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Editorial

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# Building Lifecycle Management (BLM): A Comprehensive Overview

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## Abstract

Building Lifecycle Management (BLM) has emerged as a pivotal approach to managing the complex and evolving demands of buildings throughout their entire life span from initial conception and design through construction, operation, maintenance, renovation, and eventual decommissioning. This comprehensive overview synthesizes the multidisciplinary components of BLM, offering a structured examination of its frameworks, methodologies, technologies, and applications across the building lifecycle. The paper explores how BLM integrates principles from architecture, engineering, construction, facility management, and information systems to foster improved decision-making, enhanced sustainability, cost-efficiency, and regulatory compliance. Central to BLM is the concept of data-centric management, enabled by technologies such as Building Information Modeling (BIM), Digital Twins, Internet of Things (IoT), and cloud-based platforms. The abstract outlines how these tools support seamless information flow across stakeholders and lifecycle stages, thereby reducing inefficiencies, enhancing collaboration, and supporting predictive maintenance and energy optimization. Additionally, the paper addresses current challenges in BLM implementation, including data interoperability, stakeholder alignment, cybersecurity, and the need for skilled professionals.

By presenting taxonomy of BLM stages, identifying key actors, and mapping out critical information exchanges, this overview serves as a foundational reference for academics, practitioners, and policymakers. It also evaluates emerging trends such as artificial intelligence, circular economy principles, and smart infrastructure integration. The paper concludes with strategic recommendations for advancing BLM adoption and fostering a sustainable built environment.

**Keywords:** Building lifecycle management (BLM); Building information modeling (BIM); Digital twins; Facility management; Lifecycle cost analysis; Smart buildings; Sustainability; Internet of things (IoT); Construction technology; Predictive maintenance; Circular economy; Data interoperability; Smart infrastructure; Asset management; Building decommissioning

## Introduction

Building Lifecycle Management (BLM) is a systematic approach to managing the entire lifecycle of a building from its conception and design through construction, operation, maintenance, and eventual demolition or repurposing [1]. With the growing emphasis on sustainability, efficiency, and cost-effectiveness, BLM has emerged as a critical methodology in the architecture, engineering, and construction (AEC) industry [2]. This article explores the concept, phases, benefits, challenges, and future trends of BLM, providing insights into how technology and data-driven strategies are transforming building management practices [3].

Buildings are complex assets with long lifespans and significant operational demands. Managing their entire lifecycle is essential for optimizing performance, minimizing costs, and reducing environmental impact [4]. BLM involves a coordinated approach that integrates Building Information Modeling (BIM), facility management systems, and sustainability practices to enhance efficiency and accountability [5].

### Phases of Building Lifecycle Management

BLM consists of several interconnected phases:

Conceptualization and feasibility, includes site analysis, feasibility studies, and initial cost estimation. Design and modeling, utilizes BIM to create 3D models that integrate architectural, structural, and MEP (mechanical, electrical, plumbing) designs [6]. Simulations and analysis, energy modeling, daylighting studies, and sustainability assessments are performed to optimize building performance. Project scheduling, incorporates Gantt charts and critical path methods (CPM) to streamline workflows. Resource and material management, tracks material usage and monitors inventory to prevent wastage [7]. Quality control and safety, ensures compliance with building codes and occupational safety standards. Facility management (FM) integrates Computerized Maintenance Management Systems (CMMS) for real-time monitoring of building systems. Energy efficiency and sustainability, implements energy performance tracking, smart metering, and predictive maintenance [8]. Space utilization, uses occupancy data to optimize space management and reduce underutilized areas. Structural assessment, evaluates the need for retrofitting or renovation. Energy upgrades, incorporates energy-efficient systems, such as LED lighting, HVAC optimizations, and renewable energy installations. Deconstruction planning focuses on recycling building materials to minimize waste. Lifecycle assessment (LCA), analyses the environmental impact of demolition and material disposal.

### Benefits of building lifecycle management

Reduces operating costs through predictive maintenance.

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Optimizes resource allocation during construction.

Enhances asset longevity, reducing repair and replacement expenses.

Minimizes waste by optimizing material use.

Reduces energy consumption through performance tracking.

Supports green building certifications (LEED, BREEAM).

Provides actionable insights through real-time monitoring.

Enhances transparency in construction and operations.

Enables proactive maintenance, reducing downtime.

Enhances occupant comfort and safety.

### Challenges in Implementing BLM

Incompatibility between BIM, FM systems, and legacy platforms.

Lack of standardized data formats.

Significant investment in technology and training.

Ongoing maintenance and software upgrades.

Vulnerability to cyber threats.

Ensuring compliance with data protection regulations.

Reluctance from stakeholders to adopt new technologies.

Need for extensive training and change management strategies.

### Emerging trends and technologies in BLM

Real-time virtual replicas of buildings that simulate operations.

Used for predictive maintenance and performance optimization.

Integration of sensors and IoT devices for real-time monitoring.

Enhances energy efficiency and occupant comfort.

AI-powered predictive analytics for maintenance scheduling.

Automated fault detection and diagnosis.

Emphasis on low-carbon building materials.

Incorporation of renewable energy and water recycling systems.

### Case studies

One of the world's most sustainable office buildings.

Utilizes IoT and BIM for real-time monitoring and energy optimization.

Achieved a BREEAM Outstanding rating with a 98.36% score.

Implementation of BLM in public housing projects.

Use of digital twins for facility management.

Significant reduction in energy and maintenance costs.

## Conclusion

Building Lifecycle Management is transforming the AEC industry by streamlining processes, enhancing sustainability, and reducing operational costs. The integration of BIM, IoT, AI, and digital twins is driving unprecedented efficiency and data-driven decision-making. Despite the challenges of high initial costs and data integration, the long-term benefits of BLM in terms of cost savings, sustainability, and improved facility management make it a vital approach for the future of building management.

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