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ARTICLE PROTOCOL: OPTIMIZATION IN BIM PROJECTS CLASH DETECTION PROCESS: A SYSTEMATIC LITERATURE REVIEW

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Protocol status: Working

We use this protocol and it's working

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Keywords: Project coordination, Modeling, Conflict management, Clash resolution, Automation, Optimization, Clash detection, BIM, BIM projects, Building Information Modeling, clash detection processes in bim model, optimization strategies for clash management, clash management, optimizing clash detection process, optimization in bim project, quality of multidisciplinary project coordination, general bim practice, multidisciplinary project coordination, bim project, explored general bim practice, modeling issues among different system, bim model, main practice

Abstract

This protocol presents the structure of a systematic literature review aimed to analyze and synthesize current research advancements on optimizing clash detection processes in BIM models, identifying the main practices used to address modeling issues among different systems and components. The review examines how the technologies has been used to improve the early identification and resolution of inconsistencies among architectural, structural, and MEP disciplines, thereby enhancing the efficiency and quality of multidisciplinary project coordination in the AEC sector.

Although previous reviews have explored general BIM practices, there is still no comprehensive and systematic synthesis dedicated specifically to optimization strategies for clash management. This review addresses this gap by consolidating the methods, tools, limitations and practices reported in the literature. The extraction and organization of the reported data were systematically structured according to the PRISMA guidelines.

Abstract

- 1 This protocol presents the structure of a systematic literature review aimed to analyze and synthesize current research advancements on optimizing clash detection processes in BIM models, identifying the main practices used to address modeling issues among different systems and components. The review examines how the technologies has been used to improve the early identification and resolution of inconsistencies among architectural, structural, and MEP disciplines, thereby enhancing the efficiency and quality of multidisciplinary project coordination in the AEC sector.

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PICo strategy

2

A	B
Criteria	Description
Population	BIM Projects
Interest	Optimization
Context	Clash Detection

PICO elements description of the Survey

Research questions

3

A	B
Questions	Description
Q1	What tools and technologies are currently used for clash detection in projects?
Q2	What limitations are encountered in detecting clashes in BIM models?

	A	B
	Q3	What types of clashes have been identified?
	Q4	How are the identified clashes being resolved in the projects?
	Q5	What challenges are faced in resolving clashes in BIM models?

Research Questions

Keywords and synonyms

4

	A	B
	Terms	Synonyms
	BIM Projects	(building information modeling OR building information modelling OR BIM OR modelling) AND (project OR design)
	Optimization	innovation OR optimization OR enhancement
	Clash Detection	clash detection OR conflict detection OR clashes OR conflicts

Search terms

Source selection criteria (search databases)

5 Research method in sources

This research was developed using Excel for screening and selecting articles, and Mendeley for managing references and citations.

6 Selected databases

Science Direct - <http://www.sciencedirect.com>

Scopus - <https://www.scopus.com/home.uri>

Engineering Village - <https://www.engineeringvillage.com/home.url?redir=t>

Web of Science - <https://www.webofscience.com/wos/woscc/basic-search>

Taylor & Francis Online - <https://www.tandfonline.com/>

6.1 Criteria adopted

These databases were chosen to cover the study area and topics related to the AEC sector. Furthermore, they are renowned international databases, some with a multidisciplinary and specialized focus, others with specific engineering content, ensuring broad coverage and relevance for the review.

7 **Limitations**

- Studies published in English or Portuguese;
- Journal articles;
- Last 10 years (2015-2024);
- Engineering field.

8 **Generic search string**

(innovation OR optimization OR enhancement) AND ("building information modeling" OR "building information modelling" OR BIM OR modelling) AND ("conflict detection" OR clashes OR conflicts) AND (project OR design)

8.1 **Search strings adapted for each database searched**

A	B
Databa se	Adapted String
Science Direct	(innovation OR optimization OR enhancement) AND ("building information modeling" OR BIM) AND ("conflict detection" OR clashes) AND (project OR design)
Scopus	(innovation OR optimization OR enhancement) AND ("building information modeling" OR "building information modelling" OR BIM OR modelling) AND (clashes OR conflicts) AND (project OR design)
Enginee ring Village	(innovation OR optimization OR enhancement) AND ("building information modeling" OR "building information modelling" OR BIM) AND (clashes OR conflicts) AND (project OR design)
Web of Science	(innovation OR optimization OR enhancement) AND ("building information modeling" OR "building information modelling" OR BIM) AND (clashes OR conflicts) AND (project OR design)
Taylor & Francis Online	(innovation OR optimization OR enhancement) AND ("building information modeling" OR "building information modelling" OR BIM) AND ("conflict detection" OR clashes) AND (project OR design)

Search strings adapted by database

Study selection criteria (inclusion, exclusion and quality)

9 Inclusion criteria

- IC1:** Articles that answer the research questions presented earlier;
- IC2:** Articles that discuss BIM or 3D modeling;
- IC3:** Articles that use some optimization tool or technology;
- IC4:** Articles that describe the clash detection and resolution process in projects;
- IC5:** Articles that address the coordination of architectural, structural, and building installation projects;
- IC6:** Works published and fully available in the databases searched;
- IC7:** Articles that describe the clashes types analyzed;
- IC8:** Articles that address geometric clashes.

10 Exclusion criteria

- EC1:** Non-primary research articles;
- EC2:** Articles unrelated to the keywords topic in the article title or abstract;
- EC3:** Articles that are not from journals;
- EC4:** Duplicate or paid articles;
- EC5:** Articles unrelated to the specified languages or date range;
- EC6:** Articles that only mention clash detection and resolution, but do not explore it;
- EC7:** Articles that are not in the engineering field;
- EC8:** Articles that do not discuss clash detection during design process;
- EC9:** Articles that only address non-geometric clashes, thus technical requirements (for example, proximity verification, health and safety verification).

11 Quality criteria

- QC1:** Studies that describe the clash detection process;
- QC2:** Studies that use clear, objective, and cohesive methodology.

Quality assessment form

12 **CQ1: Description of the clash detection process.**

Does the study directly address optimization in BIM projects clash detection and resolution?

Checklist:

	A	B	C
	The study mentions optimization	YES	NO



	A	B	C
	practices in BIM projects		
	The study addresses clash detection	YES	NO
	The study addresses clash detection and resolution	YES	NO

Assessment:

A	B
Unrelated to the topic	0
Mentioned superficially	1
Addresses the topic relevantly, but is not the main topic	2
Addresses the topic directly and with main focus	3

CQ2: Clear, objective, and cohesive methodology.

Does the study provide a detailed description of its methodology, covering the research design, data collection methods, and analysis techniques applied?

Checklist:

A	B	C
The research design is reported	YES	NO
The data collection approaches are clearly presented	YES	NO
The data analysis method is described	YES	NO

Assessment:

A	B
The methodology is unclear and non-objective	0
The methodology is vague or incomplete	1
The methodology is understandable but lacks detail	2
The methodology is clearly defined and cohesive	3

To ensure the quality of the methodology and findings reported in the analyzed studies, a scoring-based assessment was applied, in which each criterion of the checklist was individually evaluated. Articles received a score of 0 when none of the checklist items were met, and a score of 3 when all three items were satisfied. As a result, each study received a specific quality score. Only articles scoring 2 or 3 were included in the review.

Protocol references

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