Managing the Risks of BIM

By Joseph M. Ales Jr., Ph.D., S.E.

The future of Building Information Management (BIM) is now. With the increasing acceptance of BIM in the architectural-engineering-construction (AEC) industry, it has moved past the buzzword phase and has hit, and likely passed, the all important "tipping point." Though you may still be resistant to the idea of having to "waste" time modeling your work in 3D, at some point in the very near future you will not have an option. Making such a disruptive change in your production process can be scary.

Is BIM Required on Your Project?

More than likely, the answer to this question is no. Though everyone seems to be talking about BIM, the application of the process on any given project is probably voluntary. The more forward-thinking and larger design firms have transitioned to using BIM software for production, and may or may not request their sub-consultants to do the same. In these situations, the end product, which will be paper contract documents, will be arrived at by "doing BIM", but more as a glorified drafting tool than as the application of a new production paradigm. In this case, are there any legal concerns or additional risks that come into play by using BIM? Assuming you have a properly trained staff who can produce good quality paper documents, probably not. There are, however, many sophisticated owners, and large public entities, such as the states of Texas and Wisconsin, that now require BIM for their projects. In cases where BIM is required on a project, a careful reading of the criteria for implementation on the project is necessary, and review by an attorney familiar with BIM contract language is strongly recommended.

What about those cases where the design team would like to take full advantage of the BIM production process, and not just use it as a "glorified drafting tool?" Are there any documents or standards that provide a framework for this situation? Fortunately, yes. Two of the more commonly used documents are:

1) AGC ConsensusDOCS 301 *BIM Addendum*, created by the Associated General Contractors (AGC) of America. The primary purpose of this document is to fill the void left by typical standard form agreements, which inadequately, or do not at all, address BIM. This document covers areas such as definitions, information management, the BIM execution plan, risk allocation, intellectual property rights, and collaboration.
2) AIA E202-2008 *Building Information Modeling Protocol*, created by the American Institute of Architects (AIA). The purpose of this document is to provide a framework for determining model content, model usage, and model element responsibility.

Whether these documents are adopted as formal contract exhibits or, more informally, are adopted to provide internal team guidance on a project, they are excellent tools in managing the risks associated with implementing the relatively new technology called BIM.

What Are The Owner/Client Expectations?

Most structural engineers have probably heard at one time or another that we have the amazing ability to design everything "with the push of a button." That is, we have this amazing software that just designs everything for us, with minimal thought and effort on our part. That same ability has migrated to the world of BIM, where those with just enough knowledge to be dangerous make the assumption that the design team can produce a perfectly coordinated set of documents by using BIM. And that we can do it for the same fee, or preferably a smaller fee, because BIM makes our job easier. Waving around pieces of paper with a bunch of legalese does not replace the need to manage the expectations of your client. The champions of BIM (of which I am one) do a great job of expounding on the promise and advantages of BIM…not so much on the challenges and obstacles to implementing it. Obviously, there is a need to properly educate and manage the expectations of your client.

Standard of Care

Consider the following scenario. You have just won a large and complex building project. You and the architect use BIM software to produce the contract documents, as you have made the leap from the world of 2D. You do not, however, spend much time discussing how BIM will be implemented, and do not make use of any standard BIM documents to help define model content or responsibilities. Your contract documents are produced and, as is typical with most projects, changes occur, RFI's cover your desk, and change orders are produced – nothing that hasn't occurred on thousands of projects before. And the owner says, *But wait, don't you 'do BIM?' You know about clash detection* (which in the mind of the owner is the same as BIM). *Why didn't you run clash detection and avoid all these problems? Why, I do believe you are violating the Standard of Care!* Though this is a hypothetical situation at the moment, it may not be in the near future.

What Are The Requirements Of The Deliverables?

If you are asked to implement BIM on a project, one of your first questions should be, "What are the deliverables?" A set of contract documents is likely and expected. That means the extraction of 2D views from your model, which will require you to do enough modeling to accurately represent your structure on plan, and perhaps in section or elevation. Is clash detection going to be performed on this project? If so, those kickers and gusset plates and sloped slabs that were either typical details or annotations for your contract documents, now need to be in the model. Are you going to turn this over to a fabricator so shop drawings can be produced? Oh, boy. That means connection plates, anchor bolts, edge angles, rebar, etc. Your scope on a project is directly related to the deliverables required. These deliverables impact the schedule, determine your staffing requirements, dictate the expertise required of your staff, and of course affect your fee.

Who Owns What?

In the world of 2D CAD, the ownership of the documents was pretty straight-forward (for the purposes of this discussion, we are not referring to intellectual property rights). The architect created his plans and details, the structural engineer and MEP engineer likely traced over and copied the architectural backgrounds to initially create their drawings, and there was really no discussion or issues related to the ownership of the various "lines" in the CAD files. With the implementation of BIM, these fairly clear-cut distinctions become quite blurred. In the ideal BIM world,

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the architect creates and owns "architectural" objects, the structural engineer creates and owns "structural" objects, and the MEP engineer creates and owns the "MEP" objects. On the face, it appears easy to distinguish between model element ownership. As the structural engineer, I am going to determine the thickness of the slab, the reinforcement required, and I will specify any other parameters related to the design. The architect, however, is probably going to establish the slab edge, where penetrations are required (with input from the MEP), and what slopes may be required. Considering all this, who owns the slab? If it is determined that I own the slab, I am liable for the cost that may be incurred for a slab edge that is improperly located? Establishing the ownership of model elements at the start of a project, perhaps through the use of the E202 BIM protocol, will help to establish clear divisions of ownership.

Moving from the element level to the model level, is there such thing as ownership of the BIM model? Well, that depends on how many BIM models there are. In most projects implementing BIM, it is likely there are several BIM models, typically one for each discipline. These separate and distinct models can then be linked together to form a single "federated model." The distinct models that are provided by the various disciplines cannot be altered in the federated model, and each model creator retains ownership of his model. A common use of a federated model is for clash detection. There is no one "owner" of a federated model. At some point in the future, a truly integrated model will become a reality, in which all parties do their work in a single model.

What Are The Technical Challenges That Affect Your Risk?

In addition to the issues of model ownership that are evident in this process, an organization must be aware of various technical challenges that create risk so that it may implement mitigation measures. Some technical issues to highlight are interoperability, software limitations, and file storage and transfer limitations. The ability to interoperate between various software platforms provides engineers and companies with visions of grandeur. The concept of your analysis files driving the engineering deliverables, providing a platform for creating a more efficient and accurate product, is too much for any company to ignore. While the technology exists to perform these types of tasks, organizations should try to move deliberately and cautiously in its implementation. The interoperability bells and whistles marketed by the software venders are never quite as seamless as the brochures indicate. Don't believe everything the software vendors tell you.

Define some specific goals to integrate your software processes. Then ask yourself the tough questions. What do you want to accomplish with the integration of various software tools? Does the software have the ability to do this out of the box? Can an application programming interface (API) be developed to perform the interoperation in a manner consistent with your desires and, if so, do you have the personnel available and capable to develop, maintain, trouble shoot, and efficiently roll out the tools. Reasonable first steps would be to research the software limitations, test run some of the standard applications, evaluate their usefulness and implement on a small scale. Then use the successful applications in ways that will that will add value to your process.

Also understand that a variety of information technology (IT) issues may need to be evaluated. The data files produced by some BIM software can get very large. The size of these files may require you to rework project file size limits, corporate storage capacity, upgrade hardware, and improve backup capabilities. The opportunity to share this data upstream and downstream to various parties will present itself. While working through the legal ramifications of this activity is equally important, be prepared to implement data transfer systems that are robust enough to handle large file transfers.

Reduce Your Risk with Proper Implementation

When the decision is made to implement BIM, consideration must be given to the training required. While individual staff research is important, a focused plan on the firm wide training effort is mandatory. This can be challenging, as the development of this plan affects all aspects of the project production. Managers will need to be trained to understand software capabilities, technicians will need to be trained in the efficient use of the software, and engineering staff will often times be caught in the middle between the production issues of the technicians and the grand vision of the managers and marketing personnel. Managing expectations is critical to making sure this process in implemented at the right pace.

Organizations will often go through the following experiences during the integration of BIM into their production process:

- Cautious investigation
- Trial and Error on a small level
- Recognition of value
- The big sale on the big project… then reality strikes
- Implementation of standards
- BIM efficiency

The order of these events may vary from organization to organization, but BIM efficiency is likely never to come before the implementation and transition of corporate standards. This process needs to be considered and worked into the plan. While time consuming, it will aid in transitioning your organization from the 2D world into an efficient 3D BIM practice. Another issue that organizations will grapple with is the quality of the product. A concerted effort and investment can be required to get the new software to produce drawings that appear the same as your old deliverables. Sometimes it is wise to consider alternatives in the product output. It may be less time consuming to consider a change in the standard output and tailor it to what the software can do, rather than

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implement the strict performance guidelines developed during the CAD era.

Conclusion

The decision to implement BIM at your firm is not one to be taken lightly. You will need to make the transition if you are to remain competitive in the AEC industry. Either your clients will be demanding that you make the change, or the projects that you typically bid on will require BIM as part of the contract. As with any new technology, there will be resistance to the change and trepidation at the disruptive nature of your production process. Though the process will not be easy, you can take several steps to reduce your risks as you embark on the implementation and on-going use of BIM. Most of these steps are simple common sense, such as defining and knowing your scope, managing the expectations of your client, developing a properly trained staff, make use of standard BIM agreements, and getting the advice of an attorney for projects requiring BIM. For more information on building information modeling, please visit **www.seibim.org** for useful links and documents.▪

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2010 Engineered Wood Products Guide

a definitive listing of wood product manufacturers and their product lines

Company	Product	Description	
American Wood Council Phone: 202-463-2766 Email: **awcinfo@afandpa.org** Web: **www.awc.org**	Codes and Standards	AWC develops internationally recognized building codes and standards for engineered wood products.	Associations
Southern Pine Council Phone: 504-443-4464 Email: **info@southernpine.com** Web: **www.southernpine.com**	Glued Laminated Lumber	The Southern Pine Council (SPC) is a joint promotional body supported by members of the Southern Forest Products Association (SFPA) and the Southeastern Lumber Manufacturers Association (SLMA). Both associations represent manufacturers of Southern Pine lumber. SPC is the leading source of information about Southern Pine products for design/build professionals.	
WoodWorks Software Phone: 800-844-1275 Email: **sales@woodworks-software.com** Web: **www.woodworks-software.com**	WoodWorks® Software	WoodWorks® – produced by the Canadian Wood Council with technical guidance from the American Wood Council of the American Forest & Paper Association. Quickly design light-frame or heavy timber structures based on 2005 edition of the AF&PA's National Design Specification® (NDS®) for Wood Construction.	
Simpson Strong-Tie Phone: 925-560-9000 Email: **web@strongtie.com** Web: **www.strongtie.com**	VTCR Valley Truss Clip	Simpson Strong-Tie introduces the VTCR connector for valley trusses. It quickly installs on top of roof sheathing into framing with either nails or screws for higher uplift loads. The VTCR conveniently installs from one side, uses fewer fasteners than the VTC2 and is designed for new construction or retrofit applications.	Connectors
Anthony Forest Products Company Phone: 870-862-3414 Email: **info@anthonyforest.com** Web: **wwww.anthonyforest.com**	Power Preserved Glulam Beams™ and Columns™	Stock Power Preserved Glulam beams and columns treated with Hoover Cop-Guard and covered by 25 year warranty.	Engineered Lumber
	Stock 24F Glulam	24F Stock Glulam for residential and light commercial construction.	
Bentley Systems Phone: 800-236-8539 Email: **structural@bentley.com** Web: **www.bentley.com/Structural**	STAAD Pro and RAM Elements	STAAD.Pro supports AITC 1984 or 1994, CSA086-01 or EurocodeEC5, 1995-1-1:2004 codes; extensive database of standard sections from the AITC and Canadian suppliers. RAM Elements supports design per the latest NDS (2005) code (ASD and LRFD) and allows for optimization of members; comprehensive database of sawn lumber and glulam sections.	
Cascade Consulting Associates, Inc. Phone: 800-279-1353 Email: **sales@strucalc.com** Web: **www.strucalc.com**	StruCalc™ 8.0 for Windows	Software solution for the design and analysis of beams, columns, joists, rafters and footings using solid sawn lumber, steel and tube steel, structural composite, glulams, flitch beams, and I-joists. Includes full AISD 13th Edition Steel Calculations, hip beams, stud walls, and many other exciting features.	
Hoover Treated Wood Products, Inc. Phone: 800-531-5558 Email: **marketing@frtw.com** Web: **www.frtw.com**	Exterior Fire-X®	Exterior Fire-X:Exterior fire retardant treated lumber and plywood tested in accordance with ASTM E-84.	
	PYRO-GUARD®	PYRO-GUARD: Interior fire retardant treated lumber and plywood, tested in accordance with ASTM E-84.	
iLevel by Weyerhaeuser Phone: 888-453-8358 Email: **ilevel@weyerhaeuser.com** Web: **www.iLevel.com**	iLevel Shear Brace	A prefabricated, engineered wood panel with more predictable and consistent performance than site-built shear walls, the iLevel Shear Brace has high allowable loads at narrow widths of 12" and 24". It can be used in multi-story applications and can be field trimmed for custom heights.	
RISA Technologies Phone: 949-951-5815 Email: **info@risatech.com** Web: **www.risa.com**	RISAFloor	RISAFloor and RISA-3D for wood design – Create 3D models of your entire structure and get full design of wood walls (with and without openings), flexible wood diaphragms, dimension lumber, glulams, parallams, LVLs, joists and more. Custom databases for species, hold-downs-and panel nailing offer total flexibility.	
Southern Pine Council	See above information		
TrimJoist Corporation Phone: 800-844-8281 Email: **marty.hawkins@trimjoist.com** Web: **www.trimjoist.com**	TrimJoist™	TrimJoist is the combination of an open web floor truss and a trimmable wood-I-joist, bringing the best features of each together to form a trimmable floor truss. As the name indicates, it can be trimmed on the construction site for a custom fit.	
Universal Forest Products Phone: 574-532-6102 Email: **dsill@ufpi.com** Web: **www.ufpi.com**	Open Joist™	Speed of installation and superior load-bearing strength have made Open Joist™ a preferred choice for building designs that require longer joist spans or wider joist spacing and reduced framing costs. Open Joist features an open web design for quick and easy installation of mechanical systems.	
Wheeler Phone: 800-328-3986 Email: **info@wheeler-con.com** Web: **www.wheeler-con.com**	Timber Bridges	Wheeler specializes in the design and supply of custom engineered timber bridges for recreation and vehicular applications.	

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