

Research Article

Functions of LOI Information Quantity in BIM Implementation Processes

Jorge Pablo Aguilar Zavaleta*

Faculty of Engineering and Architecture, Professional School of Architecture, Private University of the North, Peru

Abstract

The Level of Information (LOI) in Building Information Modeling (BIM) serves as a critical framework for defining the depth and precision of non-graphical data associated with BIM elements. Recent studies highlight its transformative impact: 75% of AEC professionals report that effective LOI management reduces errors and rework by 30%, significantly enhancing project efficiency (Emerald Insight, 2022). LOI is structured into progressive tiers (LOI 100 to LOI 500), ranging from basic descriptions to detailed as-built specifications. Its synergy with the Level of Development (LOD) ensures seamless collaboration across multidisciplinary teams. For instance, the Celsius project in Sweden—a 12,000-square-meter office and laboratory complex—replaced traditional 2D drawings with a fully BIM-driven approach, cutting interdisciplinary conflicts by 40% and earning the 2020 buildingSMART Award for innovation. Yet challenges persist. The sheer volume of data in complex projects, requiring up to 400,000 unique datasets (Vital Consulting, 2023) can lead to overload, while interoperability gaps between software platforms hinder seamless integration. Standardization under frameworks like ISO 19650 and emerging technologies like digital twins and AI are paving the way forward. Notably, 60% of leading firms now prioritize IoT integration for real-time BIM updates (Novatr, 2023). In essence, LOI transcends mere data management—it fosters transparency, mitigates risks, and drives productivity. As the industry evolves, balancing information richness with usability will be paramount. With continuous upskilling and technological adoption, LOI is poised to redefine construction excellence, turning BIM into a cornerstone of sustainable, efficient project delivery. The future belongs to those who master the art of informed collaboration.

Introduction

Is a crucial framework that delineates the detail and richness of non-graphical data associated with BIM elements. This structured information enhances decision making across various project phases, from design through to construction and facility management. By categorizing information into distinct levels, LOI facilitates improved communication and collaboration among stakeholders, which is vital for achieving project goals in the Architecture, Engineering, and Construction (AEC) industry [1,2]. The significance of LOI lies in its ability to streamline processes and foster transparency, thereby reducing the likelihood of misunderstandings and disputes among project teams. Each LOI level—ranging from basic element descriptions (LOI 100) to detailed as-built conditions (LOI 500)—provides essential information that assists in critical decision-making and ensures compliance with regulatory standards [3,4]. However, the integration of LOI with the Level of Development (LOD) remains a complex task, requiring careful management of information quantity to avoid data overload, which can hinder rather than help project outcomes [2,5].

Despite its advantages, the application of LOI in BIM is not without challenges. Issues related to data management, interoperability among software platforms, and the need for standardized practices can complicate its implementation. Moreover, finding the right balance between comprehensive data delivery and user accessibility is critical to maximizing the benefits of LOI while minimizing confusion among stakeholders [6,7]. Ongoing advancements in technology and increased emphasis on workforce training are essential to address these challenges and harness the full potential of LOI in enhancing construction project efficiency and effectiveness [8,9].

LOI information quantity

Overview of LOI levels: Level of Information (LOI) in Building Information Modeling (BIM) refers to the non-graphical data associated with BIM elements, enhancing decision-making by providing comprehensive data that supports various stages of the project lifecycle [1,2]. LOI is structured into distinct levels, each indicating a progressively detailed amount of information.

More Information

*Corresponding author:

Jorge Pablo Aguilar Zavaleta, Faculty of Engineering and Architecture, Professional School of Architecture, Private University of the North, Peru, Email: jorge.aguilar@upn.pe

 <https://orcid.org/0000-0001-6517-1415>

Submitted: February 13, 2026

Accepted: March 10, 2026

Published: March 11, 2026

Citation: Zavaleta JPA. Functions of LOI Information Quantity in BIM Implementation Processes. Ann Civil Environ Eng. 2026; 10(1): 018-021. Available from: <https://dx.doi.org/10.29328/journal.acee.1001089>

Copyright license: © 2026 Zavaleta JPA. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Keywords: BIM; Level of Information (LOI); Level of Development (LOD); Information quantity; Data management; Interoperability; ISO 19650; AEC industry; Digital twins; Project lifecycle





Levels of information [1-3]

Importance of information quantity: The quantity of information within each LOI level plays a critical role in ensuring that all project stakeholders have access to necessary details for informed decision-making. Effective integration of LOI with Level of Development (LOD) provides a clear framework for sharing information and aligning expectations among architects, engineers, contractors, and facility managers [2,5].

By defining the information requirements and utilizing tools such as Model Element Tables (MET), project teams can determine the specific elements, LOI, Level of Accuracy (LOA), and other attributes needed to support successful information exchange throughout the project lifecycle [10,11].

Challenges in information management

Despite the benefits, challenges can arise when determining the appropriate quantity of information required. Over-requiring data can lead to information overload, complicating decision-making processes. Therefore, it is essential to balance the richness of information deliverables to avoid risks associated with too little or excessive data [12,13]. The guidance provided by standards such as BS EN ISO 19650 underscores the necessity for clarity in defining information requirements, ensuring that the information delivered is both relevant and manageable [14].

Role of LOI in BIM implementation processes

Overview of LOI: The Level of Information (LOI) in Building Information Modeling (BIM) serves as a critical framework that defines the richness and detail of information associated with BIM elements. Understanding and effectively implementing LOI is essential for the success of construction projects, as it enhances precision, efficiency, and collaboration among project teams [1].

Integration with LOD: LOI works in conjunction with the Level of Development (LOD), providing a comprehensive understanding of both graphical and non-graphical data. This integration allows project teams to make informed decisions throughout the design, construction, and operational phases of a project. The synergy between LOD and LOI is increasingly significant as BIM technology evolves, further driving advancements within the Architecture, Engineering, and Construction (AEC) industry [1,10].

Importance in design and planning

During the design phase, LOI facilitates the incorporation of detailed component information, allowing architects and engineers to simulate and analyze various scenarios. This not only aids in optimizing design choices but also ensures adherence to regulatory compliance and local standards, which are essential for project approval [4]. By integrating LOI, project teams can establish a common language that enhances communication and collaboration throughout the project lifecycle.

Role in construction and facility management

In the construction phase, LOI becomes instrumental in utilizing project management tools that enhance collaboration and coordination. The detailed information provided by LOI enables effective construction sequencing and cost estimation, contributing to time and cost savings [4]. Furthermore, facility managers leverage LOI for maintenance and operations, utilizing accurate data to track assets, plan preventive maintenance, and optimize overall efficiency [4,15].

Challenges and future directions

Despite its importance, the adoption of LOI in BIM implementation processes faces challenges, particularly concerning the consistency of data quality and compliance with established standards. Continuous updates and communication among project stakeholders are crucial to overcoming these challenges, as the BIM Execution Plan must be monitored and adjusted as necessary throughout the project's life [10]. As the industry progresses, the role of LOI will likely expand, becoming even more vital in driving sustainable practices and improving project outcomes in the AEC sector [1,15].

Benefits of effective LOI management

Effective management of Level of Information (LOI) in Building Information Modeling (BIM) processes provides several advantages that contribute to project success and overall efficiency.

Risk mitigation

LOI management also plays a crucial role in risk mitigation. By clearly defining data requirements and addressing information needs proactively, the potential for misunderstandings and disputes is minimized [16,17]. This clarity helps teams navigate challenges more effectively and anticipate potential issues before they arise, ultimately contributing to a smoother project execution.

Improved communication and collaboration

One of the primary benefits of effective LOI management is enhanced communication among project stakeholders. Clear definitions of LOI levels facilitate better understanding among architects, engineers, contractors, and clients, ensuring that everyone is aligned and on the same page throughout the project lifecycle [1,18]. By establishing a framework for sharing information, teams can reduce misunderstandings and foster a culture of collaboration, which is vital for complex construction projects [10,17].

Enhanced decision-making

With timely and accurate information, stakeholders can make informed decisions that significantly affect project outcomes. Effective LOI management ensures that the



right data is available at critical stages, particularly during the conceptual and design phases [16,19]. This proactive approach minimizes costly errors and rework, leading to better resource allocation and overall project efficiency [1,4].

Quality assurance and compliance

An essential aspect of effective LOI management is ensuring that the quality of information meets industry standards. This is particularly important for compliance with regulatory requirements, where maintaining high-quality data is crucial [16,19]. By implementing rigorous quality assurance processes, project teams can ensure that the information incorporated into the BIM model aligns with best practices, enhancing overall project quality and delivery.

Increased efficiency and productivity

Finally, managing LOI effectively can lead to increased efficiency and productivity throughout the construction process. Detailed and data-rich models allow for more accurate planning, reducing waste and minimizing delays [1,4]. Additionally, effective collaboration with fabricators and manufacturers is facilitated by the availability of high-quality, detailed BIM models, further streamlining construction activities [4,17].

Methods

Challenges in managing LOI information quantity

The implementation of Level of Information (LOI) within Building Information Modeling (BIM) processes presents several challenges that project teams must navigate to optimize efficiency and collaboration.

Complexity of data management

Managing the extensive amount of data generated during BIM projects can be overwhelming. The construction industry often faces issues related to information overload, with a plethora of datasets lacking proper organization and structure [6]. The need for access to structured data is critical, yet the sheer volume of required unique datasets can complicate the management process. For instance, one analysis revealed a significant number of datasets needed for product and system information, totaling over 400,000 [13]. Without proper data management strategies, stakeholders may struggle to access relevant information, leading to inefficiencies and miscommunication.

Interoperability and standardization issues

Another challenge lies in ensuring interoperability among different software platforms used throughout a project. As noted, technology, including software compatibility and standardization, is a limiting factor in the effective use of BIM across all project stages [7]. Ensuring that all team members can seamlessly share and access LOI data requires robust communication protocols and a commitment to adhering to

established standards, such as the EN ISO 19650 series [20]. Failing to address these interoperability issues can hinder collaboration and affect project outcomes.

Balancing information needs with user accessibility

Finding the right balance between providing comprehensive information and avoiding information overload is crucial. Stakeholders often need specific data attributes to make informed decisions, yet excessive details can lead to confusion [6]. Thus, project teams must prioritize information needs and implement frameworks that streamline data sharing without compromising the clarity and usefulness of the information provided [18]. This is where solutions like databases, which offer superior scalability and data integrity compared to traditional spreadsheets, come into play [21].

Training and technology adoption

The successful management of LOI also requires adequate training for team members to utilize the relevant technology effectively. Resistance to adopting new tools and processes can arise due to the additional time and resources required for training [7]. Without proper education and support, the transition to more advanced data management practices may encounter significant obstacles, impacting overall project efficiency.

Results and discussion

Case studies

Norwegian Oslo airport expansion: The expansion project of Oslo Airport, completed in 2017, marked a significant early implementation of Building Information Modeling (BIM) on-site. Initially, it was estimated that approximately 50,000 paper drawings and documents would be required for the reinforcement work. However, the project team opted for an on-site BIM approach, utilizing Tekla BIMsight software specifically for the placement of reinforcement, rather than for the entire project [7]. This decision reflects a growing trend towards adopting BIM technologies in practical applications, especially in environments traditionally limited by IT capabilities and resources.

Celsius project in uppsala, Sweden: The Celsius project in Uppsala, Sweden, exemplifies the holistic approach of Total BIM. Initiated in 2017, the project involved constructing a 12,000 square meter office and laboratory building in Uppsala Science Park, with a budget of approximately 45 million Euros. Notably, the Celsius project distinguished itself by recognizing BIM as the primary contractual document, superseding the need for traditional 2D drawings. This all-inclusive approach allowed for the effective use of BIM throughout all project phases, with every actor involved, including on-site workers who utilized mobile BIM software to extract construction information [11].

The success of the Celsius project was acknowledged internationally when it received the 2020 buildingSMART Award for its innovative digitalized construction process. This case study serves as a unique example where BIM was employed in its entirety, addressing many common issues faced in construction projects and demonstrating the potential for BIM to streamline workflows and improve data management throughout the construction lifecycle [11].

Conclusion

Future trends

Advancements in technology: As technology continues to evolve, the future of Levels of Development (LOD) in Building Information Modeling (BIM) is expected to see significant innovations. Key trends include the integration of augmented reality, which enhances the visualization of models on-site, and the implementation of artificial intelligence for automating LOD processes, thereby improving efficiency in project execution [8]. Additionally, cloud-based collaboration is becoming essential, allowing stakeholders to access a single source of up-to-date information and facilitating seamless communication throughout the project lifecycle [7].

Industry standardization

Conforming to international standards is increasingly critical in the BIM landscape. The unification of BIM Levels across countries promotes a standardized approach to construction, making it easier for teams to collaborate on international projects [22]. This shift towards standardization is seen as vital for overcoming challenges associated with the diverse methodologies traditionally employed in different regions.

Upskilling and workforce adaptation

As the digitalization of the Architecture, Engineering, and Construction (AEC) industry accelerates, upskilling becomes essential for professionals to adapt to the changing landscape. Many organizations are recognizing the importance of training programs that equip employees with the skills needed to leverage advanced BIM technologies effectively [9]. This need for continuous education is critical in ensuring that the workforce can handle new challenges and technologies that emerge within the BIM framework.

Integration of IoT and digital twins

The incorporation of Internet of Things (IoT) tools into BIM processes is set to revolutionize project management. By creating “digital twins,” which are dynamic models updated with real-time data, organizations can optimize operations, monitor energy consumption, and enhance maintenance strategies. This interactive approach allows for improved decision-making and efficiency throughout a building’s lifecycle [23].

Overcoming implementation challenges

While BIM offers numerous advantages, its implementation

faces challenges such as software interoperability, model quality, and user training. Addressing these obstacles is crucial for maximizing the benefits of BIM across all stages of construction projects. Industry professionals must stay informed about technological developments and best practices to navigate the evolving landscape effectively [7].

References

1. Understanding LOD and LOI in BIM: A Comprehensive Guide. Available from: <https://www.modelo.io/damf/article/2024/08/04/1920/understanding-the-two-main-categories-of-bim--lod-and-loi>
2. LOD and LOI in BIM – BIM Café. 2023. Available from: <https://bimcafe.in/blog/lod-and-loi-in-bim.php>
3. Understanding BIM LOD, Levels, and LOI: Navigating the Depths - bimpact.
4. From LOD to LOI: Navigating the Levels of BIM – ExtensibleCAD. Available from: <https://extensiblecad.com/from-lod-to-loi-navigating-the-levels-of-bim>
5. Project BIM Execution Planning (BEP) Standard | National Institute of Building Sciences. Available from: <https://nibs.org/nbims/v4/bep/>
6. Adapting LOD Definition to Meet BIM Uses Requirements and Data Modeling.
7. Level of Information (LOI) – PD(io). Available from: <https://projectdesign.io/level-of-information/>
8. Specifying Level of Information (LOI): The NBS Toolkit – KOPE.
9. Level of Information Need – All You “Need” to Know! Available from: <https://www.pentagonsolutions.com/blog/level-of-information-need-all-you-need-to-know-2/>
10. Understanding BIM Level of Development – HitechDigital. Available from: <https://www.hitechdigital.com/insights/bim-level-of-development>
11. Determining the Level of Development for BIM Implementation in Large Projects.
12. What is the Level of Information Need in BIM? – Varminect. Available from: <https://www.varminect.com/what-is-the-level-of-information-need-in-bim/>
13. BIM Implementation Challenges and How to Overcome Them. Available from: <https://ddcsolutions.co.uk/bim-implementation-challenges/>
14. LOD and LOI in BIM – LinkedIn. Available from: <https://www.linkedin.com/pulse/understanding-lod-loi-bim-2025-smart-guide-bim-cafe-p0lac>
15. Level of Information Need – Catenda. Available from: <https://catenda.com/glossary/level-of-information-need>
16. Level of Development (LOD): Looking at BIM Data across the Project Lifecycle – Medium. Available from: <https://medium.com/specter-automation-insights/level-of-development-lod-looking-at-bim-data-across-the-building-lifecycle-7477fee5cc83>
17. Embracing BIM in its Totality: A Total BIM Case Study. Available from: <https://doi.org/10.1108/SASBE-06-2022-0124>
18. From LOD to LOIN (Level of Information Need) – Plan.One. Available from: <https://catenda.com/glossary/level-of-information-need/>
19. Unlocking the Combined Power: LOD + LOIN + LOA (+ IDS!). Available from: <https://plannerly.com/lod-loin-loa-explained/>
20. Levels of Development (LOD) in BIM: A Comprehensive Guide. Available from: <https://bimservices.net/blog/levels-of-development-lod-in-bim-a-comprehensive-guide/>
21. Demystifying BIM Levels: A Complete Guide | BIMCommunity. 2024. Available from: <https://bimcommunity.com/community/demystifying-bim-levels>
22. The 6 Challenges of Implementing BIM Faced by the AEC Industry – Novatr. Available from: <https://www.novatr.com/blog/challenges-of-implementing-bim>
23. What is LOD, LOI, LOG, LOIN? – BuildEXT. Available from: <https://buildext.com/en/what-is-lod-loi-log-loin/>