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Advancing BIM implementation in Romania: Legal context and industry readiness for public construction projects

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Abstract Building Information Modelling (BIM) is reshaping the global construction industry by enhancing collaboration, transparency, and sustainability throughout the project lifecycle. In Romania, however, BIM implementation in publicly funded construction projects faces significant legal, institutional, and cultural challenges. This paper examines the current regulatory landscape, focusing on national strategies, public procurement laws, and relevant technical documentation frameworks. Drawing on recent national surveys and case studies, it explores industry perceptions, technical barriers, and the level of BIM maturity. The findings reveal a growing awareness and gradual adoption of BIM, yet highlight persistent obstacles such as limited professional training, unclear legal responsibilities, and high implementation costs. Based on this analysis, the paper provides strategic recommendations for improving the regulatory framework, developing national standards, fostering interdisciplinary education, and accelerating digital transformation across the Romanian construction sector in alignment with EU policies and international best practices.

Index Terms : building information modelling, public investment, digital construction, Romanian legal framework, industry readiness, BIM roadmap

I. Introduction

Construction regulations provide the necessary framework to ensure proper development of projects, aiming to safeguard the interests of the state, its citizens, and private stakeholders. This framework defines minimum requirements for safety, sustainability, and quality, helping to prevent non-compliance and systemic abuse. Bureaucratic procedures serve as administrative instruments to guarantee that investment projects meet the legal minimum standards. In this context, the standardization of data and processes plays a pivotal role in coordinating activities across the entire lifecycle of a construction project, thereby reducing errors and improving process efficiency. By harmonizing requirements, workflows, and deliverables, communication and collaboration among stakeholders are significantly enhanced. However, the rigid enforcement of regulations can hinder the adoption of innovative solutions, while excessive regulation often creates bottlenecks and incurs additional costs, negatively impacting the efficiency of design and construction phases.

Although the adoption of Building Information Modelling (BIM) in Romania remains in its early stages, multiple initiatives have emerged aiming to integrate this methodology into legislative and administrative frameworks. These efforts seek to improve efficiency and transparency in the construction sector while promoting higher standards of quality and sustainability. According to EN ISO 19650 [1], BIM involves the collaborative use of a digital representation of built assets to support design, construction, and operation processes—serving as a reliable basis for decision-making. BIM transforms how construction projects are conceptualized, designed, executed, and operated. By enabling a shared digital representation of the physical and functional characteristics of assets, BIM fosters collaboration among stakeholders, leading to improved deliverable quality, reduced project timelines, and greater transparency throughout the asset lifecycle [2], [3].

The integration of BIM practices not only streamlines project execution, but also cultivates an organizational culture oriented toward innovation and sustainability. This aligns with the global shift toward energy-efficient and environmentally responsible construction practices [4], [5]. While BIM is often associated with 3D modelling, its value extends far beyond visualization. The rich data embedded within models supports numerous management functions, including concept development, detailed design, scheduling, cost estimation, and project handover for operation [6], [7]. y enabling real-time information sharing and seamless communication among architects, engineers, contractors, and clients, BIM improves decision-making and reduces the risks of delays and cost overruns [8], [9]. Furthermore, the ability to simulate construction processes and evaluate various scenarios prior to execution significantly boosts overall productivity [10].

BIM is also recognized as a key enabler of LEAN construction practices, a practice that supports modular construction and enables more efficient workflows, reduces waste, and fosters value-driven project delivery [11], [12]. As the construction industry continues to evolve, BIM adoption becomes essential for achieving a more sustainable and technologically advanced sector, better equipped to address challenges such as rapid urbanization and environmental pressures [13], [14]. One of BIM's most significant advantages is its capacity to ensure interoperability—facilitating alignment with emerging standards and regulations. Public authorities can accelerate BIM adoption by establishing policy frameworks that encourage compliance, promote interoperability among platforms, and reduce fragmentation in industry practices [15], [16].

In Romania, the drive to modernize the construction industry positions BIM as a promising tool for transformation. However, successful adoption faces a range of obstacles. According to the Ministry of Development, Public Works, and Administration (MDLPA), as outlined in its BIM Roadmap approval memorandum [17], the key challenges include:

1) insufficient training of human resources for the use of digital construction modelling tools;
2) lack of dedicated institutional structures to facilitate the implementation of public sector projects in the BIM system;
3) lack of training or professional development programs;
4) lack of financial support tools for the private sector for digital transformation, which involves significant costs for both human resource training and the acquisition of specific equipment;
5) limited interoperability and collaboration between stakeholders involved in investment projects;
6) lack of a regulatory framework for BIM implementation;
7) lack of communication tools regarding the benefits of BIM adoption in the construction sector;
8) lack of a construction classification system;
9) lack of roles with clear responsibilities (RACI – Responsibility Assignment Matrix).

II. Legal framework in Romania

The adoption and implementation of BIM in Romania occur within a dynamic and evolving legal and regulatory landscape. This chapter outlines the current legislative context for public investment projects and highlights the key challenges and opportunities that can shape the development and promotion of BIM adoption.

II. A. Stages of development and standard content of technical-economic documentation

Government Decision No. 907 of November 29, 2016 [18], regulates the stages of development and the standard content of technical-economic documentation for achieving objectives within new investment projects in the construction field, intervention works on existing constructions, and other investment works.

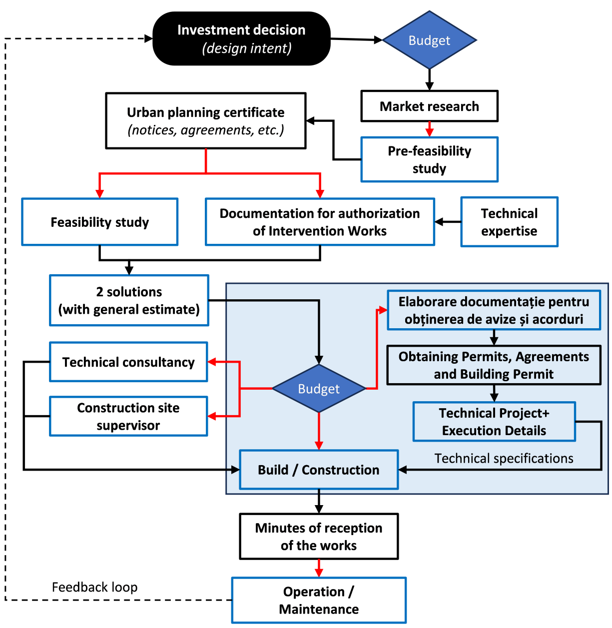

Figure 1: Process stages of investment projects implementation

Figure 1 depicts a structured process for implementing investment projects, emphasizing the importance of legal requirements (i.e., obtaining permits and agreements) and continuous budget considerations throughout the various stages, from the initial design intent to the final commissioning of the project. The process involves preliminary studies, securing necessary authorizations, detailed technical and economic planning, construction, and finally, putting the investment into operation. The iterative nature within the detailed project development phase highlights the potential need for adjustments based on budgetary constraints.

It is important to note that the preparation of the prefeasibility study, feasibility study, and/or documentation for the approval of intervention works requires prior approval of the concept note and design brief by the project beneficiary. Technical and economic documentation must be prepared by certified professionals or organizations authorized to provide design services. Furthermore, the development of the technical execution project depends on the prior approval of technical-economic indicators and the issuance of a construction or demolition permit.

II. B. Legal Framework for BIM Adoption

In June 2023, the Ministry of Development, Public Works, and Administration (MDLPA) signed a contract for the acquisition of expertise services for the implementation of the project "*Increasing the Coherence of the Regulatory Framework and the Efficiency of Technical Regulations in the Construction Sector*" SIPOCA code 731 [19]. The project aimed to promote digitalization and BIM in the construction industry and includes:

1) a national roadmap for BIM implementation.
2) two documents (technical guides, RTC-8 [20] and RTC-9 [21]) with the declared purpose of providing an initial framework for BIM implementation.

These documents are the starting point for public authorities and interested companies to adopt BIM workflows, offering guidance, definitions, and general concepts for BIM implementation. Meanwhile, professional associations [22] and industry cluster [23] contribute to promoting BIM through awareness campaigns, international certification programs [24], and dedicated conferences [25], [26]. However, the pace of adoption is uneven due to low awareness, professional resistance, and limited resources for investment in BIM.

II. B. 1) BIM roadmap

The Romanian BIM Roadmap [27] outlines the measures needed to implement BIM in a structured, phased approach. It draws from the best international practices, emerging technologies, and the experience of leading actors in the local construction sector. Implementation measures are grouped into three strategic levels:

1) Legislative Level
2) Standardizing normative acts;
3) Creating legal conditions for BIM implementation regarding public procurement procedures;
4) Creating legal conditions for organizing the specialized apparatus at the level of public administrations.
5) Administrative Level
6) Implementing and easily using BIM practices;
7) Attracting specialists within the technical departments that will use BIM;
8) Professional training of public officials;
9) Continuous inter-institutional cooperation;
10) Implementing and using BIM regulations and standards at the level of public authorities;
11) Accrediting and expanding the organization of BIM courses in various university centers;
12) Easy access to funding sources from public funds for BIM implementation at the level of public authorities.
13) Economic Level
14) Creating simple, phased financing mechanisms for BIM implementation at the level of public authorities;
15) Developing financial aid schemes in line with the BIM implementation stages specified in the roadmap, at the level of public authorities.

The implementation of actions will be carried out progressively over 4 stages, as presented in Figure 2.

Figure 2: Stages of BIM Implementation in Romania

where,
Stage 1 (Q3 – Q4 2022) – Initial stage;
Stage 2 (Q1 2023 - Q2 2024) - Preparation of the implementation framework;

Stage 3 (Q3 2024 - Q3 2026) - Launching the introduction of BIM at the national level and implementing pilot projects;
Stage 4 (Q4 2026 – Q4 2028) – Development and large-scale expansion of BIM.

II. C. Legal implications regarding public acquisitions

The Public Procurement Law [28] plays a pivotal role in BIM adoption, as it governs how public authorities acquire goods, services, and works. Article 64(1) allows the use of electronic communication methods throughout the procurement process, facilitating the integration of digital tools like BIM. Article 154(1) mandates that tender documentation must fully inform economic operators about all aspects of the procurement, while Article 156(1) requires technical specifications to be defined in terms of performance or functionality, provided the parameters are sufficiently precise. Viewed through the lens of improved efficiency and transparency, these provisions align well with the use of a Common Data Environment (CDE)—a central platform for storing and managing project information. A CDE enhances coordination, reduces errors and delays caused by outdated information, and supports transparent project governance. It also facilitates the implementation of structured information requirements [29] and supports the information management framework defined in SR EN ISO 19650 [1] (see Figure 3). Within the image the following notations were used: **OIR** - Organization Information Requirements, **PIR** - Project Information Requirements, **AIR** - Asset Information Requirements, **EIR** - Exchange of Information Requirements, **AIM** - Asset Information Model, **PIM** - Project Information Model.

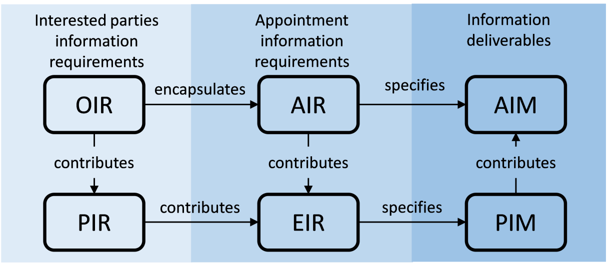

Figure 3: Hierarchy of information requirements

Additionally, Article 115(2) of the same law, allows for framework agreements with one or more suppliers, while Article 142 mandates transparency in all procurement procedures. Article 217 requires public authorities to maintain procurement documentation for a minimum of five years after contract completion. In this context, a CDE can provide a structured and controlled environment for creating, storing, sharing, and archiving project-related data, even in the absence of direct contractual ties between all involved parties.

Despite these opportunities, the Public Procurement Law also introduces several challenges. Many contracting authorities lack experience with BIM, leading to hesitation and resistance to adopting this approach. Furthermore, the upfront costs associated with BIM infrastructure (hardware, software) and personnel training remain significant barriers.

III. Construction industry perspectives on BIM

A survey conducted as part of the iBIMD project [30], co-funded by the European Union through the Erasmus+ program, aimed to assess digital skill gaps in the construction industry, with a specific focus on BIM. Designed to identify digitalization needs and barriers to BIM adoption, the survey informed the development of a comprehensive training curriculum in BIM and digital construction processes. It collected input from a wide range of industry stakeholders—architects, engineers, contractors, and building owners—from Romania, Germany, Italy, Portugal, and Denmark. The findings provided valuable insights into the key challenges, perceptions, and needs surrounding BIM implementation.

The most frequently cited obstacles were:

1) technical barriers, such as lack of interoperability between software tools;
2) skills gaps, including limited in-house expertise and BIM capabilities;
3) organizational resistance, such as perceiving BIM as irrelevant to current projects.

Other challenges included high implementation costs, inadequate alignment between BIM tools and business requirements, resistance to change at both individual and institutional levels, integration difficulties for cost planning, collaboration issues with external parties, and uncertainties regarding data ownership.

More specifically for Romania, surveys conducted in 2020 [31] and 2024 [32] by BIMTech highlight a positive evolution in the level of adoption and knowledge about BIM among stakeholders in the Romanian construction industry. The results are as follows:

1) **BIM awareness**: In 2020, 36.8% of respondents had heard of BIM in the last 2 years, and 12% stated that it was the first time they had heard of this concept. In 2024, the percentage of those who had heard of BIM in the last 2 years increased

to 37.6%, and only 8.9% of respondents had never heard of BIM. This increase indicates greater awareness of BIM in the industry.

2) **BIM perception**: In both surveys, the majority of respondents considered BIM important for the construction sector in Romania. In 2020, 67.7% of respondents considered BIM "very important, representing the future of the field," and in 2024, the percentage increased to 74.3%. This increase suggests a deeper understanding of the benefits of BIM.
3) **Knowledge of BIM concepts**: In 2020, 48.1% of respondents correctly identified BIM as a concept, not just software or a 3D design method. In 2024, the percentage of those who correctly understood the BIM concept increased to 56.4%. Additionally, in 2024, there was an increase in knowledge about CDE (Common Data Environment) and IFC (Industry Foundation Classes).
4) **BIM usage in projects**: In 2020, 33.8% of respondents stated that they had not used BIM in any project, and 25.6% had used it in less than 30% of projects. In 2024, the percentage of those who had not used BIM decreased to 7.9%, and 61.4% of respondents had used BIM in at least 30% of projects. This increase indicates a wider adoption of BIM in practice.
5) **Challenges in BIM adoption**: In both surveys, the lack of know-how, the high cost of software, and resistance to change were identified as major challenges in BIM adoption. In 2024, there was an increase in concern related to the lack of clear standards and implementation guidelines.

These results demonstrate that BIM adoption is a transformative process that disrupts traditional workflows and demands significant adaptation. Limited training and understanding, especially among recent graduates, impede the ability of organizations to fully capitalize on BIM's potential. Institutional and individual resistance to change remains a critical barrier, as traditional methods are deeply ingrained. Moreover, the lack of standardized protocols and platform interoperability limits effective collaboration across disciplines.

Despite these challenges, integrating BIM from the early design phase can deliver significant benefits: increased efficiency, improved project quality, and enhanced interdisciplinary collaboration. Additionally, BIM contributes to the sustainability and durability of buildings by enabling better resource management and energy performance optimization.

III. A. Key technical challenges in BIM implementation

The digital transformation of Romania's construction sector requires updated standards, new approaches, and refined delivery methods. In this context, information management becomes central—emphasizing consistent taxonomy, ontologies, protocols, and data exchange processes.

A successful BIM environment relies on generating high-quality, standardized information that can be exchanged, integrated, and queried across platforms and technologies. This requires the definition of a clear ontology, a structured framework that outlines concepts, relationships, and rules for how construction information is modelled and managed.

To achieve this, several foundational elements must be established:

1) The adoption or development of a classification system for construction elements, services, and processes;
2) The clear definition of project lifecycle stages aligned with construction workflows;
3) The implementation of a file naming convention for project data and documentation.

These elements must be agreed upon by industry stakeholders, tested through pilot projects (as outlined in the BIM roadmap memorandum), and gradually rolled out on a wider scale.

Classification systems such as Uniclass [33] or Omniclass [34], compliant with EN ISO 12006 [35], as referenced in EN ISO 19650-1 standard [1], have already been adopted in other countries. In Romania, the RTC-8 BIM Guide [20] emphasizes classification as a means of organizing objects, processes, roles, spaces, and construction elements, enabling a common vocabulary essential for effective collaboration. Classification involves grouping entities based on shared characteristics into a hierarchical, exhaustive system, where each item belongs to a single class.

The construction lifecycle is another valuable framework for structuring information management. While investment projects are often described linearly (from initiation to operation), information management activities follow iterative cycles. These cycles are closely tied to procurement strategies. BIM implementation does not replace existing processes but enhances them by introducing structure and improving flow. Although information management differs from information production, the two are deeply interconnected and should be coordinated throughout the project lifecycle.

A standardized file naming convention—a core requirement of BIM Level 2—is a practical tool that promotes national alignment with international standards. It reduces errors and enhances document retrieval by enforcing a common structure for naming parameters, files, directories, and other elements subject to exchange. The UK National Annex to BS EN ISO 19650-2 [36] provides a well-established example. In Romania, it is recommended that files be named using a set of fields separated by delimiters, such as:

III. B. Project-Developer-Function-SpatialDivision-Format-Discipline-Number

Among these, defining the "Discipline" field is particularly complex, as roles and responsibilities are not yet consistently mapped across the Romanian construction sector.

The construction lifecycle also appears in the CATUC framework [37], proposed by Romanian construction professionals. Following recent government revisions, the lifecycle has been grouped into five stages, though this results in a structural asymmetry: three stages in the planning phase followed by single-stage phases. This deviates from the original logic of four balanced phases with two stages each.

Figure 4 illustrates the construction lifecycle as currently applied in publicly funded projects, aligned with the general process presented in Figure 1.

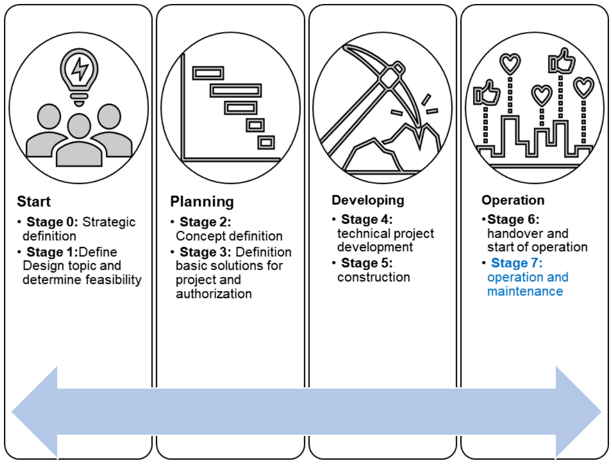

Figure 4: Construction project life-cycle

Another approach can be found in the Plan of Work developed by RIBA (Royal Institute of British Architects, Plan of Work 2020) [38], which presents the stages in sequential order without grouping them into phases.

IV. Practical BIM applications in Romania

The implementation of BIM in Romania is marked by a growing interest and adoption of this technology across various sectors of the industry. The National Road Investment Company (CNIR) announced the implementation of BIM in its infrastructure projects to increase efficiency and quality. In press releases dated December 20, 2024 [39], and January 9, 2025 [40], CNIR announced the implementation of BIM in its infrastructure projects. In the evaluation of project documentation, the financial offer has a weight of 40%, while the technical offer (60%) includes a weight of 6% for the use of BIM. Annexes 11 and 12 specifically define the requirements for modeling and information exchange (geometric level of detail – LOD and level of information – LOI), as well as information security requirements.

An example of BIM implementation in infrastructure projects is the project developed by STRABAG, where the BIM approach was used for the design and construction of 6 km of national road, 2 bridges, and 3 roundabouts to provide an alternative for transit traffic in Făgăraș. The project used a CDE from Trimble [41] to ensure easy access to updated relevant information for the actors involved in the project. The CDE was used for managing both individual and aggregated models, as well as document management. According to buildingSmart International [42], the information exchange requirement must be defined for each BIM use case throughout the entire design, construction, and operation process to enable collaborative work and efficient, error-free data exchange. Thus, at the project level, 8 BIM use cases were identified and defined as follows:

1) **Existing conditions modelling:** this involves collecting essential initial data from the field and converting it into 3D information. Input data can be obtained from existing documentation, surveys, 3D scans, photogrammetry, or a combination of these. In this case, drones were used for data acquisition from the field and photogrammetry for converting 2D images into 3D information.
2) **Model visualization:** used as a basis for project discussions about planning and execution. In this case, this use case facilitated the verification of the location of constructed objects during execution and communication with the client.
3) **Design and verification:** during the design phase, 3D models were used for checks and quality control.
4) **Discipline voordination:** by aggregating all models into a central model for alignment checks, collision detection, and systematic conflict resolution.
5) **Execution planning:** in accordance with the design to ensure efficient construction and increase project activity coherence.

6) **Quantity development:** directly correlated with the modelled dimensions in the design phase (volumes, areas, lengths, number of pieces, etc.).
7) **Construction monitoring:** using the model as a basis and drone flights for verifying site progress for technical quality and cost control. The developed model contains executed elements and remaining quantities to be executed and allows for automatic generation of interactive reports.
8) **Machine control:** by transferring relevant information from 3D models to the control system.

For project development, the openBIM [43] approach was used, based on IFC [44] to allow all involved disciplines to work independently but coordinated.

Figure 5 shows the model developed by each discipline involved in the project and the process of federating into the central model.

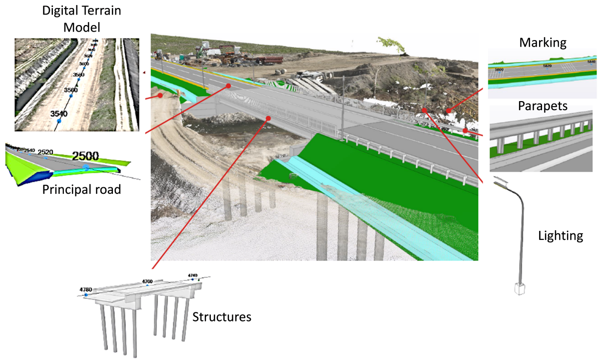

Figure 5: Federating Component Models into the Central Model

The project for the construction of the new international passenger terminal T4 at Iași Airport, the connection with the existing T3 terminal, the external parking, and access roads represents an example of BIM implementation for delivering integrated projects, construction with design. The BIM use cases for this project were as follows:

1) **Visualization:** given the basic requirement of the project for planning, as a basis for discussions with the client. The 3D model was also used for execution planning and asset construction. Additionally, by correlating with the existing situation, the information was used to verify the positions of constructed elements.
2) **Discipline coordination:** By federating the models of all disciplines into a single aggregated model, with automatic collision detection and systematic conflict resolution (Figure 6).

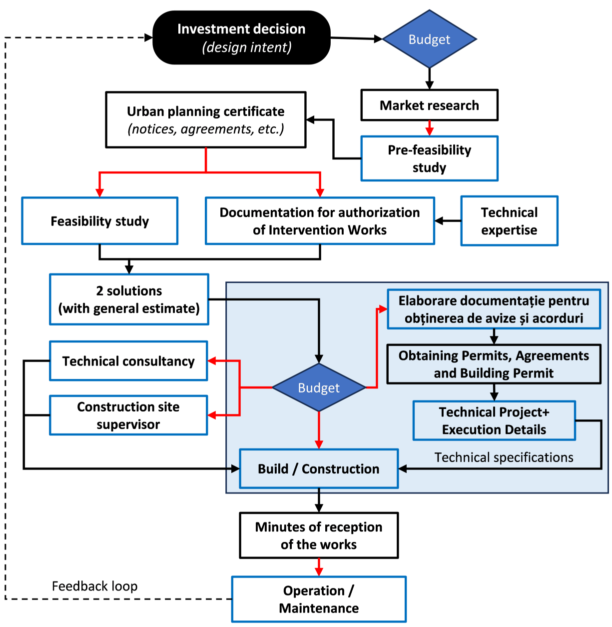

Figure 6: Federated model with automatic conflict identification

3) **Quantity development:** (volumes, areas, lengths, others) using the federated model as the calculation basis.
4) **Execution planning:** by correlating model elements with technical times (4D modelling - Figure 7).

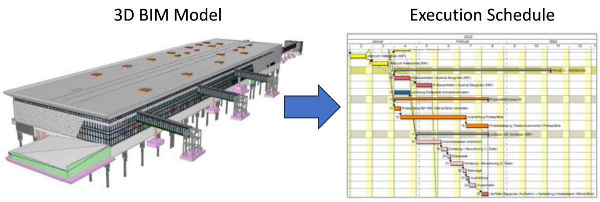

Figure 7: 4D modelling

5) **Cost optimization:** By correlating the 4D model with quantities, transport, and installation costs, a 5D model can be developed that allows simulations for cost optimization (Figure 8).

Figure 8: 5D modelling

6) **Execution monitoring:** by verifying the construction status on-site and comparing the current situation with the initial planning.

V. Concluding remarks

BIM adoption in Romania is still in its formative phase but demonstrates considerable potential to transform the construction sector, especially for publicly funded projects. The existing legal and regulatory framework creates both opportunities and constraints, highlighting the urgent need for coherent policies, technical guidance, and structured implementation strategies.

To accelerate BIM integration and maximize its benefits [45], the following strategic measures are recommended:

1) Invest in targeted training and education programs for professionals across the construction value chain, including public sector employees.
2) Refine and clarify the legal framework, aligning national regulations with ISO 19650 and ensuring support for digital project delivery within public procurement.
3) Provide financial incentives and technical support for companies investing in BIM infrastructure, tools, and workforce development.
4) Promote awareness through pilot projects, case studies, and best practice dissemination to showcase the value of BIM in terms of quality, cost-efficiency, and sustainability.
5) Support the development of standardized taxonomies and protocols, including national classification systems and naming conventions, to ensure interoperability.
6) Define clear responsibilities and roles in information management, using tools like the RACI matrix to avoid fragmentation and ambiguity.
7) Develop implementation guides based on RTC-8 and RTC-9 to assist practitioners with concrete, project-level BIM applications, including LOD, LOI, and model properties.

By systematically addressing these areas, Romania can position itself to fully leverage BIM's transformative capabilities, improve the performance of public construction projects, and contribute to the broader digitalization goals set forth at the European level.

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