A Review of Information Requirements in BuildingInformation Modeling (BIM)

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ABSTRACT

This article explores the crucial aspects of building information modeling (BIM) projects, focusing on the contractual agreements and responsibilities of key stakeholders such as BIM specialists, BIM coordinators, and BIM managers. The Employer's Information Requirements (EIRs) and the BIM Execution Plan (BEP) play a significant role in defining project objectives, model specifications, and workflows. The EIR outlines the client's BIM implementation objectives, including responsibilities, handover dates, procedures, and data exchange formats. Bidders respond to the EIR with a pre-award BEP, which is further refined after contract award. Data drops or information exchanges are essential milestones in BIM projects, aligning with stages of the design process. These exchanges include models, data structures, and reports. The ISO standards of the series 19650 provide general specifications for executing BIM projects, ensuring the creation and delivery of appropriate information throughout the project lifecycle. The article emphasizes the importance of establishing clear requirements for information exchange through the EIR. It explains that the EIR evolves from a simplified information requirements process map to a detailed document that outlines the necessary information for decision-making, procurement, and asset maintenance. The EIR includes standard methods, role definitions, an information delivery plan, and a COBie demand matrix. The BIM Execution Plan (BEP) serves to showcase the capabilities of the design team and outlines the information management implementation throughout the project. It includes a project implementation plan, collaboration goals, proposed milestones, and a deliverable strategy. The post-contract BEP further details how the EIR requirements will be met and covers management, planning, documentation, and IT solutions. The article also defines the roles and responsibilities of BIM specialists, BIM coordinators, and BIM managers. BIM specialists possess domain-specific expertise and manipulate models and data. BIM coordinators manage and coordinate multidisciplinary projects, ensuring adherence to standards and procedures. BIM managers oversee information management, coordinate teams, and make strategic decisions. Overall, understanding the contractual agreements, information exchange requirements, and roles within BIM projects is crucial for successful implementation and collaboration among stakeholders.

Keywords:-Building Information Modeling (BIM), Employer's Information Requirements (EIR), BIMExecution Plan (BEP), Information exchange, Roles and responsibilities

INTRODUCTION

To achieve successful BIM projects, it is crucial to have legally binding agreements that address various aspects such as model contents, model qualities, and workflows. These agreements, particularly those

concerning the final handover of building models to the owner, play a significant role. Typically, general contractual specifications are provided through a contract appendix, which defines the applied terminology and global responsibilities[1].

Within this context, the Employer's Information Requirements (EIRs) and the BIM Execution Plan(BEP) play a vital role and are specifically developed for the construction project. These documents form an integral part of the contractual agreements. The EIR, included in the tendering documents, outlines the client's objectives for implementing BIM in the project and details how the digital building information modeling processes will be executed. It includes precise specifications on responsibilities, handover dates, procedures, and data exchange formats. The content of the models to be delivered is specified through well-defined Levels of Development (LODs) for each element type, along with detailed attribute lists. Normally, the EIRis part of a broader asset information requirements document aligned with the organization's wider asset management plan, as defined in the organizational information requirements. Bidders, also known as potential contractors, describe their plans to meet the EIR requirements in a pre-award BEP, which is further refined into a more detailed document after the contract is awarded.

To ensure proper validation and control of BIM projects during their development, data from the evolving model is submitted to the employer at key milestones, commonly referred to as "data drops" or "information exchanges." These data drops are typically aligned with stages of the design process, and the information provided corresponds to the LOD that the project should have reached at that particular stage, similar to a stage report in conventional projects. The exchanged information includes Industry Foundation Classes (IFC) models, native Project Information Models (PIMs), data structures such as Construction Operations Building Information Exchange (COBie) files and schedules, as well as PDF reports.

General specifications for the execution of BIM projects are outlined in the ISO standards of the series 19650. These standards aim to ensure that appropriate information is created in the right format and delivered at the appropriate time, enabling better decision-making throughout the design, construction, and operation of built assets.

REQUIREMENTS FOR INFORMATION EXCHANGE

The Employer's Information Requirements (EIR) encompass all the information necessary for the client, both from their internal team and external professionals (project team, contractor, facility managers), for the project's development and the operation of the completed built asset. Extracts from the EIR are commonly included in procurement documents to guide the selection of suppliers, including advisors and consultants. Potential suppliers respond to the EIR by submitting a pre-award BIM Execution Plan (BEP), which allows evaluation of their proposed approach, capability, and capacity.

The development of the EIR is typically an iterative process. It may initially take the form of a simplified information requirements process map, outlining key decisions to be made during the project to ensure that the solution aligns with the business need. At this stage, it broadly defines the information required to make those decisions. As the project progresses, the EIR becomes more specific, identifying material, functional, and

performance information necessary for facilities, floors, and spaces. It further refines the requirements as the design evolves, specifying the information needed for proposed systems and building components to facilitate procurement. Ultimately, by project completion, the EIR clearly outlines the information necessary for the maintenance and operation of installed systems and components. It should detail the expected information deliverables, such as documents, model files, and structured information, and establish guidelines for how and when information should be exchanged throughout the project life cycle.

However, the specific characteristics of the EIR will vary based on the project's complexity and the employer's requirements. More demanding employers may develop highly detailed EIRs, whereas others may outline high-level requirements and basic guidelines, allowing the supplier to propose their approach to meeting those requirements. The EIR typically includes the following common elements:

- **Standard methods and procedures:** Defining the prescribed approach for creating, naming, and exchanging information.
- **Clear role definitions:** Clearly outlining the responsibilities of different information- related roles within the project.
- **Information delivery plan:** Establishing a plan that specifies which information deliverables should be provided, by whom, and within defined timelines.
- **COBie demand matrix:** Identifying the structured data related to the facility, floors, spaces, zones, and building components that should be delivered and specifying when they should be delivered.

To establish the contractual validity of the EIR, it can be referenced or appended to a BIM protocol. The BIM protocol serves as a contractual framework that defines the responsibilities, liabilities, and limitations related to BIM. The contract used for project appointments can be supplemented with a BIM protocol through the inclusion of a model enabling amendment clause.

EXECUTION PLAN FOR BUILDING INFORMATION MODELING (BIM)

The BIM Execution Plan (BEP), also known as BxP or referred to as a BIM delivery plan or digital execution plan, outlines the implementation of information management within the project by the delivery team. The BEP serves two primary purposes: firstly, to showcase that the design team possesses the necessary expertise, skills, software, and hardware to meet the requirements of the EIR, and secondly, to outline how these tools will be utilized throughout the project, including specifics on collaborative workflows and file naming conventions.

In the typical scenario, potential suppliers prepare a pre-award BIM Execution Plan (BEP) as part of the tendering process, presenting their proposed approach, capability, capacity, and competency to meet the requirements specified in the EIR. The pre-award BEP may encompass the following elements:

- **Project Implementation Plan (PIP):** Outlining the suppliers' capability, competency, and experience, accompanied by relevant quality documentation.
- **Collaboration and Information Modeling Goals:** Describing the intended objectives for collaboration and information modeling throughout the project.
- **Proposed Project Milestones:** Aligning the proposed milestones with the overall project schedule.

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- **Deliverable Strategy:** Defining the strategy for delivering project-specific outputs andoutcomes.

After the contract is awarded, the supplier submits a comprehensive BEP that verifies the capabilities of the supply chain and includes a Master Information Delivery Plan (MIDP). The MIDP specifies the timeline for preparing project information, assigns responsibility to specific parties, and outlines the protocols and procedures to be followed. It is based on a series of individual Task

Information Delivery Plans (TIDP) that allocate responsibilities for specific information-related tasks.
The BEP goes beyond modeling strategies and considers the connectivity of all

software utilized in the project. The post-contract-award BEP outlines how the information required in the EIR will be provided, addressing aspects such as management, planning, documentation, standard methods and procedures, and IT solutions (refer to Table 1).

If multiple suppliers are involved, there may be an overarching BEP defined in the appointment documents, which subsequent BEPs prepared by subsequent appointments should align with. Various institutions have published templates for both the EIR and BEP. For example, pre-contract and post-contract BEP templates can be accessed on the Construction Project Information Committee (CPIC) website.

Table 1:-Execution Plan for Building Information Modeling (BIM)

Area	Information required
Management	- Roles, responsibilities and authorities - Project milestones in line with the project program - Deliverable strategy - Survey strategy - Existing legacy data use - Approval of information - Authorization process
Planning and documentation	- Revised PIP confirming the capability of the supply chain - Agreed processes for collaboration and modeling - Agreed matrix of responsibilities - TIDP setting out responsibility for delivery of each supplier's information - MIDP setting out when project information is to be prepared, by whom and using what protocols and procedures
Standard method and procedure	- Volume strategy - Origin and orientation - File naming convention - Layer naming convention - Construction tolerances - Drawing sheet templates - Annotation, dimensions, abbreviations, and symbols - Attribute data
IT solutions	- Software versions - Exchange formats - Process and data management systems

ROLES AND PROFESSIONS IN BUILDING INFORMATION MODELING (BIM)

Ensuring effective management of information flow within the BIM process necessitates the precise delineation of roles and responsibilities for all project stakeholders. Simultaneously, the adoption of BIM methodology entails acquiring new skills, evolving workflows, and introducing novel professional roles[2].

Various academic and professional sources have provided insights into the profiles and competencies of professionals involved in Building Information Modeling (BIM). For example, the British Standard Institution (BSI) document PAS 1192-2:2013 identifies up to seven roles related to BIM management. It clarifies that these roles should not be confused with the professional roles within an organization but rather denote the level of authority in managing information flow in the BIM process.

In general, three main types of professionals can be identified: (1) BIM specialists, (2) BIM coordinators, and (3) BIM managers. While their responsibilities, skills, and knowledge may differ, there can be some overlap, making their definitions somewhat fluid (refer to Table 2).

BIM specialists possess expertise in using software to create BIM projects in their respective domains, such as architecture, structural engineering, plant engineering, environmental sciences, and infrastructure. They have a comprehensive understanding of technical and operational documentation, applying it to produce models and compositions. Working under the supervision and coordination of BIM coordinators or BIM managers, BIM specialists act as "information designers," responsible for graphical and non-graphical design tasks. They manipulate, edit, and extract data from the models and associated objects resulting from coordination procedures.

BIM coordinators manage and coordinate multidisciplinary BIM projects, adhering to resources, standards, and company procedures. Their role involves coordinating activities, reviewing and controlling projects using specific software tools, and utilizing technical and operational documentation for BIM deliverables and models. Their responsibilities encompass content coordination, collaboration with BIM managers, and contributing to the development of the BIM Execution Plan (BEP). Additionally, they handle content sharing, coordination, and aggregation, identifying potential interferences and inconsistencies, and proposing solutions to the BIM manager and relevant project personnel. The role of BIM specialist/coordinator for building focuses on planning, constructing, and managing buildings in various sectors, while the role of BIM specialist/coordinator for infrastructure centers on the planning and construction of roads, railways, and harbours, among others.

Given the complexity of multidimensional BIM modeling and the ongoing need for information management, BIM project teams require coordination. This responsibility is typically assigned to a trained BIM manager who defines workflows, monitors development stages, and ensures compliance with guidelines. BIM managers are responsible for maintaining, structuring, and managing the building data model and its submodels. They coordinate project teams, provide support in overcoming challenges and queries, and align their actions with available resources, standards, and business procedures. BIM managers utilize software tools for project coordination,

control, and management. External BIM managers may be engaged as consultants or to support inexperienced teams in implementing and integrating the BIM methodology.

BIM managers also oversee information management and coordination with suppliers involved in the design and management of the building. They document technical and operational aspects of the building commission and make crucial decisions regarding company strategy. These professionals often work across building and infrastructure disciplines, managing and coordinating teams across various fields such as engineering and architecture. In terms of information management, BIM managers select appropriate software programs and determine the required resources. They organize and participate in regular team meetings to track progress and coordination. When dealing with interferences or inconsistencies, they are responsible for making necessary decisions.

Table 2:-*Roles and Duties of Building Information Modeling Specialists, BIM Coordinators, and BIM Managers*

Roles	Responsibilities											
	Production		Management				Strategic					
	Modeling	Drawing production	Content creation	Model coordination	Modeling audit	Execution plan	Training	Implementation	Standards	Process + workflow	Research	Corporate objectives
BIM specialist	■	■	■									
BIM coordinator	■		■	■	■	■	■					
BIM manager						■	■	■	■	■	■	■

CONCLUSIONS

The implementation of Building Information Modeling (BIM) projects requires clear and legally binding agreements to address various aspects of model contents, qualities, and workflows. The Employer's Information Requirements (EIRs) and the BIM Execution Plan (BEP) are crucial documents that form an integral part of these agreements. The EIR outlines the client's objectives for implementing BIM in the project and specifies responsibilities, handover dates, procedures, and data exchange formats. It establishes the expected information deliverables and provides guidelines for information exchange throughout the project life cycle. The EIR evolves throughout the project, becoming more specific and detailed as the design progresses.

On the other hand, the BEP outlines the implementation of information management within the project by the delivery team. It demonstrates the team's expertise, skills, software, and hardware to meet the EIR requirements. The BEP includes a Master Information Delivery Plan (MIDP) that specifies the timeline for preparing project information and assigns responsibilities to specific parties. Both the EIR and BEP play essential roles in ensuring proper validation and control of BIM projects.

They facilitate effective information exchange, decision-making, and collaboration among project stakeholders. The ISO standards of the series 19650 provide general specifications for executing

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BIM projects and ensuring the creation and delivery of appropriate information.

Additionally, roles and professions in BIM projects need to be clearly defined to manage information flow effectively. BIM specialists, BIM coordinators, and BIM managers each have specific responsibilities in creating, coordinating, and managing BIM projects. Their roles may overlap to some extent, but they contribute to the successful implementation of BIM methodologies. Overall, by establishing clear agreements through EIRs and BEPs and defining roles and responsibilities, BIM projects can achieve better coordination, collaboration, and decision-making throughout the design, construction, and operation of built assets. These practices contribute to more efficient and sustainable project delivery and asset management in the construction industry.

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