



W78



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Collaborative platform in clashes resolution process:
Study of the added value for BIM coordination.



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1. Introduction & Definitions
2. Research Context
3. Obstacles & Research questions
4. Experimental context
5. Data collection protocols
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7. Analysis & discussion
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1. Introduction & Definitions

BIM COORDINATION

BIM (Building Information Management)

A new way of coordinating architectural, engineering and construction stakeholders

(Kubicki & al., 2019)

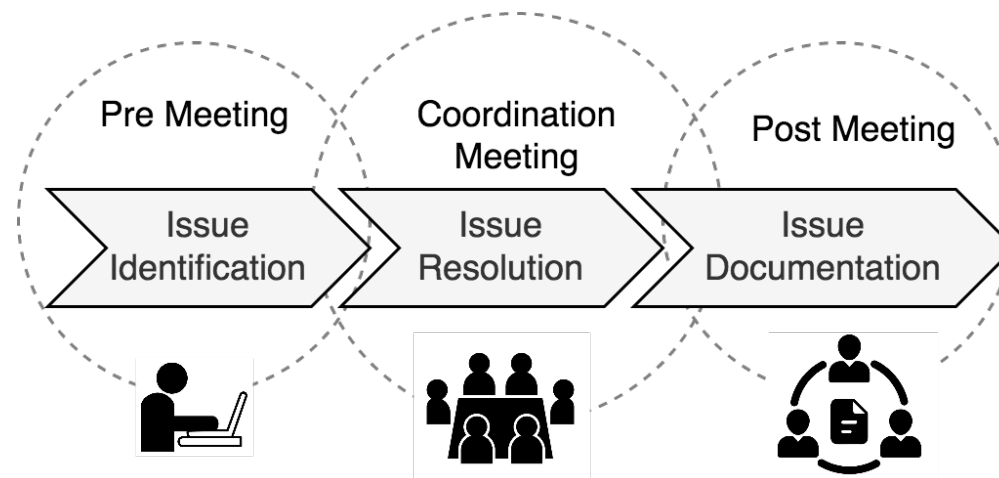
Main challenges :
Communication, monitoring, characterizing &
documenting clash resolution

(Mehrob & al., 2019)



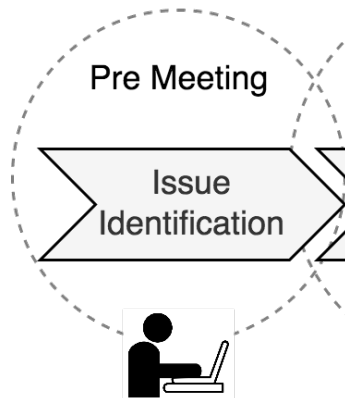
2. Research Context

Temporality of a processus Clash Detection : BIM COORDINATION IN 3 STAGES



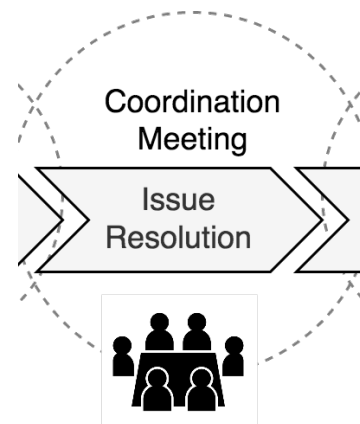
(Adapted from Mehrob & al., 2019)

2. Research Context



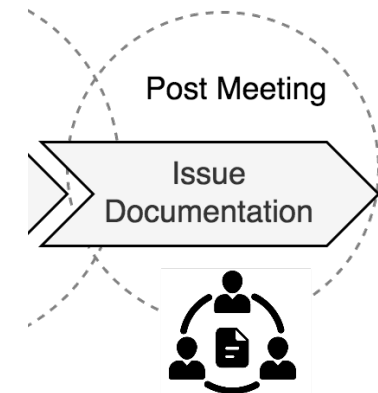
Before the meeting, BIM coordinator :

- ✓ receives the project requirements and the design specifications then integrates the models produced by each discipline into a clash detection software.
- ✓ examines the clashes detected automatically,
- ✓ identifies the real problems and prepares the meeting.



During the meeting:

- ✓ Project stakeholders come together to discuss problems and develop solutions.
- ✓ The BIM coordinator presents the clashes and exchanges with
- ✓ The project team in order to find solutions. Various media can be used.



When the discussions with the project stakeholders are completed :

- ✓ The BIM coordinator informs them of the management necessary for the resolution of clashes, as discussed during the coordination meeting... such as the choice of the chosen solution.
- ✓ He is in charge of monitoring, validating and closing clashes.

3. Obstacles & Research questions

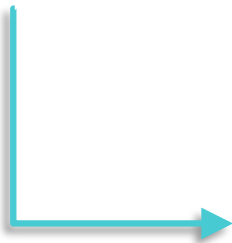
4 obstacles to clash resolution

Poor characterization of coordination issues

Poor monitoring of clash resolution

The lack of information on the clash

The lack or ineffectiveness of communication between stakeholders



Q1: Does the use of a collaborative platform facilitate the tasks of the coordinators before, during and after the coordination meeting?

Q2: Does the use of a collaborative platform facilitate the understanding of a clash and its location during and after the coordination meeting?

Q3: Does the use of a collaborative platform facilitate collaboration between project actors during and after the coordination meeting?

4. Experimental context

PROJECTS CHOICE



*"Maison de la Musique" project
2018-2019*

17 participants



*"Villa Massilia" project
2019-2020*

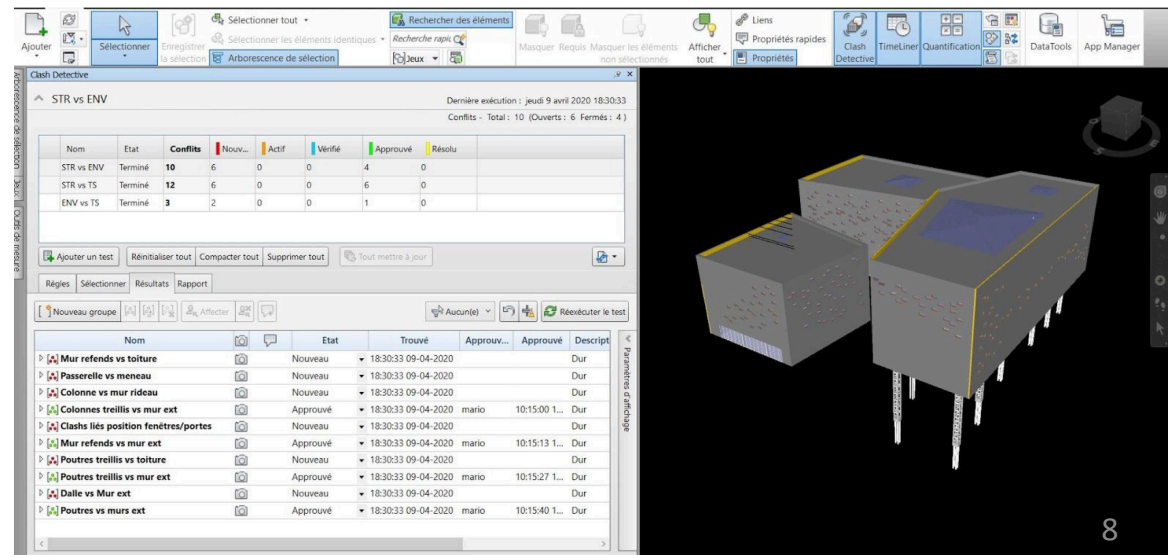
18 participants

4. Experimental context

BIM COORDINATION TOOLS

- ✓ No clash detection tool was imposed on participants :
Many tools presented Navisworks Manage, Solibri Model Checker, Tekla BIMSight, Trimble Connect...
- ✓ One condition:
A tool that make it possible to carry out the following 4 activities (Forgues & al. 2018)

1. Detection of clashes
2. Visualization of clashes
3. Verification of clashes
4. Management of collaboration

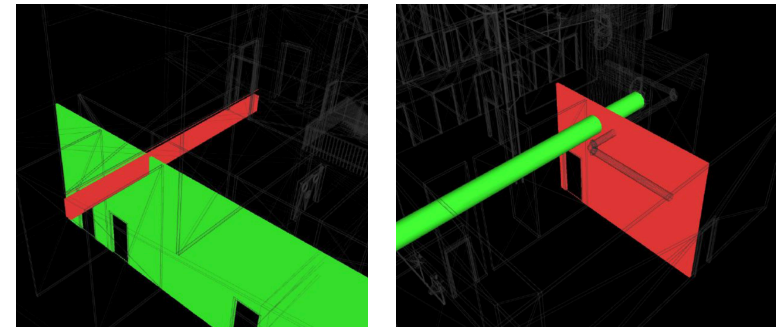


4. Experimental context

BIM COORDINATION TOOLS

✓ Definitions of geometric and non-geometric clashes (Akinci & al. 2000)

- 1. Hard Clash** - geometric spatial collisions of two unique components occupying the same space.
- 2. Design error** - involve illogical design, design conflicts of multiple systems and incorrect design details,
- 3. Modeling error** - missing information from the modeled object, following an oversight or an encoding error / omission in the modeling of a component.,
- 4. Requests** - include all queries and questions relating to design or coordination, exchanged between stakeholders.



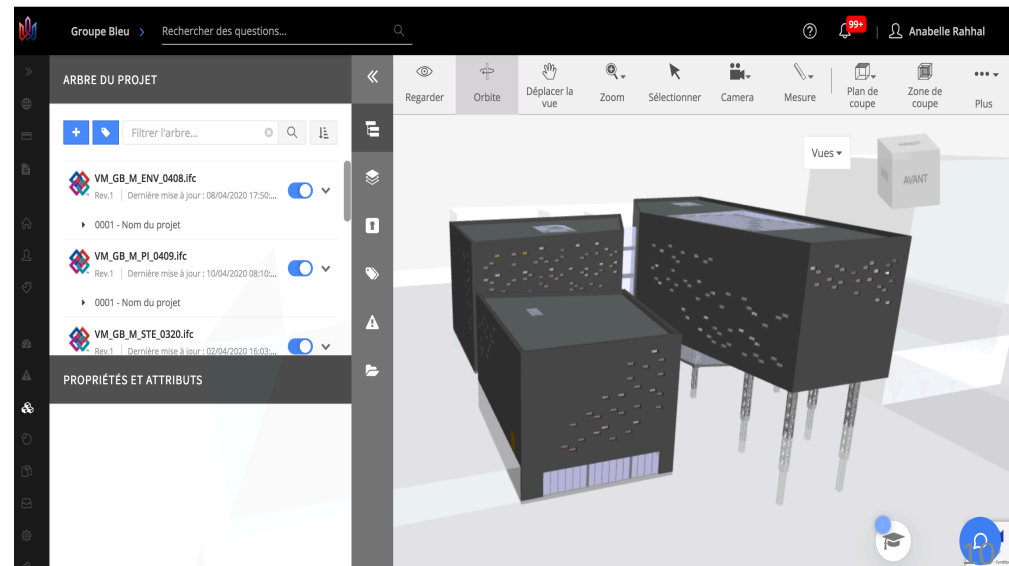
Exemples of Hard Clashes views in Naviswork
(Project Villa Massilia, 2019-2020)

4. Experimental context

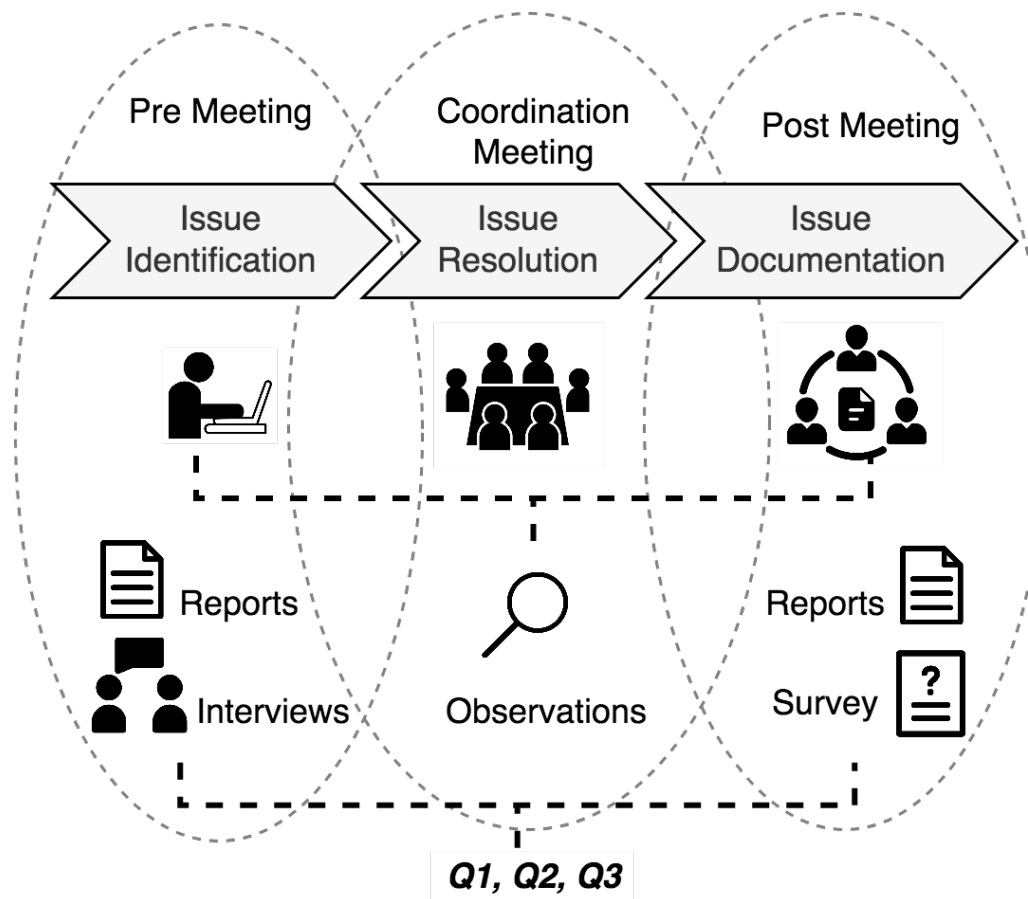
BIM COORDINATION PLATFORMS – CHOICE OF BIM TRACK

- ✓ Several collaborative platforms were compared by the participants in order to choose the most suitable for the SDC BIM modalities.
- ✓ Several criteria justify the choice of BIM Track

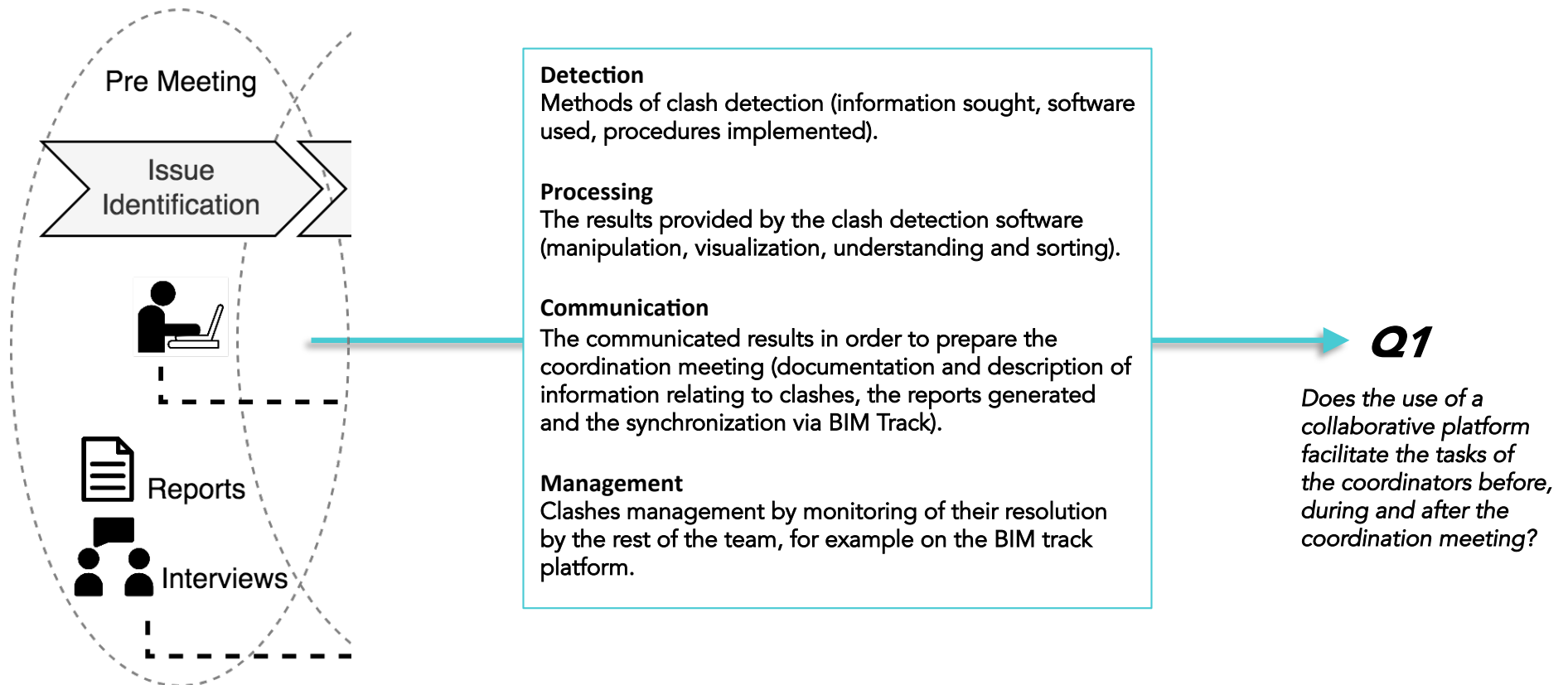
1. Importing a BCF format
2. Existence of plug-ins that allow information to be synchronized with modeling softwares and clash detection software
3. Managing and viewing clashes positioned in the model through an IFC viewer
4. Availability of a free version
5. Useful features for coordinators: creation of questions & their documentation; location, comments, view, due date, assignment to a collaborator, sorting by attribute; zone, floor, author, disciplines concerned, status, etc.



5. Data collection protocols

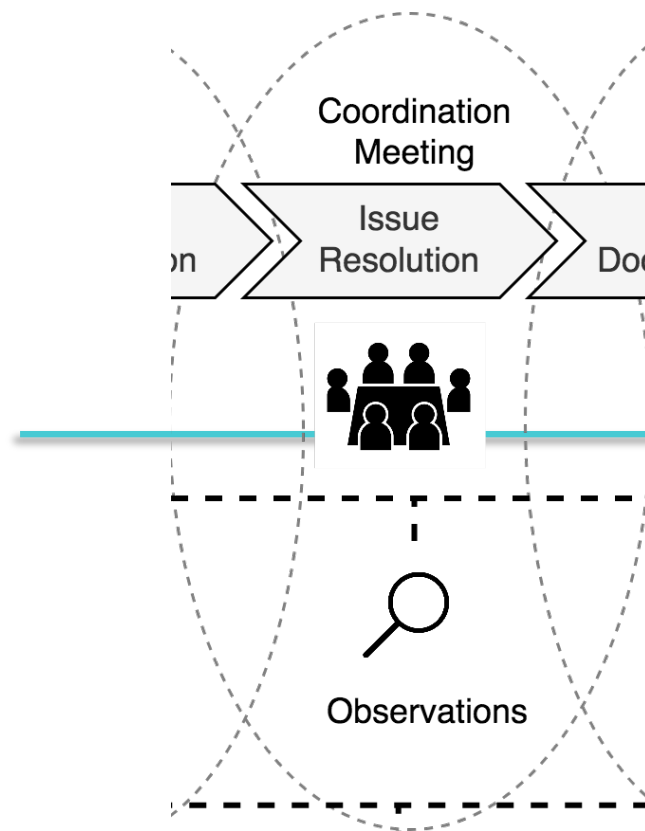


5. Data collection protocols



5. Data collection protocols

13 coordinations meetings
filmed, recorded, viewed
and encoded in an
Observation grid.



Q2 & Q3

Q2: Does the use of a collaborative platform facilitate the understanding of a clash and its location during and after the coordination meeting?

Q3: Does the use of a collaborative platform facilitate collaboration between project actors during and after the coordination meeting?

5. Data collection protocols

General

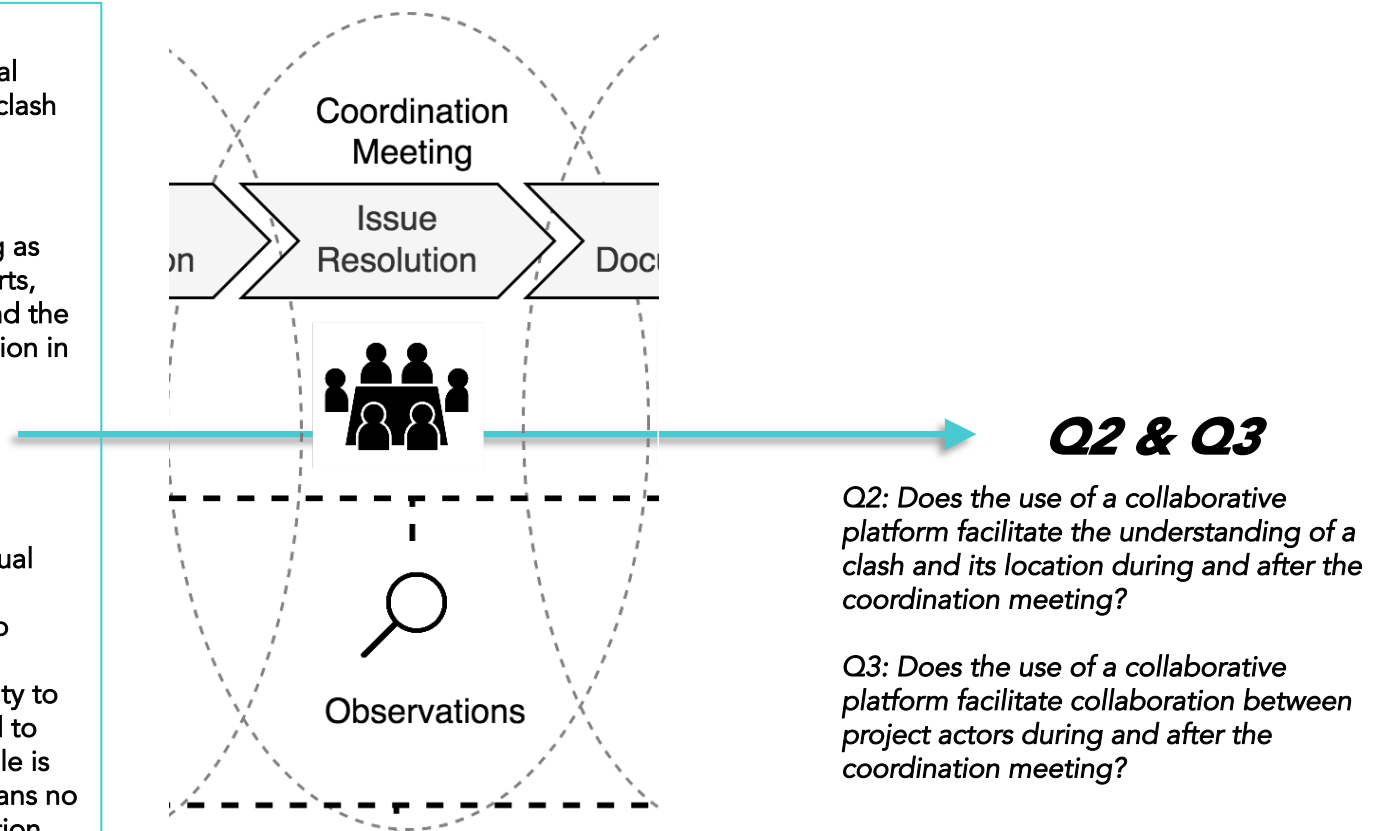
Video identification data and clash temporal data. It represents the time spent on each clash on the viewed videos.

Presentation

A description of the clash, the tools serving as visual aids and presentation support (Reports, Navisworks, Solibri Model Checker, etc.) and the used artefacts (drawings, 2D plans, navigation in the BIM model, etc.).

Discussion

- The time allotted for each clash to be determined and the assessment of the understanding of the clash using a gradual scale, for example, 'Immediate' understanding means that there were no requests for clarification.
- The assessment of the participants' ability to find a common solution to the clash and to assign it to a collaborator. A gradual scale is also used, for example, 'Immediate' means no debates and direct approval of the solution.



5. Data collection protocols

A questionnaire (GoogleForm), 5 sections

Location of clashes

The means used to find the clash,
The frequency of using functions like a "saved view" in a "Question", the "Viewer" and the synchronization of the "Questions",
The judgment on finding easily the clash.

Understanding of clashes

After the meeting.

Management of clashes by statuts

The frequency of updating of the "statuts" of resolved clashes.

Use of the platform

The frequency and the features for adding comments or an image and email notification to collaborate and communicate (+ phone call, email, instant messaging).

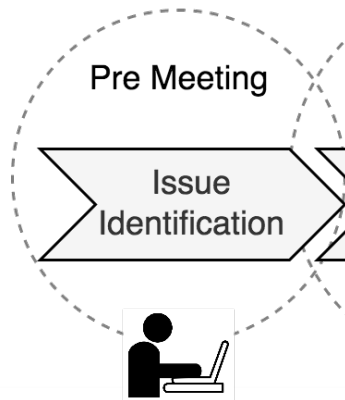
Platform capacity assessment

Context of clashes, collaborating outside a meeting or managing the resolution process. Constraints entailed by the use of a collaborative platform.

Q1, Q2, Q3



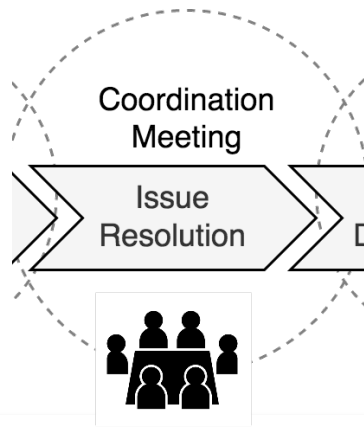
6. Collected Data



- ✓ Clashes detection procedure
- ✓ Communication of the clashes results
- ✓ Clashes management by coordinators

	Group 1	Group 2	Group 3	Group 4
Model format Location of the models, Used Software, Clashes updates	IFC	IFC	IFC	IFC & Revit
	BIMPlus Google Drive	Google Drive	Google Drive BIM Track	Google Drive BIM Track
	Solibri Checker	Tekla BIMSight Solibri Checker	Navisworks Trimble Connect	Navisworks
	IFC Models	IFC Models	/	IFC MODELS + BIM TRACK
Used tools Shared information Information support	Views/BCF note Presentation	Views/BCF note Presentation	Views/BCF note Presentation	Views/BCF note Presentation
	Title/Discipline Description	Title/Discipline Zone/ Floor level Description	Title/Discipline Zone/ Floor level	Title/Discipline Attribution Description
	PDF Report + Excel Report	BCF file + Excel Report	BIM Track synchronisation	PDF Clashes REPORT + BIM TRACK SYNCHRONISATION
Monitoring the clashes resolution of the team	Dissemination of a meeting report + Coordinators trust in their team + Additional clashes resolution meetings	Dissemination of a meeting report + Coordinators trust in their team	Coordinators trust in their team + Late use of the update conflict status option on BIM Track platform	Updating Clashes Status + Archiving resolved ones

6. Collected Data



- ✓ Number of clashes and cumulative duration of their resolution in coordination meeting
- ✓ Presentation of clashes in coordination meeting
- ✓ Pourcentage of immediate understanding of clashes
- ✓ Pourcentage of clash resolution with an immediate agreement on a solution and its assignment

	Group 1	Group 2	Group 3	Group 4
Number of clashes	46	154	50	
Cumulative duration for clashes resolution	01 :01 :01	02 :38 :05	01 :02 :53	
Average time by clash	00:01:20	00:01:02	00:01:15	
% of time spent for presentating a clash	50,71%	60,08%	59,76%	
% of time spent discussing a clash	49,29%	39,92%	40,24%	

Less clashes presented when using BIM track, less time for resolution & less time discussing.

Support of the presentation

Information Shared about the conflict > 50%

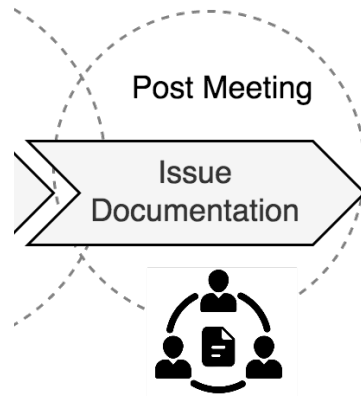
Features used > 50%

Location, Concerned displines, Problem

Agreement on a solution
Assignment of the resolution

	TeklaBIMSight Solibri Model Checker	TeklaBIMSight Solibri Model Checker	Navisworks Trimble Connect BIM Track	BIM Track
Discipline/Type Description	Title/Discipline Floor/Zone Type/Description Proposed Solution	Title/Discipline Floor/ Zone Type/Description Proposed Solution	Title/Discipline Floor/ Zone Type/Description Proposed Solution	Title/Type Discipline Proposed Solution
Navigation in BIM Model Saved views Notes/Color Transparency	Navigation in BIM Model 3D Section Saved views Notes/Color Transparency	Navigation in BIM Model 3D Section Saved views Notes/Color Transparency	Navigation in BIM Model 3D Section Saved views Notes/Color Transparency	Saved views Notes/Color Transparency
	72%	73%	70%	87%
	91%	95%	96%	100%
	57%	76%	76%	87%
	41%	47%	40%	54%
	76%	85%	84%	82%

6. Collected Data



- ✓ Frequency of use of the platform
- ✓ To finding clashes
- ✓ To understanding clashes
- ✓ To communicate



	Platform BIM Track	Report of the meeting	Clashes Reports	Other meeting notes
Finding the clash location	93%	33%	0%	7%
Understanding of a clash	80%	85%	84%	82%

LIMITED USE OF THE PLATFORM TO COMMUNICATE

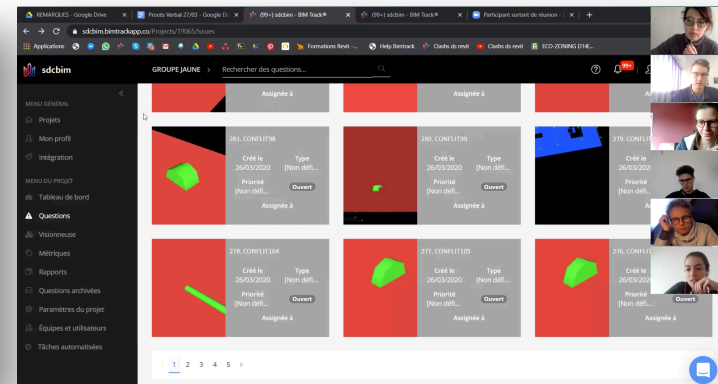
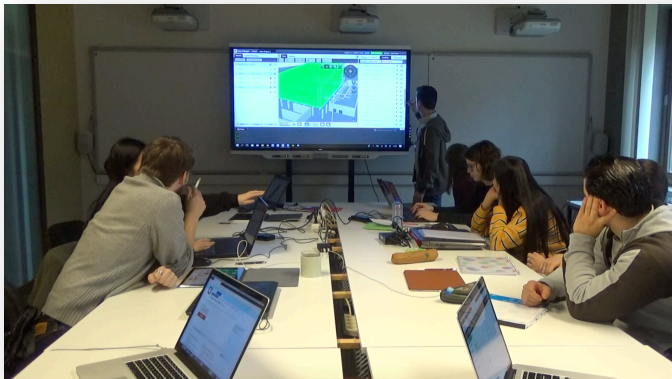
67% of participants "never" use it or "rarely" use it, those who used it added comments (33%) or images (20%) after the meeting to communicate.

Moreover, 94% of those surveyed were "agree" or "fully agree" that using BIM Track saves time after the coordination meeting for finding and understanding a clash.

7. Analysis & discussion

Q1 > Added value of a collaborative platform for coordinators' tasks

- It **changes** the pre-meeting coordination **tasks**.
- The **export of clashes reports** from clashes detection software has become obsolete.
- When the clashes are grouped together and available on the platform, the coordinator only presents **a few clashes in detail**.
- The team can find clashes as well as additional information later and **question less the coordinator**.
- The **automated synchronization** of the clash status between both the platform and the detection files ensure their consistency and facilitate their monitoring.



- Encoding the right information and communicating it on the platform requires **rigor** and represents an additional **workload** for BIM coordinators.

7. Analysis & discussion

Q2 > Added value of a collaborative platform on understanding clashes and their locations



- **One group presented their clashes directly on BIM Track :**
 - Sharing the least location information
 - Do not use 3D navigation except in complex cases
 - Best results in understanding clashes, their location & the disciplines involved.



- **Actors activities :**
 - Sorting the results and accessing the characteristics of the clashes (disciplines, location, description, status of modifications etc.)
 - Using the images saved with the clash or the "Viewer" to see the clashes in the model.

« The platform is a time-saving and efficient tool for understanding clashes and their locations »



- **Need of Revit plug-in**, for locating and accessing clash information directly in its own model.
- The BIM Track integrated **viewer is still perfectible**.
- The coordination meeting **report remains a document used**, in addition, by a majority of modelers in order to understand the clashes and the solutions to be implemented. It has the advantage of being a **support to document decisions**.

7. Analysis & discussion

Q3 > Added value of a collaborative platform on collaboration between project stakeholders

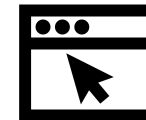
- + A presentation support in a coordination meeting



- + Access to all the information, any time.



- + Access from web interface.



- + Interacting (commenting, adding attachments or notifying people)

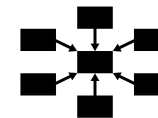


Collaborative platform



- + BCF format

Centralizing the clashes



Communication of discovered clashes



- Communication features, not the preferred exchange mode (instant messaging or direct contacts)



- + Collective decision



Synchronizing clashes, improving the transmission of information



8. Conclusion

Concluding remarks & limitations

Collaborative platform



- Improves the clash resolution process
- Comes at the cost of **great rigor and an important work of documentation** of clashes.
- Entails **additional constraints** (information encoding, sorting and documentaion time or the redundancy of certain manipulations between the detection software and the platform).

Observations



- Limited in an **experiment context**, capable of answering the research question.
- To carry out these observations, the **BIM Track platform was chosen, still imperfect.**

Future Works



1. **Technical and technological aspects of BIM coordination observed**,
> this process obviously requires a **social approach**, because the coordination meeting is notably the seat of many human interactions.



2. **Observe/compare the results of this study** with those resulting from **alternatives situations**, such as in contexts using :
 - other collaborative **platforms** (for example Revizto or BIMcollab),
 - other coordination **environments** (in professional context for example),
 - other common **data environment** (supported by BIM servers like BIM360 for example).



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Thank you for your attention.

Any questions?

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