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A MODEL FOR IMPLEMENTING GREEN BUILDING TECHNIQUES IN INDIAN PUBLIC SECTOR CONSTRUCTIONS

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Abstract

Green building's development reduces the reliance on fossil fuels and reduces the total negative environmental effect. The main objective of this research is to develop a model for the implementation of green practises in the public sector constructions in India. We aimed to assess local construction professionals' knowledge and comprehension of green building construction in the public sector by distributing an empirical questionnaire to them. Participants were asked to rate their knowledge, understanding, and importance of the eight withholding factors and six contributing factors identified in the seminal literature. We use analysis techniques like descriptive and factor analysis such as descriptive and factor analyses to analyse the survey responses. A comprehensive model proposed to facilitate the purpose of promoting the successful adoption of green building practises within India's public sector construction projects was primarily based on the insights gained from factor analysis. Based on the findings of this study, the author suggests a model for implementing green building techniques in Indian public sector constructions. The model discusses obstacles to green building initiatives, considers implementation variables, and offers suggestions such as policy ease, and green building promotion.

Keywords:

Green building;
Sustainable building;
Construction sector;
Public sector.

1 Introduction

In an era where environmental concerns are paramount, the concept of green buildings, also referred to as sustainable or eco-friendly construction, has emerged as a transformative force in the realm of architecture and urban development. These innovative structures embody a vision that extends beyond bricks and mortar, encompassing a deep commitment to both human well-being and planetary health. As articulated by the US Environmental Protection Agency, the essence of green building lies in its holistic approach, fostering responsible and resource-efficient practises across the entire lifecycle of a building – from conception and design to construction, operation, maintenance, renovation, and even eventual deconstruction [1].

The Indian Green Building Council further amplifies the significance of this paradigm by defining green buildings as havens that consume less water, optimise energy utilization, preserve precious natural resources, minimise waste generation, and provide residents with healthier living spaces, clearly outperforming conventional counterparts. This ethos, rooted in the reduction of adverse environmental impacts and the fostering of positive climate effects, has the potential to not only to improve our surroundings but also elevate our collective quality of life [2].

Within this landscape of sustainability, the economic dimensions stand resolute. Green buildings, from a stakeholder's perspective, align with prudent business strategies. Their energy efficiency, reduced water consumption, waste minimisation, and lower operational costs translate into tangible benefits. Interestingly, these structures often command higher rental values and occupancy rates compared to their conventional counterparts, igniting a synergy between fiscal prudence and ecological consciousness.

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However, the implications of green buildings extend beyond economics, venturing into the realms of social impact and corporate governance. The IGBC (Indian Green Building Council) Green Building Ratings not only advocate for improved health, safety and well-being but also encompass the social dimensions of Environmental, Social and Governance (ESG) reporting. Furthermore, the symbiotic relationship between membership in green building and certifications offered by rating bodies and organisational governance policies posits these constructs as instruments of transformative change[3].

In a rapidly evolving construction sector, the movement for green buildings emerges as an indispensable agent of change. India's construction domain, growing at an impressive 10% annually, finds within green buildings a potential remedy to rein in increasing greenhouse gas emissions and embrace climate adaptation, while optimizing costs through judicious material use, energy-efficient technologies, waste management, and reduced usage of hazardous substances [4]. In both residential and commercial contexts, green buildings are poised to be pivotal players in the ongoing struggle to mitigate and adapt to climate change.

Currently, a significant proportion of India's commercial buildings exhibit Energy Performance Indices (EPI) ranging from 200 to 400 kWh/m²/year. However, by leveraging improved design practises, this EPI could be halved to 100-150 kWh/m²/year, showcasing the transformative potential within reach (“India-Constructing-Change Report”, 2012). Alarming statistics further underscore the sector's voracious resource appetite, accounting for 40% of energy, 30% of raw materials, 20% of water, 20% of urban land use, 30% of solid waste generation, and 20% of water effluents in Indian cities [5]. Given that 70% of the buildings required by 2030 are yet to be constructed, embracing green building principles not only offers environmental comfort, but becomes an imperative for sustainable growth.

However, as the landscape of green buildings in India matures, merely 5% of buildings have the coveted green classification, reflecting a nascent stage of development. Paradoxically, this apparent challenge is a source of opportunities, serving as a canvas for the development of innovative green buildings that holds the promise of shaping a more sustainable urban future.

Guided by the vision of the International City/County Management Association, green buildings embrace an integrated approach that weaves health, aesthetics, financial viability, and environmental stewardship into a tapestry of harmonious living and working environments. Central to this ethos are goals such as sustainable site design, increased water and energy efficiency, reduced waste and emissions, the use of eco-friendly materials, and an improved indoor environment.

The very core of the green building concept is an earnest endeavour to optimise resource usage, fostering sustainability across the building's lifecycle, and enhancing the well-being of its occupants. Incentives, ranging from technical support to tax benefits, drive developers and building owners toward successful green implementations, symbolising the potent bridge between economic prosperity and environmental stewardship.

Beyond mitigating carbon emissions and energy consumption, green buildings offer a tangible solution to pressing environmental challenges, founded on recyclable, low-carbon materials. Moreover, the life-cycle cost approach not only cuts electricity expenditure but elevates a company's social standing, bolstering a competitive market for green structures.

This research embarks on a journey through the intricate tapestry of green buildings, uncovering their multifaceted implications for ecology, economy, and society. As the modern construction landscape evolves, embracing these principles presents not just a path toward a sustainable future, but a profound paradigm shift that reconciles human aspirations with planetary well-being.

2 Factors Affecting Green Building Practises in the Indian Public Sector

In general, two categories can be used: contribution factors and withholding factors to classify the variables that influence green building practises in public sector constructions. The following paragraphs give a detailed explanation of each of these factors. Table 1 summarizes the literature published for the contributing factors.

Table 1: Contributing Factors.

Factors	References
Lack of Government Support	[6]
Reduced Life-cycle cost	[7], [8]
Efficient Resource Utilization	[9]
Improving Quality of Life	[10], [11]
Improving National Economy	[12], [7]
Lower Impact to Environment	[13]

The researchers [6] mentioned the government should start campaigns to entice landlords and developers to adopt green structures, which can increase the value of buildings. Incentive policies can develop into a powerful internal driver to increase the appeal of green structures. In addition, legislation is a crucial component in advancing green construction. When creating and improving green building standards, full consideration should be given to local economic development, weather patterns, regional resources, and the level of construction. The lack of government financial incentives and the disjointed institutional and legal framework can be summarised as the main institutional barriers to the development of green buildings.

Research [8] illustrates a theory in action and shows how the life-cycle cost of a green building was assessed and calculated over a 60-year time frame. It has been determined that the future operating and maintenance expenses of the building are roughly 3.6 times more expensive than its design and construction costs. [7] Unsurprisingly, the cost of energy accounts for 48% of the building's overall life cycle costs, more than double the weight of the design and construction costs. Therefore, it was discovered that reducing energy consumption had the greatest impact on lowering the overall cost of the green building under investigation.

Green building costs, such as operating components, can be calculated once the useful life of a building has been estimated. This involves both direct and indirect benefits due to resource efficiency. Improvements in resource utilisation can, respectively, have a direct impact on energy use intensity and an indirect impact on environmental protection. Green buildings should be equipped with cutting-edge integrated strategies and technologies in the meantime [9]. The sustainability goals of green building design, construction, and operation are more specifically to reduce environmental impact, maximise resource efficiency, and maximise return on investment for each building component.

Due to the environment friendly building materials used in their construction, residents of green buildings benefit greatly in terms of their health [10]. As an illustration, environmentally conscious construction firms stay away from plastic by-products that have been shown to release toxic materials. Significant breathing problems are caused by toxic substances like carcinogens, and the risk of cancer also increased. Green building, also referred to as green construction or sustainable building, is an effective approach to enriching the environment [11]. By reducing resource consumption and simultaneously improving quality of life, it brings numerous benefits to both the human community and the natural world.

Develop a model places a strong emphasis on affordable building components and industry stakeholder satisfaction, with two moderators, expensive building components and cost-cutting tactics, as external factors [12]. This model is expected to reduce overall costs, increasing the client's interest in making an investment in green construction. This argument highlights that green buildings, which have lower energy consumption, can provide economic benefits that make them attractive to building owners and investors, especially given the rising energy prices globally. It also provides empirical evidence to support the financial advantages of reduced energy use in green buildings, but it is important to note that the conclusions are limited to the specific case studied and may not be applicable to a larger population.

The goals and recommendations focus on environmentally friendly building practises and products. As more green building materials are released, a more comprehensive selection of environmental material lines may be available at competitive prices. Green building materials could replace conventional ones and eventually become the norm. As they work to ensure that their resources are used in a far more sustainable way, environmentally friendly building materials appear to have a bright future [13]. Furthermore, it is important to emphasise that a primary goal of green building practises is to reduce environmental impact and minimise construction waste. Proper management and disposal of construction and demolition debris are crucial elements in achieving sustainable building

design. In today's fast-paced and ever-evolving world, energy and the environment have emerged as crucial areas of focus. The increasing problems of environmental pollution and solid waste pose significant challenges. However, by integrating green design principles into building construction, we can make remarkable strides in conserving energy, with potential savings of up to 60%. Table 2 summarizes the literature published for the withholding factors.

Table 2: Withholding Factors.

Factors	References
Lack of Knowledge and awareness	[14], [15]
Difficulty in Obtaining Clearances and Approvals	[16], [17]
Lack of Skilled Manpower	[18], [19]
Higher Cost of Implementation	[20], [21]
Lack of Market Demand	[22], [23]
Training and Technology	[24], [16]
Risks and Uncertainties	[21]
Finding out the Right Locations	[25],

Although builders and the community had low levels of awareness, the findings of the study shows that they had a positive attitude toward green building practices. Information should be made more accessible to all players in the construction industry and communities to raise awareness among all participants. The demonstration homes demonstrated their potential as a reliable training resource. The published information from the past was a reliable source. The few who did become aware did so through the literature. The study's [14] findings by have added to the body of knowledge about green building by highlighting the level of awareness among stakeholders in contexts related to developing nations, such as Ghana in this instance. The study also serves as a useful manual for business professionals, decision makers, academics, and proponents of green building who want to encourage the adoption of green buildings. It enables them to create appropriate green building awareness messages, choose appropriate councils, and disseminate the same through appropriate channels for increased uptake. In their research it was observed that most participants did not have much knowledge about “green buildings” [15].

This study [16] analysis revealed that there is a "lack of legal regulations and technical codes, standards, and guidelines on green building," making it "harder to early establish a competent, integrated, multidisciplinary project team for green building projects," "harder to comprehend the owner's green goals as well as the green specifications in the contract details and engineering documents," and "harder to select competent subcontractors in providing. [17] It is important to note that the top five challenges were distributed among the various areas of law, technology, human resources, and supply chain. Risk factor complex planning approval and permit procedures due to risk factors, considered to be the most significant risk of green building in China, came in first place. To reduce this risk, approval processes should be streamlined to improve management effectiveness and make life easier for green building practitioners.

Researchers have used a questionnaire survey on 62 construction projects in India, with 56% of the respondents serving as site engineers and 16% serving as project managers. The results show that the three critical issues the Indian construction sector should focus on enabling sustainable construction practises are lack of skilled resources, client resistance and limited and lack of knowledge of sustainable technology and operation [19].

Researchers [22] have delved deeply into the variables influencing the growth of the green building market. From the demand side, the size of the market is determined by consumer demand. Compared to general buildings, green buildings are in more demand and have higher rental values. Green concept promotion and sustainability education can increase market demand. The demand for green buildings will also be impacted by social issues such as consumers' fundamental understanding, purchase intent, social and humanistic needs, public attitudes, and behaviours, rebound effect, and social acceptance. The energy consumption of three government buildings in Malaysia was examined, and it was discovered that using sustainable technology and energy saving design during construction could reduce energy costs. Researchers [20] also emphasised the importance of building design for the wasteful use of water and energy resources during operation. In fact, incremental risks, benefits, and costs are closely related to the stability of the system. [23] It discovered that the gentrification

phenomenon in green buildings may be the cause of this heterogeneity. The green building premium increases with both the cost of the property and the level of the green building label. This indicates that buyers of such properties are prepared to pay the highest prices for green buildings, which have appropriate subsidies for capitalisation effects.

The evaluated risk factors associated with green retrofit projects to create a framework for risk response [21]. The outcome showed that cost, inflation, energy saving uncertainty, warranty risk, schedule, and design changes were the most serious risk factors. This study also suggested risk reduction tactics for Sri Lankan green retrofit projects. The survey results found that the most frequent risk factors were "unfamiliarity with the waste management system", "unfamiliarity with the specifications required by green projects" and "unfamiliarity with the new technologies required by green projects". "Contractor-related factors" are all these risk elements. These results suggest that a holistic approach to risk management for green building projects would be more successful than assuming that risk factors are independent.

It is necessary and practical to adjust the scale and structure of energy use in industrial, population, and urban construction with reasonable land use, based on the natural relationship between energy and land use [25]. Regardless of their industry or location, everyone should think about the role that capacity building and community-level empowerment play in advancing construction transformation and, more generally, in promoting sustainable development.

3 Research Methods

This study uses a mixed-method approach that includes a thorough examination of previous research on the topic to identify the factors influencing green building practises in the Indian public sector, a descriptive survey method for the collection of data from professionals in construction and architecture related organisations in India; and Statistical techniques appropriate to the nature of this study were used to quantify the collected data to rank the factors influencing green building practises in terms of their levels of impact. Data were collected using a descriptive survey method from professionals in Constructions and Architecture-Related Organisations in India. To identify and compile a list of the factors that influence green building practices in public buildings in the Indian context, a content analysis via a systematic literature review of the literature. An overview of the literature on the topic published worldwide is shown in literature section (Table 1 and 2). Additionally, out of the total 130 responses, 121 have been thoughtfully selected as a representative sample, meeting the survey's specified criteria, the collected data were analyzed using the Statistical Package for the Social Sciences (SPSS) software, allowing for quantitative analysis and ranking of factors based on their impact levels. SPSS facilitated pattern recognition and significance testing, providing a robust foundation for interpreting the results and drawing meaningful conclusions in alignment with the study's objectives. a pilot study, a survey-based questionnaire, and a descriptive survey method were used to investigate a specific set of factors affecting green building practises to ensure consistency with the objective of the paper. Government officials, project managers, architects, engineers, builders, and subcontractors in the Indian construction industry, as well as academics, made up the study's target population. Three sections made up the questionnaire. The respondents were asked to provide information about their respective demographic backgrounds (such as sex and age) in the first part. The second part measured the "contributing factors," or factors that, alone or in combination with others, tend to impact the result of choice. The third part sought factors that, alone or in combination with others, tend to decrease or eliminate the result of choice. Potential study participants received emails encouraging them to respond before the deadline set for receiving responses, along with a link to the online survey. To accomplish the goal of this paper, the results were ultimately analysed and appropriately interpreted.

4 Data Analysis

Data preparation must be completed before the data analysis stage can begin. In this study, the impact of the factors that influence green building practises in India's public sector was rated using a Likert scale. Data for this study were gathered using an online questionnaire survey. The next stage of the research methodology used in this study was data analysis after the data were prepared in a format appropriate for the statistical package used. This study used the factor analysis method to create a model for the implementation of green practises in public sector constructions, based on their significance.

Table3: Descriptive Statistics of the Survey Variables (Created by the author).

Factors	Mean	Std. Deviation	Analysis N
Government Support	3.678	1.3179	121
Reduced Life Cycle Cost	3.727	1.0000	121
Efficient Resource Utilization	3.579	0.9377	121
Improving National Economy	3.818	0.9309	121
Improving Quality of Life	4.074	1.1043	121
Lower Impacts to Environment	3.455	0.9661	121
Lack of Knowledge and Awareness	3.785	0.9148	121
Difficulty in Obtaining Clearances and Approvals	3.455	0.9037	121
Lack of Skilled Manpower	3.388	0.9948	121
High Cost of Implementation	3.281	0.8682	121
Lack of Market demand	3.727	0.9916	121
Training and Technology	3.752	1.0351	121
Risks and Uncertainties	3.438	0.8840	121
Finding out Right Location	3.479	0.8860	121

In Table 3 statistical results provided fascinating new information. All variables showed standard deviations above 0.5, demonstrating a striking level of diversity of respondents. This strong proof supports the existence of many correct answers, all of which were below the mean value.

5 Result and analysis

In this study, the KMO (Kaiser-Meyer-Olkin) MSA (Measurement of Sampling Adequacy) value was 0.761, significantly higher than the 0.5 threshold, indicating a high level of reliability for the variables being studied. Further refinement via component analysis may improve the study's question items, according to the resultant significance value of 0.000 (see Table). Table 4 displays the results of the PCA. Three factors are most likely to have emerged as a result of the author's use of the criterion to identify components with eigenvalues greater than one. A Scree Plot example can be seen in Figure 1 for a visual representation.

Table 4: Results of KMO Test (SPSS software).

Kaiser-Meyer-Olkin measurement of sampling adequacy.		0.761
Bartlett's Test of Sphericity	Approx. Chi-Square	530.177
	df	91
	Sig.	0.000

A scree plot can be used to choose the right number of stable factors or components in factor analysis (FA) and principal component analysis (PCA).

Table: 5 Total Variance-PCA Results (SPSS Software).

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.813	27.239	27.239	3.813	27.239	27.239	3.603	25.733	25.733
2	2.552	18.227	45.466	2.552	18.227	45.466	2.552	18.231	43.964
3	1.491	10.652	56.119	1.491	10.652	56.119	1.702	12.155	56.119
4	0.997	7.120	63.239						
5	0.868	6.197	69.436						
6	0.733	5.234	74.669						
7	0.582	4.154	78.823						
8	0.557	3.977	82.801						

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
9	0.555	3.965	86.765						
10	0.481	3.439	90.204						
11	0.443	3.163	93.366						
12	0.373	2.666	96.032						
13	0.332	2.374	98.406						
14	0.223	1.594	100.000						
Extraction Method: Principal Component Analysis.									

Scree graphs Figure 1 are vital tools for exploratory factor analysis (EFA) because they visually display the eigenvalues of the components that are arranged from left to right on the graph.

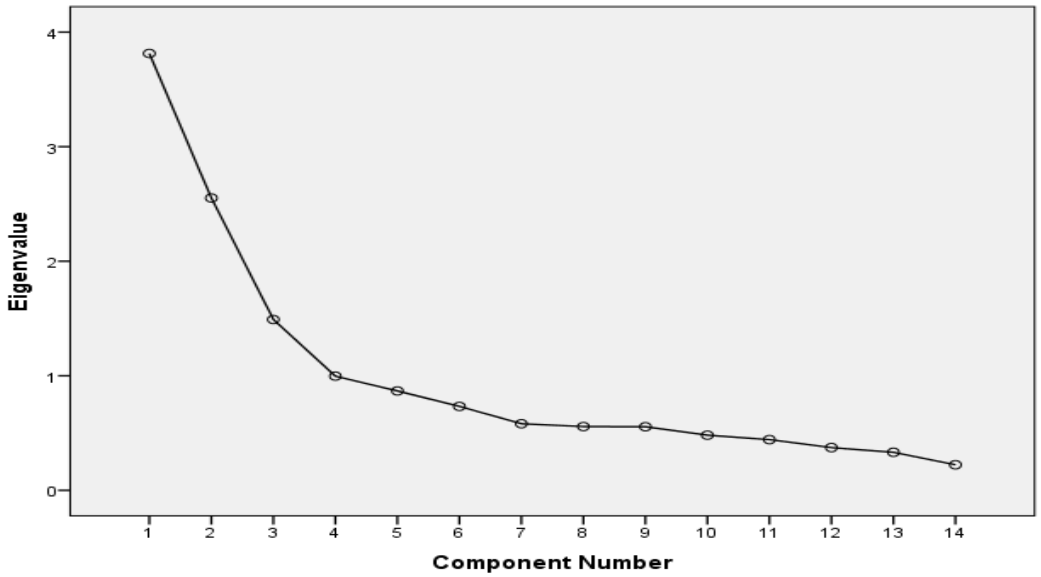


Fig.1: Scree Plot (SPSS Software).

To determine the ideal number to keep, it is necessary to locate the point of inflection. The key step in factor analysis is to determine how many factors can be extracted before the curve plateaus and shows diminishing returns.

Table 6: Component matrix (SPSS software).

Factors	Component		
	1	2	3
Government Support			0.787
Reduced Life Cycle Cost	0.650		
Efficient Resource Utilization		0.709	
Improving National Economy	0.747		
Improving Quality of Life	0.693		0.407
Lower Impacts to Environment		0.744	
Lack of Knowledge and Awareness	0.706		
Difficulty in Obtaining Clearances and Approvals		0.727	
Lack of Skilled Manpower	0.525		
High Cost of Implementation		0.603	
Lack of Market demand	0.799		

Factors	Component		
	1	2	3
Training and Technology	0.787		
Risks and Uncertainties	0.560		
Finding out Right Location		0.737	
Extraction Method: Principal Component Analysis.			
a. 3 components extracted.			

The rotating component matrix provides a Pearson correlation matrix for the pairings of "factor" and "item." By examining factor loadings, which are indicated as loadings, you can gain insight into the characteristics of a specific factor.

Tabe 6 shows the outcomes of rotating the matrix and highlights the effects of this action. It is significant to remember that zero vectors are unaffected by matrix multiplication, allowing them to rotate around the origin axis (or origin coordinates). In many disciplines, including geometry, physics, and computer graphics, rotation matrices are crucial because they offer an algebraic explanation of rotations and their useful applications.

Table 7: Rotated Component Matrix (SPSS Software).

Factors	Component		
	1	2	3
Government Support			0.744
Reduced Life Cycle Cost	0.513		0.532
Efficient Resource Utilization		0.708	
Improving National Economy	0.632		0.485
Improving Quality of Life	0.539		0.596
Lower Impacts to Environment		0.745	
Lack of Knowledge and Awareness	0.786		
Difficulty in Obtaining Clearances and Approvals		0.727	
Lack of Skilled Manpower	0.545		
High Cost of Implementation		0.606	
Lack of Market demand	0.783		
Training and Technology	0.796		
Risks and Uncertainties	0.643		
Finding out Right Location		0.737	
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.[a]			
a. The rotation converged in 4 iterations.			

Only values greater than 0.4 are taken into account and assigned to the components under study in the rotational component matrix shown in the Table 7. Here, interactions between three distinct entities are mediated by the rotating component matrix.

5.1 Observed Elements from Factor Analysis

The rotating component matrix shown in the table 7 provides insightful information about the ensuing components.

5.1.1 Component 1 Social Factor

The analysis excluded any variables with a correlation value less than 0.4. Every variable in the study has a single accurate value that can be used to explain it. As a result, five criteria became candidates for additional research. The following elements are covered by these chosen criteria: Lack of knowledge and Awareness (0.786) Lack of skilled labour (0.545) Lack of Market Demand (0.783) Training and technology (0.796) Risks and Uncertainties (0.643).

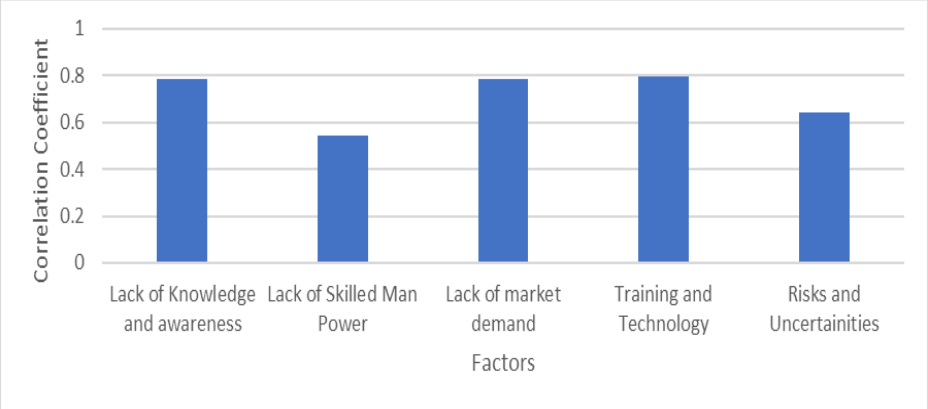


Fig 2: Factor loadings of Component 1 (Created by author).

The development of the green building sector depends on addressing the issues of lack of awareness, information, and skills, while also highlighting the advantages of sustainable construction methods. Additionally, to lower manufacturing costs and raise the calibre of green building materials, research and development expenditures are required. It takes careful technical planning, analysis, and training to ensure that green technologies are successfully implemented. To encourage the widespread adoption of green building practises, it is also necessary to address legal issues related to performance, construction risks, and uncertainties.

5.1.2 Component 2- Possibilities and Difficulties

Only one valid value for each variable remained after variables with a correlation coefficient of less than 0.4 were eliminated from the statistical analysis. To perform an in-depth analysis, five parameters were chosen, with particular attention paid to the aspects listed below.

Efficient Resource Utilisation (Correlation: 0.708): This criterion examines optimal use of resources to achieve desired outcomes. It considers factors such as productivity, efficiency, and effective allocation of resources. Lower Impacts on Environment (Correlation: 0.745): This criterion assesses the degree to which a given option or approach minimises its adverse environmental effects. Consider factors such as sustainability, eco-friendliness, and conservation practises. Difficulty in Obtaining Clearances and Approvals (Correlation: 0.727): This criterion focusses on the challenges and obstacles associated with acquiring the necessary clearances and approvals for the implementation of a particular solution. Examines regulatory compliance, legal requirements, and bureaucratic processes. High Cost of Implementation (Correlation: 0.606): This criterion evaluates the financial implications and feasibility of implementing a specific solution. Consider factors such as initial investment, operational expenses, and potential return on investment. Finding the Right Location (Correlation: 0.737): This criterion emphasises the importance of identifying an appropriate location for implementing a proposed solution. It examines accessibility, proximity to target beneficiaries, and logistical considerations.

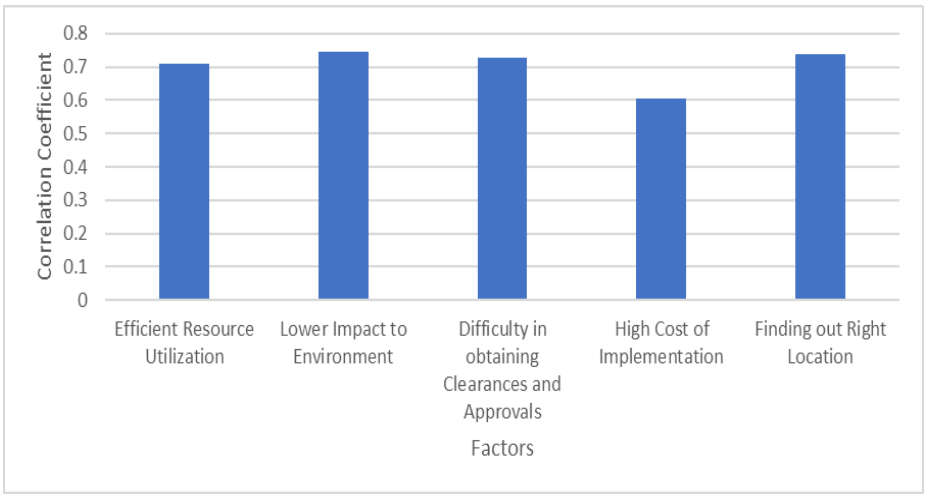


Fig 3: Factor loadings of Component 2 (Created by author).

Aspects of project organisation, resource use, environmentally friendly building techniques, and the significance of location are all covered in the text provided. It highlights the need to balance workloads to identify workload distribution among team members and maximise resource usage. To preserve predevelopment hydrology and lessen water pollution, low-impact development practises such as native plant landscaping and rainwater collection are highlighted. With a focus on green architecture, urban planning, and LEED certification, green buildings are discussed as constructions that minimise detrimental effects on human health and the environment. The importance of obtaining a clear title to the property before construction begins and the difficulties of using sustainable building materials are discussed. The text also highlights the significance of utility availability, location assessment, and integration.

5.1.3 Component 3- Economic Considerations

The analysis did not consider any variables with a correlation coefficient below 0.4. It is important to note that each variable can only have one true value. Therefore, the author identified and focused on five specific criteria for further investigation. Among these criteria, notable factors deserving recognition are as follows, along with their respective correlation coefficients: Government Support (0.744), Reduced Lifecycle Costs (0.532), Improving National Economy (0.485), and Enhancing Quality of Life (0.596).

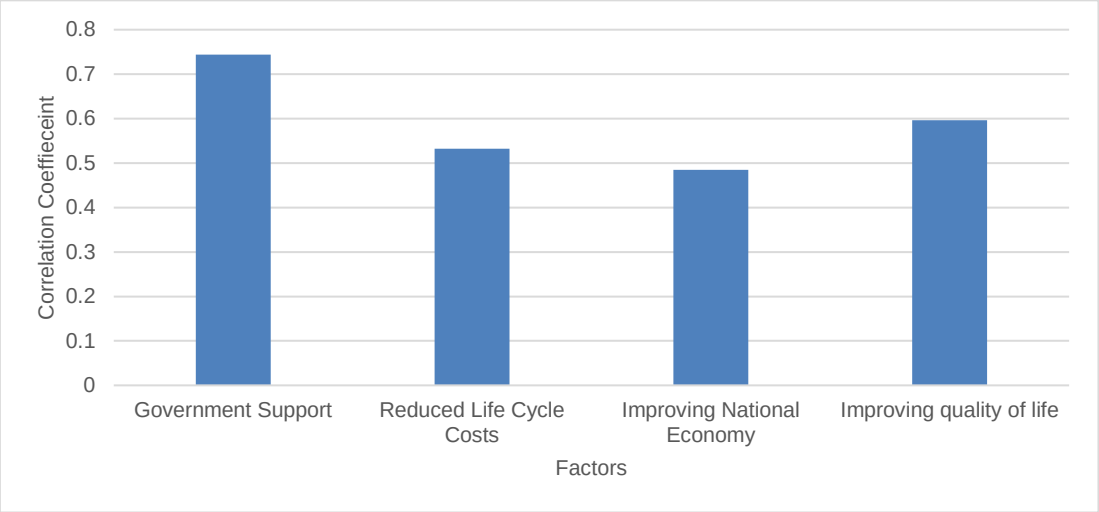


Fig 4: Factor loadings of Component 3 (Created by author).

Urbanisation and the construction industry in India present growth opportunities that call for creative policies to reduce resource use and lessen the negative effects on the environment. Concerns about the electrical grid, water supply and natural resources are the focus of recent regulations in the construction sector. The higher costs of green construction have raised some concerns, but life-cycle costing can be used to assess investments over time. Reduced maintenance requirements can be achieved by highlighting material longevity and durability, as well as environmentally friendly alternatives such as radiant cooling. Given how much indoor environmental quality affects worker productivity, occupant health and well-being, it is clear how important sustainability is for inspiring teams. By providing better lighting, thermal conditions, ergonomic features, and air quality, green buildings have been shown to improve occupant health, lower stress levels, and improve quality of life.

5.2 Development of the Model

Factor analysis is a valuable research tool for identifying and prioritising critical factors. By employing factor analysis, the author successfully pinpointed the most influential elements and derived important insights from them. In this study, the author used factor analysis to devise a formula that could serve as a blueprint for integrating eco-friendly practices into public building projects in India. The mathematical equations that describe this model are presented as follows:

$$Y = 0.27 \cdot C1 + 0.18 \cdot C2 + \ldots + 0.43 \cdot C0 \quad (1)$$

where:
Y – Effective Implementation of Green Approaches in Public Sector Constructions in India,
$C1$ – Social Factors,
$C2$ – Possibilities and Difficulties,
$C0$ – Factors that do not have much variation.

6 Conclusion

This research has clarified the status of green practises in India's public sector constructions and their implications for environmental sustainability in conclusion. The Energy Conservation Act (ECA 2001) and the Energy Conservation Building Code were highlighted in the study as essential measures taken by the Indian government to address issues with energy use and air pollution in buildings. However, it was discovered that these initiatives have not entirely succeeded in encouraging energy efficiency as intended.

The study also emphasised the importance of certifications like LEED-India, which honour structures that go above and beyond the minimum standards imposed by governments at the national level. Although there are some notable green structures in India, such as the research and administrative building of Turbo Energy Limited in Chennai, they are still uncommonly widespread.

Additionally, the research identified factors that hinder the implementation of green building concepts in the public sector. Through a comprehensive literature evaluation, the study classified these factors into contributing factors and withholding factors, along with 14 subfactors. A survey was conducted to gather information from professionals in the construction and architecture fields, and factor analysis revealed three critical components: social factors, possibilities and difficulties, and economic considerations.

Based on the findings, the author proposed a model for the effective implementation of green building approaches in public sector constructions in India. The model addresses the problems faced by green building initiatives and the factors to consider during implementation and provides additional recommendations, such as liberalising policies and regulations, ensuring government support and promoting green building initiatives.

By correctly implementing this model, the research envisions a future where green practises are integrated into various public sector constructions, including highways, ports, airports, bus terminals, and buildings. The recommendations in this study aim to address the factors that hinder eco-friendly construction, promoting sustainability and environmental awareness.

While the research focuses on India, other Asian countries may adopt similar approaches, allowing a India’s perspective on green building applications in the industry. This study is a valuable resource and a starting point for further research and development of innovative ideas for the implementation of green building principles. The proposed model has the potential to be widely applicable and can contribute to the advancement of sustainable building practises worldwide.

To expand on this research, future studies can explore additional standard components that impact the efficient use of green building approaches. Investigating the long-term benefits and implications of implementing this model in the nation's businesses would provide valuable insights. Researchers can also employ methods like Analytic Hierarchy Process) and expand the sample size to gather more data and diverse participant viewpoints, strengthening the study findings.

In summary, this research contributes to ongoing efforts to promote green building construction practises in the public sector. Addressing current challenges, proposing a model and offering recommendations, paves the way for further exploration and a more sustainable future in the building industry.

Policy and regulatory revisions that include incentives for sustainable projects should be supported to improve the use of green building practices in public sector construction in India. To motivate industry stakeholders, strong government support, monetary incentives, and awareness campaigns should be encouraged. Professional capacity-building projects must be funded, and certification programs like LEED-India must be encouraged. Campaigns to raise public awareness can generate demand for sustainable structures, and low-interest loans and other forms of financial support should be established. Knowledge sharing between governmental, commercial, and academic institutions requires collaboration, and a robust framework for monitoring and evaluation must be implemented. A more sustainable future for the building sector will be facilitated by international cooperation, continued research, and development in green building techniques, which will serve as a model for other nations worldwide.

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