optimum parameters for multi-performance characteristics in drilling by using grey relational analysis." *The International Journal of Advanced Manufacturing Technology* 28, no. 5 (2006): 450-455.

[36]. Tzeng, Chorng-Jyh, Yu-Hsin Lin, Yung-Kuang Yang, and Ming-Chang Jeng. "Optimization of turning operations with multiple performance characteristics using the Taguchi method and Grey relational analysis." *Journal of materials processing technology* 209, no. 6 (2009): 2753-2759.

[37]. Kogila, P. "Prevention of home accidents among mothers of toddler." *The Journal of Nursing Trendz* 8, no. 3 (2017): 15-17.

[38]. Mandala, Vishwanadham, T. Senthilnathan, S. Suganyadevi, S. Gobhinath, DhanaSekaran Selvaraj, and R. Dhanapal. "An optimized back propagation neural network for automated evaluation of health condition using sensor data." *Measurement: Sensors* 29 (2023): 100846.

[39]. Ponnada, Venkata Tulasiramu, and SV Naga Srinivasu. "End to End System for Pneumonia and Lung Cancer Detection using Deep Learning." *Int. J. Eng. Adv. Technol* 8 (2019).

[40]. Chan, Joseph WK, and Thomas KL Tong. "Multi-criteria material selections and end-of-life product strategy: Grey relational analysis approach." *Materials & Design* 28, no. 5 (2007): 1539-1546.

[41]. Hamzaçebi, Coşkun, and Mehmet Pekkaya. "Determining of stock investments with grey relational analysis." *Expert Systems with Applications* 38, no. 8 (2011): 9186-9195.

[42]. Bijanvand, Sajad, Mirali Mohammadi, Abbas Parsaie, and Vishwanadham Mandala. "Modeling of discharge in compound open channels with convergent and divergent floodplains using soft computing methods." *Journal of Hydroinformatics* 25, no. 5 (2023): 1713-1727.

[43]. Zeng, Guangming, Ru Jiang, Guohe Huang, Min Xu, and Jianbing Li. "Optimization of wastewater treatment alternative selection by hierarchy grey relational analysis." *Journal of environmental management* 82, no. 2 (2007): 250-259.

[44]. Mampitiya, Lakindu, Namal Rathnayake, Lee P. Leon, Vishwanadham Mandala, Hazi Md Azamathulla, Sherly Shelton, Yukinobu Hoshino, and Upaka Rathnayake. "Machine learning techniques to predict the air quality using meteorological data in two urban areas in Sri Lanka." *Environments* 10, no. 8 (2023): 141.

[45]. Spoorthi. S,; Harshith. T. N,; M. Ramachandran; Chandrasekar Raja, " A Review on Child Safety Monitoring System Based on IOT", Recent trends in Management and Commerce 4(2), 2023: 130-135.

[46]. Lin, C. L. "Use of the Taguchi method and grey relational analysis to optimize turning operations with multiple performance characteristics." *Materials and manufacturing processes* 19, no. 2 (2004): 209-220.

[47]. Lin, J. L., and C. L. Lin. "The use of the orthogonal array with grey relational analysis to optimize the electrical discharge machining process with multiple performance characteristics." *International Journal of machine Tools and manufacture* 42, no. 2 (2002): 237-244.

[48]. Wu, Hsin-Hung. "A comparative study of using grey relational analysis in multiple attribute decision making problems." *Quality Engineering* 15, no. 2 (2002): 209-217

[49]. Palanimuthu, Kogila, Birhanu Gutu, Leta Tesfaye, BuliYohannis Tasisa, Yoseph Shiferaw Belayneh, Melkamu Tamiru, and Desalegn Shiferaw. "Assessment of Awareness on COVID-19 among Adults by Using an Online Platform: 26 Countries View." *Medico-legal Update* 21, no. 1 (2021).

[50]. Çaydaş, Ulaş, and Ahmet Hasçalık. "Use of the grey relational analysis to determine optimum laser cutting parameters with multi-performance characteristics." *Optics & laser technology* 40, no. 7 (2008): 987-994.