Transactions on Engineering and Computing Sciences - Vol. 12, No. 1
Publication Date: February 25, 2024
DOI:10.14738/tecs.121.16270.
Shawky, K. A., Abdelalim, A. M., & Sherif, A. G. (2024). Standardization of BIM Execution Plans (BEP's) for Mega Construction Projects: A Comparative and Scientometric Study. Transactions on Engineering and Computing Sciences, 12(1). 103-129.

Services for Science and Education

Standardization of BIM Execution Plans (BEP's) for Mega Construction Projects: A Comparative and Scientometric Study

Kamal Ahmed Shawky
Faculty of engineering at Mataria, Helwan University, Cairo, Egypt

Ahmed Mohammed Abdelalim
(ORCID: 0000-0003-3359-715X)
Faculty of engineering at Mataria, Helwan University, Cairo, Egypt

Alaa Gamal Sherif
Helwan University

ABSTRACT

Building Information Modeling (BIM) is the foundation of the Architecture, Engineering, and Construction (AEC) industry's digital transformation. BIM is a method of creating and managing information on a construction project over its entire life cycle. The lack of standardized processes for developing Building Execution Plans (BEPs) is a significant impediment. This paper presents a comprehensive review of the development and implementation of BEPs in AEC industry. The purpose of the study is to identify and analyze the content topics of a BEP. The paper highlights the prevalence of differences in the content, structure, practice methods, contractual requirements, and project characteristics among various BIM execution planning guidelines. It also identifies the need for standardized approaches to information exchange and collaboration in BIM projects. The findings of this research provide insights for industry professionals, researchers, and technology developers interested in the current and future uses of BEPs and smart document application in BIM. This study identified and analyzed 36 BEP documents published by diverse organizations globally. Results showed a theoretical framework shared among most BEPs, despite variations in content presentation and chapter titles. The identified key elements in BEPs include project information, goals and objectives, roles and responsibilities, collaboration procedures, model structure, quality control, technology infrastructure needs, and project deliverables. Furthermore, the study proposes a comprehensive BEP framework, synthesized from the most frequently occurring sub-elements in the analyzed documents. This study conducts a thorough Scientometric analysis using the Web of Science and Scopus databases to examine the development of scientific trends and subjects in the realm of BIM Execution Plans from 2020 to 2023 as it's the most period has Development in BEP. The lack of standardized guidelines for BEP development is identified as a significant impediment, leading to inconsistencies and inefficiencies in project delivery.

Keywords: BIM Execution plan, BIM Frame work, Standardization of BIM Execution plan, BIM procedures, BIM in Construction Projects, BIM: Building information Modeling

BEP: BIM Execution Plan, MIDP: Master information Delivery plan, TIDP: Task information Delivery plan, QA: Quality Assurance, QC: Quality Control, CDE: Common Data Environment, LOD: Level of Development, AEC industry: Architecture, Engineering and Construction industry

INTRODUCTION

Although BIM and BEP hold great potential, the lack of standardized procedures for the creation and implementation of BEPs presents a significant obstacle. The objective of this research is to examine the complexities associated with BIM Execution Planning to fill a significant void in current industry standards. The justification for undertaking this research is based on the acknowledgement that the construction sector functions in a rigorously regulated setting, controlled by a complex network of regulations, standards, guidelines, and codes of conduct. The intricate nature of the industry is highlighted by the variety of these controls and enablers; therefore, a methodical and standardized strategy is required to ensure the successful deployment of BIM, [1, 2, 3, and 4].

The absence of universally accepted principles for the formulation of BEPs becomes a substantial barrier to the smooth incorporation of BIM into construction endeavors. The lack thereof leads to incoherence and inefficiency, as demonstrated by the disparate levels of specificity, organization, and substance present in BEPs for various projects and organizations. As a result, the sector encounters obstacles when it comes to attaining collaborative excellence, facilitating effective information exchange, and ensuring precise project coordination. Neglecting to confront these obstacles may result in inaccuracies, postponements, and increased expenditures on the project. This research is motivated by the critical necessity to close this divide between knowledge and application. Through an extensive analysis of current Building Envelopment Planning (BEP) systems, a comprehensive framework proposal, and a comparison with international standards and guidelines, we intend to lay the groundwork for standardized BIM Execution Plane. The objective is to ensure transparent communication, promote clarity, and guarantee the efficient execution of Building Information Modeling (BIM) across a range of construction endeavors.

Following this, we shall proceed to examine the precise obstacles delineated in the problem statement, undertake an exhaustive examination of pertinent scholarly works, explicate the approach utilized in this investigation, deliberate on the outcomes acquired, and ultimately put forth a framework that appears to be well-positioned to steer the trajectory of BIM Execution Planning in the coming years, [5,6,].

PROBLEM STATEMENT

The construction industry is currently navigating through a labyrinth of varied standards, guidelines, and regulatory measures which, while intended to guide project management, often create a challenging environment due to their diversity and complexity. The absence of a universally acknowledged and adopted framework for the creation and implementation of BEPs exacerbates this challenge, leading to significant inefficiencies and miscommunications among stakeholders. Such discrepancies are not mere inconveniences but have far-reaching

consequences, contributing to errors, project delays, and cost overruns, which can undermine the success of largescale construction projects.

Moreover, this fragmentation in processes and documentation standards is a major obstacle to achieving the seamless collaboration and integration that BIM technology promises. Without a common language and standardized protocols, the potential of BIM to revolutionize project management, from design through toconstruction and operation, remains underutilized. This study seeks to tackle these core issues head-on by analyzing current BEP practices against global standards, identifying best practices, and proposing a standardized framework that can serve as a universal guide for BIM adoption in the construction industry. This research is timely and critical, considering the rapidly evolving nature of construction technologies and the increasing complexity of mega projects. By establishing a standardized approach to BEPs, the study aims to mitigate the risks associated with current practices and to pave the way for a more efficient, transparent, and cooperative construction industry, maximizing the transformative potential of BIM. This will not only enhance the quality of project outcomes but also foster innovation and sustainability in construction practices on a global scale.

METHODOLOGY

This study adopts a comprehensive research design that integrates scientometric analysis into the investigation of the contemporary landscape of Building Execution Plans (BEPs) and their harmonization with international standards and guidelines, Figure 1 shows the Research Methodology workflow.

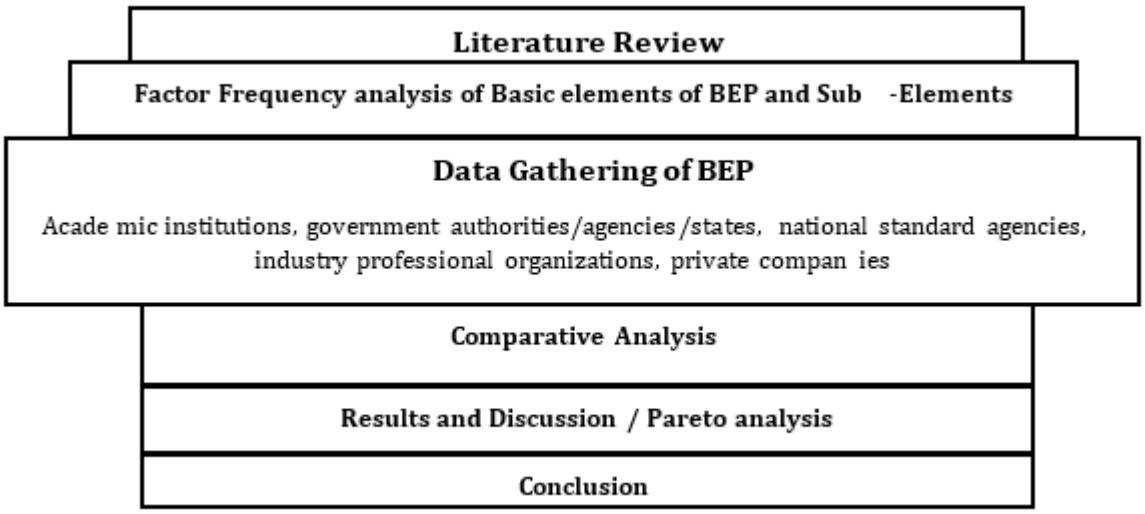


Figure 1: The Research Methodology workflow

Figure 1 delineates the sequential phases of the research methodology adopted in this study. It begins with a thorough literature review, followed by a factor frequency analysis of the fundamental elements and sub-elements of Building Information Modeling Execution Plans (BEPs). The next stage involves an extensive collection of BEP data from diverse sources, including academic, governmental, and industrial entities. This paves the way for a detailed

comparative analysis, leading to a results and discussion section that synthesizes the findings. The process culminates with the conclusion, where the research outcomes are distilled and presented.

Literature Review

A thorough review of academic databases, encompassing Web of Science, Scopus, and various international databases, is conducted to identify pertinent publications on BEP implementation from 2018 to 2023. This inclusive approach ensures a globally representative sample. The review aims to elucidate prevalent topics, trends, andinfluential dependencies within BEP literature. Employing keyword co-occurrence analyses, we seek to unravel the dynamic evolution of scholarly discourse in this domain. Scientometric study is seamlessly integrated into the literature review, affording an analysis of the scholarly impact of publications. This includes the identification of influential authors and institutions, as well as an assessment of knowledge dissemination in the field.

Document Comparison

A judicious selection of 36 BEP documents is made, discerningly chosen for their substantial contributions to BEP development. These documents are sourced globally, representing diverse organizations and encompassing a spectrum of mandates, guides, and protocols. The identified BEPs undergo a thorough comparative analysis against international standards, guidelines, and the project management body of knowledge. This encompassing comparison spans key dimensions of BEP content, structure, practice methods, contractual requirements, code compliances, project characteristics, and social and cultural considerations. Scientometric analyses are meticulously applied to the citation networks of the selected documents, **[7-10].** This facet illuminate's influential works, key knowledge sources, and the intellectual structure within the field.

Scientometric Study

The Scientometric Study in this paper focuses on analyzing research trends and developments in Building Information Modeling (BIM) Execution Plans. It utilizes citation and keyword analysis to map the scholarly landscape, identifying key authors, institutions, and influential works that have shaped BIM standards and practices. This study is crucial in highlighting significant themes and shifts in BIM research between 2020 and 2023. The insights gained from this analysis are instrumental in informing future directions and efforts to standardize BIM Execution Plans.

Co-occurrence of the Top Keywords:

Keyword co-occurrence analysis is a potent methodology for visualizing the development and changes in scientific themes across time. Figure 2 graphically represents the most commonly utilized author keywords within the domain of BIM Execution Plan studies, as indexed by the Web of Science from 2020 to 2023. This time frame was chosen because it marks the era with the highest number of publications related to BEP, totaling 36 documents. The visualization captures the frequency at which these keywords appear, offering insights into the prevailing research focuses.

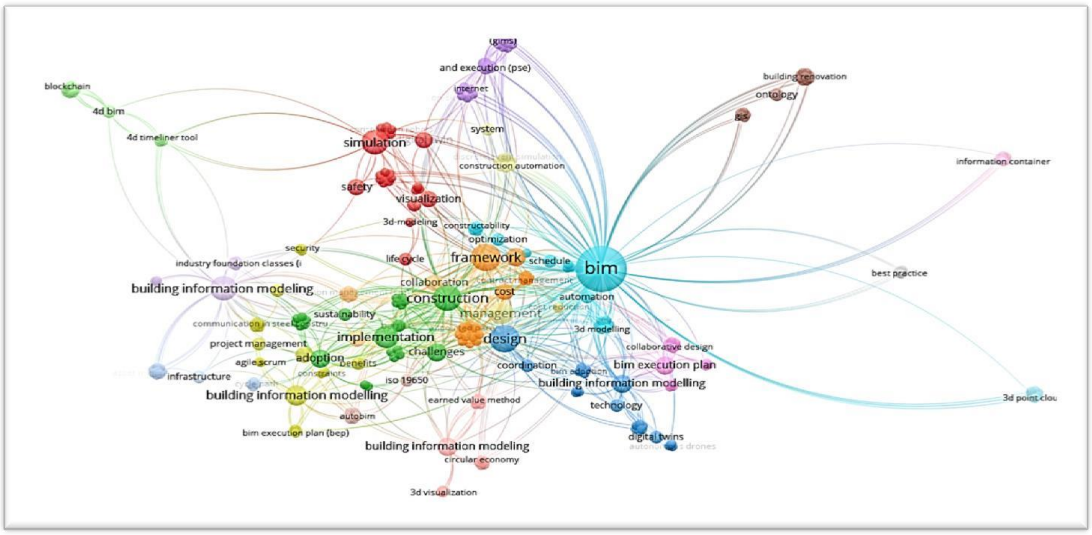


Fig. 2: Web of science searches, Co-occurrence of the top keywords

Figure 2 showcases a colorful network diagram generated by VOS viewer, a tool for constructing and visualizing bibliometric networks. It appears to map the frequency and correlation of keywords within a set of research data focused on BIM. The term "BIM" is prominently positioned, indicating its centrality to the research, with other significant terms such as "framework," "construction," and "design" forming clusters around it. Figure 3 provides a comprehensive analysis of the research environment by categorizing the different sorts of documents released during this period.



Fig. 3: Type of Documents on Web of science research with Key words (2020-2023).

Figure 3 visualizes the distribution of document types on Web of Science related to BIM Execution Plan research over the past three years. It differentiates between various scholarly outputs, with articles being the predominant type, followed by conference papers, review articles, and documents available for early access. This bar chart clearlyindicates a strong preference and higher frequency of articles in the academic community, underscoring the

importance of peer-reviewed journal articles in disseminating research findings in the field of Building Information Modeling. Figure 4 illustrates the frequency and distribution of keywords used by authors in the field of BIM Execution Plans, as documented in the Scopus database from 2020 to 2023." A total of 68 documents were obtained, indicating an increasing interest and academic research in this field. The occurrence rate of particular keywords indicates the core areas of interest and developing topics within the research community. Simultaneously, Figure 5 is configured to exhibit the annual distribution of these documents, presenting a detailed breakdown of each year. This breakdown provides valuable information about the research direction and level of activity in the field of BIM Execution Plan throughout the specified period. Figure 4, extracted using the VOS viewer tool, provides a visual exploration of the themes prevalent in BIM Execution Plan research from 2020 to 2023, as documented in the Scopus database. The intricate of keywords illustrates the dynamic nature of this field, highlighting how terms like 'architectural design,' 'construction industry ‘and’ building information modelling' frequently appear together, pointing to their strong interrelation. The diagram, with its varied color clusters, represents the depth and interdisciplinary of BIM research, marked by the analysis of 68 documents, showcasing the areas of focus and scholarly attention within the academic community.

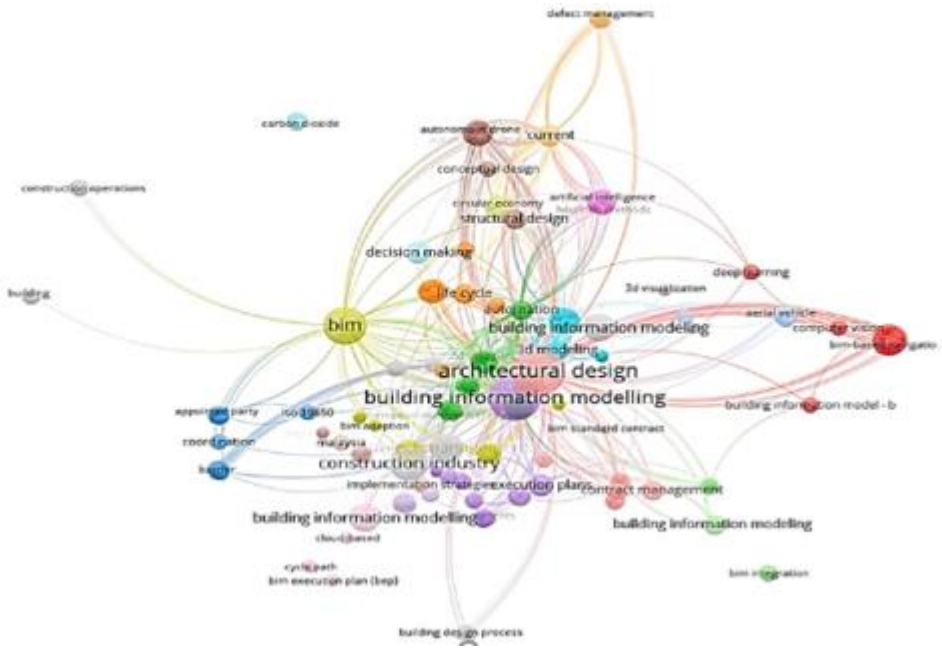


Fig. 4: Web of science searches, Co-occurrence of the top keywords.

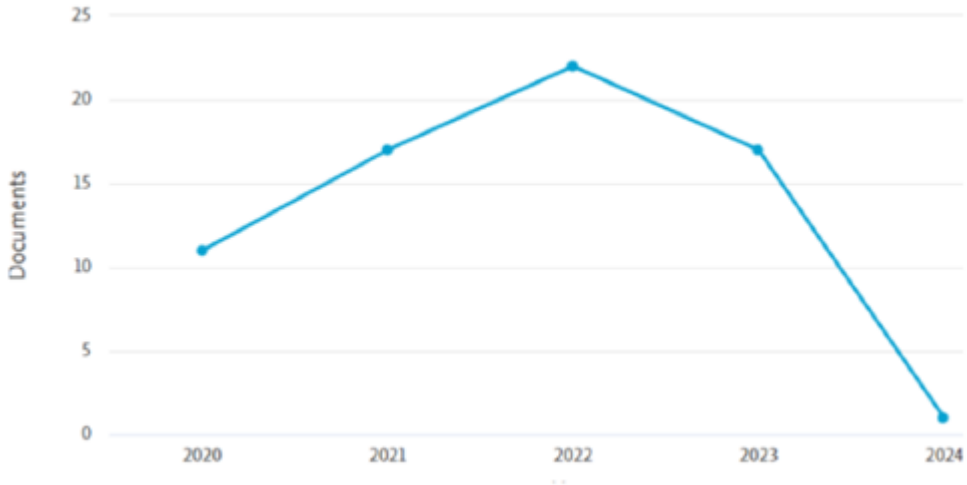


Fig.5: The Number of Documents per year on Scopus research between 20220-2023

Figure 5 displays the yearly academic production on research related to BEP from 2020 to 2023. The line graph depicts a gradual rise in publications starting from 2020, reaching its highest point in 2022. This indicates a greater emphasis on scholarly work and implies a period of vigorous research in the discipline. The ensuing decrease in 2023 and the solitary document in 2023 could potentially indicate a termination of data gathering or a change in study focus. This graphic depiction functions as a gauge for the level of academic interest and the amount of study conducted over these years.

Objectives of the Research

The primary objective was to ascertain the frequency of topics utilized in the BEP in order to comprehend the content and structure of the document. The secondary objective was to determine the connections and influential interdependencies among the content topics to gain insight into the factors that impact the development of a BEP. In order to ensure the successful implementation of BIM, various reference documents have been created, including guidelines, standards, modeling techniques, and work process manuals. Among these documents are BIM Execution Plans (BEPs), of which a total of thirty-six (36) have been identified, compared, and analyzed, see table.1. The findings emphasize the essential components required for the development of BEPs. A comprehensive explanation enables all stakeholders to comprehend the project's goals, workflow, assigned tasks, data requirements, and deliverable specifications. Therefore, this Business Execution Plan (BEP) framework can serve as a guide for the advancement and enhancement of BEP. The study's findings provide a comprehensive set of parameters for researchers and practitioners to create tools that enhance the success of implementing BIM projects. Figure 6 Shows the Frequency of the Most Frequent BEP documents per year of publication.

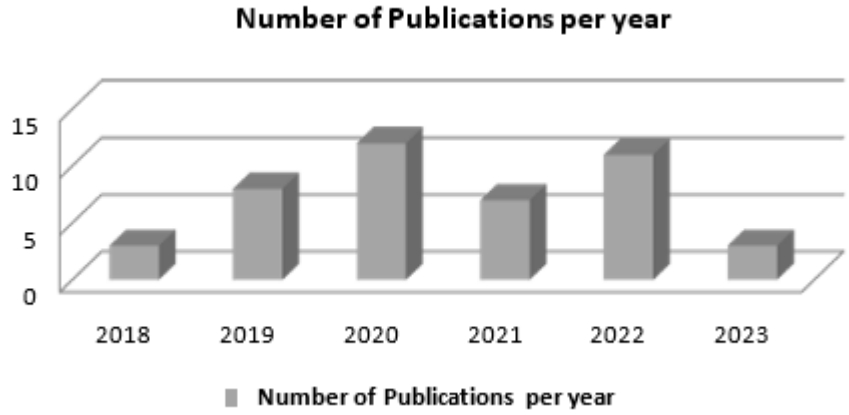


Fig. 6: Frequency of the Most Frequent BEP documents per year of publication.

Table 1: list of identified Documents.

1. Post contract-award BIM execution plan (BEP)	**19.** BIM Project Execution Plan Guide BIM-Forum
2. Australia and New Zealand guide to IOS 19650	**20.** BIM execution plan (BEP) to infrastructure superintendence of the federal university of Pernambuco - federal university in brazil
3. Template for BIM Execution Plan Christchurch City Council	**21.** Guideline (BIM) for Transport and Main Roads Queensland
4. Solar boat BIM method statement	**22.** Hong Kong housing authority BIM standards and guidelines (haBIMsg)
5.The New Zealand BIM handbook (BEP Template)	**23.** BIM project execution planning guide, version 3.0
6. O-west BIM execution plan	**24.** Smithsonian facilities BIM guidelines
7. US San Diego - BIM guidelines 2019	**25.** CIC BIM standards general 2021
8. Guide 5 BIM project guide a Guide to Enabling BIM in Projects – Malaysia - 2019	**26.** Digital twin guidelines Columbia - chips
9. BIM and ISO 19650 from a project management perspective	**27.** Georgia tech BIM execution plan template
10. State of Tennessee Office of the State Architect (TN OSA) 2020	**28.**Pre-appointment and Delivery Team's BEP GuidanceUniversity of Cambridge
11. BEP based on ISO 19650 - 1,2 Standards - Istanbul University	**29.**(BIM) for Infrastructure Federal Highway Administration (FHWA)
12. BIM Contract Conditions of Contract for Building Information Modelling (BIM) The Hong Kong Institute of Surveyors	**30.** NBIMS-US Project Committee and Public Review the National Institute of Building Sciences (NIBS)
13. BIM beyond design guidebook (2020) acrp research report	**31.** Kvmrt-BIM-execution-plan-template-intel build
14. A.3.2.1 building execution plan (BEP)	**32.** Multnomah County BIM execution plan template
15. Journal of Construction Engineering, Management & Innovation	**33.** Ohio-state_BIM_pds_v2022
16. Exchange information requirements water care	**34.** Massachusetts Institute of Technology

17. Building Information Modelling (BIM) for Transport and Main Roads A guide to enabling BIM on Road Infrastructure Projects	**35.** University of Nebraska Medical Center Project
18. Western Michigan university	**36.** University of Tennessee

Analysis of the current BEPs revealed that the majority of the documents contain the typical BEP description. Nevertheless, the structure outlines of certain BEP components varied based on their respective priority. Additionally, certain components of the BEP include supplementary chapters to enhance comprehension. Therefore, conducting additional analyses and comparisons of the guidelines will demonstrate the existing patterns in BEP frameworks. The initial phase of the literature review involved identifying scholarly articles and conference papers pertaining to the implementation of BEP. These publications were limited to the period between 2018 and 2023. Figure 6 displays the frequency of the reviewed publications according to their year of publication, [11-15]. A total of 36 documents were selected for the second step of the literature review. The chosen documents are released by national, governmental, academic, and construction owner organizations, encompassing mandates, guides, and protocols.

RESULTS AND DISCUSSION

Based on the analysis of thirty-six (36) BEPs, it was discovered that almost all of them share a theoretical framework. The presentation of the content and the titles of the chapters were Different. Project information, project goals/BIM objectives/BIM uses roles and responsibilities, BIM process design, BIM information exchange, collaboration procedures, model structure, quality control, technology infrastructure needs, and project deliverables are all outlined in the BEP. Table 3 shows the comparison results of the BEP key elements in each BEP. The 36 documents reviewed suggest developing a formal BEP that details how, when, why, at what level, and for what project outcomes BIM will be used. The fact that the BEP is a living document rather than a static document is highlighted in most documents following the start, development, and completion of a construction BIM project, [16, and 17]. Table 4 shows the frequency of sub-elements in the reviewed documents with the highest percentage (over 50%).

The factor based on the following equation:

$$\boldsymbol{Factor} = \frac{\textbf{Number of element occurrence}}{\textbf{Total number of Documents } (36)} \quad \text{Eq. 1}$$

Table 2 presents a detailed comparison of various sub-elements identified in Building Information Modeling (BIM) Execution Plans. It meticulously categorizes a wide range of elements such as project information, roles and responsibilities, model structure, and technology requirements. Each sub-element is systematically listed to facilitate a comprehensive analysis of how these components are addressed across different BIM Execution Plans. This table serves as a critical tool for understanding the variances and commonalities in BIM Execution Plan structures, offering insights for standardizing these plans in future implementations.

Table 2: The identified sub-elements for the comparison.

1. BIM Project Execution Plan Overview	15.Audit and Continuous Improvement	29. Detailed Modeling Plan
2. Project information	16.Volume Strategy	30. Document Management
3. Master information delivery plan (MIDP)	17.Model Coordination Procedures	31. Roles and Responsibility
4. Task information delivery plan (TIDP)	18.Version Control	32.Information Management Risk Register
5. Responsible Parties	19.Models Coordination	33.Key project contacts
6. Project deliverables	20. Tolerance Strategy	34.Measurement and coordinate systems
7. BIM Uses	21.Methods & Procedure	35.File Naming Conventions
8. BIM Model and Level of Development	22.Project Goals and Objectives	36.Federated Model Color Scheme
9. Collaboration procedures	23.BIM Team	37.Model structure
10. Common Data Environment "CDE"	24.Project Phases / Milestones	38. Coordination Approach
11. Software requirements	25. Modeling Information	39.Quality Management
12. Hardware	26.Model Ownership of Elements	40.Compliance plan
13.Data Validation and Verification	27.Health and safety	
14.Review and Approval Processes	28.Survey strategy	

Table 3: Summary of the Content Comparison Matrix

Publication date		Contents of Document / Document short name	BIM Project Execution Plan Overview	Project information	Task information delivery plan (TIDP)	Responsible Parties	Project deliverables	BIM Use	BIM Model and Level of Development	Collaboration procedures	Common Data Environment " CDE"	Software requirements	Hardwar	Data Validation and Verification	Review and Approval Processes	Audit and Continuous Improvement
1	**2018**	Post contract – award BIM execution plan (BEP)			◙	◙	◙			◙		◙	◙			
2	**2018**	Australia and New Zealand guide to IOS 19650								◙	◙					
3	**2019**	Template for BIM Execution Plan Christchurch City Council	◙	◙		◙		◙		◙						
4	**2019**	BIM and ISO 19650 from a project management perspective					◙	◙			◙	◙	◙			◙

5	**2019**	The New Zealand BIM handbook (BEP Template)	◙	◙		◙	◙	◙	◙	◙	◙	◙	◙		◙	
6	**2019**	O-west BIM execution plan	◙	◙		◙	◙	◙	◙	◙	◙	◙	◙			
7	**2019**	Uc san Diego - BIM guidelines 2019					◙	◙				◙	◙			
8	**2019**	BIM GUIDE 5 BIM PROJECT GUIDE A Guide to Enabling BIM in Projects –Malaysia - 2019		◙	◙	◙	◙	◙	◙	◙	◙					
9	**2020**	Solar boat BIM method statement	◙	◙		◙	◙	◙	◙	◙	◙	◙	◙	◙	◙	◙
10	**2020**	State of Tennessee Office of the State Architect (TN OSA) 2020		◙				◙			◙	◙				
11	**2020**	BIM Execution Plan based on BS EN ISO 19650‑1 and BS EN ISO 19650‑2 Standards - Istanbul Technical University	◙	◙				◙	◙							
12	**2020**	BIM Contract Conditions of Contract for Building Information Modelling (BIM) The Hong Kong Institute of Surveyors	◙	◙			◙	◙	◙							
13	**2020**	BIM beyond design guidebook (2020) ACRP research report	◙	◙				◙	◙							
14	**2020**	A.3.2.1 building execution plan (BEP)		◙		◙				◙	◙					
15	**2020**	Journal of Construction Engineering, Management & Innovation	◙			◙		◙	◙		◙					
16	**2020**	Exchange information requirements water care	◙	◙	◙			◙	◙		◙					
17	**2021**	Building Information Modelling (BIM) for Transport and Main Roads A guide to enabling BIM on Road Infrastructure Projects						◙			◙					◙
18	**2021**	BIM Project Execution Plan Guide BIM-Forum	◙	◙			◙	◙	◙	◙	◙	◙	◙			◙
19	**2021**	BIM execution plan (BEP) to infrastructure superintendence of the federal university of Pernambuco - Federal University in Brazil		◙				◙	◙							
20	**2021**	Guideline Building Information						◙	◙		◙					

		Modelling (BIM) for Transport and Main Roads Queensland														
21	**2021**	Hong Kong housing authority Building Information Modelling Standards and Guidelines (HABIMSG)	●	●	●		●	●	●	●	●	●	●	●	●	●
22	**2021**	BIM project execution planning guide, version 3.0														
23	**2021**	Smithsonian facilities BIM guidelines					●	●	●	●	●	●	●	●		●
24	**2021**	CIC BIM standards general 2021		●	●		●	●	●	●	●	●	●	●	●	●
25	**2022**	Digital twin guidelines Columbia - Chips	●	●		●	●	●	●	●						
26	**2022**	Georgia tech BIM execution plan template	●	●			●		●	●						
27	**2022**	Pre-appointment and Delivery Team's BIM Execution Plan (BEP) Guidance - University of Cambridge		●			●					●	●			
28	**2022**	Building Information Modeling (BIM) for Infrastructure Federal Highway Administration (FHWA)	●	●		●		●	●							
29	**2023**	NBIMS-US Project Committee and Public Review the National Institute of Building Sciences (NIBS)			●	●			●		●	●				
30	**2023**	KVMRT-BIM-EXECUTION-PLAN-TEMPLATE-intel build	●	●			●	●	●	●	●	●	●			
31	**2023**	Multnomah county BIM execution plan template		●			●	●	●	●	●	●	●	●	●	
32	**2022**	Ohio-state_BIM_pds_v2022	●	●				●	●							
33	**2022**	Massachusetts Institute of Technology	●	●			●	●	●	●	●	●	●	●	●	
34	**2022**	University of Nebraska Medical Center Project	●	●		●		●	●	●		●				
35	**2022**	University of Tennessee	●	●				●	●	●		●	●			
36	**202**	Western Michigan university	●	●			●	●	●	●		●	●			
SUM			**20**	**25**	**6**	**12**	**19**	**29**	**26**	**20**	**20**	**19**	**16**	**6**	**6**	**7**

Table 3: Continued: Summary of the Content Comparison Matrix

Publication date		Contents of Document / Document short name	Volume Strategy	Model Coordination Procedures	Version Control	Model Coordination	Tolerance Strategy	(Methods & Procedure)	Project Goals and Objectives	BIM team	project phases / milestones	Models Modeling Information	Model Ownership of Elements	Health and safety	Survey strategy
1	**2018**	Post contract – award BIM execution plan (BEP)	◙		◙			◙				◙		◙	◙
2	**2018**	Australia and New Zealand guide to IOS 19650								◙					
3	**2019**	Template for BIM Execution Plan Christchurch City Council		◙	◙	◙				◙					
4	**2019**	BIM and ISO 19650 from a project management perspective							◙			◙			
5	**2019**	The New Zealand BIM handbook (BEP Template)		◙	◙	◙		◙			◙				
6	**2019**	O-west BIM execution plan		◙	◙	◙	◙	◙	◙	◙	◙	◙			
7	**2019**	UC san Diego - BIM guidelines 2019						◙	◙						
8	**2019**	BIM guide 5 BIM project guide A Guide to Enabling BIM in Projects – Malaysia - 2019		◙				◙	◙						
9	**2020**	Solar boat BIM method statement		◙	◙	◙	◙	◙	◙	◙	◙	◙			
10	**2020**	State of Tennessee Office of the State Architect (TN OSA) 2020				◙			◙						
11	**2020**	BIM Execution Plan based on ISO 19650-1 - 2 Standards-Istanbul Technical University		◙					◙		◙	◙			
12	**2020**	BIM Contract Conditions of Contract for Building Information Modelling (BIM) The Hong Kong Institute of Surveyors		◙	◙	◙			◙	◙	◙	◙	◙		
13	**2020**	BIM beyond design guidebook (2020) ACRP research report		◙		◙				◙			◙		
14	**2020**	A.3.2.1 building execution plan (BEP)		◙		◙			◙			◙	◙		
15	**2020**	Journal of Construction Engineering, Management & Innovation													

16	**2020**	Exchange information requirements water care		◙					◙		◙		◙		
17	**2021**	Building Information Modelling (BIM) for Transport and Main Roads A guide to enabling BIM on Road Infrastructure Projects		◙		◙					◙				
18	**2021**	BIM Project Execution Plan Guide BIMForum		◙		◙		◙	◙		◙				
19	**2021**	BIM execution plan (BEP) to infrastructure superintendence of the federal university of PERNAMBUCO - Federal University in Brazil		◙	◙	◙			◙		◙	◙	◙		
20	**2021**	Guideline (BIM) for Transport and Main Roads Queensland		◙		◙						◙			
21	**2021**	HONG KONG HOUSING AUTHORITY Building Information Modelling Standards and Guidelines (HABIMSG)	◙	◙	◙	◙	◙	◙	◙	◙	◙		◙	◙	
22	**2021**	BIM project execution planning guide, version 3.0													
23	**2021**	Smithsonian facilities BIM guidelines		◙		◙		◙			◙	◙			
24	**2021**	CIC BIM standards general 2021	◙	◙	◙	◙	◙	◙	◙	◙	◙	◙	◙	◙	◙
25	**2022**	Digital twin guidelines Columbia - CBIPS		◙		◙			◙				◙		
26	**2022**	Georgia tech BIM execution plan template		◙	◙	◙			◙	◙	◙	◙			
27	**2022**	Pre-appointment and Delivery Team's (BEP) Guidance - University of Cambridge	◙					◙							
28	**2022**	Building Information Modeling (BIM) for Infrastructure Federal Highway Administration					◙	◙	◙	◙	◙	◙			
29	**2023**	NBIMS-US Project Committee and Public Review the National Institute of Building Sciences (NIBS)	◙		◙	◙		◙							
30	**2023**	KVMRT-BIM-EXECUTION-PLAN- TEMPLATE-intel build		◙		◙	◙	◙	◙	◙	◙	◙			
31	**2023**	Multnomah county BIM execution plan template		◙	◙	◙	◙	◙	◙	◙	◙	◙			
32	**2022**	Ohio-state_BIM_pds_v2022		◙		◙							◙		
33	**2022**	Massachusetts Institute of Technology		◙	◙	◙	◙	◙	◙	◙	◙				

34	**2022**	University of Nebraska Medical Center Project		◙		◙			◙			◙	◙		
35	**2022**	University of Tennessee							◙	◙	◙				
36	**202**	Western Michigan university		◙	◙	◙			◙	◙	◙	◙	◙		
		SUM	**5**	**25**	**14**	**24**	**8**	**16**	**23**	**15**	**19**	**17**	**11**	**3**	**2**

Table 3: Continued: Summary of the Content Comparison Matrix

Publication date		Contents of Document / Document short name	Detailed Modeling Plan	Document Management	Roles and Responsibility	Information Management Risk Register	Master information delivery plan (MIDP)	Key project contact	Measurement and coordinate systems	File Naming Conventions	Federated Model Color Scheme	Model structur	Coordination Approach	Quality Management	Compliance plan
1	**2018**	Post contract – award BIM execution plan (BEP)		◙	◙				◙	◙			◙	◙	◙
2	**2018**	Australia and New Zealand guide to IOS 19650					◙								
3	**2019**	Template for BIM Execution Plan Christchurch City Council				◙	◙	◙	◙				◙		
4	**2019**	BIM and ISO 19650 from a project management perspective			◙						◙	◙			
5	**2019**	The New Zealand BIM handbook (BEP Template)			◙		◙		◙				◙	◙	◙
6	**2019**	O-west BIM execution plan		◙	◙			◙	◙	◙		◙	◙		
7	**2019**	UC San Diego - BIM guidelines 2019							◙	◙		◙			
8	**2019**	BIM GUIDE 5 BIM PROJECT GUIDE A Guide to Enabling BIM in Projects – Malaysia - 2019			◙							◙			
9	**2020**	Solar boat BIM method statement			◙			◙	◙	◙				◙	
10	**2020**	State of Tennessee Office of the State Architect (TN OSA) 2020					◙		◙	◙		◙		◙	
11	**2020**	BIM Execution Plan based on BS EN ISO	◙	◙			◙			◙					
		19650₋1 and BS EN ISO 19650₋2 Standards - Istanbul Technical University													
12	**2020**	BIM Contract Conditions of Contract for Building Information Modelling (BIM) The Hong Kong Institute of Surveyors	◙	◙	◙										

13	**2020**	BIM beyond design guidebook (2020) carp research report	◙			◙	◙		◙			◙			
14	**2020**	A.3.2.1 building execution plan (BEP)		◙	◙					◙					
15	**2020**	Journal of Construction Engineering, Management & Innovation			◙		◙	◙	◙		◙		◙		
16	**2020**	Exchange information requirements water care		◙				◙							
17	**2021**	Building Information Modelling (BIM) for Transport and Main Roads A guide to enabling BIM on Road Infrastructure Projects					◙		◙	◙		◙			◙
18	**2021**	BIM Project Execution Plan Guide BIMForum	◙	◙	◙		◙	◙	◙	◙	◙	◙	◙	◙	
19	**2021**	(BEP) to infrastructure superintendence of the federal university of Pernambuco - federal University in Brazil	◙			◙		◙	◙		◙			◙	
20	**2021**	Guideline (BIM) for Transport and Main Roads Queensland	◙	◙						◙					
21	**2021**	HONG KONG HOUSING AUTHORITY Building Information Modelling Standards and Guidelines (HABIMSG)	◙	◙	◙	◙	◙	◙	◙	◙	◙	◙	◙	◙	◙
22	**2021**	BIM project execution planning guide, version 3.0													
23	**2021**	Smithsonian facilities BIM guidelines													
24	**2021**	CIC BIM standards general 2021	◙	◙	◙	◙	◙	◙	◙	◙	◙	◙	◙	◙	◙
25	**2022**	Digital twin guidelines Columbia - chips	◙				◙	◙		◙		◙		◙	
26	**2022**	Georgia tech BIM execution plan template	◙		◙		◙	◙				◙			
27	**2022**	Pre-appointment and Delivery Team's BIM Execution Plan (BEP) Guidance - University of Cambridge			◙	◙	◙	◙			◙			◙	
28	**2022**	Building Information Modeling (BIM) for Infrastructure Federal Highway Administration (FHWA)	◙		◙	◙	◙								
29	**2023**	NBIMS-US Project Committee and Public Review the National Institute of Building Sciences (NIBS)		◙			◙		◙	◙		◙			◙
30	**2023**	Kvmrt-BIM-execution-plan-template-intel build	◙	◙	◙			◙	◙	◙		◙		◙	
31	**2023**	Multnomah county BIM execution plan template	◙		◙		◙	◙	◙	◙		◙		◙	
32	**2022**	Ohio-state_BIM_pds_v2022	◙	◙				◙				◙			
33	**2022**	Massachusetts Institute of Technology			◙		◙	◙	◙	◙		◙	◙	◙	
34	**2022**	University of Nebraska Medical Center Project	◙		◙		◙							◙	

35	**2022**	University of Tennessee					◙					◙		◙	
36	**202**	Western Michigan university	◙	◙	◙	◙				◙	◙	◙		◙	
SUM			**16**	**14**	**20**	**8**	**20**	**16**	**18**	**19**	**8**	**19**	**9**	**16**	**6**

The table.4 is a structured compilation of key topics frequently addressed in the literature pertaining to BIM Execution Plan (BEP) standardization. It categorizes 40 distinct aspects ranging from foundational elements like "BIM Project Execution Plan overview" to more specialized topics such as "federated model color scheme." This tabulation serves as a reference point for the distribution of focus areas within the body of BEP literature, highlighting the multifaceted nature of BIM implementation and management in construction projects.

Table 4: Frequency Distribution of Key Topics in BIM Execution Plan Literature

1. BIM Project Execution Plan Overview	13. Review and Approval Processes	25. Document Management	37. Model structure
2. Project information	14. Audit and Continuous Improvement	26. Roles and Responsibility	38. Coordination Approach
3. Task information delivery plan (TIDP)	15. Volume Strategy	27. Information Management Risk Register	39. Quality Management
4. Responsible Parties	16. Model Coordination Procedures	28. Master information delivery plan (MIDP)	40. Compliance plan
5. Project deliverables	17. Version Control	29. Key project contacts	
6. BIM Uses	18. Models Coordination	30. Measurement and coordinate systems	
7. BIM Model and Level of Development	19. Tolerance Strategy	31. Modeling Information	
8. Collaboration procedures	20. (Methods & Procedure)	32. Model Ownership of Elements	
9. Common Data Environment "CDE"	21. Project Goals and Objectives	33. Health and safety	
10. Software requirements	22. BIM Team	34. Survey strategy	
11. Hardware	23. Project Phases / Milestones	35. File Naming Conventions	
12. Data Validation and Verification	24. Detailed Modeling Plan	36. Federated Model Color Scheme	

Figure 7 shows the percentage of occurrence of the sub-element's topics in the reviewed documents in order to select the topics with the highest percentage as the main elements for the proposed BIM execution plan framework. Figure 8 shows the elements in the document comparison with the highest percentage.

Figure 7 illustrates a bar chart detailing the frequency of occurrence for various sub-elements within the topics covered in the reviewed BIM Execution Plan documents. The chart presents a descending order of frequency, starting with the most commonly occurring sub-elements on the left. The percentages above each bar indicate the proportion of documents that mention each sub-element, providing a clear visual representation of which aspects within the BIM Execution Plans are given the most emphasis in the literature. Table 5 shows the highest percentage of the Sub-elements in the reviewed documents.

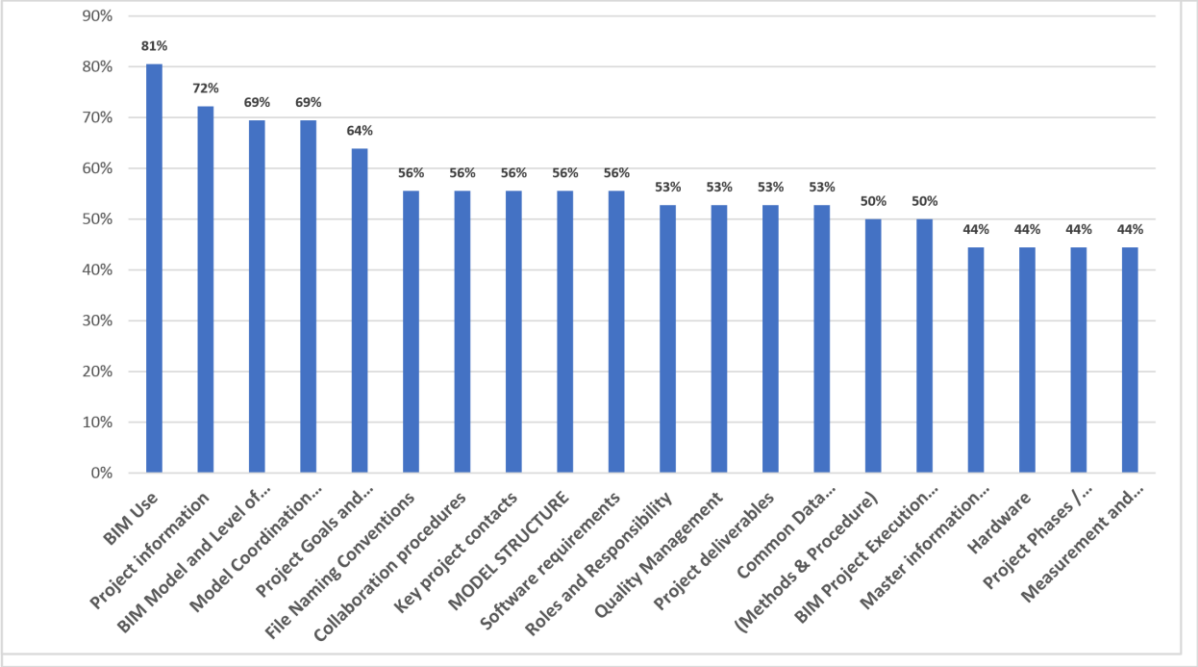


Figure 7: The Percentage of occurrence of the Sub-element's topics in the reviewed documents

Table 5: The highest percentage of the Sub-elements in the reviewed documents.

1	BIM Project Execution Plan Overview	**11**	(Methods & Procedure)
2	Project information	**12**	Project Goals and Objectives
3	Project deliverables	**13**	Project Phases / Milestones
4	BIM Use	**14**	Roles and Responsibility
5	BIM Model and Level of Development	**15**	Master information delivery plan (MIDP
6	Collaboration procedures	**16**	Measurement and coordinate systems
7	Common Data Environment "CDE"	**17**	File Naming Conventions
8	Software requirements	**18**	Model structure
9	Hardware	**19**	Key project contacts
10	Model Coordination Procedures	**20**	Quality Management

Pareto Analysis

Pareto Analysis, a statistical technique in decision-making, is based on the Pareto Principle, which posits that for many events; roughly 80% of the effects come from 20% of the causes. This method is integral to identifying the most significant factors in a set of data, which in the context of BIM Execution Plans, helps prioritize the standardization efforts. By focusing on the few critical elements that cause the most significant impact, researchers and practitioners can streamline processes, optimize resource allocation, and drive substantial improvements in project outcomes, see table.6, Fig.8.

Table 6: Pareto Analysis of BEP Sub-Elements by Frequency and Impact

	Sub-elements	**Number of Sub-elements**	**percentage**	**percent 80%**
1	BIM Use	29	7%	80%
2	BIM Model and Level of Development	26	14%	80%

3	Project information	25	20%	80%
4	Model Coordination Procedures	25	26%	80%
5	Project Goals and Objectives	23	32%	80%
6	Collaboration procedures	20	37%	80%
7	Roles and Responsibility	20	42%	80%
8	Common Data Environment "CDE"	20	47%	80%
9	BIM Project Execution Plan Overview	20	51%	80%
10	Master information delivery plan (MIDP	20	56%	80%
11	Model structure	19	61%	80%
12	Software requirements	19	66%	80%
13	Project deliverables	19	71%	80%
14	Project Phases / Milestones	19	75%	80%
15	File Naming Conventions	18	80%	80%
16	Measurement and coordinate systems	18	84%	80%
17	Key project contacts	16	88%	80%
18	Quality Management	16	92%	80%
19	Methods & Procedure	16	96%	80%
20	Hardware	16	100%	80%
	Total	**404**		

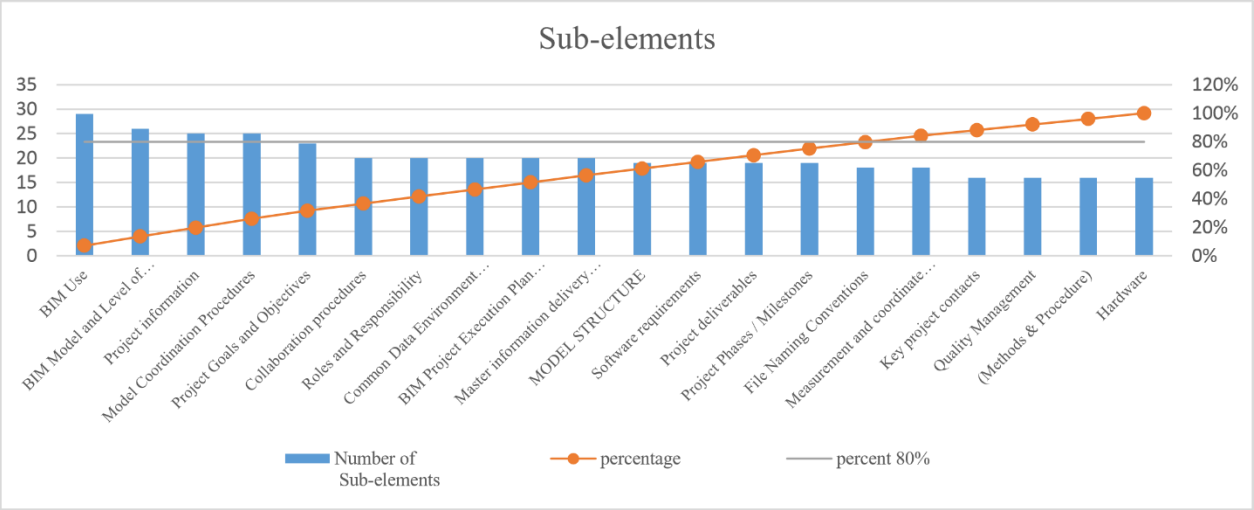


Fig. 8: the highest percentage of the sub-elements in the Review documents.

Figure 8 represents a Pareto analysis, displaying the number and relative importance of sub-elements within BIM Execution Plans. The blue bars indicate the number of occurrences of each sub-element in the reviewed documents, while the orange line charts the cumulative percentage, highlighting that a small number of sub-elements account for a large percentage of the focus in BIM documentation. This analysis is a strategic tool for identifying key areas for standardization andimprovement. In the Pareto analysis figure, the sub-elements that surpass the 80% (BIM Use, BIM Model and Level of Development, Project information, Model Coordination and Project Goals and objective) threshold are of particular significance as they

comprise the core content within the BIM Execution Plans. These critical elements are the primary contributors to the substance of the documentation, representing the majority of what is deemed essential in the literature. Identifying these allows for focused improvements in areas that will yield the most substantial impact on the standardization of BIM Execution Plans, See tables 7.8., Abdelalim, A.M, et al. [18-44].

Table 7: The highest sub-element percentage based on comparison results and percentages of sub- elements.

BIM Project Execution Plan Overview	Define the BIM mission statement and other executive summary level information. Also establish the importance of the plan. Also, Revision history, allows you to see what was revised, who made the revision, compare two revisions, and revert to another revision if necessary.
Project information and Project scope of work	The Plan should include critical project information such as project Scope of work, project location, project description, and critical schedule dates for future reference.
Project deliverables	To implement BIM is essential that each member of the project team understands the expected deliverables and their respective roles and therefore they should be documented
BIM Use	Once defined the project information and the necessary information about the project´s stakeholders the planning team should perform a detailed analysis of the project´s main goals and the necessary actions to achieve them with the appropriate BIM Uses. The BIM Uses should be identified as early as possible, to be possible to create appropriate models for the uses. This point of the BEP is one of the most important and very specific to BIM related projects.
BIM Model and Level of Development	Level of development (LOD) refers to a collection of specifications that empower professionals in the Architecture, Engineering, and Construction (AEC) industry to accurately and clearly document, describe, and specify the content of Building Information Modeling (BIM). LOD, which stands for Level of Development, establishes the standardized stages of system development within the field of Building Information Modeling (BIM). LOD specifications facilitate unambiguous communication among architects, engineers, and other professionals.
Common Data Environment "CDE"	A common data environment (CDE) is a digital platform that consolidates the storage and access of project data, usually pertaining to a construction project and building information modeling (BIM) workflows. The data initially contained Building Information Modeling (BIM) data and related information within a Common Data Environment (CDE). Currently, a CDE encompasses not only project contracts, estimates, reports, material specifications, but also other pertinent information related to the design and construction procedures of a project. A CDE, or Common Data Environment, is a comprehensive storage system for data produced by a project team during the stages of design, construction, and operation. Project stakeholders from various disciplines have the ability to access the Common Data Environment (CDE) at any time and from any location using a computer, mobile phone, tablet, or field machines.

Software Versions	This section explains Before beginning the project, the design team and contractor must agree on the BIM software and versions to be used. The models should be created with appropriate BIM authoring software applications that allow the assembly of data-rich models as well as the production and verification of coordinated drawings and documentation. To enable BIM interoperability, BIM authoring tools must be IFC compliant.
Quality management	• Data Validation and Verification: Detail the methods for validating and verifying the accuracy and completeness of data within the BIM models. This involves checking against project requirements and standards. • Review and Approval Processes: Define the processes for reviewing and approving BIM models at various stages of the project. Specify who is responsible for these reviews and the criteria for approval. • Audit and Continuous Improvement: Implement regular audits to assess the effectiveness of the QA/QC processes and identify areas for improvement. Encourage a culture of continuous improvement • Model Development Procedures: Document the step-by-step procedures for creating, updating, and managing BIM models. This includes information on software usage, data exchange protocols, and model coordination.
Hardware Specifications	The BIM Manager is responsible for giving detailed instructions to the consultants and contractors regarding the procurement of BIM data servers, workstations, and viewing platforms. The specifications should encompass suggestions for the operating system, CPU, memory, video cards, hard disk space, and network speeds.
Model Coordination Procedures	Interdisciplinary coordination of an information model refers to the process of integrating multiple models from various aspects of a project, such as architectural, ventilation, and electrical systems. Furthermore, interdisciplinary collaboration is conducted to verify the precision of the data within the models, generate collision reports, compile inventories of model components, and facilitate coordination meetings.
Method and procedures	Model Guide and Standard: In order to facilitate collaboration and ensure effective implementation of BIM, it is crucial to establish a well-structured folder organization system and maintain consistent file naming conventions on the interactive platform. Furthermore, it is crucial to facilitate the precise and efficient retrieval of information, as well as to determine the most current information available.
BIM Goals	An essential step in the planning process is to precisely determine the potential value of Building Information Modeling (BIM) on the project and for project team members by establishing the overall objectives for BIM implementation. The goals may be derived from project performance and encompass objectives such as shortening the schedule duration, enhancing field productivity, improving quality, minimizing the cost of change orders, or acquiring significant operational data for the facility.
BIM Project phases/ Milestones	The schedule for integrating Building Information Modeling (BIM) throughout the entire duration of the project. The table is pre-filled with suggestions regarding the timing of each activity phase. Customize as necessary according to the specific requirements of the project.

Roles and Responsibility	It is critical to define the roles and responsibilities of the consultant and contractor team members at the start of a project. The authorities for the various roles associated with the creation and management of building information models must be defined. These roles should be agreed upon and followed throughout the life cycle of a project. On a smaller project, one person may be assigned to multiple roles and responsibilities
Team Roles and Responsibility	Describe BIM roles and responsibilities such as BIM Managers, Project Managers, Drafts persons, etc.
information Delivery Plan	The Master Information Delivery Plan (MIDP) is a key strategy employed to oversee the dissemination of information throughout the duration of a project. Usually, the project delivery manager, in cooperation with the task team managers, creates it, and later utilizes it to facilitate the dissemination of project information throughout the project.
Collaboration procedures	Effective implementation of BIM relies on the crucial aspects of strong communication and collaboration among team members and stakeholders. At this phase there should documented the electronic and collaboration activity procedures. The document encompasses the establishment of the common data environment, the scheduling and agendas of meetings, as well as the procedures for managing the model, including file permissions and access rights.
Measurement and Coordination Systems	Detail procedures for coordinating models from different disciplines, including clash detection and resolution processes. Specify the units and coordinate systems to be used throughout the project for consistency and accuracy.
Naming Convention	Establish guidelines for the naming conventions used in the volume strategy to promote consistency and clarity.
Model Structure	Whether working solo or with a small team or a firm with multiple stakeholders, one of the first things you should do before starting a project is to set up the file or model structure. With time, the project gets complex and oversized. The well-structured model is divided depending on the disciplines, zone, floor, hardware, etc. and should be taken into consideration from the first day. The proposed BEP framework is presented in Table 6. It is constructed by assigning eight categories to each individual BEP element, in accordance with the definitions of those categories in the Reviewed Documents. BIM Project Execution Plan Overview, Project information, Management, Project Goals / BIM Uses, Technical Requirements, Quality Assurance / Quality Control (QA/QC) Plan, Model Process & Standards for the Project and Communication and Collaboration Procedures.

Table 8: The proposed elements BEP framework

Document Release History	**File Naming Conventions**
Definition	Model structure
	Key project contacts
BIM Project Execution Plan Overview	Quality Management
	Vision Statement

	References
Project information	Project Description
	Project Stakeholders
	Project Scope of Work in details
	Project Masterplan
	Buildings Key plan
	Key Project Contacts
	Key Project BIM Management
Management	Project phases/ Milestones
	Key Roles and Responsibilities
	Project Deliverables
	Project Information Model Delivery Strategy
	Task information delivery plan (TIDP)
	Master information delivery plan (MIDP)
Project Goals / BIM Uses	Major BIM Uses
	BIM Workflow
	Level of Development (LOD)
	Level of Development Matrix
Technical Requirements	Exchange Formats
	Software Needs / Scope
	Hardware Needs
	Data Security
	IT Upgrades
	Training
Quality Assurance / Quality Control (QA/QC) Plan.	QUALITY ASSURANCE / QUALITY CONTROL (QA/QC)
	Design content Check
	Visual / Coordination Check
	Standards Check
	Interference Check
	Clash Criteria
	Model Size
	model Warnings
	Information exchange
	Coordination Process
	Clash Matrix

CONCLUSION

By performing an extensive Scientometric analysis utilizing the Web of Science and Scopus databases, this study investigates the progression of scientific topics and trends within the domain of Building Information Modeling (BIM) Execution Plans (BEP) between 2020 and 2023. This time period is characterized by notable advancements in BEP. The study's literature review provides an overview of the current state of research and implementation of BEP content and structure in BIM projects. Notwithstanding the criticality of BEPs for effective project execution in BIM-enabled endeavors, the research highlights a substantial dearth in specialized literature concerning the factors that impact the advancement of BEPs. The absence of standardized guidelines for the development of BEPs is a clear indication of this deficiency, which results in inconsistent and inefficient project execution. In order to examine this, the

research examines 28 subjects contained in 36 BEP documents from a variety of organizations, sizes, and countries. The findings are subsequently arranged into a thematic structure comprising eight primary categories. Consistent with the standard, this framework functions as a foundation for subsequent testing and implementation of BEP in construction projects encompassing varying scales and degrees of intricacy. The research highlights the criticality of concentrating enhancements in domains that will generate the greatest influence on the standardization of BIM Execution Plans.

References

1. Antunes, B. M. C. (2015). BIM Execution Plan Proposal.

2. Olbina, S. and Elliott, J.W., 2019. Contributing project characteristics and realized benefits of successful BIM implementation: A comparison of complex and simple buildings. *Buildings*, *9*(8), p.175.Synek, J. (2018). Conditions for the success of using a BIM model in a construction project. Magazine Construction Industry, 09(18).

3. Galitskaya, I., Procurement utilizing building information modeling in civil construction, CZECH TECHNICAL UNIVERSITY IN PRAGUE 2019.

4. Ding, Z., Liu, S., Liao, L. and Zhang, L., 2019. A digital construction framework integrating building information modeling and reverse engineering technologies for renovation projects. *Automation in Construction*, *102*, pp.45-58.

5. Çekin, E. and Seyis, S., 2020. BIM execution plan based on BS EN ISO 19650‗1 and BS EN ISO 19650‗2 standards. In *6th International Project and Construction Management Conference (e-IPCMC2020)*. Istanbul Technical University.

6. Sarı, R. and Pekeriçli, M.K., 2020. An investigation of comparison and evaluation of official BIM documents released in the USA, UK and Turkey. *J. Constr. Eng*, *3*, pp.67-84.

7. Almarri, K., Aljarman, M. and Boussabaine, H., 2021. Emerging managerial risks from the application of building information modelling. *Journal of Facilities Management*, *19*(2), pp.228-248.Dao, T.-N., Chen, P.-H., & Nguyen, T.-Q. (2020). Critical success factors and a contractual framework for construction projects adopting building information modeling in Vietnam. [Journal Article], Iran University of Science and Technology.

8. Abd-Ellatif, A.M.A. and Nassar, A.H., 2021. CLAIMS AND DISPUTES RESOLUTION USING BIM TECHNOLOGY AND VDC PROCESS IN CONSTRUCTION CONTRACT RISK ANALYSIS. *Technology (IJCIET)*, *12*(4), pp.82-107.

9. Panagiotidou, N., Pitt, M. and Lu, Q., 2022. Building information modelling execution plans: a global review. *Proceedings of the Institution of Civil Engineers-Smart Infrastructure and Construction*, *40*(XXXX), pp.1-22.

10. Ayerra, I., Castronovo, F., Mastrolembo Ventura, S. and Nikolic, D., 2021. Next steps in BIM execution planning: a review of guides in the USA.

11. Gadi, M., 2023. Evaluating BIM Execution Planning Elements and Their Alignment to International Information Management Standards.

12. Oyarhossein, M.A., Ghiasi, S.H.B. and Khiali, V., 2021. Identifying barriers of Implementing BIM in Construction.

13. Panagiotidou, N., Pitt, M. and Lu, Q., 2022. Building information modelling execution plans: a global review. *Proceedings of the Institution of Civil Engineers-Smart Infrastructure and Construction*, *40*(XXXX), pp.1-22.

14. Nechyporchuk, Y. and Bašková, R., 2023, August. Requirements of construction scheduling for the BIM execution plan: A literature review. In *AIP Conference Proceedings* (Vol. 2887, No. 1). AIP Publishing.

15. James, D., Sabu, B. and James, D., 2023. BIM Implementation Strategy-A proposal for KMRL. In *ISARC. Proceedings of the International Symposium on Automation and Robotics in Construction* (Vol. 40, pp. 597-600). IAARC Publications.

16. Celoza, A., de Oliveira, D.P. and Leite, F., 2023. Role of BIM Contract Practices in Stakeholder BIM Implementation on AEC Projects. *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, *15*(2), p.04523002.

17. AbuMoeilak, L., AlQuraidi, A., AlZarooni, A. and Beheiry, S., 2023. Critical Success Factors for Building Information Modeling Implementation as a Sustainable Construction Practice in the UAE. *Buildings*, *13*(6), p.1406.

18. Abd El-Hamid, S.M, Farag, S., Abdelalim, A.M., 2023, "Construction Contracts' Pricing according to Contractual Provisions and Risk Allocation", International Journal of Civil and Structural Engineering Research ISSN 2348-7607, Vol.11, Issue.1, pp.11-38, DOI: https://doi.org/10.5281/zenodo.7876040.

19. Abd El-Karim, M. S. B. A., Mosa El Nawawy, O. A., & Abdel-Alim, A. M. (2017). Identification and assessment of risk factors affecting construction projects. *HBRC journal*, *13*(2), 202-216. https://doi.org/10.1016/j.hbrcj.2015.05.001.

20. Abdelalim, A. M. (2019). Risks Affecting the Delivery of Construction Projects in Egypt: Identifying, Assessing and Response.

21. In *Project Management and BIM for Sustainable Modern Cities: Proceedings of the 2nd GeoMEast International Congress and Exhibition on Sustainable Civil Infrastructures, Egypt 2018–The Official International Congress of the Soil-Structure Interaction Group in Egypt (SSIGE)* (pp. 125-154). Springer International Publishing. https://doi.org/10.1007/978-3-030-01905-1_7.

22. Abdelalim, A. M. IRVQM, 2018, A Conceptual Framework for Integrating Risk, Value and Quality Management for Construction Project Management, the 2nd International Conference of Sustainable Construction and Project Management, Sustainable Infrastructure and Transportation for Future cities, ICSCPM-18, 16-18 December, 2018, Aswan, Egypt.

23. Abdelalim, A. M., & Eldesouky, M. A. (2021). Evaluating Contracting Companies According to Quality Management System Requirements in Construction Projects, International Journal of Engineering, Management and Humanities (IJEMH) Volume 2, Issue 3, pp.: 158-169.

24. Abdelalim, A.M., El Nawawy, O.A. and Bassiony, M.S., 2016. 'Decision Supporting System for Risk Assessment in Construction Projects: AHP-Simulation Based. IPASJ *International Journal of Computer Science (IIJCS)*, 4(5), pp.22-36. https://doi.org/10.1007/978-3-030-01905-1_12.

25. Abdelalim, A. M., Elbeltagi, E., & Mekky, A. A. (2019). Factors affecting productivity and improvement in building construction sites. International Journal of Productivity and Quality Management, 27(4), 464-494. https://doi.org/10.1504/IJPQM.2019.101927.

26. Abdelalim, A. M., Khalil, E. B., & Saif, A. A. The Effect of Using the Value Engineering Approach in Enhancing the Role of Consulting Firms in the Construction Industry in Egypt. International Journal of Advanced Research in Science, Engineering and Technology, ISSN: 2350-0328 Vol. 8, Issue 2, pp. 16531-16539.

27. Abd-Elhamed, A., Amin, H. E., & Abdelalim, A. M. Integration of Design Optimality and Design Quality of RC buildings from the perspective of Value Engineering, 2020, International Journal of Civil and Structural Engineering Research ISSN 2348-7607 (Online) Vol. 8, Issue 1, pp.:105-116.

28. Ali Mohamed, N., Mohammed Abdelalim, A., Hamdy Ghith, H., & Gamal Sherif, A. (2020). Assessment and Prediction Planning of RC Structures Using BIM Technology. Engineering Research Journal, 167, 394-403. https://doi.org/10.21608/erj.2020.145845

29. Amin Sherif, Abdelalim, A.M., 2023, "Delay Analysis Techniques and Claim Assessment in Construction Projects", International

30. Journal of Engineering, Management and Humanities (IJEMH), Vol.10, Issue.2, 316-325. DOI: https://doi.org/10.5281/zenodo.7509156.

31. Amr Afifi, Elsamadony, A and Abdelalim, A.M., 2020, "A Proposed Methodology for Managing Risks in Construction Industry in EGYPT", International Journal of Civil and Structural Engineering Research ISSN 2348-7607 (Online) Vol. 8, Issue 1, pp.: 63-78.

32. Amr Afifi, Elsamadony, A and Abdelalim, A.M., 2020, "Risk Response Planning for Top Risks Affecting Schedule and Cost of Mega Construction Projects in Egypt", International Journal of Civil and Structural Engineering Research ISSN 2348-7607 (Online) Vol. 8, Issue 1, pp.: 79-93.

33. El Dean, S. M., & Abdelalim, A. M. (2021). A Proposed System for Prequalification of Construction Companies & Subcontractors for Projects in Egypt, International Journal of Management and Commerce Innovations ISSN 2348-7585 (Online), Vol. 9, Issue 2, pp.: 290-304.

34. El-Kholy, A. M., & Abdelalim, A. M. (2016). A comparative study for fuzzy ranking methods in determining economic life of equipment. International Journal of Construction Engineering and Management, 5(2), 42-54.

35. El-Samadony, A. A., Abdelalim, A.M & Elharony, A. A. (2016). Quantitative Risk Assessment and Mitigation for Construction Projects in Egypt. The International Conference of Sustainable Construction and Project Management, ICSCPM-16, 29-31March, 2016, Aswan, Egypt.

36. Hassanen, M. A. H., & Abdelalim, A. M. (2022). Risk Identification and Assessment of Mega Industrial Projects in Egypt. International Journal of Management and Commerce Innovation (IJMCI), 10(1), 187-199. DOI: https://doi.org/10.5281/zenodo.6579176.

37. Hassanen, M. A. H., & Abdelalim, A. M., A Proposed Approach for a Balanced Construction Contract for Mega Industrial Projects in Egypt, 2022, International Journal of Management and Commerce Innovations ISSN 2348-7585, Vol.10, Issue.1, pp: 217-229.

38. DOI: https://doi.org/10.5281/zenodo.6616913.

39. Khaled Al-Barghouth, El. Samadony, A. And Abdelalim, A.M, 2016, "The Applicability of Public Private Sector Partnership (PPP) in the futuristic Reconstruction in Syria", The Engineering Sciences Magazine- Faculty of Engineering at Mataria- Helwan University, Vol.148, Issue.1

40. Khedr, R. and Abdelalim, A.M., 2021, Predictors for the Success and Survival of Construction Firms in Egypt",", International Journal of Management and Commerce Innovations ISSN 2348-7585 (Online), Vol. 9, Issue 2, pp.: (192-201).

41. Khedr, R., & Abdelalim, A. M. (2022), The Impact of Strategic Management on Projects Performance of Construction Firms in Egypt. International Journal of Management and Commerce Innovations ISSN 2348-7585 (Online) Vol. 9, Issue 2, pp.: (202-211), Available at: www.researchpublish.com.

42. Medhat, W., Abdelkhalek, H., & Abdelalim, A. M. (2023). A Comparative Study of the International Construction Contract (FIDIC Red Book 1999) and the Domestic Contract in Egypt (the Administrative Law 182 for the year 2018), DOI: https://doi.org/10.5281/zenodo.7813262.

43. Rizk Elimam, A. Y., Abdelkhalek, H.A, Abdelalim, A.M., 2022, "Project Risk Management during Construction Stage

44. According to International contract (FIDIC)", International Journal of Civil and Structural Engineering Research ISSN 2348-7607 (Online) Vol. 10, Issue 2, pp: (76-93), Month: October 2022 - March 2023, pp.76-93, DOI: https://doi.org/10.5281/zenodo.7635679.

45. Yousri, Elhosin, Ahmed El Badawy Sayed, Moataz AM Farag, and Ahmed Mohammed Abdelalim. "Risk Identification of Building Construction Projects in Egypt." Buildings 13, no. 4 (2023): 1084, https://www.mdpi.com/2075-5309/13/4/1084.

46. Zena A. Fadhel, Elsamadony, A. and Abdelalim, A.M, 2020, "Studying the Applicability of Public Private Sector Partnership in the Reconstruction Projects in Iraq "International Journal of Civil and Structural Engineering Research ISSN 2348-7607 (Online) Vol. 8, Issue 1, pp.: 137-150.

47. Abdelalim, A.M. and Said, S.O.M., 2021. "Dynamic labor tracking system in construction project using BIM technology", International Journal of Civil and Structural Engineering Research ISSN 2348-7607 (Online), Vol. 9, Issue 1, pp: (10-20), Month: April 2021 - September 2021.

48. Abdelalim, A.M. and Said, S.O.M., 2021." Theoretical Understanding of Indoor/Outdoor Tracking Systems in the Construction Industry", International Journal of Civil and Structural Engineering Research ISSN 2348-7607 (Online) Vol. 9, Issue 1, pp: (30-36), Month: April 2021.