Building Information Modeling (BIM): Framing the Issues

WORKSHOP: Using BIM to Eliminate Construction Site Hazards
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Overview

- What is Building Information Modeling (BIM)?
- Why is it important for safety and health?
- Suggestions for framing the issues

The findings and conclusions in this presentation have not been formally disseminated by the National Institute for Occupational Safety and Health and should not be construed to represent any agency determination or policy.
What is BIM?

Building Information Model
A digital representation of physical and functional characteristics of a facility. As such, it serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life cycle from inception onward.


Many additional definitions available
BIM enables **Visualization**

Basic Premise of BIM

→ Software, Process, Teams, Information

Stakeholders insert, extract, update or modify information in the BIM model at different life-cycle phases that reflect their role in the project.

The BIM model is a shared digital representation founded on open standards for interoperability.

Graphic/dimensional data + embedded attribute data.
BIM is becoming an industry-wide standard

Required by many large clients

Examples: General Services Administration (GSA), Veterans Administration (VA), Ohio and other states.

Industry-wide adoption of BIM surged from 28% in 2007….. to 71% in 2012

(Contractors 74%, architects 71%, engineers 67%)

Why is BIM important for S & H?

BIM encourages early collaboration and communication

Requires all construction project parties and disciplines to commit to information sharing at an early stage.

Like integrated project planning, it brings contractors and subcontractors into the earlier pre-construction phases.

Opportunities for S&H to contribute to and make use of pre-construction discussions
BIM enhances coordination and planning

Makes it easier to visualize the design, make earlier decisions, reduce uncertainty, and resolve problems.

Example
“Clash detection” → software used during the coordination process to identify any spatial conflicts so they can be remedied prior to installation.

Can help to minimize craft interference problems.
BIM supports Life Cycle thinking
“Life Cycle Safety” → useful approach

Tendency to focus safety efforts on initial construction

What about construction workers involved with:

- Operations and Maintenance (O&M)
- Renovation
- Repair
- Replacement
- Demolition or facility re-use

This workshop is structured to consider Life Cycle safety considerations and opportunities
BIM enables **Prevention through Design** (PtD)

- Provides a tool for exploring PtD options
- Can use virtual mock-ups to model different options during design review
- Assists with engaging end-users during design process

NORA Construction Goal 13:
Increase the use of PtD approaches to prevent or reduce safety and health hazards in construction

Research Goal 13.3.1
Explore potential opportunities for integrating PtD into newly emerging design tools and practice trends such as use of Building Information Models (BIM) and Integrated Project Delivery.
PtD engagement example: Lurie Children’s Hospital, Chicago

BIM used to help design large mechanical floor for 23 story hospital. Engaged facility O&M personnel in design.

“....The designer or engineer may think they need this type of fan, but the facilities person is thinking – to service this piece of equipment I have to pull it out a certain way and it weighs 150 pounds, so how do I get it out and down safely?

These are the kinds of exercises the team can do on the front end that can make the difference between 50 years of a bad design or a design that is efficient, easy, and safe.”

Potential to enhance safety and health practice

Examples:

- Helping to integrate S&H into production details
- Pre-task planning
- Code checking/compliance validation
- Communication via simulations
  - Project site orientation
  - Hazards and Exposures
  - Procedures – simulations and solutions
  - Incident investigations
- Review of upcoming complex tasks
- Activity clash detection – site traffic and safe working zones
Some findings from 2013 McGraw Hill Survey

48% of General Contractors and 36% of Specialty Contractors were using BIM

For BIM users,

53% → reported no safety impact
43% → positive safety impact
4% → negative safety impact

For the Positive impact group, top safety functions were:

47% → Identifying hazards before construction begins
23% → clash detection to minimize trade interference

BIM section Pgs 39-42
http://www.cpwr.com/pdfs/SafetyManagementinConstructionSMR%282013%29.pdf
What about S&H involvement in BIM?

- 43% get involved just prior to construction start
- 40% throughout the construction process
- 26% of GC (8% of Specialty) at Design Inception
- 21% of GC S&H staff
- 22% of Specialty S&H staff

Never get involved with BIM
Suggestions for framing the issues

What can Researchers tell us?

Building Information Modeling (BIM) and Safety: Automatic Safety Checking of Construction Models and Schedules

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BIM for Construction Safety: A Case Study

By Alex Behringer and Salman Arber

A CHEWAL FACTOR IN CONSTRUCTION SAFETY PLANNING is to properly identify all possible hazards before they occur. A building information model (BIM) allows construction stakeholders to visually assess job-site conditions and recognize hazards, and it provides them sufficient time to develop adequate hazard mitigation plans.

The utilization of BIM technology can result in improved occupational safety by connecting the safety issues more closely to construction planning. This provides a more holistic view of construction, while providing methods for managing and visualizing up-to-date plans and site-specific information. The use of BIM also encourages other project partners, such as designers, sub-contractors and safety specialists, to become actively involved in both risk assessment and planning.

This article reports an in-progress research project where BIM technology is utilized to perform safety planning and management for an ongoing construction project located at the campus of the Auburn University, in Auburn, Alabama. The project is a Recreation & Wellness Center. BIM models and 3D simulations are used to communicate the following safety plans: 1) crane management; 2) fall protection; and 3) emergency response plans. 3D phasing simulations, 3D walk-throughs and 3D renderings are utilized to identify various hazards and to communicate safety management plans to the workers.

Figure 1. A 3D rendering of the project

Figure 2. The crane work zone and steel beam placement in the crane management plan

CRANE MANAGEMENT PLAN

The purpose of a crane management plan is to 1) identify the swing radius of the crane to ensure its safe distance from power lines and nearby structures; 2) identify what trades/crane will be utilizing the crane at a particular time. On this project, two lattice boom crawler cranes are being utilized to pick and place the structural members. The crane on the Northside of the project is a 115-ton Link-Belt 218 HSLAB unit and the crane on the Southside is a 250-ton Manitowoc Model 988 unit. FIGURE 2 illustrates the steel beam placement in the crane management plan.

As depicted in this image, the colored masses (yellow, orange and blue) are used to demonstrate the crane’s swing radius and zone of influence. The yellow mass communicates the possible extent of the crane’s swinging boom at any moment during a particular day. Collision detection can be utilized to generate weekly reports of any non-crane installation activities scheduled to take place within the crane’s planned swing radius, according to the placement dictated by the overall project schedule. The resulting
What can Practitioners tell us?

NYC Site Safety Plans include location of:

- construction fences and sidewalk sheds around job site
- guardrails around excavation when required
- Crane and derrick loading areas
- Horizontal and vertical safety netting
How can current BIM systems be used for safety and health “as is”?

What kind of safety “add-on” features have been developed to provide additional safety capabilities?

What types of new features would be useful?
What “research to practice” efforts and/or information products would be useful?

• BIM case studies to show actual examples where BIM was used to address safety?

• Additional suggested examples where BIM could be used?

• What OSH professionals need to know to use BIM?

• Safety Object Library?
What are the pros and cons of using the “n D” model to develop a “Safety BIM”?

2D  Blueprint view
3D  3-Dimensional view
4D  + Schedule
5D  + Budget
6D  + Facilities management
7D  + Sustainability
8D  + Occupational safety and health?
NIOSH view going into workshop

✓ Growing BIM momentum $\rightarrow$ workshop is timely

✓ BIM $\rightarrow$ strong potential for enabling PtD and S&H

✓ BIM $\rightarrow$ important research and r2p target

✓ Building researcher/practitioner partnerships is key

Thanks to all for participating and look forward to presentations and panels to stimulate additional discussions
For Life Cycle Safety Panels to follow

Questions and Issues to Use as a Guide

- How existing BIM features are being used for safety
- How BIM add-ons are being used for safety
- Areas where additional research and development would be helpful
Questions and Issues (continued)

- Are you using BIM for
  - Prevention through Design (aka prevention by design)
  - Constructability Reviews
  - Site set-up and access reviews
  - Safety clash detection/code checking
  - Plan-ahead meetings and visualization of upcoming complex tasks
  - Site Orientation training
  - Safety and health training
  - Other?
Thanks!

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