BIM Obstacles in Industrial Projects: A Contractor Perspective

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Outline

- Introduction
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- Solution
  - Short-term solution
  - Long-term solution
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Introduction

- Industrial projects are complex projects where a maze of pipes and modules have to be installed in congested work areas under tight time schedule.

- BIM offers potential benefits (e.g. visualization, collaboration, alignment ...etc.) that can be key for complex project success.
Current Practice
BIM Utilization

- BIM usage can be categorized into passive and active utilization*.
- Passive usage encompass engineering analyses like safety and scheduling.
- While active usage works on extracting embedded knowledge in BIM.
- These benefits have not been fully implemented in industrial projects.

Active Usage: Scaffolding

- It was required to estimate scaffold man-hour for each component separately (e.g. modules, vessels, etc.).
- After many trials, we were unable to build a reliable model due to
  - poor database structure.
  - trying to match data from different sources that are not fully consistent.
Issues

- **BIM ownership (contractual level):** The contractor receives only the compiled model for reviewing and visualization,

- **Lack of standards (contractual level):** labels based on the engineering firm convention,

- **Software limitation (technical level):** Quantity take-off accuracy, and

- **Interoperability (technical level):** transfer data between different systems or software.
Solution

Short-term solution
- Enhance industry’s current practice.
- Build on existing tools.
- Clarify limitations.

Long-term solution
- Research objectives.
- Bounded only by imagination.
- A better solution for industry.
Short-term solution
Planning: grouping

- Model might contain 1 million items without enough attributes “dump model”.
- It is required to filter model items based on trade (e.g. extract all concrete piles, or all pipes).
- It takes significant time for a coordinator to visually inspect model items.
Planning: grouping

- Criteria ID = 1
- Condition ID = 1
- Category = Pipe
- Category Display name =

Group by each item
(using OR rule)

Pipe ➔ 11000
Planning: work areas

- Group items according to their location.
- Work area can be intersected with discipline (e.g. concrete items in work area 2).
Just short-term solutions

- The user has to visually inspect the model to find filtering rules.
- Rules can filter steel items, but it cannot tell their classes.
- Customized configuration for each project (very hard to automate).
- Work areas & scaffold logs are saved in a separate database.
- Problems in quantity take-off (only boundary volume is available).
Long-term solution
Long-term Solution

3D CAD models → BIM models

3D CAD models

Shape recognition

Attributes

Ontology based data format

Automation

Partial models

SPARQL

Planning phase

Schedule

Execution phase

Scaffold
Shape recognition

- 3D shape recognition (object retrieval) to search or query 3D objects.
- Each 3D object has a shape signature (graph or vector), that can be compared to previously stored signatures.
- There are many techniques to calculate shape signature:
  - Feature
  - Shape histogram
  - Topological graphs
  - Spatial function
  - Section images
  - Shape statistics
- Spatial function, Shape histogram and section images (prismatic sections) are applicable in our case.
Shape histogram

1- Generate distribution for the unlabeled shape

2- Match and pick from standard sections’ distribution

- W610x92
- W 410x85
- C section
- HSS section
Shape histogram

Weight Difference %

- 100 distances: 10%
- 1,000 distances: 9%
- 50,000 distances: 7%
- 500,000 distances: 10%
- 1,000,000 distances: 8%

Graphs showing:

- Success rate
- Average Time (seconds)

- 1,000,000 distances:
  - Success rate: 91%
  - Average Time: 15 seconds

- 500,000 distances:
  - Success rate: 84%
  - Average Time: 9.8 seconds

- 50,000 distances:
  - Success rate: 82%
  - Average Time: 1 second

- 1,000 distances:
  - Success rate: 30%
  - Average Time: 0.05 seconds

- 100 distances:
  - Success rate: 16%
  - Average Time: 0.04 seconds
What is semantic web?

Mouse is Mammal is Animal

Mouse is Animal

IBM Manufactures Mouse

IBM Ontology Animal
Why semantic web?

“What is the point of having countless books and libraries whose titles the owners can scarcely read through in a whole lifetime?” (“Time Magazine, Sep 8, 2014,”)

The roman philosopher Seneca, c. 4 BC - AD 65

- American consumed about 3.6 zettabytes of information in 2008*.
- Semantic web technology enables machines to derive knowledge from existing information.

Application #1: Scaffold (revisited)
Application #2: Schedule generation

- Each work package will be mapped to an activity.
- Work package is a detailed plan that contains 500 : 1000 hours to be executed during one rotation*.
- Relationships between activities:
  - Spatial based on work areas.
  - Traditional sequences between trades.

Conclusion

- Challenges for utilizing BIM.
- Short-term solution can mitigate the problem.
- Long-term solution to enhance the process.
Thank you