Smart Design Policies
2026, Volume 3, Number 1, pages 127–144
Original scientific paper

# From BIM to LIM: A Structured Review of Revit's Landscape Modelling Capacity and Ecological Information Gaps

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**ARTICLE INFO:**

**Article History:**
Received: 23 March 2026
Revised: 8 August 2026
Accepted: 12 August 2026
Available online: 15 August 2026

**Keywords:**
Landscape Information Modelling (LIM);
Building Information Modelling (BIM);
ecological intelligence;
structured literature review;
Sustainable Development Goals;
smart design policy.



**ABSTRACT**

*Landscape Information Modelling (LIM) extends Building Information Modelling (BIM) to represent topography, vegetation, hydrology, and ecological processes in support of sustainable design. Landscape architecture has adopted BIM-based workflows more slowly than building disciplines, and the specific capacity of Autodesk Revit, the most widely used commercial BIM authoring tool, to function as a LIM platform remains fragmented across the literature rather than assessed as a single, structured question. This study addresses that fragmentation through a structured, PRISMA-informed literature review. Formal database searching covered Scopus, Web of Science, ScienceDirect, and SpringerLink; Google Scholar and ResearchGate were used as supplementary discovery and retrieval tools rather than as primary databases. Sources published between 2013 and 2026 were screened for relevance to BIM, LIM, or Revit-based landscape modelling. Twenty-nine studies (18 journal articles and 11 conference papers) met the eligibility criteria, from an initial pool of 100 records identified across six sources and narrowed through deduplication and screening, and were coded across five review-based dimensions: geometric modelling, data integration, ecological intelligence, interoperability, and sustainability support. Screening and coding followed a predefined study-level protocol; ambiguous records were reassessed against the eligibility criteria, while reviewer-level agreement statistics were not available and are not claimed. The reviewed evidence suggests that Revit is effective for coordinated geometric representation and BIM-based documentation of several landscape components, including terrain, hardscape, and built infrastructure, but its native capacity for temporal vegetation change, ecological process modelling, and performance indicators linked to SDG 13 and SDG 15 remains limited according to the studies reviewed. Complementary civil engineering, GIS, and ecological simulation tools reported in the literature are used to extend Revit-based workflows toward these functions. The study's contribution is a structured synthesis that distinguishes geometric and documentation capacity from temporal and ecological intelligence, clarifies the difference between building-oriented Levels of Detail and the information needs of living landscape systems, and sets out a conceptual hybrid workflow proposed for future empirical validation. The review is limited by its literature-based method and its dependence on secondary evidence; empirical software testing is needed to confirm these review-based findings. SDGs 9, 11, 13, and 15 are interpreted here through defined capability indicators linking software function to measurable landscape tasks, rather than treated as outcomes achieved through software use alone.*

SMART DESIGN POLICIES (2026), *3*(1), 127–144.
https://doi.org/10.38027/smart.v3n1-8

www.smartdpj.com


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**How to cite this article: (APA Style)**
Nafeed, F. M., & Saputra, W. E. (2026). From BIM to LIM: A structured review of Revit's landscape modelling capacity and ecological information gaps. *Smart Design Policies, 3*(1), 127–144. https://doi.org/10.38027/smart.v3n1-8

## 1. Introduction

### 1.1 Background and Context

Building Information Modelling (BIM) has changed how projects are delivered in the architecture, engineering, and construction (AEC) sector by replacing two-dimensional drafting with coordinated, information-rich digital models that carry a project's physical and operational data from design through its operational life (Warpas et al., 2026). Beyond geometry, the BIM literature describes scheduling (4D), cost estimation (5D), sustainability assessment (6D), and facility management (7D) functions, with safety and risk management (8D), lean construction (9D), and industrialised construction (10D) proposed as further dimensions under active development (Ershadi et al., 2021;

Warpas et al., 2026). Governments across Europe, Asia, and the Gulf have made BIM a requirement for publicly funded projects, which has turned BIM adoption from a competitive advantage into a baseline expectation for project delivery (Abdirad & Lin, 2015; Saputra et al., 2024). BIM's expanding dimensional scope has also been discussed specifically for landscape and park projects, where multi-dimensional (3D-7D) BIM applications have been proposed for habilitating and maintaining public green space (Azzam & Aljraki, 2022).

Landscape architecture has not reached a comparable level of BIM adoption. Engagement with BIM in the landscape sector remains limited, which risks excluding landscape professionals from projects that rely on shared, information-based coordination with other disciplines. Emara (2021) reports that BIM implementation in landscape practice is particularly slow in the Arab region. Part of the reason lies in a mismatch between how BIM authoring tools represent objects and how landscape elements actually behave. Built environment objects are typically manufactured, static, and geometrically stable, with predictable behaviour and a definable lifecycle. Landscape and natural elements are different in kind: they are dynamic, contain living components that change with time, respond to environmental conditions, and carry ecological indicators that built elements do not. Vegetation, in particular, requires attributes such as leaf area index (LAI), leaf area density (LAD), biomass, carbon storage, root area index (RAI), specific root length (SRL), and root system architecture (RSA) that do not correspond to the geometry-and-parameter logic that BIM authoring tools were built around (Chen et al., 2025).

Landscape Information Modelling (LIM) developed as a response to this mismatch. It was first proposed conceptually by Stephen Ervin at Harvard University in the early 2000s to address the absence of plant and ecological information in existing digital models of buildings and urban spaces, and was later formalised as a framework for organising plant, terrain, infrastructure, and environmental information within integrated digital models (Zajíčková & Achten, 2013). LIM's stated potential includes standardising how landscape information is represented, supporting information exchange between the disciplines involved in a project's life cycle, and supporting more effective long-term maintenance (Borkowski & Wyszomirski, 2021a; Warpas et al., 2026). More recent work has extended LIM towards parametric ecological design and nature-based solutions (Carvalho et al., 2020), while separate strands of research have applied ecological functions historically associated with other domains, such as CityGML-based semantic modelling, plant-growth simulation, and Tree Information Modelling, to landscape and urban-space representation (Chen et al., 2025; Shu et al., 2022; Trisyanti et al., 2019). Despite more than two decades of conceptual development, the reviewed literature continues to describe uneven BIM uptake and fragmented digital practice across landscape architecture (Hagras et al., 2025), and no structured, cross-study assessment currently exists of what a mainstream BIM authoring tool such as Autodesk Revit can and cannot document within a LIM framework.

### 1.2 Conceptual Foundations

The terms used analytically throughout this review are defined here before they are applied.

Building Information Modelling (BIM) refers to the process of creating and managing coordinated, information-rich digital models of the physical and functional characteristics of a facility across its life cycle.

Landscape Information Modelling (LIM) refers to the extension of BIM-type digital modelling to landscape systems, integrating topography, vegetation, hydrology, soils, and ecological processes alongside the geometric and infrastructural information already captured in BIM (Zajíčková & Achten, 2013).

Ecological intelligence, as used in this review, refers to a model's capacity to represent living-system processes, including growth, seasonal change, biological interaction, and measurable ecological indicators, as distinct from the capacity to represent an object's static geometry or its stored attribute data. This review treats ecological intelligence as a spectrum with at least four distinguishable components: (i) geometric representation of an element's form; (ii) attribute storage describing an element's properties at a fixed point in time; (iii) temporal change, meaning the representation of how an element’s form or properties evolve; and (iv) ecological process modelling, meaning the simulation of biological or environmental mechanisms (growth, competition, microclimate interaction) that produce that change. A fifth and sixth component, performance calculation and interoperability with specialist ecological or environmental systems, are treated separately in this review because they depend on data exchange rather than on the authoring model itself.

Temporal modelling refers to a model’s capacity to represent an element’s state at more than one point in time.

Temporal Level of Detail (temporal LoD), as used in this review, is a three-level classification adapted from the reviewed literature: temporal LoD 1 describes a single static representation of a design at one construction stage; temporal LoD 2 describes discrete representations of an element at multiple defined growth or development stages; temporal LoD 3 describes continuous or near-continuous simulation of change over time, including interaction with the surrounding environment. Temporal LoD is a concept proposed and applied within this review; it is not a component of the AIA/BIMForum LoD 100-400 system or of the CityGML LoD 1-4 system, and this review does not treat the three systems as directly convertible (see Section 3.4).

Geometric Level of Detail (geometric LoD) refers to the degree of geometric definition of a modelled element, most commonly expressed through the AIA/BIMForum LoD 100-400 scale for building elements or the CityGML LoD 1-4 scale for 3D city and landscape objects. These two systems classify different things (BIMForum LoD reflects the development and reliability of an authored model element; CityGML LoD reflects spatial and geometric resolution across scales of representation) and are treated separately in this review.

Level of Information refers to the non-geometric attribute data (material, species, condition, maintenance history, and similar properties) attached to a modelled element, independent of its geometric resolution.

Sustainability support refers to a software function’s capacity to generate, store, or export data that can inform a sustainability assessment or decision, such as solar exposure, stormwater behaviour, or carbon accounting. It does not imply that using the function achieves a sustainability outcome.

Smart design policy, for the purposes of this review, refers to the standards, procurement requirements, and governance decisions that determine how digital design and ecological information is created, exchanged, assessed, and maintained across a project’s life cycle and across the public and private organisations involved in it.

SDG alignment, as used in this review, refers to a documented or inferable link between a software capability and a measurable landscape task that is relevant to a specific SDG target or indicator. It does not imply that the capability, by itself, achieves the SDG.

This review avoids the term “intelligence gap” except where it is explicitly defined, because the term was used without an operational definition in earlier drafts of this study and was identified by reviewers as insufficiently precise. Where the concept is needed, this review instead specifies which of the four ecological-intelligence components (geometric representation, attribute storage, temporal change, ecological process modelling) is present, limited, or absent, and on what evidence.

### 1.3 Smart Design Policy Relevance

The distinction between what a BIM authoring tool documents and what a living landscape system requires is not only a technical question. It bears directly on how digital design standards, procurement requirements, and information-exchange protocols are written. Public and institutional clients increasingly require BIM execution plans, common data environments, and structured information exchange as a condition of project delivery; where these requirements are written with building elements in mind, they may not specify how ecological, temporal, or performance data for landscape elements should be created, exchanged, or maintained. This matters for climate adaptation and biodiversity reporting, where public bodies increasingly need auditable digital records of vegetation, carbon storage, and stormwater performance over time, and for long-term asset management, where landscape elements change in ways that building elements generally do not. A structured account of what a mainstream authoring tool such as Revit can document natively, what it can document through extensions or add-ins, and what requires an external tool entirely, is directly relevant to how future information-exchange standards, procurement documents, and landscape BIM execution plans should be written.

### 1.4 Research Gap

Six specific gaps motivate this review. First, existing assessments of Revit's landscape capability are fragmented across individual case studies and are rarely synthesised into a single cross-study comparison (Borkowski et al., 2023; Hagras et al., 2025). Second, the LIM frameworks proposed to date (for example, Zajíčková & Achten, 2013; Trisyanti et al., 2019; Shu et al., 2022; Chen et al., 2025) have not been compared with each other in terms of scope, method, or validation status, which makes it difficult to establish what a new synthesis can add. Third, no existing synthesis brings geometric, temporal, ecological, and interoperability evidence about Revit together within one transparent coding structure. Fourth, the relationship between BIMForum LoD, CityGML LoD, and any proposed temporal representation of landscape change has not been clarified conceptually, and prior work (including an earlier version of this study) has at times treated the three as interchangeable. Fifth, the literature connecting LIM software capability to measurable sustainability-support functions remains largely descriptive rather than analytically structured around specific SDG targets and indicators. Sixth, it is not consistently clear, across the reviewed literature, which Revit-based landscape functions are native to the software, which depend on Autodesk extensions or third-party add-ins, and which require an entirely external tool; this distinction matters for anyone deciding how to resource a landscape BIM workflow.

### 1.5 Aim, Objectives, and Research Questions

The aim of this study is to critically review and synthesise peer-reviewed and conference literature to assess the documented capacity of Autodesk Revit as a platform for landscape information modelling, and to identify where the evidence is strong, where it is limited, and where it is absent. The review has four objectives: (1) to synthesise documented evidence of Revit's landscape modelling functions across terrain, vegetation, hydrology, and infrastructure; (2) to develop a literature-derived, evidence-classified account of achievable representation levels for landscape components in Revit; (3) to identify gaps between Revit's documented performance and LIM's information requirements as described in the literature; and (4) to propose a conceptual hybrid workflow, derived from the reviewed literature, for future empirical testing.

The review is guided by five research questions:

RQ1. What landscape modelling functions of Revit are documented in peer-reviewed and conference literature, and which are native, extension-based, or dependent on external tools?

RQ2. How does the literature describe the geometric, informational, and temporal representation of key landscape components in Revit-based workflows?

RQ3. Which ecological processes and indicators are not supported natively by Revit, according to the reviewed evidence?

RQ4. Which complementary tools and data exchanges are proposed in the literature to extend Revit-based workflows toward LIM?

RQ5. What policy, standardisation, and research implications follow from these findings?

### 1.6 Contribution and Paper Structure

This review's contribution is not that Revit has limitations; that observation appears throughout the literature already cited above. The contribution is in bringing fragmented, single-study evidence about Revit's landscape capability into one structured, evidence-classified comparison; in separating geometric and documentation capacity from temporal and ecological intelligence using an explicit, defined vocabulary; in clarifying the conceptual difference between building-oriented Levels of Detail and the temporal information needs of living landscape systems; in identifying which conclusions are well supported across multiple independent sources and which remain single-study or absent from the literature; in linking these findings explicitly to smart design policy, information-exchange standards, and future tool development; and in providing a transparent, literature-derived basis for future empirical testing rather than claiming that such testing has already occurred. Section

2 sets out the review method. Section 3 reports the results by landscape component, representation dimension, and evidence strength. Section 4 discusses the findings, compares them with existing LIM frameworks, and sets out policy implications and a conceptual hybrid workflow. Section 5 concludes and proposes future research.

## 2. Materials and Methods

### 2.1 Review Design

This study is a structured literature review. Its reporting structure was informed by PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses). Stage-by-stage record counts (identification, screening, eligibility, and inclusion; see Section 2.5) are reported in full, recovered from the authors' original review records. Full PRISMA compliance is nonetheless not claimed, because a registered review protocol and a complete, database-by-database account of exclusion reasons at every stage are not available, so this review is described as PRISMA-informed rather than PRISMA-compliant.

### 2.2 Review Scope and Eligibility

The review covers peer-reviewed journal articles and peer-reviewed conference papers published between 2013 and 2026, in English, addressing BIM, LIM, or Revit specifically in relation to landscape architecture, site design, ecological modelling, or digital representation of environmental systems. Studies addressing Level of Detail, vegetation modelling, plant growth simulation, or ecological performance measurement outside a BIM context were also included where they provided a basis for comparison with Revit's documented capability. Conceptual and theoretical papers were included where they contributed to defining LIM requirements. Non-peer-reviewed sources, preprints, theses, and vendor training materials were excluded, as were sources addressing BIM in architecture or structural engineering only, with no landscape relevance. Grey literature was not systematically searched; where a grey-literature source appeared during supplementary searching, it was excluded unless no peer-reviewed equivalent existed.

### 2.3 Information Sources

Formal database searching was conducted in Scopus, Web of Science, ScienceDirect, and SpringerLink. SpringerLink is a publisher platform rather than a citation index and is described as such here; it was searched directly because a meaningful share of the LIM literature is published in Springer-affiliated venues. Of the 29 included studies, Scopus indexed 22 (14 journal articles, 8 conference papers), Web of Science indexed 16 (12 journal articles, 4 conference papers), SpringerLink indexed 3 (2 journal articles, 1 conference paper), and ScienceDirect indexed 2 (2 journal articles). Google Scholar was used as a supplementary discovery source; it indexed all 29 included studies (18 journal articles, 11 conference papers). ResearchGate was used only as a supplementary retrieval source, to obtain author-hosted copies of studies already identified through formal database or Google Scholar searching; it indexed 28 of the 29 included studies (17 journal articles, 11 conference papers). That Google Scholar and ResearchGate index nearly all of the included studies, rather than contributing a distinct subset of their own, supports treating them as broad-coverage discovery and retrieval tools rather than as independent databases on the same footing as Scopus, Web of Science, ScienceDirect, and SpringerLink.

### 2.4 Search Strategy

The phrases that were combined with the search terms used Boolean AND/OR operators to search in the title, abstract, and keyword fields where the database supports them: Landscape Information Modelling, LIM Revit, BIM landscape, Revit landscape, Level of Detail landscape, ecological modelling BIM, plant growth simulation 3D, plants information modelling, vegetation information modelling, tree LoD 3D modelling, and sustainable landscape BIM SDG. Publications 2013-2026 were searched. The master search vocabulary is the listed terms, and the syntax was modified to fit the field and the type of boolean operators included for each platform. Owing to the non-saved search history per platform in the source documents, exact query strings and run dates cannot be reconstructed and are reported as a limitation of reproducibility.

**2.5 Screening and Study Selection**

A total of 100 records have been found in the six sources mentioned in section 2.3. On the 'Title/Abstract' screen, 36 unique records were remaining after removal of the duplicates and irrelevant records for landscape modelling in LIM/Revit. After screening for the eligibility criteria in Section 2.2, this was reduced to 33 records, which proceeded to full-text assessment. One record was removed at full-text level because it was not peer-reviewed, one because it was not relevant to the subject, and two because they were practitioner handouts from Autodesk University. As with this section, the Abstract, the Results (Section 3.1), and the Conclusion, the same 29 studies (18 journal articles, 11 conference papers) were included in the final set. Eligibility was determined and followed by the screening and full-text assessment according to the predefined eligibility criteria. Records were re-evaluated using those criteria before deciding whether to include them; no information regarding statistics of agreement between reviewers is available and is not claimed.

**2.6 Quality Assessment**

A lightweight quality consideration was applied at the inclusion stage rather than as a separate scoring step: peer-review status was used as a filter for inclusion (Section 2.2), and each included study was read for whether it stated a clear aim, described its method or software workflow with enough detail to be checked, and reported its own limitations. This consideration informed how much weight a given study's claims were given during synthesis (Section 3), but it was not converted into a numerical quality score, and it did not itself determine inclusion or exclusion beyond the peer-review filter already described. A more formal, criterion-based quality appraisal (for example, using a published checklist and reporting individual scores per study) was not carried out and is identified as a limitation in Section 2.11.

**2.7 Data Extraction and Coding**

Each study included was coded on a pre-established set of fields: bibliographic information; type of study (empirical case study, conceptual/framework paper, or review); software or platform examined; examined landscape or landscape component(s); reported geometric representation; reported attribute data; reported temporal capacity; reported ecological variables; reported interoperability or data-exchange approach; limitations stated by the own authors of the study; validation method used by the study, if applicable; and functions described that are relevant to SDGs. Mostly deductive coding, with categories of the field list above refined inductively when a study reported a field that was not initially in the list (e.g. COBie-based maintenance data handover, which was added as an interoperability sub-category in the coding process). All coding was performed using a common template. Inter-coder reliability information (e.g., Cohen's kappa) was not calculated and the synthesis is therefore not independently reliability-tested content analysis. If a field was not filled in from a study (e.g., a study did not report about validation), this was noted as "not reported" and not considered as evidence of absence of the capability.

**2.8 Evaluation Dimensions**

Five dimensions structure the synthesis in Section 3: geometric modelling, data integration, ecological intelligence, interoperability, and sustainability support. These are described here as a review-based analytical structure rather than a validated instrument. Geometric modelling and data integration correspond broadly to the representational and documentation functions long associated with BIM authoring tools generally, and with Revit specifically, in the reviewed literature (Warpas et al., 2026; Borkowski & Wyszomirski, 2021a). Ecological intelligence draws on the four-component definition set out in Section 1.2 and is informed most directly by the plant-growth and ecological-indicator literature (Chen et al., 2025; Shu et al., 2022; Zajíčková & Achten, 2013). Interoperability draws on the data-exchange and cross-platform literature (Shu et al., 2022; Borkowski et al., 2023). Sustainability support draws on the SDG-linked landscape literature reviewed in Section 3.7. Each dimension is coded descriptively per study, using the evidence classification set out in Section 2.9, rather than scored numerically; where a study provides no information relevant to a dimension, this is recorded as "not documented in the reviewed studies," not as evidence of absence.

### 2.9 Evidence Classification

Earlier drafts of this review used radar charts, a capability matrix with numerical scores, and a colour-graded SDG heat map to summarise findings. These visualisations implied a level of measurement precision that the underlying evidence, drawn from qualitative descriptions in the reviewed studies rather than from a standardised test, does not support, and reviewers correctly identified that no coding protocol, weighting method, or inter-coder reliability check was reported for these figures. This review therefore replaces numerical scoring with a six-category evidence classification, applied per landscape component and per evaluation dimension:

Documented native support: the capability is reported as available in Revit without an add-in or extension, by at least one reviewed study.

Documented support through add-in or extension: the capability is reported as available through an Autodesk-published extension (for example, the Environment for Revit plugin) or a third-party add-in.

Documented support through external workflow: the capability is reported as achievable only by exporting data to, or otherwise combining Revit with, a separate platform (for example, Civil 3D, GIS, or an ecological simulation tool).

Limited evidence: the capability is mentioned in only one reviewed study, or is described in general terms without a specific example.

Conflicting evidence: reviewed studies disagree about whether or to what extent the capability is available.

Not documented in the reviewed studies: no reviewed study addresses the capability; this is not treated as proof that Revit cannot do it, only that the literature identified for this review does not document it. Each classification in Section 3 is reported together with the number of supporting studies and a brief note of the strength of that evidence (single study, multiple independent studies, or conflicting studies).

### 2.10 SDG Mapping Method

This review does not treat a software capability as achieving an SDG. Each SDG-relevant finding in Section 3.7 is instead reported as a chain: (1) a specific software capability documented in the literature; (2) the landscape task that capability supports; (3) a measurable environmental or planning function that task contributes to; and (4) the SDG target or indicator that function is relevant to, cited to the specific reviewed study that established the link. Each link is then classified as direct support (the capability itself produces data usable for the SDG-relevant function), indirect support (the capability supports a task that in turn requires further processing to become SDG-relevant), potential support (a plausible link is described in the literature but not demonstrated), or insufficient evidence (no reviewed study establishes the link). This chain is used to keep the analysis focused on support for design and information functions related to the SDGs, not on claims of SDG achievement.

### 2.11 Bias and Limitations

This review is prone to a number of types of bias typical of literature-based synthesis. Publication bias should be expected – studies that are successful with their use of LIM concepts are likely to be published in the literature, while those that are unsuccessful or abandoned are not likely to be published. Bias in language is present as only English language sources were reviewed. Coverage varies by publisher and region, and database bias is still possible despite a coverage of four databases, each of which indexed between 2 and 22 of the 29 studies included (see Section 2.3). Citation bias is also possible when influential early papers (e.g., Zajíčková & Achten, 2013) have received repeated citations by later studies, which can lead to the latter studies' citations being more selective of the framing of the former studies. Reviewers and coding records are not retained so agreement cannot be calculated and there is a potential for selection and interpretation bias. The review is based on secondary evidence, that is, the evidence included reports the findings of other studies, but does not test Revit itself, and the results may not represent the latest versions of Revit software if the studies included are based on an earlier version. Not all of the studies included report the method used to validate their test, and some do not explicitly specify the method; this makes it difficult to make comparisons with the other studies with confidence.

### 2.12 Methodology Diagram

The overall review process is summarised in figure 1, from identification and screening through evidence classification, LoD mapping, SDG-support interpretation and synthesis of the conceptually hybrid process.

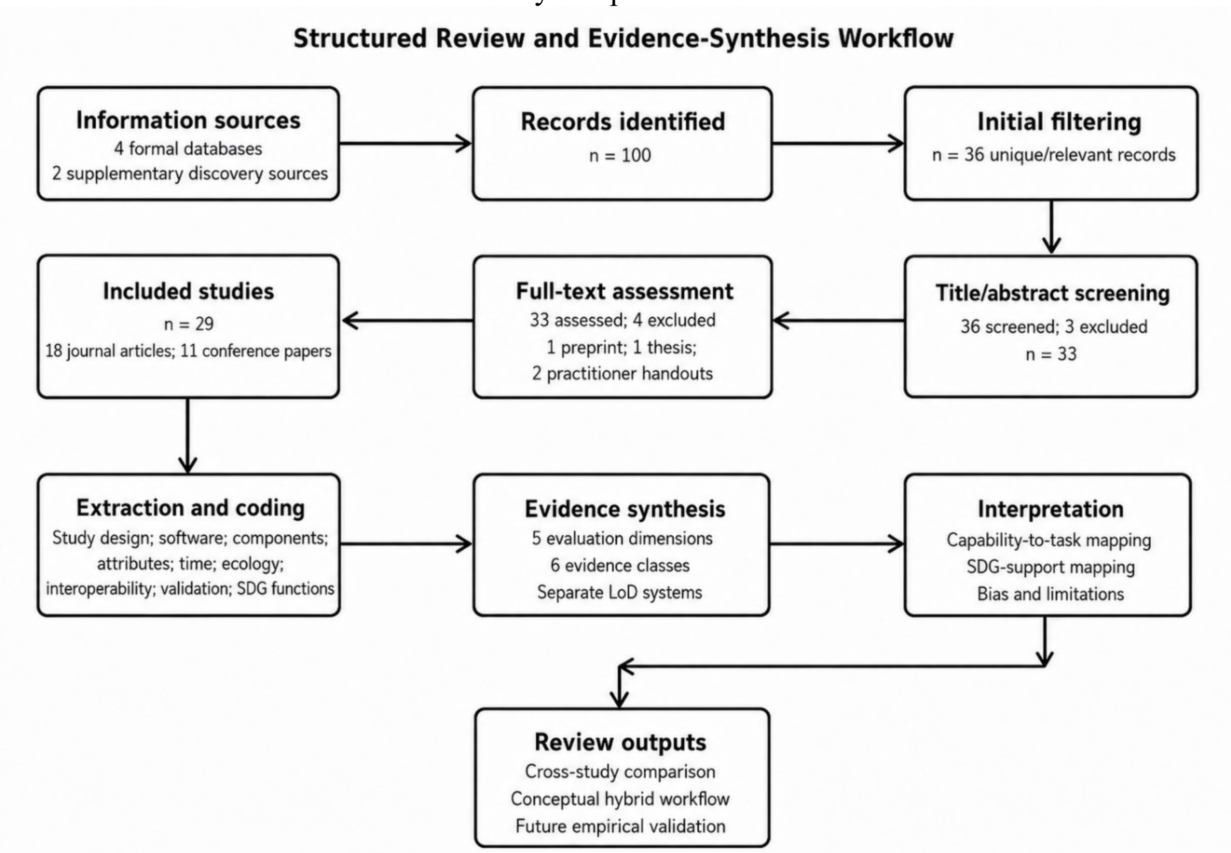


**Figure 1.** Structured review and evidence-synthesis workflow. Source: Developed by the authors from the verified study-selection counts and review protocol.

## 3. Results

### 3.1 Characteristics of Included Studies

The studies included (n = 29) range in year from 2013 to 2026, and consist of 18 peer-reviewed journal articles and 11 peer-reviewed conference papers. The proportion of formally indexed studies in the databases are reported in Section 2.3: Scopus had the highest coverage (22 out of 29), Web of Science (16), SpringerLink (3), and ScienceDirect (2); they were used as supplementary sources and accounted for almost all of the included studies (29 and 28 respectively). Geographic focus was not reported in a manner that matched the other sources to support a reliable geographic distribution and is therefore not quantified and treated as a reporting limitation. The studies cover a wide variety of landscape topics (terrain and grading, vegetation and plant-growth modelling, hardscape and infrastructure, hydrology, and heritage and cultural landscapes), and a variety of software, including Revit, Civil 3D, GIS software, CityGML based pipelines, and dedicated ecological-simulation software like Blender with The Grove and ENVI-met. If reported, validation methods are based on comparison with the LiDAR point cloud, field measurement or, for the most part of the conceptual papers, none at all.

### 3.2 Revit's Documented Landscape Modelling Functions

The reviewed literature distinguishes three levels of Revit-based capability. Native functions are reported for terrain modelling using the Toposolid tool, for creating solid terrain geometry from laser-scanned point cloud data (Warpas et al., 2026), and for parametric family creation used to represent hardscape, infrastructure, and vegetation as static geometric objects. Extension- or add-in-based functions are reported using the Environment for Revit plugin for elevation and slope analysis (Borkowski & Łuczkiewicz, 2023), Dynamo for construction-management scripting workflows built on Revit's native parametric model (Chen et al., 2019; Zhao et al., 2022; Picuno et al., 2022; Borkowski et al., 2023; Warpas et al., 2026), and custom parametric families such as PlantingSMART for more detailed vegetation representation than Revit's default plant families allow (Luka & Guo, 2021). External-workflow functions, requiring a separate platform entirely, are reported for scan-to-BIM terrain import from photogrammetric point clouds (Cianci & Molinari, 2019), for higher-resolution terrain modelling using Civil 3D once LoD 350 or above is required (Fritsch et al., 2019; Borkowski et al., 2023), and for all ecological process modelling reported in the literature reviewed here (Section 3.5).

### 3.3 Landscape Components

Terrain and grading. Revit's Toposolid tool is reported as capable of producing detailed terrain geometry from laser-scanned or photogrammetric point cloud data, reaching a documented geometric LoD of approximately 300 (Warpas et al., 2026; Cianci & Molinari, 2019). A recurring limitation, reported independently in two studies, is the absence of break-line import for representing sharp changes in terrain, which limits achievable precision without Civil 3D (Fritsch et al., 2019; Borkowski et al., 2023). Evidence classification: documented native support for general terrain modelling; documented support through external workflow for break-line-accurate grading.

Vegetation. Revit's plant families provide static geometric representation of trees and other vegetation but do not natively store age, root structure, phenology, or growth-stage data (Fritsch et al., 2019; Saputra et al., 2024). Custom parametric families such as PlantingSMART add further attribute detail but remain static objects rather than models capable of representing growth or environmental interaction (Luka & Guo, 2021; Trisyanti et al., 2019). Dynamic, multi-stage growth simulation of vegetation, including allometric growth modelling, phototropism, and inter-tree competition, is documented in the literature using tools entirely outside Revit, most notably a Blender/The Grove/Houdini/ENVI-met workflow applied to a large urban park case study (Chen et al., 2025). No reviewed study reports a completed Revit-native or Revit-add-in workflow reaching what this review defines as temporal LoD 2 or above (Section 1.2). Evidence classification: documented native support for static geometric representation; not documented in the reviewed studies for dynamic growth simulation within Revit itself.

Soil, hydrology, and stormwater. The reviewed literature identifies a consistent absence of native stormwater or drainage simulation in Revit, with hydrological and pedological characteristics identified as primary LIM input data that current BIM tools generally do not capture (Hagras et al., 2025). Where hydrological or microclimate analysis is reported, it is achieved through external tools such as SWMM, GIS extensions, Grasshopper-based workflows, or ENVI-met (Carvalho et al., 2020, 2023; Chen et al., 2025). Evidence classification: not documented in the reviewed studies for native Revit hydrological simulation; documented support through external workflow where reported.

Hardscape and infrastructure. This is where the reviewed literature reports Revit's strongest documented LIM-relevant capability. Studies report Revit hardscape and infrastructure families reaching a documented geometric LoD of 350-400, together with COBie-based maintenance-data handover generated from within the model (Chen et al., 2019; Zhao et al., 2022; Picuno et al., 2022; Borkowski et al., 2023; Warpas et al., 2026). A reported limitation is that inclined elements and non-planar retaining walls require Generic Model workarounds rather than dedicated landscape-object families, reflecting the absence of landscape-specific BIM schemas comparable to OmniClass or IFC classes for building elements (Abdirad & Lin, 2015; Emara, 2021). Evidence classification: documented native support, with documented support through add-in (Dynamo) for enhanced scheduling and maintenance-data workflows.

Ecological indicators (LAI, LAD, biomass, carbon). No reviewed study reports native Revit generation of leaf area index, leaf area density, biomass, or carbon-storage indicators. Where these indicators are reported, they are calculated from 3D vegetation models built and simulated entirely outside Revit (Chen et al., 2025), with related but less developed sub-canopy indicators (sap flow, root extent, decay parameters) reported by a dedicated Tree Information Modelling platform (Shu et al., 2022). Evidence classification: not documented in the reviewed studies for native or add-in-based generation within Revit; documented support through external workflow only.

### 3.4 Geometric, Informational, and Temporal Representation

Three distinct classification systems appear in the reviewed literature and are kept separate in this review, consistent with the correction requested by both reviewers of an earlier draft. BIMForum LoD (100-400) describes the development and reliability of an authored building or landscape element within a BIM model; it is the system most consistently applied to Revit-based hardscape, infrastructure, and terrain elements in the reviewed studies (Warpas et al., 2026; Borkowski & Łuczkiewicz, 2023). CityGML LoD (1-4) describes spatial and geometric resolution of 3D city and landscape objects independent of any specific authoring software, and is applied in the reviewed literature to campus-scale tree inventories built through a photogrammetry-to-CityGML pipeline entirely outside Revit (Trisyanti et al., 2019). Temporal representation, defined in Section 1.2 as temporal LoD 1-3, describes change over time and is not part of either the BIMForum or CityGML systems; it is applied in the reviewed literature to a dynamic vegetation-growth model built outside Revit (Chen et al., 2025). No reviewed study proposes or validates a formal conversion rule between these three systems. Where this review presents them together in the same table (Table 2), the juxtaposition is explicitly conceptual and intended to compare what each system was built to measure, not to imply that a value on one scale corresponds to a specific value on another.

**Table 1:** Evidence-Based Capability Matrix for Landscape Elements in Autodesk Revit (synthesised from the 29 reviewed studies; see Section 2.9 for the evidence classification system)

| Landscape Element | Geometric Representation | Evidence Classification | Supporting Studies (n) | Key Limitation Reported | Tool(s) Required Beyond Revit |
|---|---|---|---|---|---|
| **Terrain / grading** | Up to BIMForum LoD ~300 | Documented native support (general); documented support through external workflow (break-line precision) | 3 | No native break-line import; Toposolid imprecision on complex grading | Civil 3D; Environment for Revit plugin |
| **Vegetation - trees (static)** | Up to BIMForum LoD ~200 (geometry only) | Documented native support (static geometry only) | 4 | No age, root, phenology, or growth data | Custom parametric families; external growth-simulation tools |
| **Vegetation - dynamic growth** | Not applicable in native Revit object model | Not documented in the reviewed studies (within Revit) | 1 (outside Revit) | No reviewed study reports Revit-based growth simulation | Blender + The Grove plugin; ENVI-met |
| **Vegetation - shrubs/groundcover** | Minimal | Limited evidence | 2 | Minimal species data; ecological attributes largely absent | Dedicated planting-design or CityGML platforms |
| **Hardscape (paths, paving)** | Up to BIMForum LoD ~400 | Documented native support | 3 | Inclined elements require generic-family workarounds | Floor/generic model families |
| **Infrastructure (walls, furniture)** | Up to BIMForum LoD ~400 | Documented native support; documented support through add-in (Dynamo) | 4 | Non-planar retaining walls require generic-model workarounds | Generic model families; schedules |
| **Hydrology / water features** | Limited | Not documented in the reviewed studies (native); documented support through external workflow | 2 | No native stormwater or drainage simulation | GIS; Grasshopper; SWMM; ENVI-met |
| **Ecological indicators (LAI, LAD, biomass, carbon)** | Not applicable | Not documented in the reviewed studies (within Revit) | 1 (outside Revit) | Indicator calculation requires 3D growth simulation not present in Revit | Blender/The Grove + Houdini + ENVI-met; external ecological databases |

**Table 2:** Conceptual Comparison of Geometric, CityGML, and Temporal Representation Approaches Across Four Sources (this comparison is explicitly conceptual; no formal conversion rule is proposed between the three systems)

| Dimension | Trisyanti et al. (2019): CityGML / SketchUp | Chen et al. (2025): Blender / The Grove | Shu et al. (2022): TIM Framework | Revit Native / PlantingSMART (Luka & Guo, 2021) |
|---|---|---|---|---|
| **Classification system used** | CityGML LoD 1-3 achieved; LoD 4 conceptual | Temporal LoD 1-3 (this review's terminology); not a formal published scale | Framework-specific LoD 1-3 | BIMForum-style: native approx. LoD 1-2; custom parametric approx. LoD 2 |
| **Geometry** | Semantic 3D tree objects from UAV survey | Branch, twig, and leaf models for 65 species, allometrically constrained | Voxel canopy; isodensity root-layer modelling | Approximate crown shape; no branch/leaf detail |
| **Growth dynamics** | Static inventory; no growth simulation | Dynamic: phototropism, competition, obstacle response, allometric growth equations | Partial: sap flow and decay modelling | None: static families only |
| **Ecological indicators reported** | Height, crown diameter, trunk diameter, species | LAI, LAD, aboveground biomass, carbon storage, calculated from 3D geometry | Sap flow, root extent, decay parameters | None in native Revit |
| **Microclimate output** | Shadow analysis only | ENVI-met microclimate simulation across growth stages | Not addressed | Sun/shade analysis only (Revit Insight) |
| **Scale reported** | 47 ha; approx. 3,050 trees | Approx. 50.67 ha; approx. 21,685 trees, 65 species | Individual tree / urban inventory scale | Individual project scale |
| **Validation reported** | Compared against LiDAR point clouds | Compared against LiDAR point clouds and field measurement reported by the source study; exact accuracy values were not used in this review | Conceptual framework; not empirically validated in the reviewed publication | No independent accuracy validation reported |
| **Revit used?** | No (SketchUp / FME / CityGML pipeline) | No (Blender, The Grove, Houdini, ENVI-met, CloudCompare) | No (dedicated TIM platform) | Yes |

### 3.5 Ecological Information and Process Modelling

Ecological information in the reviewed literature comes from several distinct strands of work, not from a single study. Zajíčková and Achten (2013) and Zajíčková and Achten (2013) established the conceptual case for treating plants as first-class LIM components requiring dedicated attribute sets, rather than as static geometric objects, and their work underlies the definitions used throughout this review. Trisyanti et al. (2019) demonstrated a production-scale, CityGML-based semantic tree inventory built from UAV photogrammetry, validated against LiDAR, but without any growth or temporal dimension. Shu et al. (2022) proposed a dedicated Tree Information Modelling platform addressing sap flow, root extent, and decay, filling a below-ground and physiological gap that neither the CityGML nor the Revit-native approaches address, while explicitly describing their own framework as conceptual rather than production-validated. Chen et al. (2025) extended this line of work substantially by combining a parametric 3D growth simulation (Blender, The Grove) with a microclimate model (ENVI-met) at the scale of a full urban park, extracting LAI, LAD, biomass, and carbon-storage indicators directly from the simulated 3D geometry and validating canopy geometry against LiDAR point clouds. Carvalho et al. (2020, 2023) and Haddadian and Haghighatbin (2021) contribute a complementary, workflow-level strand, applying Grasshopper-based nature-based-solution optimisation and urban-metabolism concepts to LIM rather than growth simulation specifically. Read together, these strands show that ecological process modelling for landscape systems is an active area of research, but one that is currently distributed across several platforms and research groups rather than consolidated in any single tool, BIM-based or otherwise.

Chen et al. (2025) is the most methodologically detailed source available on dynamic vegetation-growth simulation and is treated in this review as a relevant ecological-modelling benchmark conducted entirely outside a Revit-centred BIM workflow. It is cited here for what it demonstrates is achievable in principle for park-scale ecological modelling, not as a description of, or a substitute for, Revit's own documented capability, and it is not treated as the sole basis for this review's conclusions about ecological intelligence; see the synthesis above for the other contributing sources. Reported limitations of the Chen et al. (2025) workflow, including the absence of below-ground root and carbon modelling, the absence of shrub, groundcover, and seasonal-phenology representation, and reduced accuracy for structurally complex mixed-canopy areas, are also treated in this review as open research questions for LIM generally, not only as limitations of one study.

### 3.6 Evidence-Based Capability Matrix

**Table 3:** Evidence-Based Capability Summary Across Five Evaluation Dimensions

| Evaluation Dimension | Evidence Classification | Supporting Studies (n) | SDG Relevance (see Section 3.7 for the evidence chain) |
|---|---|---|---|
| **Geometric modelling** | Documented native support (terrain, hardscape, infrastructure) | 5 | SDG 9, SDG 11 |
| **Data integration** | Documented native support with documented support through add-in (COBie, schedules, Dynamo) | 4 | SDG 9, SDG 11 |
| **Ecological intelligence (including growth simulation)** | Not documented in the reviewed studies (within Revit); documented support through external workflow only | 3 (all outside Revit) | SDG 13, SDG 15 |
| **Interoperability** | Documented support through external workflow (IFC export, Civil 3D exchange); limited evidence for GIS/simulation-tool round-tripping | 3 | SDG 9 |
| **Sustainability support** | Limited evidence (sun/shade and basic 6D functions via plugins); not documented in the reviewed studies for full lifecycle ecological assessment including carbon quantification | 2 | SDG 11, SDG 13, SDG 15 |

The category labels replace the "critical/high/moderate" gap-severity labels used in an earlier draft of this review, which reviewers correctly identified as lacking a stated threshold or scoring rule. The evidence classification above is descriptive, not scored, and each row's classification can be traced to the specific studies cited in Sections 3.2-3.5.

### 3.7 Sustainability and SDG Support

Applying the evidence chain set out in Section 2.10: for SDG 9 (industry, innovation, and infrastructure), Revit's documented BIM coordination functions (Section 3.2, 3.3) provide direct support for the specific task of coordinated infrastructure documentation and data handover, a function several reviewed studies link explicitly to industry digitalisation goals (Warpas et al., 2026; Borkowski et al., 2023). For SDG 11 (sustainable cities and communities), Revit's terrain and infrastructure documentation functions provide indirect support, since they inform, but do not themselves constitute, sustainable urban design decisions; direct support for specific microclimate-informed design decisions is reported only for the external ENVI-met-based workflow (Chen et al., 2025). For SDG 13 (climate action), no reviewed study reports Revit generating carbon-storage or growth-related climate data natively; the only reviewed source reporting such data is the external Blender/ENVI-met workflow, which this review classifies as potential support for a hybrid Revit-centred workflow (Section 4.6) and insufficient evidence for Revit alone. For SDG 15 (life on land), the same pattern holds: LAI and LAD data relevant to canopy-structure-based biodiversity assessment are reported only through the external workflow, classified here as potential support for a hybrid workflow and insufficient evidence for native Revit capability. Across all four SDGs, this review's evidence chain distinguishes capabilities that generate SDG-relevant data directly from capabilities that would require an external tool to do so; only the former are classified as direct support.

## 4. Discussion

### 4.1 Revit as a Documentation and Coordination Platform

The reviewed evidence is consistent in describing Revit as an effective BIM-based coordination and documentation platform for several landscape components. Terrain modelling at approximately BIMForum LoD 300, hardscape and infrastructure documentation at approximately LoD 350-400, COBie-format data export, and multi-dimensional (up to 7D) lifecycle documentation are each reported by more than one independent study (Warpas et al., 2026; Zhao et al., 2022; Picuno et al., 2022; Borkowski & Łuczkiewicz, 2023). These functions correspond closely to what BIM authoring tools were designed to do: coordinate static, geometrically stable, manufactured or constructed elements across disciplines. Within that scope, the reviewed evidence does not support a claim that Revit performs poorly; it performs largely as a mainstream BIM tool is expected to perform.

### 4.2 Limits of Revit's Native Object Model

The reviewed evidence is equally consistent, across independent sources rather than a single study, that Revit's native object model does not represent temporal vegetation change, growth dynamics, or the ecological indicators (LAI, LAD, biomass, carbon storage) that living-system LIM applications require (Section 3.3, 3.5). This limitation is best understood as arising from at least three distinguishable sources rather than one. First, Revit's parametric family model was built to represent static, manufactured objects, which is a structural characteristic of the software's object model rather than a documentation gap that could be closed by better use of existing tools. Second, some limitations arise from the absence of landscape-specific data standards and schemas, such as dedicated IFC classes or OmniClass categories for landscape elements (Abdirad & Lin, 2015; Emara, 2021), which is a standards and interoperability limitation rather than a limitation of Revit's geometry engine specifically. Third, some apparent limitations may simply reflect the state of the published literature rather than a demonstrated software limitation; because no reviewed study reports a completed attempt at, for example, Revit-native root-system modelling, this review cannot distinguish between "not possible" and "not yet attempted or not yet published." This distinction matters for how confidently a reader should treat each finding in Table 1 and Table 3, and it is why this review avoids describing any of these limitations as a proven, structural incompatibility.

### 4.3 Living Systems Require Temporal and Ecological Information Beyond Geometric Detail

The conceptual foundations set out in Section 1.2 are directly relevant here. A landscape element modelled at a high geometric LoD (for example, a hardscape path at LoD 400) is fully and reliably documented for construction and coordination purposes. A tree modelled at the same nominal LoD is not comparably documented, because its relevant information, growth stage, root development, seasonal condition, and ecological function, is temporal and process-based rather than purely geometric. The reviewed literature's clearest illustration of this distinction is the contrast between Trisyanti et al. (2019), whose CityGML-based tree inventory is geometrically and semantically detailed but entirely static, and Chen et al. (2025), whose Revit-independent growth simulation is geometrically simpler at any single time step but captures the temporal and ecological dimension that a static inventory, however detailed, cannot. Existing LoD frameworks, including BIMForum LoD and CityGML LoD, do not capture this split because neither was designed to describe change over time; this is the specific conceptual gap that this review's temporal LoD categories (Section 1.2) are intended to make explicit, not to resolve.

#### 4.4 Comparison with Existing LIM Frameworks

**Table 4:** Comparison of LIM-Relevant Frameworks and Studies with the Present Review.

| Study / Framework | Main Purpose | Landscape Components | Temporal Capacity | Ecological Indicators | LoD Approach | Software Focus | Validation Method | Difference from Present Review |
|---|---|---|---|---|---|---|---|---|
| **Zajíčková & Achten (2013); Zahrádková & Achten (2015)** | Conceptual definition of LIM and required components | Plants as primary focus | Not addressed | Conceptual identification of required indicator types | Not proposed | Software-agnostic | Conceptual; not empirically tested | Present review builds on these definitions but adds an evidence-classified, multi-study synthesis rather than a conceptual proposal |
| **Trisyanti et al. (2019)** | Production-scale 3D tree inventory from UAV survey | Trees (individual and inventory scale) | Static (single time point) | Height, crown diameter, trunk diameter, species | CityGML LoD 1-3 | SketchUp / FME / CityGML pipeline (not Revit) | Validated against LiDAR point clouds | Present review treats this as one of several evidence sources rather than the primary benchmark, and does not adopt CityGML LoD as equivalent to BIMForum or temporal LoD |
| **Shu et al. (2022)** | Dedicated Tree Information Modelling data- | Individual trees, below-ground focus | Partial (sap flow, decay modelling) | Sap flow, root extent, decay parameters | Framework-specific | Dedicated TIM platform (not Revit) | Conceptual framework; not empirically validated | Present review treats this as evidence of a distinct, complementary research strand rather than folding it into a single combined score |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | exchange platform | | | | | | | |
| **Chen et al. (2025)** | Park-scale parametric growth simulation and ecological indicator extraction | Trees at urban park scale | Dynamic, three growth stages (temporal LoD 3 in this review's terms) | LAI, LAD, biomass, carbon storage | Not a formal LoD scale; growth-stage based | Blender / The Grove / Houdini / ENVI-met (not Revit) | Validated against LiDAR and field measurement | Present review treats this as one benchmark among several, corrects an earlier draft's overreliance on it, and does not treat it as defining LIM requirements for the field as a whole |
| **Borkowski & Wyszomirski (2021a, 2021b); Borkowski et al. (2023)** | BIM-GIS integration for cubature, infrastructure, and planning-scale landscape projects | Terrain, infrastructure, planning-scale landscape | Static | Not a primary focus | BIMForum-style, applied to Revit-GIS workflows | Revit combined with GIS | Case-study based | Present review incorporates these findings within the terrain/infrastructure/interoperability dimensions rather than as a separate framework |
| **Present review** | Structured, evidence-classified synthesis of Revit's documented LIM capacity across the literature | Terrain, vegetation, hardscape, infrastructure, hydrology, ecological indicators | Defined but literature-derived (temporal LoD 1-3), applied only where reported | Synthesised across multiple sources (Section 3.5), not primarily one study | BIMForum LoD, CityGML LoD, and temporal LoD kept explicitly separate | Revit-centred, with documented native/add-in/external distinctions | Literature-based; no new empirical validation performed | Distinguishing feature: cross-study evidence classification with an explicit chain of reasoning from capability to SDG relevance, and explicit separation of the three LoD systems |

The comparison shows broad agreement across the literature that geometric and documentation functions are well served by existing BIM tools, including Revit, and that ecological process modelling for vegetation is a distinct, less mature, and largely non-BIM research strand. Where the literature disagrees, or where evidence is thin, is on the question of how far a BIM-centred workflow can be extended, through add-ins, external tools, and data exchange, to incorporate ecological intelligence without abandoning BIM's coordination strengths; this is the question the conceptual hybrid workflow in Section 4.6 responds to.

### 4.5 Smart Design Policy Implications

The findings above have direct implications for smart design policy, understood as set out in Section 1.3. Information-exchange standards and BIM execution plans written primarily around building elements should specify, explicitly, how ecological, temporal, and performance data for landscape elements are to be created, exchanged, and maintained, rather than assuming that existing building-oriented LoD requirements transfer directly to vegetation and other living systems. Procurement documents for publicly funded landscape and urban-greening projects could specify which landscape data (species, growth stage, expected carbon trajectory, maintenance schedule) must be delivered in a structured, machine-readable format, independent of which specific software produces it. Long-term asset management and climate/biodiversity reporting obligations increasingly require auditable digital records of vegetation condition and performance over time; the absence of native temporal and ecological data in mainstream BIM tools means that, at present, this data is generated outside the BIM environment (Section 3.5) and needs a defined, policy-specified path back into the coordinated model if it is to remain usable for asset management. Finally, software interoperability standards (IFC extensions for landscape objects, standardised plant-attribute schemas) are identified in the reviewed literature as a precondition for closing this gap in practice, not merely a technical convenience.

### 4.6 Proposed Conceptual Hybrid Workflow

The four-stage workflow below is synthesised from the reviewed literature. It is presented as a conceptual proposal for future empirical testing, not as a validated or implemented solution; no reviewed study reports the complete four-stage sequence having been carried out as a single integrated workflow, and the "feedback loop" described at Stage 4 has not been demonstrated in practice in any source reviewed for this study.

**Table 5:** Proposed Conceptual Hybrid LIM Workflow.

| Stage | Task | Software Category | Input | Output | Exchange Format | Possible Information Loss | Supporting Source(s) | Validation Status |
|---|---|---|---|---|---|---|---|---|
| 1 | Geospatial context, ecological baseline, soil and drainage data, biodiversity inventory | GIS platform (e.g., ArcGIS, QGIS) | Site survey, remote sensing, existing GIS datasets | Georeferenced site model with baseline ecological data | Shapefile / GeoJSON / GeoPackage | Attribute schema mismatch when exporting to CAD/BIM formats | Borkowski et al. (2023); Warpas et al. (2026) | Not validated as an integrated workflow in the reviewed literature |
| 2 | Break-line-accurate terrain and grading | Civil 3D | Point cloud / survey data | Digital Terrain Model | LandXML / DWG | Loss of GIS attribute metadata not carried by LandXML | Fritsch et al. (2019); Borkowski & Łuczkiewicz (2023) | Individually validated per study for terrain accuracy; not validated as part of this combined sequence |
| 3 | BIM coordination, parametric families, scheduling, COBie handover; in parallel, external growth simulation for ecological indicators | Autodesk Revit (BIM hub) plus Blender/The Grove (external, parallel) | DTM from Stage 2; planting design; species/location data | Coordinated BIM model; separately, ecological indicator dataset (LAI, LAD, biomass, carbon) | IFC / COBie (Revit); proprietary Blender/Grove project files (external) | Geometric and ecological datasets are not natively merged; species/location identifiers must be matched manually or via a defined key | Luka & Guo (2021); Warpas et al. (2026); Chen et al. (2025) | Each component individually reported; the parallel-and-reconnect structure itself is this review's proposal and is not reported as implemented in any single reviewed study |
| 4 | Ecological performance simulation and feedback to design | Simulation tools (SWMM, ENVI-met, Revit Insight) | Ecological indicator dataset from Stage 3; stormwater and solar data | Microclimate and stormwater performance data; revised planting parameters | Tool-specific outputs, manually reintroduced to Revit parameters | Feedback into Revit is manual in every reviewed source; no automated round-trip is reported | Carvalho et al. (2020, 2023); Hagras et al. (2025); Chen et al. (2025) | Not validated as a feedback loop in any reviewed study |

Format conversion, coordinate-system alignment, object-identity persistence across tools, version control, and the licensing and skills implications of running four separate software environments are not resolved by any source reviewed here and are identified as open questions requiring dedicated empirical testing, ideally through a case study applying this workflow to a single, shared terrain, planting, hydrology, and ecological-performance dataset (see Section 5).

## 5. Conclusion

This review set out to assess, through structured literature synthesis of 29 peer-reviewed studies (18 journal articles, 11 conference papers), the documented capacity of Autodesk Revit as a platform for landscape information modelling. In answer to RQ1, the reviewed literature documents Revit landscape functions at three levels: native (terrain via Toposolid, parametric hardscape and infrastructure families), extension- or add-in-based (Environment for Revit, Dynamo, custom families such as PlantingSMART), and external-workflow-dependent (Civil 3D for high-precision grading, and all reviewed ecological process modelling). In answer to RQ2, geometric and informational representation of terrain, hardscape, and infrastructure is well documented and reaches BIMForum LoD 300-400 in multiple independent studies, while vegetation is documented only at a static geometric level, with no reviewed study reporting Revit-based temporal representation beyond this review's temporal LoD 1. In answer to RQ3, the ecological processes and indicators not documented as natively supported by Revit include dynamic growth simulation, root-system modelling, phenology, LAI, LAD, biomass, and carbon storage. In answer to RQ4, the literature reports GIS platforms, Civil 3D, Blender with The Grove, Houdini, ENVI-met, and SWMM as complementary tools used to extend Revit-based workflows toward these functions, though not as a single integrated pipeline in any reviewed study. In answer to RQ5, these findings point towards specific smart design policy needs: landscape-specific information-exchange standards, procurement requirements that specify structured ecological data delivery independent of authoring software, and interoperability standards (including landscape-specific IFC extensions) that do not yet exist in a form the reviewed literature describes as mature.

The review's academic contribution is a structured, evidence-classified synthesis that brings fragmented single-study evidence about Revit's landscape capability into one cross-study comparison; that separates geometric and documentation capacity from temporal and ecological intelligence using an explicit vocabulary; that clarifies the conceptual difference between building-oriented Levels of Detail and the temporal information needs of living landscape systems; and that identifies, transparently, which findings are supported by multiple independent sources and which rest on a single study, most notably the ecological-indicator findings, which depend heavily on Chen et al. (2025) even after this revision's efforts to broaden the synthesis (Section 3.5). This should be read as a boundary of the current evidence base, not a limitation specific to this review's method.

Within the boundaries of this review, the findings are strongest, and most consistent across independent sources, for Revit's terrain, hardscape, and infrastructure documentation capacity, and weakest, resting on a smaller and less diverse evidence base, for ecological process modelling. The degree to which these findings transfer to other BIM authoring platforms cannot be established from this review, since the reviewed literature is substantially Revit-focused; the conceptual distinctions proposed here (the three-component ecological-intelligence spectrum, the separation of BIMForum, CityGML, and temporal LoD) are offered as transferable, but the specific capability findings in Section 3 are not. The major limitations of this review were the reliance on secondary and published material for software testing findings, a limited number of studies (for several of the findings, only one study was used) for findings on ecological-intelligence, and the lack of an inter-reviewer agreement calculation due to the fact that the screening and coding records were not retained by the reviewers. What this review has done so far is to establish a conceptually feasible hybrid workflow, which should be tested empirically in a future comparative case study to test the proposed workflow, using the same terrain, planting, hydrology and ecological-performance dataset, but on Revit and at least one other BIM or landscape platform.

**Acknowledgements**

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

**Funding**

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

**Conflicts of Interest**

The authors declare no conflicts of interest.

**Data Availability Statement**

No new empirical data were generated for this literature review. The data supporting this study's synthesis are the peer-reviewed and conference publications listed in the References section.

**Institutional Review Board Statement**

Not applicable. This study is a literature review and did not involve human or animal participants.

**CRediT Author Statement**

Conceptualization: F.M.N. and W.E.S.; Methodology: F.M.N. and W.E.S.; Validation: F.M.N. and W.E.S.; Formal analysis: F.M.N. and W.E.S.; Investigation: F.M.N. and W.E.S.; Data curation: F.M.N. and W.E.S.; Visualization: F.M.N. and W.E.S.; Writing - original draft preparation: F.M.N.; Writing - review and editing: F.M.N. and W.E.S.; Supervision: F.M.N. and W.E.S.; Project administration: F.M.N. and W.E.S. Both authors contributed equally to the research and have read and approved the final version of the manuscript.

**References**

Abdirad, H., & Lin, K.-Y. (2015). Advancing in object-based landscape information modeling: Challenges and future needs. In Computing in Civil Engineering 2015 (pp. 548–555). American Society of Civil Engineers. https://doi.org/10.1061/9780784479247.068

Azzam, G. S., & Aljraki, S. M. S. (2022). Enhancing the role of BIM in the habilitation of urban parks: Multi-dimensional approach (3D-7D): Al-Sabki Park, Damascus. International Journal of Neutrosophic Science. https://doi.org/10.54216/IJNS

Borkowski, A. S., & Łuczkiewicz, N. (2023). Landscape Information Model (LIM): A case study of Ołtarzew Park, Poland. Budownictwo i Architektura, 22(2), 41-56. https://doi.org/10.35784/bud-arch.3547

Borkowski, A. S., Kochański, Ł., & Wyszomirski, M. (2023). A case study on BIM and LIM models including geospatial data. Geomatics and Environmental Engineering, 17(1), 19-35. https://doi.org/10.7494/geom.2023.17.1.19

Borkowski, A. S., & Wyszomirski, M. (2021a). Landscape information modelling: Cubature, infrastructure, and planning projects. Geomatics, Landmanagement and Landscape, 1, 7-22. https://doi.org/10.15576/GLL/2021.1.7

Borkowski, A. S., & Wyszomirski, M. (2021b). Landscape information modelling [Repository version]. Geomatics, Landmanagement and Landscape. https://doi.org/10.15576/GLL/2020.4.7

Carvalho, T. F., & Moura, N. C. B. (2025). LIM: A framework for responsive landscape design. Paranoá, 18, e57493. https://doi.org/10.18830/1679-0944

Carvalho, T. F., Moura, N. C. B., Guedes, J., Medeiros, J. V. F., Deodato, J. P., & Appleyard, M. G. C. (2023). LIM for vulnerable landscape recovery: Bom Jardim, Fortaleza, Brazil. In Proceedings of SIGraDi 2023. https://doi.org/10.5151/sigradi2023-404

Carvalho, T. F., Moura, N. C. B., & Santos, D. G. (2020). Landscape Information Modeling: Digital platform Mariposa for NBS and ecosystem services. Pós: FAUUSP, 27(51), e168291. https://doi.org/10.11606/issn.2317-2762.posfau.2020.168291

Chen, A., Li, W., & Zhang, W. (2025). Extraction of plant ecological indicators and use of environmental simulation methods based on 3D plant growth models: A case study of Wuhan’s Daijia Lake Park. Forests, 16, 1487. https://doi.org/10.3390/f16091487

Chen, Y.-J., Kuo, H.-Y., & Chen, C.-J. (2019). Study on the establishment of a maintenance mode for a BIM-based landscape project. WIT Transactions on the Built Environment, 192. https://doi.org/10.2495/BIM190161

Cianci, M. G., & Molinari, M. (2019). Information modeling and landscape: Intervention methodology for reading complex systems. In ISPRS Archives, Commission II. https://doi.org/10.5194/isprs-archives-XLII-2-W9-269-2019

Emara, M. S. (2021). Toward a suggested proposed model for the use of BIM in the implementation phase for landscaping. Ain Shams Engineering Journal, 12(4), 3761-3772. https://doi.org/10.1016/j.asej.2021.08.017

Ershadi, M., Jefferies, M., Davis, P., & Mojtahedi, M. (2021). Implementation of Building Information Modelling in infrastructure construction projects: A study of dimensions and strategies. International Journal of Information Systems and Project Management, 9(4), 43–59. https://doi.org/10.12821/ijispm090403

Fritsch, M., Clemen, C., & Kaden, R. (2019). 3D landscape objects for BIM. ISPRS Annals, IV-4/W8, 67-74. https://doi.org/10.5194/isprs-annals-IV-4-W8-67-2019

Haddadian, B., & Haghighatbin, M. (2021). LIM with the approach of controlling urban metabolism. Space Ontology International Journal, 10(4), 81-96. https://doi.org/10.22094/SOIJ.2021.1934434.1431

Hagras, A., Kalaiarasu, S., Sharmin, F., Bhoan, I., Pustorino, G., Kyei, S., Leon, M., Prabhakaran, A., & Silverio, K. (2025). DLIM: BIM and NBS for net-zero, smart and sustainable urban greenscapes. In Proceedings of SASBE 2025. https://doi.org/10.66408/sasbe.2025.2531

Huang, Y., & Li, T. (2024). Design efficacy evaluation of a LIM-SD approach for ecological engineered landscaping. Landscape Architecture Frontiers, 12(5). https://doi.org/10.15302/J-LAF-1-020103

Ivankovic-Waters, J., White, M. G., Haeusler, M. H., & Zeunert, J. (2024). Advancing planting design through digital technologies in teaching landscape architecture. Journal of Digital Landscape Architecture, 9, 848-857. https://doi.org/10.14627/537752079

Kim, M.-K., Park, D., Yun, S., Park, W.-H., Lee, D., Chung, J.-D., & Chung, K.-J. (2023). Establishment of a LIM and AI convergence plan through 3D digital transformation of railway surroundings. Drones, 7(3), 167. https://doi.org/10.3390/drones7030167

Luka, A., & Guo, Y. (2021). PlantingSMART: Parametric trees in BIM with full lifecycle application. Journal of Digital Landscape Architecture, 6, 370-380. https://doi.org/10.14627/537705033

Picuno, C. A., Godosi, Z., & Picuno, P. (2022). Implementing a LIM tool for planning leisure facilities and landscape protection. In Proceedings of MendelNet 2022. https://doi.org/10.11118/978-80-7509-831-3-0186

Saputra, W. E., Lai, L. Y., & Nafeed, F. M. (2024). Digital transformation: Elevating landscape architecture through BIM. In Proceedings of ICCAUA-2024. https://doi.org/10.38027/ICCAUA2024EN0063

Sędzicki, D., Cudzik, J., Bonenberg, W., & Nyka, L. (2022). Computer-aided automated greenery design: Towards a Green BIM. Sustainability, 14(14), 8927. https://doi.org/10.3390/su14148927

Shu, Q., Rötzer, T., Detter, A., & Ludwig, F. (2022). Tree information modeling: A data exchange platform for tree design and management. Forests, 13(11), 1955. https://doi.org/10.3390/f13111955

Trisyanti, S. W., Sari, R. K., Cahyono, A. B., & Sukojo, B. M. (2019). 3D landscape recording and modeling of individual trees. HAYATI Journal of Biosciences, 26(4), 185-194. https://doi.org/10.4308/hjb.26.4.185

Warpas, J., Zwirowicz-Rutkowska, A., Wieczorek, T., Lisowski, M., & Doskocz, A. (2026). A case study on a 7D LIM for greenery maintenance. Applied Sciences, 16, 3067. https://doi.org/10.3390/app16063067

Yang, C., Han, F., Wu, H., & Chen, Z. (2019). Heritage landscape information model (HLIM): A contextualised framework for China. In ISPRS Archives, XLII-2/W15. https://doi.org/10.5194/isprs-archives-XLII-2-W15-1221-2019

Zahrádková, V., & Achten, H. (2015). Required components for Landscape Information Modelling (LIM): A literature review. In E. Buhmann, S. M. Ervin, and M. Pietsch (Eds.), Peer Reviewed Proceedings of Digital Landscape Architecture 2015 at Anhalt University of Applied Sciences (pp. 284–288). Herbert Wichmann Verlag. [Conference proceeding without an assigned DOI.]

Zajíčková, V., & Achten, H. (2013). Landscape information modeling: Plants as components. In eCAADe 31 (Vol. 2, pp. 515-524). https://doi.org/10.52842/conf.ecaade.2013.2.515

Zhao, L., & Zhou, Z. (2020). Research on landscape information model construction based on visualization technology. Journal of Physics: Conference Series, 1693, 012126. https://doi.org/10.1088/1742-6596/1693/1/012126

Zhao, X., Li, M., Sun, Z., Zhao, Y., Gai, Y., Wang, J., Huang, C., Yu, L., Wang, S., Zhang, M., & Huang, L. (2022). Intelligent construction and management of landscapes through BIM and mixed reality. Applied Sciences, 12(14), 7118. https://doi.org/10.3390/app12147118