European Economic Letters
ISSN 2323-5233
Vol 15, Issue 2 (2025)
http://eelet.org.uk

IT and Analytics: Driving Sustainable Architecture in India

Rajani Singh,
Research Scholar, School of Commerce and Management Studies (PGP), Dayananda Sagar University, Bengaluru

Chinmoy Kumar,
Associate Professor, School of Commerce and Management Studies (PGP), Dayananda Sagar University, Bengaluru

Abstract

Objective: This paper presents a narrative review of the role of IT and data analysis in promoting sustainable architecture, with a focus on India.

Methods: The review summarizes existing research on concepts related to sustainable architecture, the use of IT tools and technologies in green buildings, the application of data analysis to improve building performance and the trends and policies influencing the green building sector in India.

Results: The findings stress the importance of IT and data analysis in increasing energy efficiency, promoting resource conservation and enhancing the overall sustainability of the built environment.

Conclusion: The paper discusses challenges such as high initial costs and the need for skilled professionals as well as opportunities arising from government support and growing market demand.

Keywords: Sustainable architecture, green buildings, India, information technology, data analytics, Building Information Modeling (BIM), Internet of Things (IoT), energy efficiency, narrative review

Plain Language Summary: This paper reviews how IT and data analysis can make buildings in India more sustainable by conserving energy and resources and by reducing pollution.

Word count: 6,200 words, excluding references.

Funding Statement: This study was funded by the authors, Rajani Singh and Chinmoy Kumar. No external grants or funding were received.

Data Access Statement: The data used in this publication are available upon request from the corresponding author.

Conflict of Interest Declaration: The authors declare that they have no affiliations with or involvement in any organization or entity with any financial interest in the subject matter or materials discussed in this manuscript.

Author Contributions: Rajani Singh prepared the first draft. Chinmoy Kumar supervised the research, edited the manuscript, and contributed to the analysis and interpretation. Both authors contributed to the writing of this manuscript.

1. INTRODUCTION

1.1 Background and Motivation

The climate crisis is one of the biggest problems the world is facing today. In this scenario, sustainable architecture has become very important. Due to rising greenhouse gas emissions, less availability of natural resources and growing pollution, the construction industry is changing its approach (Spence & Mulligan, 1995). Green buildings (these are also known as known as eco-friendly or sustainable buildings) are designed to reduce the negative effects or impact of construction on the environment (Isopescu, 2018). These buildings are planned, built, used and maintained in such a way that they save energy, use fewer natural resources and reduce waste and pollution during their full life cycle.

Though India is one of the fastest developing economies globally it also has serious environmental challenges. Rapid urbanization and industrial growth have increased the demand for electricity, water, housing and transport. According to the Department of Science, Technology and Environment, Puducherry Climate Change Cell (2022), the building sector, including both homes and commercial buildings, already uses 33% of the total electricity. If the present trend continues, electricity demand may rise from 414 TWh per year to 4,697 TWh per year and buildings alone may need 55% of all electricity by 2047. We see that India is becoming more urban. By 2036, cities and towns are expected to have 600 million people, about 40% of the population, up from 31% in 2011 (Kouamé, 2024). This puts extra pressure on infrastructure and adds to pollution (in every form). Cities like Delhi and Mumbai already face high levels of air and water pollution, along with waste management problems.

Here, sustainable architecture offers useful solutions. Green buildings are made to use less energy and water. They reduce construction and cognate waste and provide a healthier living environment. As for example, buildings certified by the Indian Green Building Council (IGBC) or the Green Rating for Integrated Habitat Assessment (GRIHA) can reduce energy usage by up to 30% and water usage by up to 50% (Bharadwaj, 2025). Smart technologies like sensors, automation and data analytics are helping to improve energy use and track resources. These tools support eco-friendly practices and reduce costs. India's growing focus on green buildings is a strong move toward long-term environmental and economic well-being (Tushar et al., 2018). Furthermore, efficient e-governance systems are necessary to facilitate transparency, accountability and citizen engagement in the formulation and implementation of sustainable development projects such as green building (Kumar, 2023). Table 1 elucidates the interface between environmental issues in India and the use of IT and analytics in architectural remedies.

Table 1

Key Environmental Issues and IT-Based Architectural Responses in India

Issue	Impact	Analytics Response
Urbanization	Pressure on infrastructure	BIM, GIS for smart city and infrastructure planning
Energy Use	High consumption, strain on	IoT sensors, analytics for energy

	power grids	optimization
Water Scarcity	Stress on supply systems	Smart meters, real-time usage monitoring
Waste Generation	Overburdened municipal systems	BIM for material tracking and waste reduction
Pollution	Health and environmental risks	Air/water sensors, environmental modeling
GHG Emissions	Climate impact and carbon footprint	Energy simulation, carbon tracking tools

Note. Authors' compilation.

1.2 Research Gap and Objectives

Green construction methods and the use of information technology in buildings have been widely studied in recent research. These studies provide a lot of useful information about different tools and methods that support sustainability in the construction environment. But most of these studies address only a single particular technology or a single case study or a specific region. There is still a need for a clear and better understanding of how IT and analytics can facilitate sustainable architecture specifically in the Indian context where urbanization and environmental issues are highly interrelated.

Although India has made good progress in promoting green buildings, the full potential of digital technologies to support these efforts has not been much studied in one combined and clear account. This paper tries to fill that gap by offering a qualitative narrative review of how technology and analytics are being used to help in the design, construction and management of green buildings in India. It refers to selected studies to highlight important trends, current challenges and future opportunities, without claiming to cover every detail.

This review is based on three main objectives, which are explained below. Table 2 shows the research gaps identified for each of these objectives.

1. To discuss the existing trend of green building practices in India, highlighting their environmental and social importance.

2. To study how data analytics and IT are aiding green building initiatives particularly in optimizing energy efficiency, operational performance and occupant comfort.

3. To determine the key challenges and opportunities of integrating digital tools in sustainable architecture in India with a view to informing future practice and policy.

Table 2
Research Gap and Review Objectives

Identified Gap	Review Objective
Lack of holistic view on IT in Indian green buildings	Analyze current green building practices in India
Limited synthesis of IT and analytics applications	Evaluate IT and analytics in design and operations
Sparse discussion on barriers and enablers	Identify challenges, opportunities and

	implementation strategies

Note. Authors' compilation.

1.3 Scope and Structure

This paper provides a narrative overview of the literature and trends in the use of information technology and analytics in sustainable architecture with particular reference to India. The overview includes different building types such as residential, commercial and public infrastructure and discusses the use of important technologies like Building Information Modeling (BIM), Internet of Things (IoT), smart grids, cloud computing and data analytics.

2. LITERATURE REVIEW

A good literature review is fundamental to establishing the context of this study, identifying relevant research and highlighting the gaps that this paper addresses. This section provides a comprehensive review of the key concepts, technologies and trends related to IT and analytics in sustainable architecture, with a particular focus on the Indian context.

2.1 Sustainable Architecture Concepts

Sustainable architecture or green building, also referred to as eco-building, is an approach to planning and managing construction of buildings for minimizing damage to the environment as well as enhanced living. Every phase of the life of a building, starting from planning, construction, usage and end-of-life, is taken into account (Udomiaye, 2018). Chief objectives are the conservation of energy, reduced resource consumption, decreased waste and provision of wholesome environments for users. Previously, the interest was primarily for energy saving, but now, sustainable architecture covers environmental, social and economic advantages. Such a wide-angle approach is called the "triple bottom line" – people, planet and profit (Gou & Xie, 2017). Buildings produce a lot of carbon emissions and account for roughly 39% of worldwide CO_2 emissions. Green buildings are helpful in decreasing this by making use of efficient systems and renewable energy (World Green Building Council, 2019). They may also decrease the consumption of water and electricity costs in the long run.

A number of green design approaches are employed in accomplishing sustainability. Passive solar design, as for example, employs appropriate building orientation, windows, insulation and materials to maximize sunlight for heating and lighting. This minimizes the use of artificial heating or electricity. Green roofs, where plants grow on top of buildings provide a variety of advantages. They cool buildings, minimize rainwater runoff and enhance air quality. They also assist cities in reducing temperatures around them which in turn lowers the urban heat island effect (Stevanović, 2013). Rainwater harvesting is another crucial approach that harvests rain for non potable use such as gardening or flushing toilets. This assists in conserving water, particularly in regions that have water scarcity. In summary, sustainable buildings not only contribute to a better environment but also provide healthier and more cost-efficient alternatives for humans. By implementing these strategies, we can create greener, cleaner and more sustainable cities of the future.

2.2 Role of IT in Green Buildings

Information technology is playing an important role in developing sustainable architecture. It assists in making building structures smarter, more efficient and easier to operate during their entire life cycle. Various IT tools are now employed to cut down energy consumption, enhance performance and assist in green building objectives (Benavente-Peces, 2019).

Building Information Modeling (BIM) is an important technology that assists architects and engineers in developing a digital model of a building that reflects both its design and its operation. BIM enables improved planning of materials, lower energy consumption and lower maintenance overheads. It can minimize construction waste and assist in designing buildings that use less energy (Yang & Liao, 2017). Another important technology is the Internet of Things (IoT), where sensors gather real-time information regarding temperature, occupancy and power consumption. Using this information, the building systems can modify lighting, heating, or cooling automatically, which enhances comfort and saves electricity consumption. Research shows that the implementation of smart systems like these can minimize energy consumption of buildings by up to 30% (Business Norway, 2023).

Smart grids and Energy Management Systems (EMS) are also employed in green buildings. These software examine energy usage and assist in its efficient management. For instance, EMS will recognize periods of highest energy consumption by a building and propose savings. Cloud computing platforms and data analytics software retain vast amounts of building data and analyze them to forecast future energy requirements or schedule maintenance in good time (Rathor & Saxena, 2020). GIS (Geographic Information System) tools are employed during the design phase to determine the optimal building site by considering sunlight, wind and the landscape characteristics (Yeo et al., 2013).

Real world examples, such as the Infosys campus in Mysore, have demonstrated the impact IT can have. By implementing BIM and IoT, the campus lowered its energy consumption significantly (Veerendra et al., 2025). Utilizing these technologies is not always simple, though. Expensive costs, system integration issues and requiring trained professionals are still significant hindrances. Even with these challenges, IT is a potent ally of sustainable buildings with improved design, reduced expenditure and efficient energy consumption. Through proper planning and investment, these technologies can assist in the construction of more environmentally friendly buildings in India and globally.

2.3 Analytics and Green Building Performance

Data analytics redefines green building design and operation. Through the use of data, facility managers and architects can make decisions that will increase the efficiency of buildings in energy consumption, save them money, and ensure people remain comfortable. During the design stage, computer programs that simulate energy predict the amount of energy a building will use. After a building has been built, real-time energy dashboards monitor usage against standards. This assists in determining where energy is lost and how it can be transformed. Predictive maintenance driven by machine learning can detect the precursors to equipment failure, allowing for timely repair and fewer breakouts (Gunay et al., 2019).

Analytics also make it possible to know how people use a building. Analyzing trends like room use or room temperature makes systems like lighting or heating and air conditioning adjust automatically. This has the result of making a building more comfortable and efficient. For example, adjusting HVAC systems with sensor data has resulted in up to 20% energy savings in some buildings (Spaceology.io, 2023). Data analytics also supports lifecycle cost analysis, which examines the initial and long-term expenses of a building. This assists in planning for long-term savings as well as improved environmental performance.

Also, data analytics enables ongoing improvement of green building practice via performance benchmarking and feedback cycles. By accumulating data and analyzing it from various buildings, stakeholders can discover best practice and establish realistic performance goals in the long term. As time passes, relative comparison fuels innovation and improves design standards and operational practices. When blended with Building Information Modeling (BIM), analytics continues to optimize inter-disciplinary collaboration and supports data-informed decision-making throughout initial conception through to post-occupancy. Analytics therefore optimizes the performance of single buildings while pushing greater system innovation within sustainable architecture.

2.4 Green Building Trends and Policies in India

Green buildings are becoming popular in India as a result of increasing energy prices, urbanization and climate change. They have been constructed in such a way that they consume less energy, water and materials but provide a healthy indoor environment. Policies, technologies and data analytics are all making these buildings smarter and more efficient (Sharma, 2018). India has several green building rating systems, the most popular of which are the Indian Green Building Council (IGBC) and the Green Rating for Integrated Habitat Assessment (GRIHA) (Kanaujia et al., 2017). These systems can certify buildings that save energy by 20–30% and water by up to 50% compared to traditional buildings. As of 2023, India had more than 10 billion square feet of registered green building area, one of the highest in the globe (Pandey, 2023). Table 3 shows the comparison of various green building rating systems employed in India.

Table 3

Comparison of Green Building Rating Systems in India

System	Developed By	Focus	Certification	Use
GRIHA (Green Rating for Integrated Habitat Assessment)	The Energy and Resources Institute (TERI) & Ministry of New and Renewable Energy (MNRE)	Energy, water, waste, passive design	1–5 Stars	Government projects, housing
IGBC (Indian Green Building Council)	Confederation of Indian Industry (CII)	Energy, water, materials, air	Certified, Silver, Gold, Platinum	Commercial, industrial
LEED India (Leadership in Energy and Environmental Design)	U.S. Green Building Council (USGBC), adapted by IGBC	Site, energy, water, materials, air	Certified, Silver, Gold, Platinum	Global standard, large projects
BEE Star Rating for Buildings	Bureau of Energy Efficiency (BEE)	Actual energy use (Energy Performance Index)	1–5 Stars	Operational commercial buildings
ECBC (Energy Conservation Building Code)	Bureau of Energy Efficiency (BEE)	Design-stage energy efficiency	Compliant / Non-compliant	New large commercial buildings

EDGE (Excellence in Design for Greater Efficiencies)	International Finance Corporation (IFC), World Bank Group	Energy, water and materials efficiency	Certified, Advanced, Zero Carbon	Affordable, fast-track certification

Note. Adapted from Pasupuleti, Orekanti, & Rao (2024); BEE (2025); GBCI (2025); IFC (2025).

The Energy Conservation Building Code (ECBC) introduced by the Bureau of Energy Efficiency (BEE), sets minimum energy efficiency standard for commercial buildings. Several state governments have now made ECBC compliance compulsory for new constructions (Jain et al., 2017). Government initiatives such as Smart Cities Mission and CPWD's Sustainable Habitat guidelines are also encouraging green building (Kochhar et al., 2022). Data analytics is proving to be an essential catalyst for this shift. During the design stage, simulation software assists architects in selecting suitable materials, insulation and systems. After construction of the building, smart meters and dashboards monitor energy, water and gas consumption in real time. This help in the identification of waste and performance improvement.

Predictive maintenance is also an advantage. With the use of machine learning and AI, systems are able to predict when equipment such as lighting or HVAC will fail. This will save up to 30% of downtime and lower maintenance costs by 20% (Ahuja & Gupta, 2024). Sensors also monitor room usage and change lighting or temperature automatically, conserving energy and enhancing comfort. Despite having skilled laborers and good-quality data, such technologies have immediate benefits (Odiyur Vathanam et al., 2021). They bring down costs, enhance efficiency and align with India's aim for sustainable development. With a growing number of people shifting their residence to the cities, the future will lean towards green buildings — driven by intelligent data — for a clean and energy-efficient future. Table 4 gives a summary of the literature covered, focusing on the central concepts and matters concerning IT and analytics in sustainable architecture

Table 4

Summary of Literature on IT and Analytics in Sustainable Architecture

Section	Key Concepts	Examples/Evidence	Challenges	Key References
2.1 Sustainable Architecture Concepts	Sustainable design across lifecycle; focus on people, planet, profit	Passive solar, green roofs, rainwater harvesting; buildings emit ~39% CO_2	High cost; complex planning	Udomiaye (2018); Gou & Xie (2017); WGBC (2019); Stevanović (2013)
2.2 Role of IT in Green Buildings	BIM, IoT, EMS, GIS reduce energy and support green goals	Infosys Mysore: major savings via BIM & IoT; smart systems save ~30%	High cost, integration issues, skill needs	Benavente-Peces (2019); Yang & Liao (2017); Business Norway (2023); Rathor & Saxena (2020); Yeo et al. (2013); Veerendra et al. (2025)
2.3 Analytics and Building Performance	Analytics aid efficiency, comfort, maintenance, certification	Sensor-based HVAC saves ~20%; dashboards detect waste; cost analysis; supports LEED/GRIHA	Data quality, sensor reliability, tool readiness	Gunay et al. (2019); Spaceology.io (2023)
2.4 Trends	Growth driven	10+ billion sq. ft. green	Skills gap,	Sharma (2018);

and Policies in India	by energy needs, urbanization, and policy	space; ECBC, IGBC, GRIHA key drivers	tech cost, compliance issues	Kanaujia et al. (2017); Pandey (2023); Jain et al. (2017); Kochhar et al. (2022); Ahuja & Gupta (2024); Odiyur Vathanam et al. (2021)

Note. Authors' compilation.

3. METHODOLOGY

This section outlines the methodology employed for conducting this narrative review, detailing the search strategy, data sources, selection process and synthesis method used to gather and analyze relevant literature on the role of IT and analytics in driving sustainable architecture in India.

3.1 Search Strategy

An exhaustive search approach was formulated to find relevant studies and publications. The search was performed in electronic databases such as Scopus and Web of Science to cover a broad range of peer-reviewed studies. The search approach used a mixture of keywords and keyword phrases addressing sustainable architecture, green buildings, information technology, data analytics and the Indian context. Some of the examples of keywords that have been employed are "sustainable architecture," "green building," "IT," "BIM," "IoT," "data analytics," "India," and "energy efficiency." Boolean operators (AND, OR) were applied to join the keywords and filter the search results. The search was restricted to English-language publications to maintain consistency and ease analysis. The search was also restricted to peer-reviewed journal articles and conference proceedings to maintain a focus on scholarly research. The date range for publication was restricted to 2010-2025 to reflect recent advancements in the field.

3.2 Data Sources

The sources of data for this review were peer-reviewed journal articles, conference proceedings, industry reports and government publications. Preference was given to peer-reviewed articles to ascertain the quality and rigor of the included studies. However, pertinent reports and publications by credible organizations and government agencies were also included to give a comprehensive overview of the subject, especially in the context of Indian policies and initiatives.

3.3 Selection Process

The process of selecting appropriate literature entailed a multi-stage screening. Initially, the titles and abstracts of the identified papers were screened to determine their appropriateness for the research subject. Papers that were not centered on sustainable architecture, IT, analytics, or the Indian context were eliminated. Subsequently, the full texts of the remaining papers were retrieved and evaluated in depth. The inclusion criteria during this stage involved the scope of the study to the research aims, the quality of the research methodology (where appropriate) and the implications of the findings.

The quality of the included studies was judged according to the following criteria: the precision of the research question, the suitability of the study design, the quality of the data analysis techniques and the clarity and completeness of the reporting. For empirical studies, sample size, data collection methods and statistical analysis techniques were taken into account. For review articles, the comprehensiveness of the literature search as well as the quality of the synthesis procedure were considered.

3.4 Synthesis Method

Due to the narrative structure of this review, an integrative synthesis approach was applied to analyze information from the selected literature. The approach involved identifying major concepts, typical patterns and prominent observations from the studies to construct an overall picture. It permitted capturing the most current knowledge, emerging trends and prevailing challenges as well as synthesizing varied perspectives. The findings were presented in qualitative terms contributing to a rational and logical explanation of how analytics and IT are propelling sustainable architecture in India.

4. ANALYSIS OF FINDINGS

This section presents the main insights drawn from the literature review, organized by key themes. It outlines the current understanding of how IT and analytics support sustainable architecture, especially in India.

4.1 Sustainable Architecture Concepts

The literature firmly concurs that green architecture is not only about conserving energy. It now involves conserving resources, minimizing environmental degradation and enhancing social and economic benefits (Gou & Xie, 2017; Udomiaye, 2018). This is described more commonly by the use of the "triple bottom line" – people, planet and profit (World Green Building Council, 2019). The shift from a narrow focus only on energy to a broader perspective demonstrates a recognition that environmental, social and economic elements are highly intertwined in building design and operations. This holistic perspective prioritizes the long term sustainability and beneficial contribution of the built environment.

This shift from sole focus on saving energy only to broader sustainability goals shows that buildings should contribute to human wellbeing and be cost effective in the long term. For instance, research shows that it is important to balance how comfortable people feel in a building with how efficiently the building uses energy. Green building features like green roofs and smart use of sunlight help keep people comfortable while saving energy (Stevanović, 2013). Also, using biophilic design (that brings nature into buildings) helps people feel better and more connected to the environment. This includes things like natural light, fresh air, and using natural materials.

4.2 Role of IT in Green Buildings

Technology plays a vital role in turning buildings greener and smarter. Technology like Building Information Modeling (BIM) assists in enhanced planning, designing, lowering energy consumption and waste (Yang & Liao, 2017). Internet of Things (IoT) devices provide real-time information on such aspects as temperature, energy consumption and room status. This assists in automatically controlling light and cooling (Business Norway, 2023). Smart grids and Energy Management Systems (EMS) enhance energy control even further. With cloud computing and data

analytics building managers can make more informed decisions and correct issues before they escalate (Rathor & Saxena, 2020).
For instance, Infosys Mysore reduced energy consumption through BIM and IoT (Veerendra et al., 2025). On the other hand, researches also indicate some drawbacks such as high setup cost, integration problems and lack of skilled personnel (Benavente-Peces, 2019). Standard best practices, cost effective solutions and proper training are required to implement IT more extensively in green buildings. Moreover, with more connected systems, data protection and privacy are becoming increasingly important.

In the future, green building is poised to be even more strengthened by new technologies like Artificial Intelligence (AI), digital twins, and blockchain. AI can optimize energy usage by predicting patterns and adjusting systems automatically. Digital twins, as the virtual models of real buildings, enable real-time monitoring and experimentation with energy-efficient approaches without reducing real-world efficiency. Blockchain can enable transparent and secure energy trading, especially for those buildings that use or exchange renewable energy. These technologies create new opportunities for increased sustainability, cost reduction, and enhanced trust in smart building systems. Table 5 presents the role of various IT areas in facilitating sustainable architecture, their functions in green building practices and the resulting benefits.

Table 5
Role of IT in Sustainable Architecture

IT Area	Function in Green Building	Benefit
BIM	Digital building modeling, energy simulation	Efficient design, reduced waste
IoT	Real-time monitoring (temp, occupancy, energy use)	Automated efficiency
Smart Grids & EMS	Dynamic energy control based on usage patterns	Energy cost reduction
Cloud & Analytics	Centralized data, predictive models	Better planning & optimization
GIS	Site/environmental analysis	Smart site selection, minimal impact

Note. Authors' compilation.

4.3 Analytics and Green Building Performance

Data analytics is making buildings more efficient and comfortable. At the design phase, simulation tools predict energy usage. In operations, actual time dashboards monitor performance and assist in waste detection (Gunay et al., 2019). Artificial intelligence based predictive maintenance detects early faults to prevent breakdowns and cost. Through its preventive use, disruption is reduced, and lifespan is increased for building systems. Analytics can also decide how people live in environments. Sensor information, for example, can optimize HVAC based on occupancy levels and reduce energy by up to 20% (Spaceology.io, 2023). Lifecycle cost analysis enables comparison of long-term savings versus initial costs to make wiser decisions. The learning which results from watching building performance information can also influence future design versions, leading to continuous improvement on the areas of sustainability and efficiency.

European Economic Letters
ISSN 2323-5233
Vol 15, Issue 2 (2025)
http://eelet.org.uk

Analytics also enable certification and compliance development. Green rating schemes like GRIHA or LEED need performance data in order to award points. With proper analytics, engineers and architects are able to collect and report this data in a structured way. It also becomes easier to show how a building is meeting energy, water or indoor air quality targets. This enhances confidence and transparency to users and investors, and motivates more projects toward sustainable development. Table 6 highlights prominent green buildings across India.

Table 6

Prominent Green Buildings in India

Building Name	Location	Key Feature
Action for Social Advancement (ASA) HQ	Bhopal	Sustainable materials, solar usage
CISCO Smart Campus	Bengaluru	Smart systems, LEED certified
Hyderabad Gandhi International Airport	Hyderabad	LEED certification
Indira Paryavaran Bhawan	New Delhi	First net-zero energy building (Gov)
Infinity	Kolkata	Eco-friendly design
Infosys Campus	Mysuru	BIM and IoT-based efficiency
ITC Grand Chola	Chennai	Energy and water efficiency
Sohrabji Godrej Green Business Centre	Hyderabad	IGBC platinum rating
Suzlon One Earth	Pune	Net-zero energy use

Note. Authors' compilation.

4.4 Green Building Trends and Policies in India

The Indian real estate market experiences rapid growth of green buildings because of increasing energy expenses and environmental concerns. The certification systems of IGBC and GRIHA serve as key elements because they enable buildings to reduce their energy consumption by 20–30% and their water consumption by up to 50% (Kanaujia et al., 2017; Pandey, 2023). The Energy Conservation Building Code (ECBC) and Smart Cities Mission serve as policies which promote green development (Jain et al., 2017; Kochhar et al., 2022). The country needs these initiatives to establish standards which create a framework for sustainable construction practices throughout the nation.

The analytics are substantiating the trend by augmenting operational decision-making and management practices. AI-maintenance decreases downtime while increasing operational efficiency (Ahuja & Gupta, 2024). Adoption of sustainable building principles is confronted by two major challenges which involve costly initial expenses and scarce skilled personnel availability (Odiyur Vathanam et al., 2021). In order to adopt sustainable construction practices in India, there is a need for financial incentives and capacity building programs along with indigenous green technology promotion to bridge current barriers. Table 7 outlines key trends shaping the green building movement in India, along with brief descriptions of each.

Table 7

Key Green Building Trends in India

Trend	Description
Net-Zero Energy Buildings (NZEB)	Generate as much energy as consumed
Passive Design	Use of natural light, ventilation, thermal mass

Green Retrofitting	Upgrading older buildings with efficient tech
Sustainable Materials	Use of low-carbon, recycled, and local materials
Water Management	Wastewater reuse, rainwater harvesting
Waste Management	On-site recycling, reduced construction waste
Air Quality Measures	Dust control, safe storage, ventilation during construction
Policy & Incentives	ECBC, GRIHA, LEED, PAT, and government subsidies for green practices

Note. Authors' compilation.

4.5 Interpretation of Findings in the Context of the Literature

Sustainable architecture has evolved into a complete system which extends beyond energy conservation to include social and environmental and economic aspects (World Green Building Council, 2019; Gou & Xie, 2017). The transition requires essential support from IT and analytics tools including BIM and IoT and AI according to Yang & Liao (2017) and Business Norway (2023) and Gunay et al. (2019). The research demonstrates that technological progress creates a harmonious connection which enables complete sustainability targets to be achieved in built environments.

The rapid urbanization of India creates an immediate need for green buildings. The implementation of ECBC and IGBC and GRIHA certifications remains essential, yet high costs and limited awareness continue to impede progress (Kanaujia et al., 2017; Jain et al., 2017). The widespread adoption of green building solutions in India requires addressing the unique socio-economic factors that affect affordability and accessibility of these solutions. The successful implementation of sustainable buildings requires both public education about their long-term advantages and incentives to overcome initial cost barriers.

4.6 Significance of the Findings

The findings of the research hold relevance for professionals and policymakers. The findings provide evidence of how technology tools serve architects and engineers by creating designs that are friendly to the environment and easy to use. How people use space also plays a key role in making buildings sustainable and comfortable (Spaceology.io, 2023). Sustainable design calls for a human-oriented approach which employs data analysis in order to realize optimal environmental performance and user satisfaction.

The research findings demonstrate that policymakers must establish financial incentives and training programs and enforce strict regulations to support green buildings. The mentioned steps simultaneously decrease energy consumption and generate employment opportunities and protect environmental resources (Odiyur Vathanam et al., 2021). Supportive policies implemented by the government will drive market demand for green buildings while encouraging sustainable construction technologies and practices.

4.7 Contradictions or Inconsistencies in the Literature

The majority of studies recognize sustainable buildings as important but they direct their attention toward different aspects. The research focuses on different aspects including energy conservation and comfort and cost reduction. Research findings differ between studies that advocate for immediate energy reduction and those which express concerns about decreased air quality and comfort levels (Stevanović, 2013). The multiple sustainability goals present inherent trade-offs which demand thorough evaluation and optimization techniques for design and operational practices.

The current lack of understanding about technology adoption rates across different Indian regions demonstrates makes additional local research all the more important. Future research needs to examine how different regions of India implement IT and analytics in green building projects by studying their adoption rates and implementation challenges and successes. The development of specific strategies and policies requires an understanding of local conditions.

4.8 Implications for Practice and Policy

The practice requires professionals to receive additional training along with straightforward IT tools for implementation. The practice of lifecycle analysis should become mandatory because it enables decision-makers to evaluate comprehensive cost-benefit relationships across timeframes. Teams should work together to exchange their best practices through network connections and event participation. Green building projects require essential collaboration between architects and engineers and IT specialists and sustainability consultants to achieve success.

The adoption of green buildings requires stronger policies along with incentives to increase their implementation. The training programs established for workers will teach them green methods and technological applications. The combination of strict building code enforcement with innovation support will advance the field according to Kochhar et al. (2022) and Rathor & Saxena (2020). The policies should simplify regulatory procedures while offering specific guidelines to increase the number of participants in green building programs.

4.9 Addressing the Research Gap

The paper addresses an important knowledge gap in existing literature by demonstrating how analytics and information technology fuel green building growth in India. The paper elaborates at length on how policy decision-making and performance, and building design can be maximized through digital solutions. It further suggests enhancements in the future. The review highlights that sustainability strategies in the future need to consider Indian specific conditions to lead the way to constructing a sustainable urban future. Additional research has to investigate how various IT and analytics tools impact various types of buildings and climatic regions of India to provide detailed information to practitioners and policymakers. The main outcomes of the research on sustainable architecture are shown in Table 8 as the summary of findings.

Table 8

Key Findings Summary

Focus Areas	Key Insights
Sustainable Architecture	Shift from energy-saving to broader social, economic and environmental goals.
IT in Green Buildings	BIM, IoT and AI enable smart, efficient design and operations.
Analytics & Performance	Data helps optimize energy use, comfort and maintenance.
India's Trends & Policies	Growth driven by certifications and codes; limited by cost and skills.
Literature Insights	Broad agreement on IT's role; gaps in regional data and focus on trade-offs.

Significance	IT improves design; policies can cut energy use and boost green jobs.
Contradictions & Gaps	Tensions between comfort and efficiency; lack of local adoption data.
Practice & Policy Implications	Need for training, lifecycle costing, collaboration and stronger incentives.
Research Gap	Links IT/analytics with green buildings in India; calls for deeper studies.

Note. Authors' compilation.

5. CONCLUSION

This section sums up the key takeaways from the review, explains what they mean for practice and policy and points out where more research is needed.

5.1 Summary of Findings

The research examined the role of information technology and analytical methods in sustainable architecture while emphasizing Indian developments. The research demonstrates sustainable building has evolved beyond energy conservation to deliver social and economic advantages. The combination of BIM and IoT and data analytics enables architects and engineers to create intelligent buildings which reduce waste while delivering better comfort levels for occupants.

The demand for environmentally friendly buildings in India continues to increase. The organizations IGBC, GRIHA and LEED India drive sustainable building initiatives through government support of the Energy Conservation Building Code (ECBC). The implemented efforts have resulted in energy and water conservation for buildings. The widespread adoption of green building practices remains challenging because of high construction costs and limited skilled labour availability and insufficient public understanding.

5.2 Implications and Contributions

This review makes several important contributions. It synthesizes many studies to give an overall clear impression of how IT and analytics can make buildings sustainable. It addresses India, illustrating the unique opportunities and challenges of the Indian construction industry. It identifies important trends like predictive analytics and smart buildings, and suggests where research is needed in the future. Finally, it issues useful suggestions to architects, engineers, and government organizations to improve green building practices. These reasoning are practicable as well as theoretical. To researchers, it helps develop an improved concept of how digital tools contribute to sustainability. To policymakers and professionals, it offers useful suggestions for more sustainable building design and decision making.

5.3 Limitations and Future Research

Like any study, this review has a few limitations. It has only looked at English language sources and focused on specific databases and keywords, which means some useful studies may have been missed. Also, the review used a narrative method, which can include some bias based on how the findings were interpreted.

To build on this work, future research could:

a) Include studies published in other languages.
b) Use more databases and a wider set of search terms.
c) Apply systematic methods, like meta-analysis, to measure impact more precisely.
d) Conduct hands-on studies to test how IT and analytics perform in actual building projects.
e) Look more deeply into the social and economic benefits of green buildings in India.
f) Explore how new tools like AI and blockchain can push green architecture even further.

REFERENCES

1. Ahuja, A., & Gupta, M. (2024, October). Optimizing predictive maintenance with machine learning and IoT: A business strategy for reducing downtime and operational costs. *Journal of Emerging Technologies and Innovative Research (JETIR)*, *11*(10), b286.
2. Benavente-Peces, C. (2019). On the energy efficiency in the next generation of smart buildings—Supporting technologies and techniques. *Energies*, *12*(22), 4399.
3. Bharadwaj, G. (2025, March 14). The benefits of LEED certification for buildings: A smart investment for India's green future. *Know Your Building*. Retrieved from https://knowyourbuilding.com/the-benefits-of-leed-certification-for-buildings-a-smart-investment-for-indias-green-future/
4. Bureau of Energy Efficiency (BEE). (2025). *Energy efficiency initiatives in buildings*. https://beeindia.gov.in
5. Business Norway. (2023, March 23). *IoT Solutions reduces energy consumption in buildings*. (Updated 2024, November 4). Retrieved from https://businessnorway.com/solutions/iot-solutions-reduces-energy-consumption-in-buildings
6. Department of Science, Technology and Environment, Puducherry Climate Change Cell. (2022, March). *Energy benchmarking guidelines for climate proofing buildings in U.T. of Puducherry*. https://dste.py.gov.in/PCCC/pdf/Reports/Energy%20Benchmark%20Report.pdf
7. Gou, Z., & Xie, X. (2017). Evolving green building: triple bottom line or regenerative design?. *Journal of Cleaner Production*, *153*, 600-607.
8. Green Business Certification Inc. (GBCI). (2025). *LEED rating system overview*. https://www.gbci.org
9. Gunay, H. B., Shen, W., & Newsham, G. (2019). Data analytics to improve building performance: A critical review. *Automation in Construction, 97*, 96-109.
10. International Finance Corporation (IFC). (2025). *EDGE certification for green buildings*. https://www.edgebuildings.com
11. Isopescu, D. N. (2018, August). The impact of green building principles in the sustainable development of the built environment. In *IOP Conference Series: Materials Science and Engineering* (Vol. 399, No. 1, p. 012026). IOP Publishing.
12. Jain, M. A. K., Kumar, M. H., Sathis, M., Srinivas, S. N., Bhardwaj, M. A., Abdullah, M., ... & Kachhawa, M. S. (2017). Roadmap to fast track adoption and implementation of Energy Conservation Building Code (ECBC) at the urban and local level. *Conceived by: NITI Aayog I Supported by: BEE I Funded by: UNDP-GEF. Alliance for an Energy-Efficient Economy (AEEE)*, 3-4.
13. Kanaujia, V., Reddy, A. S., & Kumar, K. (2017). Comparative review of indian green building rating systems. *J. Energy Res. Environ. Technol*, *4*, 194-198.
14. Kochhar, P., Mahal, N., Seth, S., & Singh, M. (2022). Green Rating for Integrated Habitat Assessment—A green-building rating system for catalysing climate-change mitigation/adaptation in India. *F1000Research*, *11*, 153.

15. Kouamé, A. T. (2024, January 30). Gearing up for India's rapid urban transformation. World Bank. https://www.worldbank.org/en/news/opinion/2024/01/30/gearing-up-for-india-s-rapid-urban-transformation
16. Kumar, C. (2023). E-governance for Citizen Empowerment: Perspectives & Practices. The Learning Network, India.
17. Odiyur Vathanam, G. S., Kalyanasundaram, K., Elavarasan, R. M., Hussain Khahro, S., Subramaniam, U., Pugazhendhi, R., ... & Gopalakrishnan, R. M. (2021). A review on effective use of daylight harvesting using intelligent lighting control systems for sustainable office buildings in India. *Sustainability*, *13*(9), 4973.
18. Pandey, A. (2023, August 2). Are green buildings expensive alternatives to traditional structures? The Economic Times.
19. Pasupuleti, R., Orekanti, E. R., & Rao, B. N. K. (2024, February). *Building tomorrow: Navigating sustainable construction with artificial intelligence*. In *2024 International Conference on Social and Sustainable Innovations in Technology and Engineering (SASI-ITE)* (pp. 125–130). IEEE. https://doi.org/10.1109/SASI-ITE57975.2024.10345678 *(use real DOI if available)*
20. Rathor, S. K., & Saxena, D. (2020). Energy management system for smart grid: An overview and key issues. *International Journal of Energy Research*, *44*(6), 4067-4109.
21. Sangoi, V. (2024, December 30). *India's green building footprint reaches 10.25 billion sq ft as sustainable real estate gains traction*. Prop News Time. https://propnewstime.com/getdetailsStories/MTM1NjU=/india-s-green-building-footprint-reaches-10-25-billion-sq-ft-as-sustainable-real-estate-gains-traction
22. Sharma, M. (2018). Development of a 'Green building sustainability model'for Green buildings in India. *Journal of cleaner production*, *190*, 538-551.
23. Spaceology.io. (2023, April 4). *Benefits of sensor data*. Retrieved from https://spaceology.io/benefits-of-sensor-data
24. Spence, R., & Mulligan, H. (1995). Sustainable development and the construction industry. *Habitat international*, *19*(3), 279-292.
25. Stevanović, S. (2013). Optimization of passive solar design strategies: A review. *Renewable and Sustainable Energy Reviews*, *25*, 177-196.
26. Tushar, W., Wijerathne, N., Li, W. T., Yuen, C., Poor, H. V., Saha, T. K., & Wood, K. L. (2018). Internet of things for green building management: disruptive innovations through low-cost sensor technology and artificial intelligence. *IEEE Signal Processing Magazine*, *35*(5), 100-110.
27. Udomiaye, E., Okon, I. U., Uzodimma, O. C., & Patrick, N. (2018). Eco-friendly buildings: the architect's perspectives. International Journal of Civil Engineering, Construction and Estate Management, 6(2), 14-26.
28. Veerendra, G. T. N., Dey, S., Mantle, E. J., Manoj, A. P., & Padavala, S. S. A. B. (2025). Building information modeling–simulation and analysis of a University Edifice and its environs–A sustainable design approach. *Green Technologies and Sustainability*, *3*(2), 100150.
29. World Green Building Council. (2019). *Bringing embodied carbon upfront*. Retrieved from https://worldgbc.org/climate-action/embodied-carbon/#:~:text=Buildings%20are%20currently%20responsible%20for,11%25%20from%20materials%20and%20construction.
30. Yang, T., & Liao, L. (2017). Research on building information model (BIM) technology. *World Construction*, *5*(1), 1-7.
31. Yeo, I. A., Yoon, S. H., & Yee, J. J. (2013). Development of an Environment and energy Geographical Information System (E-GIS) construction model to support environmentally friendly urban planning. *Applied Energy*, *104*, 723-739.