The Challenges of Advancing BIM in the Curriculum while Addressing Current Accreditation Standards for Construction

Tammy McCuen
Associate Professor
Haskell & Irene Lemon Construction Science Division
University of Oklahoma
Introduction

• Need:
  – Graduates with BIM skills and knowledge
  – Integration into construction curriculum

• Challenges:
  – Limited resources
  – Current accreditation standards

• This presentation focuses on aligning industry demand, accreditation standards, and the challenges educators face to balance resources, accreditation, and BIM instruction
Introduction

• 2012 *SmartMarket Report* (Jones & Bernstein, 2012)
  – 582 respondents
  – 71% of respondents have adopted BIM
  – 35.7% of total respondents were contractors

• Contractors reported using BIM for spatial coordination, constructability, and job site planning/site logistics.

• As the rate of BIM adoption by contractors increases so will the rate of organizations expecting to hire graduates with BIM skills and knowledge.

Current Industry Demand

• 2011 survey of construction companies revealed that companies prefer to hire graduates that have both conceptual knowledge and software skills (Ku & Taibet, 2011).

• Companies’ prioritized BIM knowledge and competencies for the immediate, near future, and far future as:
  – Visualization (immediate)
  – Constructability (immediate)
  – Model based estimating and cost controls (near future)

Current State of BIM in Construction Programs

• Another survey included an investigation into the level of BIM integration in construction education (Becerik-Gerber et al., 2011).

• Results revealed that construction programs actually teach students how to use BIM on projects in class and students are not expected to learn BIM skills on their own.
  – Unique when compared to participating architecture and engineering programs.

Current State of BIM in Construction Programs

- Construction programs reported offering 3.1 BIM courses on average in undergraduate curriculum
- Majority of courses are elective
- Courses offered include:
  - Constructability
  - 4D scheduling
  - Model based estimating
  - Design
  - Visualization
  - Cost control

Current State of BIM in Construction Programs

• Limitations to integrating BIM in the curriculum:
  – 45% reported lack of resources
  – 27% reported lack of accreditation specificity

AMERICAN COUNCIL FOR CONSTRUCTION ACCREDITATION [ACCE]

• ACCE assesses the quality of construction programs using its standards and criteria

• ACCE acts as a conduit between post-secondary education and the construction community

• Ensures that students receive a quality professional education so they have the skills and knowledge and meet the industry demand
AMERICAN COUNCIL FOR CONSTRUCTION ACCREDITATION [ACCE]

• ACCE curriculum criteria requires a minimum of 120 semester, or 180 quarter, credit hours divided into five categories:
  1. General education
  2. Mathematics and science
  3. Business and management
  4. Construction science
  5. Construction

*courses required in categories 1-3 above account for 40% of the required credit hours for accreditation

*1 semester credit hour equals 15 instructional hours
*1 quarter credit hour equals 10 instructional hours
AMERICAN COUNCIL FOR CONSTRUCTION ACCREDITATION [ACCE]

• Breakdown by category and requirements

1. General education – 15 semester hours in courses such as communications, human relations, psychology, sociology, philosophy, and history.

2. Mathematics and science – 15 semester hours outside of construction in courses such as analytic geometry, physics, calculus, and statistics
• Breakdown by category and requirements

3. Business and management – 18 semester credit hours that must be taught within the academic business unit at the institution. Courses include economics, principles of management, organizational behavior, financial accounting, and labor relations.
• Breakdown by category and requirements

  – The first three categories total 48 credit hours of which all must be taught outside of the construction program.

  – Result is that 72 semester credit hours remain in which BIM could possibly be integrated into the curriculum.
• Breakdown by category and requirements

4. Construction science – 20 semester credit hours focused on design theory, analysis and design of construction systems, construction methods and materials, construction graphics, construction surveying, and ethics.

<table>
<thead>
<tr>
<th>Core Subject Matter</th>
<th>Minimum Academic Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design theory</td>
<td>3 semester (4 quarter) hours</td>
</tr>
<tr>
<td>Analysis and design of construction systems</td>
<td>6 semester (9 quarter) hours</td>
</tr>
<tr>
<td>Construction methods and materials</td>
<td>6 semester (9 quarter) hours</td>
</tr>
<tr>
<td>Construction graphics</td>
<td>1 semester (1.5 quarter) hour(s)</td>
</tr>
<tr>
<td>Ethics</td>
<td>1 semester (1.5 quarter) hour(s)</td>
</tr>
</tbody>
</table>
• Breakdown by category and requirements

4. Construction science – Purpose is to introduce students to the design disciplines’ processes and how to communicate with design professionals.

Examples of course content in this category are: structural mechanics, soil mechanics, structural systems, HVAC, plumbing, mechanical, construction graphics, value analysis, feasibility studies, and site planning.

Overall requirement for this category is for courses that focus on communicating with design disciplines to solve practical construction problems.
Breakdown by category and requirements

5. Construction – minimum 20 semester credit hours focused on effective management of personnel, materials, equipment, costs, and time in the context of office and field activities.

<table>
<thead>
<tr>
<th>Core Subject Matter</th>
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<tbody>
<tr>
<td>Estimating</td>
<td>3 semester (4 quarter) hours</td>
</tr>
<tr>
<td>Planning and scheduling</td>
<td>3 semester (4 quarter) hours</td>
</tr>
<tr>
<td>Construction accounting and finance</td>
<td>1 semester (1.5 quarter) hour(s)</td>
</tr>
<tr>
<td>Construction law</td>
<td>1 semester (1.5 quarter) hour(s)</td>
</tr>
<tr>
<td>Safety</td>
<td>1 semester (1.5 quarter) hour(s)</td>
</tr>
<tr>
<td>Project management</td>
<td>3 semester (4 quarter) hours</td>
</tr>
<tr>
<td>Ethics</td>
<td>1 semester (1.5 quarter) hour(s)</td>
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</tbody>
</table>
• Breakdown by category and requirements

5. Construction – minimum 20 semester credit hours focused on effective management of personnel, materials, equipment, costs, and time in the context of office and field activities.

Examples of course content include drawings and specifications, contract documents, quantity surveying, pricing, bidding strategy, quality control, scheduling, cash flow, job supervision, and safety.

Topics in this category should address the constructor as a member of a multi-disciplinary team, the assessment of project risk, and the alternate project delivery methods.
OPPORTUNITIES, CHALLENGES, AND DISCUSSIONS

• Construction science category
  – Opportunity 1: Integrate BIM in the construction graphics requirement.
  – Challenge 1: Construction graphics are often taught as lower level course dedicated to developing skills only.
  – Strategy: Integrate BIM tools with instruction to develop a basic skill set.
OPPORTUNITIES, CHALLENGES, AND DISCUSSIONS

• Construction science category
  – Opportunity 2: Integrate BIM into the analysis and design of construction systems courses.
  
  – Challenge 2: Requires instructors with knowledge about BIM application for analysis and additional time in the course sequence dedicated to BIM for analysis.
  
  – Strategy: Supplement or replace the analysis tools currently used with BIM tools to analyze structural systems and to design construction systems such as formwork.
OPPORTUNITIES, CHALLENGES, AND DISCUSSIONS

• Construction science category
  
  – Challenge 3: Requires additional coordination between faculty and programs across disciplines to provide resources such as time and tools.

  – Strategy: Evolve to a culture of collaboration and integration.
OPPORTUNITIES, CHALLENGES, AND DISCUSSIONS

• Construction category
  – Opportunity 4: Integrate BIM tools for analysis in estimating, planning and scheduling, safety, and project management.

  – Challenge 4: Requires instructors with knowledge about BIM application for analysis and additional time in the course sequence dedicated to BIM for analysis.

  – Strategy: Provide resources for faculty development.
Future Standards and Criteria

• New ACCE standard for accreditation based on student learning outcomes was proposed in 2012.

• The proposed criteria is based on Bloom’s taxonomy for learning.

• Revised accreditation criteria will require construction programs demonstrate student learning across 19 criteria.
Conclusion

• Integrating BIM in existing curriculum presents programs with challenges at both the program level and accreditation level.

• Limited resources – Time and Faculty

• The future of construction education requires coordination to meet the needs of programs, accrediting bodies, and industry.
Questions?

Thank you!

tammymccuen@ou.edu