

A Conceptual Framework for Deriving Lifecycle Information Requirements from Stakeholder Activities, Decisions and Lifecycle Trigger Events

Bjørn Arild Godager

Department of Manufacturing and Civil Engineering,
Norwegian University of Science and Technology (NTNU),
Gjøvik, Norway

Corresponding author: bjoern.godager@ntnu.no

Abstract—Effective asset management (AM) depends on reliable lifecycle information that supports stakeholder activities and decision-making. While the ISO 55000, ISO 19650, and emerging ISO 7817 series provide complementary principles for AM, information governance, and Level of Information Need (LOIN), existing standards provide limited conceptual guidance on how lifecycle information requirements are systematically derived from stakeholder activities, decision-making, and lifecycle trigger events. This paper develops a conceptual framework that explains how stakeholder activities, lifecycle trigger events, and decision points generate information purposes from which lifecycle information requirements are systematically derived. The framework was developed through a qualitative conceptual synthesis of international standards and the scientific literature, integrating complementary concepts related to AM, lifecycle information management, information governance, and LOIN. The proposed framework distinguishes between the conceptual derivation of lifecycle information requirements and their operationalisation. It establishes explicit conceptual relationships between stakeholder activities, lifecycle trigger events, decision points, information purposes, lifecycle information requirements, and their subsequent specification and governance. By establishing explicit traceability from organisational objectives to operational information use, the framework supports information continuity, transparent decision-making, and consistent lifecycle information management. The principal contribution of this research is a coherent conceptual foundation that explains the conceptual relationships between the complementary roles of ISO 55000, ISO 19650, and ISO 7817 and supports the systematic derivation and operationalisation of lifecycle information requirements.

Keywords—Asset Management; Lifecycle Information Management; Lifecycle Information Requirements; Level of Information Need (LOIN); Information Purposes; Decision-Making

I. INTRODUCTION

Context and relevance

The ISO 55000 series establishes principles for asset management (AM) and emphasises information as a strategic resource supporting value realisation and informed decision-making [1-3]. The ISO 19650 series provides a governance framework for lifecycle information management [4-6], while the ongoing revision of the series further strengthens its lifecycle and AM orientation [7-9]. The emerging ISO 7817 series introduces a methodology for specifying and operationalising Level of Information Need (LOIN) [10]. Together, these standards provide complementary perspectives on lifecycle-oriented asset information management.

Motivation and gap

Nevertheless, existing research has largely addressed AM, information management, and LOIN as separate domains. Although the ISO 55000, ISO 19650, and ISO 7817 series provide complementary perspectives on lifecycle-oriented asset information management, limited research has examined how information requirements can be systematically derived from stakeholder activities, decision-making processes, and lifecycle trigger events across the asset value chain [2, 11, 12].

To address this gap, this study develops a conceptual framework that explains how stakeholder activities, decisions, and lifecycle trigger events give rise to information purposes, which in turn form the basis for deriving lifecycle information requirements.

Objectives and research question

The aim of this study is to develop a conceptual framework that systematically derives lifecycle information requirements

from stakeholder activities, decisions, and lifecycle trigger events across the asset value chain. Specifically, the study contributes by:

- developing a conceptual derivation process that links stakeholder activities, decisions, and lifecycle trigger events to information purposes and lifecycle information requirements across the asset value chain;
- explaining the conceptual relationships between the complementary roles of ISO 55000, ISO 19650, and ISO 7817 within a lifecycle-oriented asset information management framework; and
- demonstrating how LOIN operationalises lifecycle information requirements to support information continuity and informed decision-making throughout the asset lifecycle.

The study is guided by the following research questions:

- **RQ1:** *How can stakeholder activities, decisions, and lifecycle trigger events across the asset value chain be translated into information purposes and lifecycle information requirements for built assets?*
- **RQ2:** *How does LOIN operationalise lifecycle information requirements throughout the asset lifecycle?*
- **RQ3:** *How can the complementary roles of ISO 55000, ISO 19650, and ISO 7817 be explained within a lifecycle-oriented asset information management framework?*

The remainder of the paper is organised as follows. Section II reviews related work and identifies the research gap. Section III describes the research methodology. Section IV presents the proposed conceptual framework, which is discussed in Section V. Finally, Section VI concludes the paper and outlines limitations and future research.

II. RELATED WORK

A. Asset Management and Information Requirements

Asset management (AM) concerns the coordinated activities through which organisations realise value from assets. This requires information that supports strategic, tactical, and operational decision-making across the asset lifecycle [1, 3]. Recent research therefore treats asset information as an organisational resource rather than merely a project deliverable. Asset Information Management (AIM) must support technical, financial, environmental, and organisational objectives, while providing reliable information for maintenance, compliance, sustainability, risk management, and long-term value creation [2]. However, existing studies show that operational information needs are frequently insufficiently defined. Information about installed products, materials, systems, and maintenance histories may be incomplete, fragmented, or poorly aligned with stakeholder activities and decisions [13, 14]. Although the ISO 55000 series establishes the value-oriented rationale for information, it provides limited detail on how stakeholder decision needs should be translated into specific and maintainable information requirements.

B. Lifecycle Information Management

The ISO 19650 series provides a governance framework for managing information throughout the lifecycle of built assets. Its information requirement hierarchy—including Organisational Information Requirements (OIR), Asset Information Requirements (AIR), Project Information Requirements (PIR), and Exchange Information Requirements (EIR)—is intended to connect organisational objectives with information production, exchange, and use [4-6].

This lifecycle perspective is further reinforced by the ongoing revision of the ISO 19650 series, which restructures information management as a continuous lifecycle process rather than separate project delivery and operational phases [7-9].

Research nevertheless reports persistent problems in transferring and maintaining information between project delivery and operations. These include inconsistent information quality, fragmented information flows, weak traceability, organisational silos, and limited alignment between project information and operational AM [13-16]. Enterprise BIM research responds to this problem by positioning information management at the organisational and lifecycle level rather than within individual projects. ISO 19650 provides the governance mechanisms for information management but assumes that appropriate information requirements already exist.

C. Level of Information Need

Level of Information Need (LOIN), formalised through ISO 7817, provides a structured basis for specifying the information required for a defined purpose, actor, object, and milestone [10]. In contrast to predefined levels of detail, LOIN starts from the decision or activity that information must support and specifies the necessary geometrical information, alphanumerical information, and documentation.

Recent studies demonstrate the application of LOIN in areas such as heritage management and sustainability assessment [17-19]. These studies indicate that LOIN can improve the relevance, proportionality, and consistency of information requirements. However, most applications remain domain-specific. LOIN provides a mechanism for specifying

information requirements once these have been established. However, little attention has been given to how information requirements are derived from stakeholder activities, decisions, and lifecycle trigger events.

D. Research Gap

The reviewed literature demonstrates significant advances in AM, lifecycle information management, and the specification of information requirements. Collectively, the ISO 55000, ISO 19650, and ISO 7817 series provide complementary perspectives on lifecycle-oriented asset information management. ISO 55000 establishes why information is needed to support value realisation and organisational decision-making. ISO 19650 provides a governance framework for managing information throughout the asset lifecycle, while ISO 7817 introduces a structured approach for specifying information requirements through LOIN.

Despite these advances, the relationship between these perspectives is not well explained. Current research largely treats AM, information governance, and LOIN as separate domains, with limited focus on how they interact within a cohesive lifecycle information management process. Specifically, there is a lack of guidance on how stakeholder activities, decisions, and lifecycle trigger events lead to information purposes, how these purposes are translated into information requirements, and how those requirements are defined and governed throughout the asset lifecycle. Consequently, the proposed framework addresses this conceptual gap by explaining how stakeholder activities, decisions, and lifecycle trigger events are translated into lifecycle information requirements, thereby linking organisational objectives with lifecycle information governance.

This gap motivates the development of the conceptual framework presented in this paper. Figure 1 illustrates the conceptual position of the proposed framework in relation to existing research and highlights the additional derivation process introduced in this study. The framework explains the conceptual relationships between the complementary perspectives of ISO 55000, ISO 19650, and ISO 7817 by showing how stakeholder activities, decisions, and lifecycle trigger events generate information purposes, how these are transformed into lifecycle information requirements, how LOIN specifies the required information, and how information governance supports information continuity throughout the asset lifecycle.

Conceptual position of this research

From predefined information requirements to a conceptual derivation process

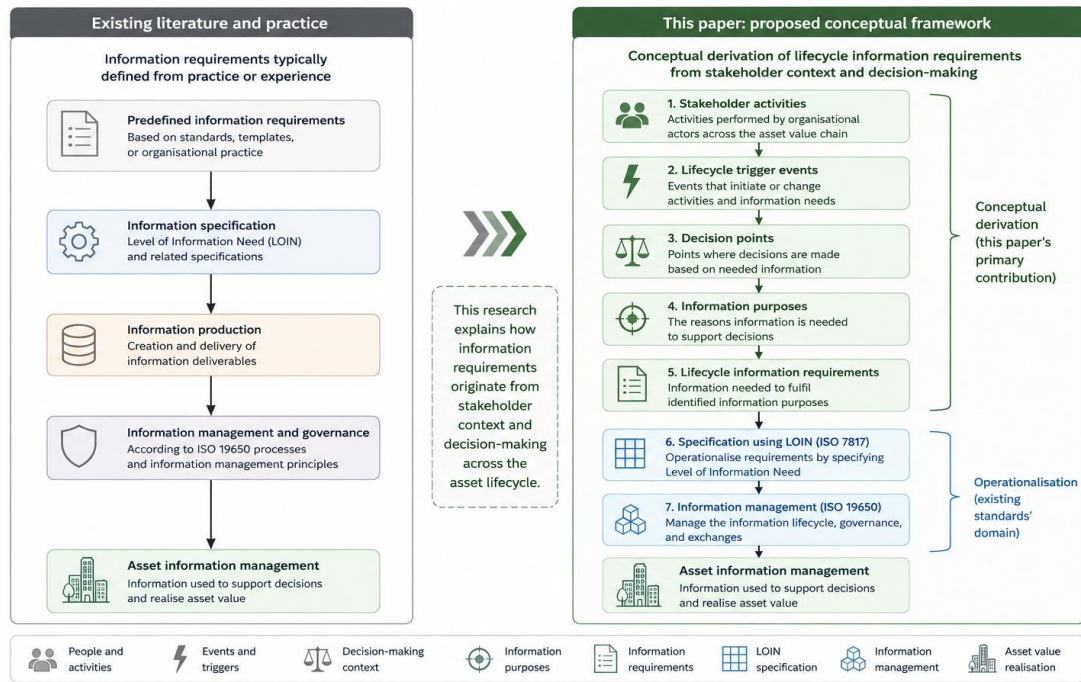


Figure 1. Positioning of the proposed conceptual derivation framework in relation to existing research.

III. METHODOLOGY

3.1 Research design

This study adopts a qualitative conceptual research design to develop a lifecycle-oriented conceptual framework for AM. The study synthesises concepts from international standards and the scientific literature to explain how stakeholder activities, decisions, and lifecycle trigger events give rise to information purposes, information requirements, LOIN, and lifecycle information governance.

The study draws on two complementary sources of knowledge. First, a structured analysis of three complementary international standards was conducted, comprising the ISO 55000 series on AM, the ISO 19650 series on lifecycle information management, and the emerging ISO 7817 series on LOIN. These standards were selected because together they represent complementary perspectives on lifecycle-oriented asset information management, namely AM objectives, information governance, and the specification of information requirements.

Second, a focused review of the scientific literature was undertaken to identify current research on asset information management, lifecycle information continuity, information quality, traceability, Enterprise BIM, stakeholder information requirements, and LOIN. The literature was used to establish the current state of knowledge, identify research gaps, and provide complementary perspectives on the concepts addressed in the standards.

3.2 Analysis methods

The analysis focused on the concepts, principles, processes, and relationships described in the selected standards rather than on a clause-by-clause comparison of their normative requirements. An iterative qualitative analysis was conducted through concept identification, comparison, synthesis, and conceptual refinement.

First, the principal concepts related to lifecycle-oriented asset information management were identified across the ISO 55000, ISO 19650, and ISO 7817 series. Particular attention was given to stakeholder activities, decisions, lifecycle trigger events, information purposes, information requirements, LOIN, and lifecycle information governance.

Second, the identified concepts were analysed to determine how they relate to one another across the three standards. Rather than comparing the standards independently, the analysis examined how concepts introduced in one standard provide the basis for concepts addressed in another. This included analysing how stakeholder activities, decisions, and lifecycle trigger events create information purposes, how information purposes give rise to information requirements, how LOIN specifies those requirements, and how lifecycle information governance supports their production, exchange, maintenance, and use throughout the asset lifecycle.

Findings from the literature review were analysed in parallel to examine how these concepts have been interpreted and applied in previous research, to identify consistencies and unresolved challenges, and to assess whether relationships identified across the standards were supported by existing research.

Finally, the findings from the standards analysis and literature review were synthesised into a conceptual framework describing the derivation, specification, and governance of lifecycle information requirements. The framework synthesises the complementary perspectives of ISO 55000, ISO 19650, and ISO 7817 into a coherent lifecycle information management process linking stakeholder activities, lifecycle trigger events, information purposes, information requirements, LOIN, and lifecycle information governance.

The resulting framework is intended as a conceptual foundation for future empirical validation and practical implementation. Rather than representing a linear process, it

describes a reusable conceptual model that can be applied repeatedly throughout the asset lifecycle as stakeholder activities, lifecycle trigger events, and information needs evolve.

IV. RESULTS

4.1 Overview of the conceptual derivation process

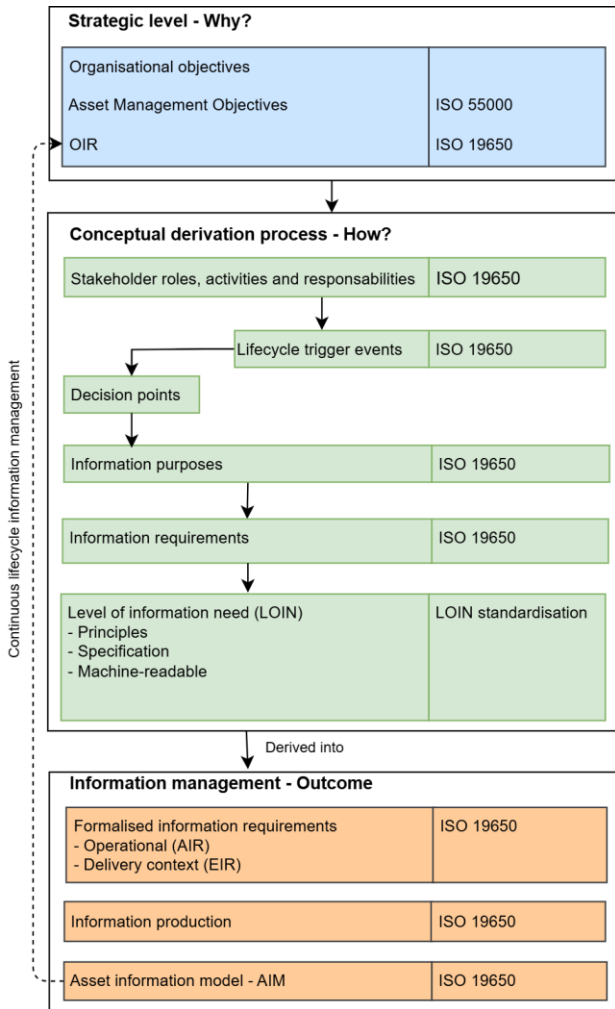


Figure 2. Conceptual derivation process for lifecycle information requirements.

Building on the conceptual positioning established in Figure 1, Figure 2 illustrates the proposed conceptual framework for deriving lifecycle information requirements. The model establishes traceable conceptual relationships between organisational objectives, stakeholder activities, lifecycle trigger events, decision points, information purposes, lifecycle information requirements, and their subsequent specification and lifecycle information governance. The proposed model distinguishes between a conceptual derivation phase and an operationalisation phase. The conceptual derivation phase explains how lifecycle information requirements emerge from organisational objectives, stakeholder activities, and decision-making contexts, whereas the operationalisation phase specifies, formalises, produces, and governs lifecycle information throughout its use.

Table 1 summarises the conceptual elements of the proposed framework together with their functional roles within the model. Together, Figure 2 and Table 1 provide an overview

of the conceptual structure before the individual elements are described in more detail in the following sections.

Table 1. Functional roles of the conceptual elements in the proposed lifecycle information derivation process.

Concept	Function role in the derivation process
Organisational objectives	Define strategic intent
Stakeholder roles and activities	Establish operational context
AM objectives	Translate organisational objectives into AM objectives.
OIR	Define strategic information requirements supporting organisational and AM objectives.
Lifecycle trigger events	Initiate decision-making situations
Decision points	Create demand for information
Information purposes	Define why information is needed
Information requirements	Define what information is required to fulfil an information purpose
LOIN	Specify the required information content, quality, granularity, and representation for implementation and exchange.
Formalised information requirement specifications	Operationalise requirements for implementation
Information production	Produce, maintain and exchange information
AIM	Support lifecycle AM

Sections 4.2–4.9 present each conceptual element of the model in sequence, explaining its role in the derivation process and its relationship to the adjacent elements. The focus is on the conceptual relationships established by the proposed model rather than on describing the underlying standards individually.

Although presented sequentially for clarity, the framework represents a continuous lifecycle information management process rather than a linear sequence of activities. As stakeholder activities evolve and new lifecycle trigger events occur, new information purposes and lifecycle information requirements may be derived, specified, formalised, and governed throughout the asset lifecycle.

4.2 Strategic level

Organisational objectives define the strategic intent of the asset-owning organisation and establish the value expected from its assets. These objectives are translated into AM objectives, which provide the strategic context for identifying Organisational Information Requirements (OIR). OIR define the information necessary to support organisational and AM objectives and establish the strategic information context from which lifecycle information requirements are subsequently derived.

4.3 Stakeholder roles, activities and responsibilities

Stakeholder roles, activities and responsibilities establish the operational context in which lifecycle information requirements arise. Rather than focusing on organisational ownership or BIM responsibilities, the model emphasises the activities performed by stakeholders throughout the asset lifecycle.

These activities operationalise the organisational and AM objectives established at the strategic level. As stakeholders perform lifecycle activities, planned and unplanned situations arise that require decisions to be made.

These situations are represented in the proposed model as lifecycle trigger events and associated decision points, which establish the context for deriving information purposes and subsequent information requirements.

4.4 Lifecycle trigger events and decision points

Lifecycle trigger events represent situations that change, or are expected to change, an asset during its lifecycle. These events establish the operational context in which decisions become necessary, and lifecycle information requirements emerge. Trigger events may be planned, such as scheduled inspections or periodic maintenance, or unplanned, such as equipment failures, regulatory changes or unexpected asset deterioration.

Decision points represent situations in which stakeholders evaluate available information before selecting an appropriate course of action. While trigger events initiate the need for action, decision points determine why information is required and therefore establish the context from which information purposes are derived.

4.5 Information purposes

Within the proposed model, information purposes constitute the crucial conceptual mechanism that transforms operational decision-making contexts into lifecycle information requirements. They explain why information is required by linking stakeholder decision-making to the information needed to support those decisions.

Information purposes emerge from the decision points created by lifecycle trigger events. Rather than specifying information directly, they express the underlying reason why information is required before defining what information should be produced. Consequently, information purposes provide the conceptual basis from which lifecycle information requirements are derived.

Information purposes may originate from organisational management, AM, project delivery or external stakeholders such as regulators. Although these perspectives differ in their objectives and responsibilities, the proposed model treats information purposes as the common conceptual mechanism that links decision-making contexts to lifecycle information requirements.

Different stakeholders may have different information purposes for the same decision situation, while a single information purpose may generate multiple information requirements. Likewise, similar information requirements may support several information purposes across different lifecycle activities. The proposed model therefore represents a logical derivation process rather than a set of one-to-one relationships.

Once the purpose of the information has been established, lifecycle information requirements can be derived by defining the information necessary to fulfil each identified purpose.

4.6 Derivation of lifecycle information requirements

Within the proposed conceptual framework, lifecycle information requirements are derived from identified information purposes. Whereas information purposes explain why information is needed, information requirements define what information is required to support stakeholder activities and decisions at specific lifecycle stages. The derivation process therefore establishes the conceptual link between operational decision-making and lifecycle information management.

A single information purpose may generate one or more information requirements, while the same information requirement may support multiple information purposes across different stakeholder activities. Consequently, the proposed framework represents a many-to-many conceptual relationship rather than a linear sequence.

The derived lifecycle information requirements are subsequently organised within the ISO 19650 information requirement hierarchy. Depending on their organisational scope and intended use, they contribute to OIR, AIR, PIR, and EIR. Rather than existing independently, these categories represent different organisational perspectives on the same underlying information needs.

Deriving lifecycle information requirements establishes what information is needed to support stakeholder activities and decisions. However, derived requirements alone are insufficient for implementation. They must also be specified in terms of the required information content, quality, and level of detail. Within the proposed framework, this specification is achieved through LOIN, which is described in the following section.

4.7 Specification of lifecycle information requirements through Level of Information Need (LOIN)

Within the proposed framework, LOIN does not create information requirements. Instead, it operationalises previously derived information requirements by transforming them into implementable information specifications. This distinction separates the derivation of information requirements from their practical implementation and supports traceability between stakeholder decision-making and information production.

The specification process defines the required information content, quality, granularity, responsible actors, lifecycle milestone, and information representation necessary to satisfy each information requirement. This ensures that information producers understand precisely what information is required without requesting unnecessary information.

Once lifecycle information requirements have been specified through LOIN, they can be formalised into structured information requirement specifications that support information production, information exchange, and lifecycle information governance within the ISO 19650 information management framework.

4.8 Formalisation and lifecycle information governance

Once lifecycle information requirements have been derived and specified through LOIN, they can be formalised into structured information requirement specifications suitable for implementation within an information management process. Formalisation transforms conceptually derived information requirements into structured and reusable information requirement specifications that support consistent implementation and facilitate future digital interoperability. Within the proposed framework, these formalised information requirement specifications provide the operational basis for information production throughout the asset lifecycle. They establish a common reference for the consistent implementation of lifecycle information requirements across projects and operational activities, thereby enabling subsequent information production, exchange, and governance throughout the asset lifecycle.

4.9 Information production and lifecycle governance

Building upon the formalised information requirement specifications established in the previous stage, information production creates, exchanges, validates, and maintains the information required to support stakeholder activities throughout the asset lifecycle. The formalised specifications provide a common reference for information producers, information users, and information managers, ensuring that information is generated consistently and in accordance with the derived lifecycle information requirements.

Within the proposed framework, lifecycle information governance coordinates the management of information from its initial production to subsequent exchange, maintenance, and operational use. Building on the governance principles established in ISO 19650 and previous work on Enterprise BIM [16], this governance ensures that information remains traceable to stakeholder activities, lifecycle trigger events, decision points, information purposes, and the information requirements from which it was derived.

The resulting information contributes to the AIM, supporting asset operation, maintenance planning, regulatory compliance, performance monitoring, and strategic decision-making. As new stakeholder activities and additional lifecycle trigger events arise, new information purposes and information requirements may be derived, specified through LOIN, and formalised into updated information requirement specifications.

Consequently, the proposed conceptual framework represents a continuous lifecycle information management process rather than a linear sequence of activities. By maintaining traceability from organisational objectives to operational information use, the framework supports information continuity, informed decision-making, and long-term asset value realisation throughout the asset lifecycle.

V. DISCUSSION

5.1 Answering the research questions

The proposed framework addresses the research questions by introducing an explicit conceptual derivation process for lifecycle information requirements. Previous research has primarily focused on AM principles, information governance, or the specification of information requirements. While these perspectives are complementary, they provide limited guidance on how lifecycle information requirements originate from stakeholder activities and operational decision-making. The principal contribution of the framework is that it shifts the focus from managing and specifying information requirements to explaining how they originate. Rather than treating information requirements as predefined artefacts, the framework demonstrates that they emerge through a traceable conceptual process in which stakeholder activities, lifecycle trigger events, and decision points generate information purposes that subsequently form the basis for deriving lifecycle information requirements. This establishes the missing conceptual link between organisational objectives and lifecycle information management identified in the literature review.

The framework therefore provides an answer to RQ1 by explaining how organisational objectives are translated into operational information requirements through successive conceptual transformations. Information requirements are not defined in isolation but are derived from the information purposes associated with stakeholder decision-making. This provides a systematic rationale for information requirements

that is directly traceable to organisational objectives, lifecycle activities, and operational decisions. This distinction has broader implications for lifecycle information management. By making the derivation process explicit, information requirements become justified by stakeholder activities and operational decisions rather than being defined solely from organisational practice or project experience. This strengthens both the traceability and the transparency of lifecycle information management.

RQ2 concerns the role of LOIN in lifecycle information management. The proposed framework distinguishes conceptually between deriving and specifying information requirements. Lifecycle information requirements are first derived from stakeholder activities and decision-making contexts before being specified through LOIN. Consequently, LOIN is positioned as a specification mechanism rather than a derivation mechanism. This distinction clarifies the complementary relationship between conceptual information analysis and operational information specification while strengthening traceability between stakeholder needs and information production.

Additionally, this separation of the conceptual derivation of information requirements from their specification through LOIN has practical implications. By ensuring that information requests are based on supporting identified stakeholder decisions rather than adhering to predefined modelling practices, organisations can improve both the relevance and appropriateness of lifecycle information, thereby reducing unnecessary information production.

RQ3 concerns how the complementary roles of ISO 55000, ISO 19650, and ISO 7817 can be explained within a lifecycle-oriented asset information management framework. Rather than representing competing or overlapping approaches, the proposed framework demonstrates that the three standards address interdependent and complementary stages of the same lifecycle information management process.

ISO 55000 establishes the organisational objectives and AM context that create the demand for information. Building on this strategic foundation, stakeholder activities, lifecycle trigger events, and decision points generate information purposes from which lifecycle information requirements are conceptually derived. ISO 19650 then provides the governance framework for managing these requirements throughout the information lifecycle, while ISO 7817 operationalises them by specifying the information needed to satisfy each identified requirement through LOIN.

By positioning the standards within a single conceptual derivation process, the framework clarifies their respective roles while establishing explicit traceability from organisational objectives to operational information use. This conceptual framework extends beyond aligning existing standards; it provides a coherent conceptual explanation of how strategic objectives are translated into information requirements, how these requirements are specified, and how they are subsequently governed throughout the asset lifecycle. Consequently, the proposed framework contributes a lifecycle-oriented perspective that complements the individual standards and supports more consistent and transparent lifecycle information management.

5.2 Contribution and implications

The principal theoretical contribution of this research is the introduction of a conceptual derivation process that explains how lifecycle information requirements originate from

stakeholder activities and operational decision-making. While previous research has focused on information governance, information quality, and LOIN, comparatively little attention has been given to the conceptual processes through which information requirements are identified and justified. The proposed framework contributes by establishing explicit traceability between organisational objectives, stakeholder activities, information purposes, lifecycle information requirements, and subsequent information production.

Methodologically, the study demonstrates how concepts originating from different international standards can be synthesised into a coherent conceptual framework. Rather than comparing the ISO 55000, ISO 19650, and ISO 7817 series independently, the framework highlights their complementary roles within a unified lifecycle information management process. This illustrates how conceptual synthesis can be used to integrate standards that address different aspects of the same domain.

The ongoing revision of the ISO 19650 series reflects a broader transition from project-oriented information management towards lifecycle-oriented asset information management. By restructuring information management as a continuous lifecycle process, the revised series places greater emphasis on maintaining information continuity across planning, delivery, operation, and subsequent lifecycle activities. This evolution reinforces the importance of establishing lifecycle information requirements from the outset rather than treating them as project-specific deliverables. While the revised series emphasises that information requirements should support the entire asset lifecycle, it does not explicitly explain how such requirements are systematically derived. The framework proposed in this paper complements the revised standard by explaining how stakeholder activities, decisions, and lifecycle trigger events generate information purposes that form the basis for lifecycle information requirements before these are governed through the ISO 19650 information management process. The proposed framework therefore complements the revised distinction between information management and information production by addressing the conceptual step that precedes both, namely the systematic derivation of lifecycle information requirements.

From a practical perspective, the framework provides asset owners and information managers with a structured approach for deriving lifecycle information requirements from actual stakeholder activities and decision-making contexts. This may improve the consistency, traceability, and relevance of organisational, asset, project, and exchange information requirements while reducing the risk of requesting unnecessary or poorly justified information. By linking information production directly to operational decision-making, the framework also supports information continuity throughout the asset lifecycle.

The study is subject to several limitations. The proposed framework is conceptual and has not yet been validated through empirical case studies or implementation in operational AM environments. Future research should therefore evaluate the framework across different asset types, organisational settings, and lifecycle phases. Further research could also investigate how the derivation process may be supported through model-based information management, digital twins, and emerging artificial intelligence techniques for information requirement analysis and specification.

Taken together, the findings suggest that lifecycle information requirements should be understood as the outcome of a systematic conceptual derivation process rather than as predefined information requirements established independently of stakeholder activities and decision-making. By establishing explicit traceability from organisational objectives to operational information use, the proposed framework complements existing standards and provides a coherent conceptual foundation for lifecycle information management. This perspective may support future empirical research, digital implementation, and the continued evolution of asset information management practice.

VI. CONCLUSION AND FUTURE WORK

This paper addressed the lack of a systematic conceptual explanation of how lifecycle information requirements are derived from stakeholder activities, decision-making, and lifecycle trigger events within lifecycle-oriented asset information management. While ISO 55000, ISO 19650, and ISO 7817 provide complementary principles for asset management (AM), information governance, and Level of Information Need (LOIN), they offer limited guidance on the conceptual processes through which lifecycle information requirements originate.

To address this gap, the paper developed a conceptual framework that explains how stakeholder activities, lifecycle trigger events, and decision points generate information purposes, which subsequently form the basis for deriving lifecycle information requirements. The framework further distinguishes between the conceptual derivation of information requirements and their operationalisation through LOIN, formalised information requirement specifications, information production, and lifecycle information governance. In doing so, it establishes explicit traceability from organisational objectives to operational information use throughout the asset lifecycle.

The principal contribution of this research is the introduction of a conceptual derivation framework that explains how lifecycle information requirements are systematically derived rather than assumed or predefined. By explaining the conceptual relationships between the complementary roles of ISO 55000, ISO 19650, and ISO 7817, the framework provides a coherent conceptual foundation that supports lifecycle information continuity, transparent decision-making, and more consistent asset information management. The proposed framework is conceptual and therefore represents an initial step towards a more comprehensive understanding of lifecycle information requirements. It has not yet been validated through empirical case studies or implementation within operational AM environments. Future research should therefore evaluate the framework across different asset types and organisational contexts while investigating its application within digital information management environments, including digital twins and AI-supported methods for deriving and managing lifecycle information requirements. By making the derivation of lifecycle information requirements explicit, the proposed framework provides a conceptual foundation for future research and for the practical implementation of lifecycle-oriented information management in support of digital twins, asset management and next-generation ISO information management standards.

REFERENCES

1. ISO, ISO 55000:2024. Asset management — Vocabulary, overview and principles. 2024.
2. A. Buttgerit, M. Block, D. Gogolin, D., and S. Gomolluch, "Potential of holistic asset information management", in *Life-Cycle of structures and infrastructure systems*. 2023, CRC Press. p. 2313–2320, DOI: 10.1201/9781003323020-282
3. ISO, ISO 55001:2024 Asset management — Management systems — Requirements. 2024.
4. ISO, a., ISO 19650-1:2018. Concepts and principles. 2018.
5. ISO, b., ISO 19650-2:2018. Delivery phase of the assets. 2018.
6. ISO, ISO 19650-3:2020. Operational phase of assets. 2020.
7. ISO, ISO/DIS 19650-1:2026. Concepts and principles. 2026.
8. ISO, ISO/DIS 19650-2:2026. Information management process. 2026.
9. ISO, ISO/DIS 19650-3:2026. Implementation of the information management process. 2026.
10. ISO, ISO 7817-1:2024. Building Information Modelling. Level of Information Need. Part 1: Concepts and principles. 2024: ISO.
11. V. Malla, M. Tummalapudi, and V .S. K. Delhi, "Perceptions of Built-Environment Professionals on Using ISO 19650 Standards for Information Management," *Leg. Aff. Dispute Resolut. Eng. Constr.*, 2023. 16(1), <https://doi.org/10.1061/JLADAH.LADR-1076>
12. M. Aydin, "Standardization of Level of Information Need (LOIN) in Building Information Modeling (BIM): Transition from BS EN 17412-1:2020 to ISO 7817-1:2024," *JASA*, 2025. 10(2): p. 730–752, <https://doi.org/10.30785/mbud.1614834>
13. K. Mohn and J. Lohne, "On knowing what is inside the walls– Challenges to Asset Management from a product perspective," in *IOP Conference Series: Earth and Environmental Science*. 2023. IOP Publishing, DOI: 10.1088/1755-1315/1176/1/012019
14. K. Mohn and J. Lohne, "Chaos and black boxes – Barriers to traceability of construction materials," in *ECPPM 2022-eWork and eBusiness in Architecture, Engineering and Construction 2022*. 2023, CRC Press. p. 99–105, <https://doi.org/10.1201/9781003354222-13>
15. G. S. Tsay, S. Staub-French, and E. Poirier, "BIM for FM: understanding information quality issues in terms of compliance with owner's Building Information Modeling Requirements," *Front. Built Environ.*, 2023. 9, DOI: 10.3389/fbuil.2023.1117066
16. B. Godager, K. Mohn, C. Merschbrock, O. J. Klakegg and L. Huang, "Towards an improved framework for enterprise BIM: the role of ISO 19650," *ITcon* 2022. 27: p. 1075–1103, DOI: 10.36680/j.itcon.2022.053
17. A. Alsehray, M. Tong, and O. Amoudi, "Leveraging ISO 7817 for BIM-driven sustainability assessments: The GLOIN framework," *J. Build. Eng.*, 2025. 116: p. 114527 DOI: 10.1016/j.jobbe.2025.114527
18. Y. Hentour, I. Bennani, and Y. El Ganadi, "Supporting Decision-Making in Cultural Heritage Management Utilizing the Level of Information Need and HBIM: The Case of Bou Inania Madrasa in Meknes, Morocco," *Buildings*, 2026. 16, 1707, DOI: 10.3390/buildings16091707.
19. Y. Hentour, Y. Elganadi, and M. Bolpagni, "Level of information need in heritage building management: a case study in Morocco," in *Proceedings of the 41st Int. Conference of CIB W*. 2024, w78-2024-paper_38.pdf.