

Developing Standards-Based Education Modules for Building Information Modeling

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Project Background

- Building Information Modeling (BIM) is a digital representation of physical and functional characteristics of a facility.
 - Enables the consistent and continuous use of digital information **across the life cycle** of a built facility by **different stakeholders**
- BIM has been integrated into the curriculum of Architecture, Engineering, and Construction programs in many universities.
 - Immersed in existing courses
 - Standalone courses
 - Integrated in students' project work
- Currently, most BIM courses have a strong focus on the training of students' practical skills of software use but are weak on the foundational interoperability technology.



BIM Education Requirements vs. Our Project Focus

Table 3. BIM Education Requirements for Construction Management—Part 2: Technology

Number	BIM skills and technologies	Recommended level of achievement		
		First degree	Masters/30 credits	Experience
2.1	Basic BIM operating skills	3	4	5
2.2	Modeling with standard catalog elements	3	3	4
2.3	Creating and modeling with custom elements	3	4	5
2.4	Massing/solid modeling	3	4	6
2.5	Central databases/information repositories	2	4	5
2.6	Interoperability (file formats, standards, and structure for data sharing)	2	3	5
2.7	Communication tools, media, channels and feedback	3	5	6
2.8	Ways to store and share information (e.g., cloud computing, networking, big-room equipment)	3	3	5
2.9	Choosing right BIM technologies/processes/tools for specific purposes	3	5	6
2.10	Laser scanning	2	3	4

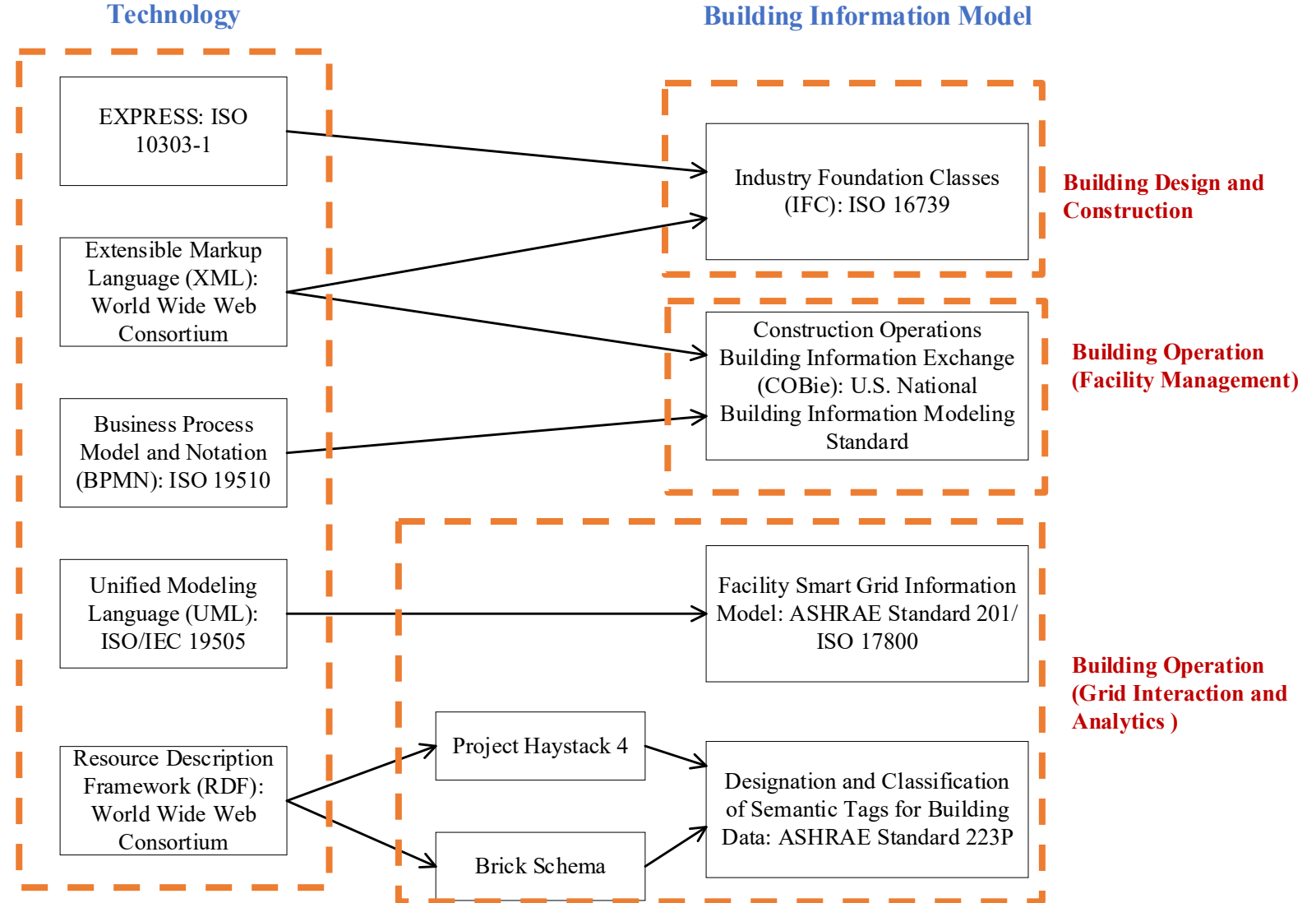
Source: Sacks, R. and Pikas, E., 2013. Building information modeling education for construction engineering and management. I: Industry requirements, state of the art, and gap analysis. *Journal of Construction Engineering and Management*, 139(11), p.04013016



Project Goals

- To develop standards-based education modules that strengthen the connection between BIM and its fundamental technology and the connection between BIM and documentary standards.

Project Approach



Project Deliverables

- 4 Education Modules, 6 Sessions
 - Each session includes lecture slides and recorded video presentations (~ 3 hours)
 - The lecture slides include learning objectives, in-class exercises, homework and further readings

Module	Major Content	Sessions	Video Length
Semantic data modeling	Object-oriented modeling concepts Semantic modeling languages XML and UML	2	~110 minutes
Industry Foundation Classes (IFC)	Fundamentals of IFC Advanced IFC	2	~30 minutes
Construction operations building information exchange (COBie)	COBie file formats (IFC, XML, and Spreadsheet). Content of COBie spreadsheet files	1	~25 minutes
Semantic interoperability for grid-interactive efficient buildings	ASHRAE Standard 201: Facility Smart Grid Information Model	1	~30 minutes

Project Deliverables (con't)

- A website (<https://bim.charlotte.edu/>) to host all lecture slides and videos
 - Launched in August 2025
 - Facilitate sharing and dissemination
 - Plan to continue maintaining and improving the website after the project

Project Evaluation

- External peer review
 - North Carolian A&T University
 - Western Carolina University
 - University of Houston

Questions Used for Project Evaluation

- **Question 1:** To what degree will the course modules achieve the goal of strengthening the connections between BIM and its fundamental technology and the connections between building information models and documentary standards?
- **Question 2:** Do you think the overall structure and contents of the education modules and the slides of each module align well with the learning objectives and the project goals?
- **Question 3:** Do you see any missing contents/components that should be covered in the context of the proposed work?
- **Question 4:** Do you see any potential of using these course materials in your own courses or any other courses you are aware of in your department? If there is any potential, how do you plan to use them?
- **Question 5:** Except for the previous comments, what other inputs do you like to share with us?

Potential Adoption by Peer Reviewers

Quotes from Review Comments:

- *There is clear potential to use these materials in my graduate-level course Building Information Modeling (BIM) Applications for Construction Management.*
- *I would consider integrating the UML section when teaching system modeling or workflows in BIM-enabled project delivery. The gbXML content would be especially useful when covering energy modeling or sustainable design topics in my course LEED & GREEN Construction Principles in Construction Management.*
- *Yes, the COBie module is directly applicable to my BIM course and can be used in a course on Facilities Management.*
- *I will consider using the developed materials for my graduate level course, Computer Application in Construction.*



Lessons Learned

- Curriculum planning subject to external factors
- Challenges to introduce cross disciplinary materials to undergraduate courses
- Additional efforts needed to “decipher” technical standards into curriculum materials



Thank You and Q/A

