



Strategic Development and Management of Built Environment Systems

*Umar Aliyu Abdullahi¹ and Yusuf Ibrahim Kofarmata²

¹ Department of Estate, Kano State Polytechnic (C/O Director, Estate, Kano State Housing), Nigeria.

² Department of Economics, Faculty of Social and Management Sciences, Northwest University, Kano, Nigeria.

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*Corresponding Author: **Umar Aliyu Abdullahi**

Department of Estate, Kano State Polytechnic (C/O Director, Estate, Kano State Housing), Nigeria.

Abstract

Buildings, roads, public facilities and other parts of the built environment play an important role in everyday life. They support housing, transport, business activities, public services and community development. Because of this, they must be properly planned, built, managed and maintained. However, many built environment systems are now affected by climate change, rising costs, ageing facilities, limited resources and fast changes in technology. This article examines how these systems can be developed and managed in a more organised and effective way over their entire life cycle. The study reviewed 32 peer-reviewed journal articles published between 2020 and 2025. The selected studies were examined under five main areas: digital technology, sustainability and resource use, asset and facilities management, risk and resilience, and social and governance issues. The review found that most recent studies give strong attention to digital technology and sustainability. Less attention is given to how decisions made during planning, construction, operation, maintenance and renewal can be properly connected. The findings also show that tools such as Building Information Modelling, digital twins and Internet of Things systems can improve monitoring and decision-making. However, these tools are more useful when there is good data, skilled staff and clear management responsibility. The studies further show that reuse, recycling and future changes to buildings should be considered from the early planning stage. Regular maintenance, proper risk planning and learning from past problems are also important for long-term performance. Based on the findings, the article presents a lifecycle framework with six main stages: understanding current conditions, setting priorities, planning, managing project delivery, monitoring performance, and renewing or improving assets when needed. The study concludes that built environment projects should not be judged only by whether construction is completed on time. Greater attention should also be given to how well the facilities continue to serve users, control costs and remain useful over time.

Keywords: Built environment; strategic development; lifecycle management; digital twin; BIM; facilities management; resilience; circular economy.

1.0 Introduction

The built environment is more than a collection of buildings and infrastructure. It is a connected system of physical assets, users, organisations, technologies, finance, regulations and environmental conditions. A housing estate, hospital, university, transport hub or commercial district succeeds only when these parts continue to work together over time. For this reason, strategic development is not simply the act of delivering a new project. It involves deciding what should be built or renewed, why it is needed, how it will be financed and governed, how it will perform in use, and how it will adapt when conditions change. Recent studies show why this broader view has become necessary. Sustainability research in construction increasingly calls for decisions to be made across the project lifecycle rather than at the construction stage alone (Kiani Mavi et al., 2021). Murtagh et al. (2020) similarly argue that resilient and sustainable construction depends on relationships, long-term value and social context, not only on technical efficiency. Circular-economy research adds a further concern: design and procurement decisions made today can either preserve or destroy future opportunities for

reuse, recovery and adaptation (Munaro et al., 2020; Benachio et al., 2020). These findings indicate that built environment strategy must connect immediate project objectives with long-term asset outcomes.

Digitalisation has also changed the management problem. Building Information Modelling (BIM), Internet of Things (IoT) sensors, digital twins, cloud platforms and automated analytics can make asset information more visible and current. However, technology by itself does not create strategic value. Opoku et al. (2021) found that digital twin applications in construction were still concentrated in limited lifecycle areas, while Olanipekun and Sutrisna (2021) showed that digital transformation depends on organisational enablers and deliberate strategic action. More recent work continues to identify interoperability, data quality, implementation cost and organisational readiness as central obstacles (AlBalkhy et al., 2024). The practical lesson is clear: information systems must be designed around management needs, not added as isolated technical tools. The management challenge is especially important because the built environment has long asset lives. Poor planning can lock in energy use, maintenance burdens, inflexible layouts and operational inefficiencies for decades. Conversely, strong early decisions can improve maintainability, adaptability, user value and residual value. Research on BIM-supported facilities management shows that the operation stage can benefit greatly from reliable asset information, but public and private organisations still struggle to transfer usable data from project delivery into day-to-day management (Pinti et al., 2022). Mannino et al. (2021) also note that incomplete as-built information limits the usefulness of BIM in facilities management. The gap between project delivery and operational management therefore remains a major strategic weakness.

This article addresses that weakness by treating built environment development and management as one connected lifecycle system. It does not assume that every organisation needs the same technology or management model. Instead, it identifies recurring strategic functions that can be adapted to different asset types and institutional settings. The central argument is that good performance comes from aligning decisions about value, sustainability, resilience, information, delivery and operations from the beginning, and then updating those decisions with evidence from actual asset performance.

1.1 Objectives of the study

The aim of the study is to develop an evidence-based framework for strategic development and management of built environment systems. The specific objectives are to:

- (1) clarify the main concepts that define strategic built environment management;
- (2) examine the theoretical logic linking system integration, organisational adaptability and lifecycle value;
- (3) compare recent empirical and review evidence published from 2020 onward;
- (4) identify dominant and neglected themes in the literature; and
- (5) propose a practical model that connects strategic planning, project delivery, operations, renewal and learning.

2. Literature Review

2.1 Conceptual Review

2.1.1 Built Environment Systems and Strategic Development

A built environment system can be understood as the set of assets and relationships that support human, economic and social activity within a physical setting. The word “system” is important because asset performance depends on interactions. A high-quality building can still perform poorly if maintenance information is missing, funding is unstable, users are not considered, or infrastructure services fail. In the same way, technically efficient infrastructure can deliver weak public value when governance, accessibility or long-term operating responsibilities are unclear. Strategic development therefore begins before design. It starts with the identification of needs, constraints and future conditions. This includes demand, affordability, regulatory requirements, environmental risk, asset condition, technology choices, funding capacity and stakeholder expectations. Sustainability reviews have repeatedly shown that stronger outcomes occur when sustainability is considered during feasibility and early design rather than treated as a late compliance exercise (Kiani Mavi et al., 2021; Araújo et al., 2020). The strategic stage should therefore translate broad goals into priorities that can be measured during design, construction and operation.

Management then extends through the full lifecycle. The delivery phase remains important because it converts plans into physical assets, but long-term performance depends on what happens after handover. Facilities management research stresses the need for structured asset information, condition assessment, maintenance planning and operating feedback. Cao et al. (2022) found that BIM can support operation and maintenance in green buildings, while Altohami et al. (2021) showed the potential of combining BIM, IoT and facilities management in existing buildings. These studies move the discussion from static documentation toward continuously updated information that supports maintenance and renovation decisions. Lifecycle management also includes renewal and end-of-life choices. Circular-economy studies show that the construction sector still focuses strongly on waste treatment and recycling, while deeper practices such as design for disassembly, component reuse and circular business models remain less developed (Çimen, 2021; Guerra et al., 2021). Charef and Emmitt (2021) demonstrate that BIM can help overcome some information barriers to circularity, but use at

end of life is still limited. Strategic management should therefore record material, component and asset information in forms that preserve future options rather than allowing knowledge to disappear after completion.

2.1.2 Sustainability, Resilience and Adaptability

Three ideas are central to contemporary built environment strategy: sustainability, resilience and adaptability. Sustainability asks whether the system creates value without imposing unacceptable environmental, social or economic costs. Lima et al. (2021) found that sustainability research in construction has expanded substantially, but the field still contains uneven emphasis across sustainability dimensions. Social sustainability remains particularly difficult to standardise. Rostamnezhad and Thaheem (2022) identified a wide range of social indicators, including stakeholder interests, health and safety, human resource development, community factors and government roles. Kordi et al. (2022) further showed that there can be a gap between perceived social sustainability and actual project practice.

Resilience addresses the ability to continue functioning, recover and adapt under disruption. It is not limited to structural resistance. A resilient built environment system must also manage supply interruptions, climate stress, financial shocks, changing patterns of use and organisational disruption. Eldesoky and Abdeldayem (2023) show that urban form and resilience are closely connected but not yet fully integrated in research. Tajuddeen and Sajjadian (2024) similarly identify the built environment as a major field for climate mitigation and adaptation. This means strategic planning should consider uncertainty explicitly rather than assume stable operating conditions.

Adaptability links sustainability and resilience to decision-making over time. An adaptable system is easier to reconfigure when user needs, technology, regulation or climate conditions change. From a management perspective, adaptability is supported by flexible design, reliable data, modular choices, maintainable systems and periodic review of priorities. Sustainable risk management research now moves beyond one-time risk registers toward approaches that combine resilience, flexibility and long-term sustainability (Almashhour et al., 2025). This shift supports the view that risk should be treated as a continuous management process rather than a document produced mainly for project approval.

2.1.3 Digital Integration and Lifecycle Information

Digital integration has become one of the strongest themes in recent built environment research. BIM provides a structured digital representation of asset information, while IoT technologies add live measurements and digital twins create a stronger link between physical assets and continuously updated virtual representations. Shahzad et al. (2022) describe digital twins as bidirectionally linked physical and digital environments that support simulation and data-centred decisions. Arisekola and Madson (2023) show that digital twins are increasingly applied to asset management, with real-time data and decision-making emerging as central topics.

The strategic benefit of digital systems lies in integration. A BIM model that is not updated after construction has limited operational value. An IoT system that collects large amounts of data without clear management questions can also become an expensive information burden. Digital information should therefore be designed around decisions: what must be monitored, who is responsible, what threshold requires action, and how evidence will affect maintenance, investment or user management. Naderi and Shojaei (2023) identify interoperability as a continuing challenge in infrastructure digital twins, while Tuhaise et al. (2023) show that digital twin applications depend on combinations of enabling technologies rather than one platform.

Digitalisation also needs governance. Data ownership, security, standards, access rights, model updating, skills and procurement responsibilities must be clear. Su et al. (2023) propose lifecycle digital-twin thinking, but their review also underlines the practical difficulty of connecting technology across all phases. Zhang et al. (2023) show that operations and maintenance applications depend on enabling technologies and well-defined implementation strategies. Thus, the strongest strategic model is not “technology first”; it is a management system in which technology strengthens visibility, coordination and learning.

2.1.4 Governance, Strategic Value and Organisational Learning

Strategic governance is the mechanism that connects long-term objectives with day-to-day decisions. In a built environment system, many organisations can influence performance: clients, public authorities, designers, contractors, operators, utility providers, communities and technology vendors. When responsibilities are fragmented, an objective may be agreed in principle but lost during procurement, handover or operation. Strategic governance therefore requires clear decision rights, performance ownership and review points across the lifecycle. A useful distinction is between project success and asset success. Project success often emphasises completion against cost, time, scope and quality targets. Asset success asks whether the completed facility continues to provide the intended service at an acceptable lifecycle cost and risk. These measures are related but not identical. A project may finish on time and still create an asset that is difficult to maintain or expensive to operate. Conversely, a project may require additional early investment that produces better operating performance over decades. The strategic management task is to make these trade-offs visible before decisions become difficult to reverse.

Evidence from sustainability and digital research supports this broader performance view. Durdyev et al. (2021) show that BIM is increasingly linked with building energy assessment, which allows design information to support environmental performance decisions. Olanrewaju et al. (2022) similarly found growing integration between BIM and green building certification, but noted that research remains heavily concentrated on energy relative to social and economic dimensions. These findings suggest that digital information can support sustainability, yet organisations still need balanced objectives and governance rules so that one easily measured indicator does not dominate the entire value case.

Governance is also important after occupancy. Tripathi et al. (2023) demonstrate the potential of integrating BIM, IoT and geographic information for post-occupancy evaluation. This type of integration can connect asset data with real user and environmental conditions, but it also creates questions about data ownership, privacy, maintenance and who has authority to act on the findings. The value of post-occupancy information is therefore realised only when organisations have a defined process for turning evidence into operational changes or capital investment. Organisational learning strengthens this process. AlMaian and Bu Qammaz (2023) found that learning capacity contributed to construction-organisation resilience during major disruption. For built environment owners, learning means more than recording lessons at project close-out. It means comparing expected and actual performance, identifying why gaps occurred, and applying the findings to future briefs, standards, procurement routes and maintenance plans. In this sense, performance measurement is not the end of management; it is the input to the next strategic cycle.

The practical implication is that strategic value should be expressed through a small set of connected outcomes rather than a long list of disconnected targets. Typical outcome groups include service quality, safety, affordability, lifecycle cost, carbon and resource performance, resilience, user experience, maintainability and adaptability. Each outcome should have an owner, a measure, a review frequency and a clear relationship to decisions. This creates continuity from strategy to design, delivery, operation and renewal, which is the central purpose of system-based built environment management.

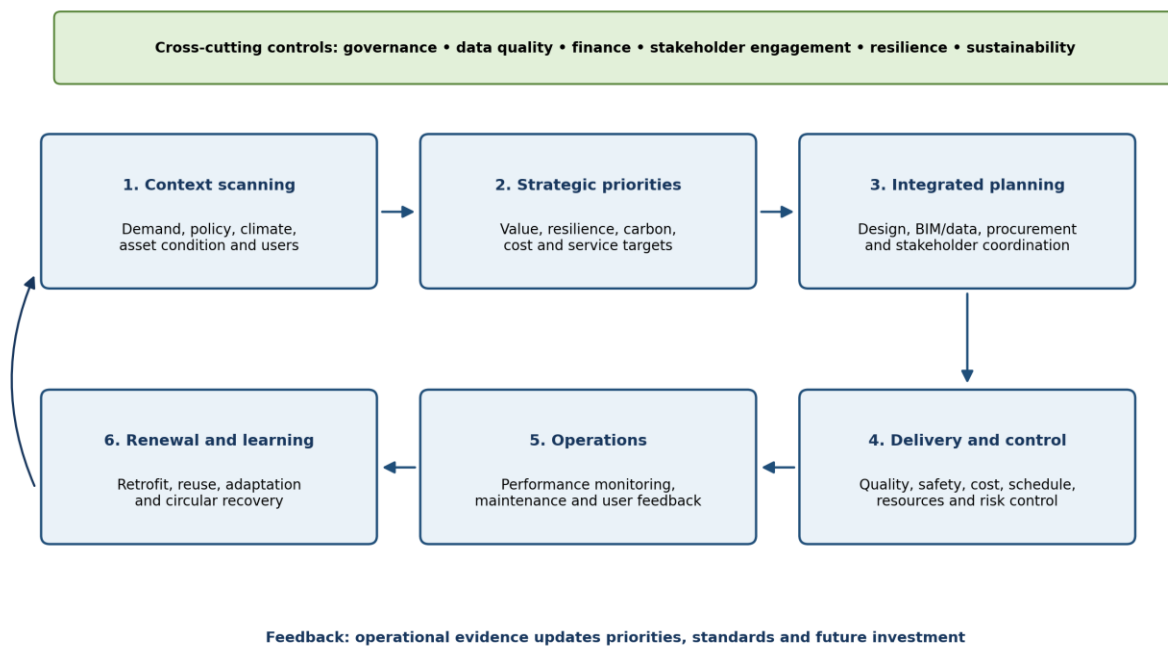


Figure 1. Strategic lifecycle framework for built environment systems.

2.2 Theoretical Framework

This study adopts an integrated theoretical framework combining a systems perspective with the logic of dynamic organisational capability. The systems perspective explains why built environment outcomes cannot be understood through isolated project variables. Physical assets, finance, users, supply chains, institutions, data and environmental conditions influence one another. A change in one part of the system can create consequences elsewhere. For example, a decision to reduce initial capital cost may increase operating cost, maintenance risk or energy use later. Similarly, a digital requirement added during design may have little value if the operating organisation has no process for maintaining the data.

Recent construction research supports this connected view. Murtagh et al. (2020) emphasise that sustainable and resilient construction depends on social relationships and changing value over time. Olanipekun and Sutrisna (2021) also describe

digital transformation as a process in which technologies create effects that require strategic responses, enabling conditions and barrier reduction. These findings fit a systems explanation because performance emerges from relationships among technical and organisational elements.

Dynamic capability logic adds the question of adaptation. Built environment organisations operate in changing conditions: climate risk changes, regulations are revised, technology develops, budgets tighten, user patterns shift and assets deteriorate. Effective organisations must therefore be able to sense important change, seize suitable options and reconfigure resources or processes. In this article, these ideas are translated into six management actions: sense, prioritise, integrate, deliver, measure and adapt. The purpose is not to turn the built environment into a purely corporate strategy problem. Rather, it is to explain why long-lived assets require management processes that learn and adjust.

Together, the two perspectives lead to a lifecycle-value proposition: the quality of strategic built environment management depends on the extent to which decision-makers understand interdependence and maintain the capability to adjust the system over time. The expected outcome is not simply project completion. It is sustained service value, including reliability, user benefit, lower environmental burden, manageable lifecycle cost, resilience and the preservation of future options. Figure 2 presents this theoretical relationship.

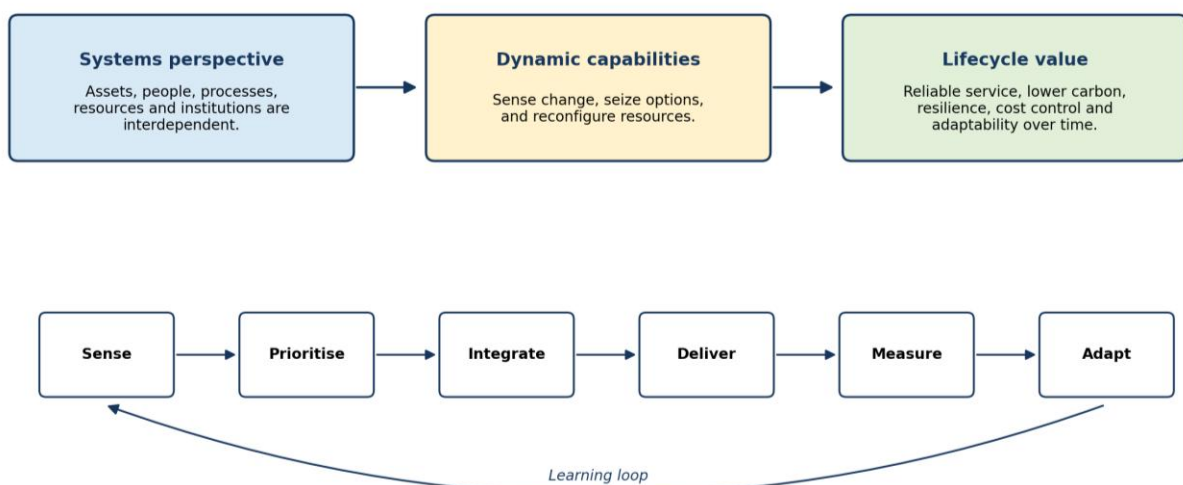


Figure 2. Integrated systems and dynamic-capability model for lifecycle value.

2.3 Empirical Review

Recent studies approach built environment management from different angles, including sustainability, circularity, digitalisation, facilities management, social value and risk. Table 2.1 summarises a selection of the reviewed evidence. The studies were chosen to show variation in method and subject rather than to repeat papers making the same point. Across the evidence, a common pattern is visible: strong technical advances are not enough when governance, lifecycle continuity and organisational capability remain weak.

Table 2.1. Selected empirical and review evidence on strategic built environment management

Study	Method/context	Main focus	Key finding relevant to this article
Munaro et al. (2020)	Systematic review; 318 papers	Circular economy in built environment	Research is concentrated on waste minimisation and reuse; circular business models and stakeholder integration need more development.
Murtagh et al. (2020)	Critical review	Sustainable and resilient construction	Long-term value, leadership and human relationships are central to sustainability and resilience.
Olanipekun & Sutrisna (2021)	Systematic review; 36 papers	Digital transformation in construction	Digital tools create transformation effects, but enablers, barriers and strategic responses determine results.
Mannino et al. (2021)	Literature review	BIM-IoT integration for FM	As-built data gaps limit BIM use in FM; IoT can strengthen operational information if data is integrated.
Guerra et al. (2021)	Global scan	Circular construction adoption	Waste-as-resource practices are more common than advanced circular business models.

Pinti et al. (2022)	Systematic review	BIM for FM in public organisations	BIM-FM adoption is increasing but remains fragmented and lacks standardisation in the public sector.
Rostamnezhad & Thaheem (2022)	Systematic review; 22 papers	Social sustainability indicators	Social sustainability spans stakeholder, workforce, project, community, industry and government factors.
Shahzad et al. (2022)	Literature review + expert interviews	Digital twins in built environment	Digital twins can support lifecycle decisions, but standards, security, integration and cultural change remain barriers.
Arisekola & Madson (2023)	Systematic review + social network analysis	Digital twins for asset management	Real-time data and decision-making are prominent themes across asset-management applications.
Naderi & Shojaei (2023)	Systematic review	Infrastructure digital twins	Interoperability remains a major limitation to connected infrastructure digital twins.
Tajuddeen & Sajjadian (2024)	Systematic review	Climate change and built environment	Built environment decisions are central to both mitigation and climate adaptation.
Almashhour et al. (2025)	Systematic review; 79 papers	Sustainable risk management	Risk management is shifting toward resilience, adaptability and sustainability rather than isolated risk treatment.

2.4 Gap in Literature

The reviewed literature shows strong growth in sustainability, BIM, digital twins and circular construction, but the streams are still commonly studied apart. Munaro et al. (2020) and Guerra et al. (2021) focus on circularity, while Opoku et al. (2021) and AlBalkhy et al. (2024) concentrate on digital twins. Pinti et al. (2022) examine BIM for facilities management, and Tajuddeen and Sajjadian (2024) emphasise climate response. These studies provide useful depth, yet fewer studies connect strategic need identification, project delivery, operational performance, renewal and learning in one management logic. End-of-life decisions also receive less attention than planning and operations, despite their importance for circular value. A further gap is the limited integration of social indicators with digital and asset-management decisions. This article addresses these gaps by proposing a lifecycle framework that treats governance, data, sustainability, resilience and stakeholder value as cross-cutting controls rather than separate topics within strategic asset decisions.

3. Methodology

The study used a structured integrative review. This method was selected because the topic crosses construction management, facilities management, sustainability, infrastructure, digital engineering and urban resilience. A narrowly defined meta-analysis would have excluded useful qualitative reviews, conceptual frameworks and technology studies that are necessary to understand the management system as a whole.

The review covered publications from 2020 to 2025. Each paper was coded using a simple review matrix. The fields were: publication year, principal subject, research approach, lifecycle stage, management issue and main implication. To prevent double counting in the main thematic graph, each paper was assigned one primary theme even where it covered several topics. The five primary themes were: digital integration; sustainability and circularity; asset and facilities management; resilience and risk; and social or governance issues. Lifecycle coding was non-exclusive because one study could address several stages. The stages were planning/design, construction/delivery, operation and maintenance, and renewal/end-of-life.

The analysis was descriptive and interpretive. Descriptive coding was used to show where the reviewed evidence is concentrated. Interpretive comparison was then used to identify recurring management principles, barriers and points of agreement across different research streams. The proposed framework was developed by translating these recurring findings into a sequence of management functions. No fabricated project, survey or financial data were introduced. Numerical results in the article relate only to the coded review corpus.

Quality control was applied in two ways. First, the reference list was checked against the in-text citations so that cited studies appear in the final list and uncited items are avoided. Second, the review deliberately included studies from different journals and research teams to reduce dependence on one author group or one method. The approach does not claim to be a formal exhaustive systematic review of every paper published since 2020. Its purpose is to provide a transparent, recent and sufficiently broad evidence base for a strategic management framework.

4. Results

The study shows that recent built environment research is concentrated in digital integration and sustainability/circularity. Each of these themes accounts for ten papers in the primary coding. Asset and facilities management accounts for five papers, resilience and risk for four, and social or governance issues for three. Figure 3 shows this distribution. The pattern does not mean that social or governance questions are unimportant. Instead, it shows that they are less often treated as the central research subject than technical and environmental themes.

The evidence also shows a lifecycle imbalance. Planning and design appear in 22 reviewed papers, construction and delivery in 18, and operation and maintenance in 19. Renewal and end-of-life issues appear in only 10. Figure 4 illustrates this pattern. Since lifecycle categories are non-exclusive, the total is higher than 32. The comparatively low attention to renewal is important because circular-economy value depends on decisions about adaptation, disassembly, reuse and recovery. This supports the concern raised by Charef and Emmitt (2021) that BIM use at the building end-of-life stage remains limited.

The cross-theme comparison also reveals that the literature often treats performance measures separately even though asset owners must make combined decisions. Environmental studies usually emphasise carbon, energy, materials or waste; digital studies emphasise information quality and decision support; facilities-management studies focus on maintenance and operational reliability; resilience studies examine continuity and adaptation; and social studies focus on users, workers and communities. In practice, these outcomes compete for the same budgets and management attention. A strategic system therefore needs a common decision frame that can compare short-term cost with long-term service, risk and adaptability. This is consistent with Lima et al. (2021), who found that sustainability research in construction remains diverse and uneven, and with Rostamnezhad and Thaheem (2022), who show that the social dimension contains many indicators that are difficult to apply without structure. The proposed framework responds by treating the themes as cross-cutting controls around one lifecycle process rather than as separate programmes.

A further result concerns the point at which information becomes useful. Across the digital studies, value increases when information is linked to a defined operational decision. Energy models can inform design choices; asset models can support maintenance; sensors can identify abnormal conditions; and post-occupancy information can reveal whether spaces or systems work as expected. Yet the same evidence shows that data volume is not a substitute for decision quality. The management system must specify what information is required, when it is needed, who validates it and what action follows. This finding explains why technically advanced systems can still produce weak organisational outcomes when roles and processes are unclear.

A second result is the strong movement from static information toward connected operational data. Mannino et al. (2021) emphasise BIM-IoT integration for facilities management, while Shahzad et al. (2022) and AlBalkhy et al. (2024) describe digital twins as a more dynamic link between the physical and digital asset. Arisekola and Madson (2023) similarly identify real-time information and decision-making as major themes in digital-twin asset management. The evidence therefore suggests a maturity path: organisations move from document storage to structured models, from models to live data integration, and from live data to predictive or adaptive decisions.

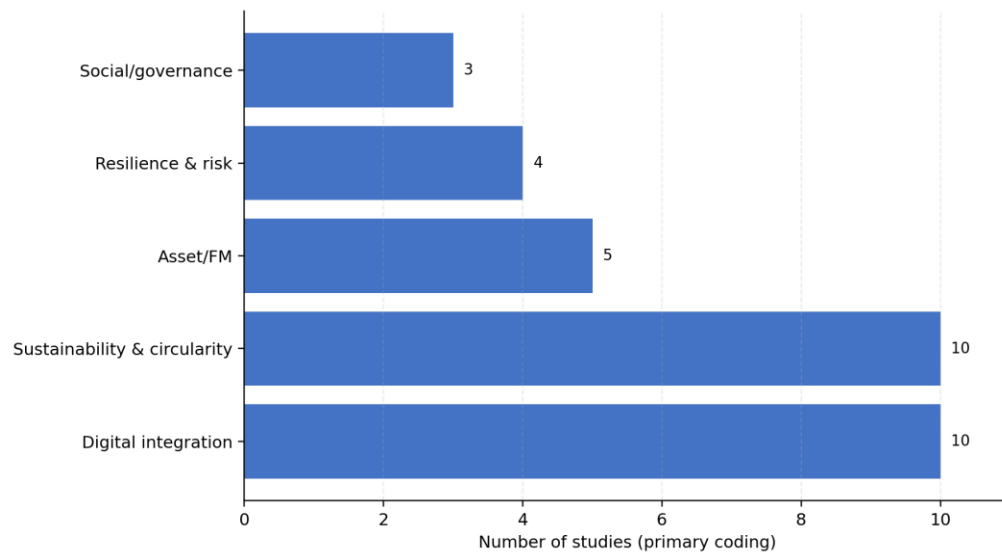
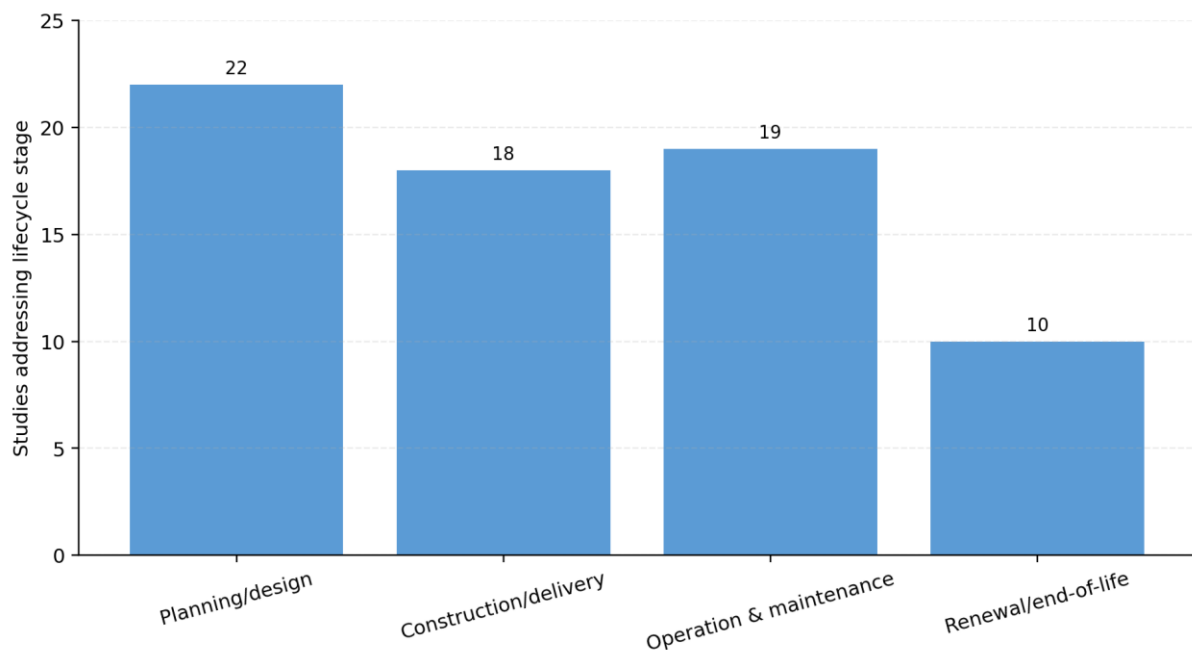
However, the review also shows that digital maturity is uneven. Technology studies repeatedly identify interoperability, data completeness, standards and organisational capability as barriers. Pinti et al. (2022) found that BIM for facilities management in public organisations remains fragmented and lacks standardisation. Naderi and Shojaei (2023) found continuing interoperability challenges in infrastructure digital twins. These findings indicate that a technically sophisticated platform can still fail as a management system when roles, data requirements and maintenance processes are weak.

The sustainability evidence also shows a shift from narrow environmental control toward lifecycle and multi-dimensional value. Early circular construction reviews identify waste reduction and reuse as dominant themes, but also point to underdeveloped business models and whole-lifecycle integration (Munaro et al., 2020; Osobajo et al., 2020). Later global evidence shows wider adoption of circular practices, while still noting that advanced business models are less common than treating waste as a resource (Guerra et al., 2021). Social sustainability research extends the issue further by including workforce, stakeholder, community and government indicators (Rostamnezhad & Thaheem, 2022).

Finally, resilience and risk studies support continuous rather than one-time management. Tajuddeen and Sajjadian (2024) show that the built environment is central to both climate mitigation and adaptation. Almashhour et al. (2025) argue for risk management that incorporates resilience, adaptability and sustainability. Taken together, these findings support a management system in which strategic priorities are periodically reviewed using operational and environmental evidence rather than fixed at project approval.

Table 4.1. Primary thematic distribution of the reviewed studies (n = 32)

Primary theme	Studies (n)	Share (%)	Interpretive emphasis
Digital integration	10	31.3	BIM, IoT, digital twins, interoperability and decision support.
Sustainability and circularity	10	31.3	Lifecycle sustainability, circular construction, material value and low-carbon decisions.
Asset/facilities management	5	15.6	Operational data, maintenance, condition and public-asset management.
Resilience and risk	4	12.5	Climate adaptation, organisational resilience and sustainable risk.
Social/governance	3	9.4	Stakeholder value, social indicators, roles and governance.

**Figure 3. Primary thematic distribution of the reviewed corpus.****Figure 4. Lifecycle-stage coverage in the reviewed studies (non-exclusive coding).**

5. Discussion

The findings reinforce the argument that built environment development should be managed as a lifecycle system rather than a sequence of separate professional tasks. The concentration of recent studies in digital integration and sustainability shows where the field has invested most attention. Yet the strongest practical message across the literature is not that every organisation should acquire more technology or add more environmental indicators. It is that information, sustainability, risk and service goals must be connected to decisions throughout the asset life.

This interpretation agrees with Kiani Mavi et al. (2021), who found that sustainability should be embedded from early project stages and monitored across the lifecycle. It also aligns with Araújo et al. (2020), whose review identified weaknesses in sustainability assessment and uneven attention to different building contexts. If sustainability objectives are set only after major design and procurement choices are fixed, the organisation has already lost many of its lowest-cost opportunities for change. Strategic development should therefore convert broad goals such as low carbon, resilience or accessibility into design requirements, procurement criteria and operating indicators before delivery begins.

The circular-economy evidence provides a similar lesson. Munaro et al. (2020) found that research was strongly focused on construction and demolition waste and that circular business models remained underdeveloped. Çimen (2021) later confirmed that waste valorisation and circular transition were among the most studied subjects. This suggests that the sector still tends to think about circularity after materials have already entered a project. A more strategic approach asks earlier questions: Can the asset be adapted instead of replaced? Can components be maintained, separated and reused? Can material information be retained? Can procurement preserve future residual value? These questions shift circularity from waste management to asset strategy.

The digital evidence also supports the proposed lifecycle framework. Opoku et al. (2021) observed that digital twin applications were often restricted to particular lifecycle phases. Su et al. (2023) responded to this problem by proposing digital-twin-enabled lifecycle management, while Zhang et al. (2023) examined enabling technologies for operations and maintenance. The sequence of these studies shows a movement from isolated use cases toward lifecycle integration. However, the practical barriers identified by Pinti et al. (2022), Naderi and Shojaei (2023) and AlBalkhy et al. (2024) show why many organisations do not reach that level. Interoperability, data governance, skills and process ownership are management issues as much as technical issues.

For facilities management, the implications are significant. If asset information is created mainly to satisfy design and construction needs, operators receive incomplete or poorly structured data. Mannino et al. (2021) identify this as a major limitation in BIM-FM integration. Cao et al. (2022) show that BIM can support operation and maintenance in green buildings, but capability depends on how information is prepared and used. The proposed framework therefore treats operational requirements as an input to planning, not an activity that starts after handover. Facility managers should be involved in defining maintainability, data, commissioning and performance requirements before construction.

The resilience evidence strengthens the case for a feedback loop. Murtagh et al. (2020) emphasise that resilient construction involves human relationships and long-term value. Tajuddeen and Sajjadian (2024) show the growing climate burden on the built environment, while Eldesoky and Abdeldayem (2023) highlight the relationship between urban form and resilience. A fixed strategy can become unsuitable when hazard patterns, service demand, technology or finance change. Periodic performance review is therefore not a minor administrative exercise; it is the mechanism through which a long-lived asset remains strategically relevant.

Social value should also be made more visible in system management. Rostamnezhad and Thaheem (2022) demonstrate that social sustainability extends across stakeholders, health and safety, workforce development, communities and government. Kordi et al. (2022) show that actual practice may lag behind stated perceptions. This is important because digital and environmental improvements can still produce poor outcomes when users are excluded, access is unequal or work conditions are weak. A built environment system should therefore be judged by who benefits, how safely it operates, and whether it supports the intended service, not simply by technical efficiency.

The proposed strategic framework combines these lessons. Context scanning creates awareness of demand, condition, regulation and future risk. Priority setting translates this information into measurable value goals. Integrated planning connects design, information, procurement and operations. Delivery control protects quality, safety, schedule, cost and resource performance. Operational management measures actual service and asset condition. Renewal and learning use this evidence to decide whether to maintain, retrofit, reconfigure, reuse or replace. Governance, data, finance, stakeholder engagement, resilience and sustainability cut across every stage.

This framework also addresses the theoretical issue raised earlier. The systems perspective explains why trade-offs and dependencies must be visible across functions. Dynamic capability explains why the management process must sense change and reconfigure resources. Together, they lead to a practical conclusion: built environment strategy should be treated as a repeating management cycle, not a one-off master plan. This is particularly relevant for public agencies and

large property owners, where portfolios must be adjusted over many years and where operational evidence should inform future capital programmes. For decision-makers, this also changes how performance should be reported. A portfolio dashboard should not show capital expenditure and completion dates alone. It should combine a small number of lifecycle measures such as service reliability, condition, energy or carbon intensity, safety, user outcomes, maintenance backlog, risk exposure and adaptability. The purpose is not to create another reporting burden. It is to make trade-offs visible and to help leaders direct limited funds toward interventions that protect long-term value. When the same indicators are used at strategic review, project approval and operational review, the organisation gains continuity between policy and asset management.

6. Practical and Managerial Implications

The findings have several practical implications. First, asset owners should define lifecycle outcomes before appointing designers and contractors. Requirements for energy, resilience, accessibility, maintainability, data, expected service life and future adaptability should be included in early briefs. This reduces the risk that long-term needs are treated as late additions. Second, digital requirements should be selective and decision-led. The purpose of BIM, sensors or digital twins should be linked to specific management decisions such as condition monitoring, preventive maintenance, space use, energy control or compliance. This helps organisations avoid collecting data that they cannot maintain or use. Third, handover should be treated as a transfer of operational capability, not only a transfer of documents. Facility teams need verified asset information, training, commissioning records, maintenance requirements and clear responsibility for data updates. This is consistent with the BIM-FM gaps identified by Pinti et al. (2022) and Mannino et al. (2021). Fourth, portfolio reviews should include renewal and circular options. Maintenance, retrofit, adaptive reuse, component recovery and replacement should be compared using lifecycle value rather than initial cost alone. Finally, governance should assign clear ownership for cross-cutting outcomes. Sustainability, resilience, social value and information management should not sit in isolated departments without influence on capital and operational decisions.

7. Conclusion

Strategic development and management of built environment systems requires a wider view than traditional project delivery. The reviewed evidence shows major advances in sustainable construction, circularity, BIM, IoT, digital twins and asset management, but it also shows persistent fragmentation between lifecycle stages and professional functions. The strongest research themes are digital integration and sustainability, while renewal, end-of-life and cross-lifecycle governance receive less attention. The article proposes a six-function framework that links context scanning, strategic priority setting, integrated planning, delivery control, operational performance management, and renewal with feedback. The framework is supported by a systems perspective and dynamic capability logic. Its main principle is that long-term service value should guide decisions from the beginning and should be reviewed as evidence changes. For practice, this means involving operations in early planning, defining measurable lifecycle outcomes, connecting digital tools to management decisions, strengthening data governance, and using performance evidence to guide maintenance and reinvestment. It also means treating resilience, sustainability and social value as recurring management responsibilities rather than one-time assessments.

The study is limited by its integrative review design and its focus on a selected verified corpus rather than an exhaustive database census. Future research can test the framework empirically across public infrastructure portfolios, institutional buildings, housing estates and commercial property systems. Comparative studies could also examine how different governance and digital maturity levels affect lifecycle value. Even with these limitations, the evidence supports a clear conclusion: built environment systems perform better when strategy, delivery, operations and renewal are managed as one connected learning process.

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