Furthering Collaboration
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1. The Evolution of BIM

Building Information Modeling (BIM) technology has arrived and is being used by designers, contractors, and suppliers to reduce their costs, increase quality, and, in some instances, achieve designs that would be impossible without digital design and fabrication. Studies by Stanford University's Center for Integrated Facility Engineering report that BIM use has risen significantly and will continue to rise in the near future. Moreover, by Spring of 2008, McGraw–Hill estimates that the tipping point was reached where more teams are using BIM than exploring it.[i] This explosive growth[ii] has been supported by preliminary development of BIM standards,[iii] contractual protocols for BIM use,[iv] and by related issues, such as modern electronic data licensing and file transfer agreements. And as the technical issues of standards and interoperability are addressed, the software capabilities will develop further.[v] BIM is not tomorrow's vision; it is today's reality.

But this reality raises new questions. BIM has being adopted, but for what purposes and by whom? Currently, the depth of adoption varies significantly between designers, contractors, subcontractors and owners and differences exist between individual disciplines.[vi] Not surprisingly, this first phase of BIM adoption has focused on areas of immediate benefit, notably 3D design and physical clash detection or for fabrication, although often not linked to the design BIM. These are all tasks that could be done with prior tools and processes, albeit more easily accomplished with BIM. Thus, the BIM of now improves traditional and essentially solitary processes. But BIM can do more.

The BIM of the future addresses a broader range of issues that cannot be solved without the combined efforts of design, construction and facility management.[vii] For example, constructability requires direct interaction between the designers and those who construct the project. Architects and engineers must learn to create designs in BIM that correspond to how the project will be constructed. Similarly, use of BIM for scheduling and logistics analysis requires integrating information about how and in what sequence the structure is erected. Estimating cost also requires close interaction and communication between designers, contractors, trades and vendors. Designs must be organized to facilitate flowing information from and into the BIM or into separate analysis software regardless of who authors or uses the information. Sustainability also requires information from a broad range of sources: users, designers, builders and facility managers. Thus, the BIM of the future is collaborative, shifting the focus from individual processes to project workflows and seamless interactions.

2. The Future of BIM is Collaborative

BIM's need for collaboration to achieve its most powerful and sophisticated outcomes, is balanced by its strength as a collaborative framework. Dazzling 3D images are the most visible aspect of BIM, but BIM's real power stems from being an organized collection of related numbers. As noted in an National Building Information Modeling Standard (NBIMS) definition, BIM is a "computable representation of all the physical and functional characteristics of a facility".[viii] Because it is "just numbers", the information can be extracted, analyzed, mathematically manipulated, and combined or related to other data. BIM data has many sources and multiple uses—a characteristic that can be exploited to create more sustainable projects because the data provided by designers, contractors, vendors and others can be combined and analyzed to iteratively optimize the design. Similarly, the design information in the BIM can be linked to a contractor's cost and constructability information to create the near continuous cost data analysis required for target value design. Moreover, because BIM information is centrally managed, entered once, and multiply viewed, it creates the communication framework and common basis of understanding necessary for collaboration.

BIM's power is enhanced by collaboration and collaboration is made more effective through BIM.

Collaboration is not a hallmark of the AEC industry. Traditionally, design, construction and facility management have been separated at a professional and legal level. Standard construction contracts carefully delineate the boundaries between owner, designer and contractor and forswear any responsibility of one for the others. This has lead to a highly fragmented and inefficient process that has reduced construction quality and efficiency. In response to declining construction productivity, the Construction Users Roundtable (CURT) issued two white papers[ix] that analyzed the sources of inefficiency and recommended strategies for improvement. A key finding was that "The building process cannot be optimized without full collaboration among all members of the design/build/own project."[x] To achieve this goal, CURT recommended open information sharing, early involvement of all key participants and the use of virtual building models (BIM).[xi]

The power of collaborative BIM goes beyond improving efficiency. Sustainability, perhaps the most important challenge for the design and construction community, is at the intersection of BIM and collaborative project delivery, drawing strength from both. As noted by the American Society of Heating, Refrigerating and Air-Conditioning Engineers:

> The *integrated design process* facilitates higher building performance by bringing major issues and participants into the project early in the design process. For the most part, the opportunities for creatively addressing solutions occur very early in the design process. Early team building and goal setting can reduce total project costs. This collaborative process will inform building form, envelope, and mechanical, electrical, plumbing and other systems.[xii]

Building Information Modeling provides the tools for iteratively analyzing and optimizing design and collaboration provides the content and the creativity that empowers the tools.

3. Trends Leading to Greater Collaboration

3.1 The Trend to Open Communication and Reliance

As noted previously, traditional construction contracts confine parties to their assigned roles and similarly segregate liability. This was a feasible risk management approach because the *economic loss doctrine* applicable in many states prevents an injured party from recovering pecuniary losses unless they have a contractual relationship to the defendant.[xiii] If the parties are walled off contractually, they cannot be sued under the contract and cannot be sued outside of it. But as parties began to exchange CADD data electronically, questions arose concerning the ability of the receiving party to rely on the information and the liability of the transmitting party for its accuracy. Under Restatement of Torts Second §522, a person who negligently supplies incorrect or misleading information to a person who justifiably relies on the information is liable for any financial loss sustained.[xiv] Free exchange of CADD data thus raised concerns of expanded liability to third parties. In response, parties reinforced the contractual walls by disavowing responsibility for the transmitted information.[xv] But this approach leads to inefficiency, misunderstanding, and poor outcomes, which inevitably leads to claims.[xvi] And project efficiency requires reliable communication. A change was needed.

In 2007, the American Institute of Architects issued the *Digital Data Licensing Agreement*[xvii] and the *Digital Data Protocol Exhibit.*[xviii] Rather than limit reliance on digital data, these documents explicitly permit reliance for permitted project purposes.[xix] The Associated General Contractors similarly adopted more open communication standards with their *Electronic Communications Addendum.*[xx] There are significant differences between the documents with the *Electronic Communications Addendum* using a check-list and mechanics approach to data transfer whereas the *Digital Data Protocol Exhibit* focuses on the procedures, formats and purposes of the data exchange through the *Project Protocol Table*.[xxi] But their differences are dwarfed by their similarities. Both assume that information must be freely transferred and that the receiving party may rely on the information in executing its project responsibilities.

The philosophical shift continued in 2008 when the AGC issued its *Building Information Modeling Addendum*[xxii] which was shortly followed by the AIA's *Building Information Modeling*

Protocol Exhibit.[xxiii] Again, the documents differ significantly in focus and methodology[xxiv], but both seek to structure efficient and enhanced data exchange through the building information model or models. The contractual walls are being torn down and replaced with free-flowing, but controlled communications.

3.2 The Transformation to Integrated Project Delivery

The development of data exchange and BIM protocols removes barriers to collaborative communication but does not require collaborative action. By themselves, these changes cannot overcome traditional construction practices, such as competitive low bid procurement, guaranteed maximum price and similar contract structures that have fostered an individualistic, zero-sum approach to construction.[xxv] Although the AEC industry has praised collaborative behavior, it has used business structures that reward individuals based on their own performance and which foster antagonistic relationships.[xxvi]

Integrated Project Delivery (IPD) transforms collaboration from a behavior we would like to occur (an *aspiration*) to a behavior that has consequences (a *value*). A value is a behavior that is rewarded if achieved and enforced if ignored. Moreover, Integrated Project Delivery provides a management and risk sharing structure that supports a truly collaborative project.

IPD stems from many sources, but none more significant than Project Alliancing project developed in the United Kingdom and used most successfully in Australia.[xxvii] The key elements of Project Alliancing are: 1) guaranteed payment of participants direct costs; 2) joint sharing of project overruns/underruns; 3) joint project management; and 4) waiver of claims between participants. Essentially, once an alliance is formed, the participants are bound to succeed or fail together.

In the United States, the Lean Construction Institute began promoting collaborative project structures to support project collaboration. The shift accelerated in 2007 when the American Institute of Architects, California Counsel issued its *Integrated Project Delivery: A Working Definition,*[xxviii] which was shortly followed by the joint AIA/AIACC's *Integrated Project*

Delivery: A Guide.[xxix] AIA also issued a revised policy statement on project delivery, which states:

> The AIA believes that every project delivery process must address the quality, cost-effectiveness, and sustainability of our built environment. This can best be affected through industry-wide adoption of an integrated approach to project delivery methodologies characterized by early involvement of owners, designers, constructors, fabricators and end user/operators in an environment of effective collaboration and open information sharing.[xxx]

These AIA/AIACC documents provide the theoretical framework for IPD and create a structure where the key participants (owner, designers, contractors and significant trades) are deeply involved from project inception with information openly shared among them. In addition, the parties share risk and reward based on project outcome, jointly manage the project to achieve shared goals, and agree to limit liability to each other. Although BIM is theoretically not required for IPD, both the *Working Definition* and the *Guide* recognize BIM is a fundamental collaborative tool and will almost always be used on an integrated project.[xxxi] These fundamental provisions create a value based virtual organization aligned to the project.

As significant as these structural changes are, IPD requires even more profound changes in belief and behavior. IPD is a trust based project delivery methodology and will not succeed, regardless of structural changes, unless the team understands why IPD works. For example, a few "postulates" of IPD are:

> Optimization Requires Collaboration;
> Collaboration Unlocks Creativity;
> Joint Control Creates Joint Ownership;
> Timely Payback on Project Outcome Creates Selflessness;
> Challenge Stimulates Creativity; but
> Fear Creates Defensiveness

Teams need to believe that these assertions are true, and as discussed below, contracts being developed to support IPD, must support and embrace the key principles and postulates.

3.2.1 IPD Contracts as Collaborative Tools

The Associated General Contractors and the American Institute of Architects have recently issued contract documents that support IPD. However, IPD in the United States is an evolving practice and experimentation is still the norm. The variance in IPD practice also reflects differences between project teams and between different projects. IPD documents must reflect the participants' differing characteristics, capabilities and preferences. At a minimum, dimensions such as project duration, project size, the size and financial capability of the participants, type of financing, project complexity, prior IPD experience, and risk tolerance all affect how IPD is implemented. At present, each project needs to be separately crafted although several different approaches are beginning to emerge.

(a) Multi-Party Integrated Agreement (MPIA)

In several recent projects, the author used a contractual approach that translates the Australian Project Alliance into an American commercial and legal framework. Owner, architect and contractor execute a single agreement that is consistent with IPD principles and postulates. This contract structure has been used on LEED Platinum tenant improvements, hospital projects, and is being developed into standard IPD agreements for a national architectural firm and a multi-disciplinary program manager. Portions of this approach have also been used on a wide variety of other projects where greater integration is sought, but full integration is not possible because of public procurement restrictions.

Under these contracts, the project team jointly develops financial and other targets based on the owner's program and budget. Using target value design, the team then works collaboratively to design and construct the project to the agreed target. The project is managed by a three party Project Management Team composed of participant representatives. All PMT decisions must be unanimous, with deadlocks being broken by a majority vote of senior representatives. The owner can still override the non-owner participants,(Owner's Directive) but if an Owner's Directive is issued, the target cost and schedule will be equitably adjusted. Compensation is based on project outcome which can result in the non-owner participant's profit being increased, decreased, or even eliminated. Actual costs, however, are guaranteed by the owner. In addition, the amount of profit can be adjusted based on quality and schedule. Liability is waived between the key parties for damages related to cost and schedule.

(b) ConsensusDOCS 300 Standard Form of Tri-Party Agreement for Collaborative Project Delivery

In 2007, the Associated General Contractors issued an integrated agreement based on the Lean Construction Institute contract. It expresses a desire to collaborate and imports some Lean Construction concepts. Like the MPIA, the owner, contractor and architect sign a single agreement. Also like the MPIA, the parties share risk and reward based on agreed targets. However, the ConsensusDOCS 300 sets the targets shortly before construction, which removes much of the opportunity for target based design and much of the incentive for the designer or constructor to develop a cost efficient approach during the design phase. In addition, because the potential savings are primarily in the construction phase, the designer is placing its profit at risk *after* it has lost control over the outcome. The ConsensusDOCS 300 has options that affect the level of project integration and need to be considered carefully, such as an option to retain traditional liability and risk allocation or to more broadly waive liability. Like all form contracts, the ConsensusDOCS 300 requires modification to tailor it to a specific project, specific project team, and specific jurisdiction. However, it contains many interesting concepts and its issuance was an important event in developing integrated project delivery in the United States.

(c) American Institute of Architects Integrated Project Delivery Agreements

In 2008, the American Institute of Architects issued two integrated project delivery approaches. The first is a "transitional" set of documents that has separate owner-contractor[xxxii] and owner-architect[xxxiii] agreements and a joint set of general conditions.[xxxiv] This document series does favor collaboration, but it does not have the risk sharing, joint project control or liability waivers that full integration requires. The second approach is fully integrated, but is more complex and requires extensive customization for specific projects and specific jurisdictions. The AIA's Single Purpose Entity (SPE) approach[xxxv] implements IPD by using a separate limited liability company jointly owned by the owner, contractor and architect. The owner contracts with this single purpose entity to design and construct the project. The SPE manages the project though a controlling board with the owner having a majority interest. The SPE contracts with the architect and contractor on a cost or reduced profit basis with final profitability based on project outcome. The SPE approach is significantly more complex than other forms and requires consideration of licensing, taxation and corporate compliance issues that the others do not require. Because of the legal complexity of this approach, it will most likely be used on larger projects. The SPE approach is appropriate for some project types, however, and many of the document's concepts are can be used with other approaches.

3.3 Legal Implications of Collaboration[xxxvi]

Collaboration changes the rules and, depending upon your point of view, these changes are threatening or refreshing. For example, if information is freely exchanged with the intent that it be used and relied on, then concepts of privity and the economic loss doctrine are largely obsolete. Designers, in particular, are concerned that they are now exposed to a broader range of potential claimants including contractors and sub-contractors. But collaboration can also serve to reduce potential liability as shown by a narrowing of the hallowed *Spearin* doctrine*.*

Introduced by the Supreme Court in 1918, The *Spearin* doctrine allocates design risk by implying an owner's warranty that plans are complete and accurate. The *Spearin* court found that "the one who provides the plans and specification for a construction project warrants that those plans and specifications are free from defect."[xxxvii] Although initially a defensive doctrine, *Spearin* has evolved into an offensive weapon that permits contractors to recover whenever plans have errors or omissions.[xxxviii] In principle, *Spearin* does not affect design professionals because the implied warranty flows from owner to contractor. In practice, however, it overshadows much of construction litigation because it encourages the contractor to allege design deficiencies that will trigger the absolute *Spearin* warranty and forces the owner to assert indemnity claims against its designer.

But if the contractor participates in design development, can it rely on *Spearin*? Decisions involving performance[xxxix] specifications strongly suggest that *Spearin* is less effective in a collaborative environment because there is no need to imply a warranty to design information provided by the contractor.[xl] The applicability of *Spearin* to hybrid specifications–those that blend prescriptive and performance requirements–has also been questioned.[xli] *Spearin* will not apply. In a fully modeled project, particularly in a collaborative project where subcontractor and vendor information is incorporated into the design, it appears that courts would turn to cases of hybrid specifications to determine whether to imply a warranty. This will be a factual inquiry, but the deeper a contractor's involvement in the design, the less likely a warranty will be implied. And as recently noted, "It is not unreasonable to project that the threshold for invocation of *Spearin* by a contractor and BIM participant … will be set quite high."[xlii]

Collaboration also impinges on professional responsibility rules that were created for an insular world. Our tri-partite division between design, construction and ownership places the architect and engineer as master of the design with responsibility to safeguard the public against unsafe structures. To achieve this public policy, the appropriate design professional must sign and seal the construction documents to signify responsibility for the design. Moreover, the statutes and regulations require the designer to be "in responsible charge,"[xliii] which requires that work be performed by the licensed professional, or under his or her supervision. But in a collaborative, BIM enabled project, there is a gray intersection between work performed by the design professional, work performed by the software, and work performed by unlicensed professionals.

Intelligent modeling software can perform certain design work historically performed by design professionals. Structural design and detailing software, for example, is capable of modifying the connection details in response to design changes, such as the length of a beam. This occurs without input from the design professional and in response to an algorithm that the design professional did not develop and may not even understand. In addition, the ability to exchange data between models, and to collaborate through the models, creates the possible–and likely desirable–result that design details created by subcontractors and vendors will be incorporated into the model and the final construction documents.[xliv]

These issues are not entirely new. For years, engineers have relied on analysis programs using programming code the engineers have never seen and might not be able to understand.[xlv] Similarly, some portion of design has always existed in the coordination drawings, shop drawings and submittals issued by the contractor and its sub-contractors. But with BIM, what were ancillary or supporting documents are now part of the model, and possibly the contract documents themselves. The gap between statutory requirements and good professional practice is widening. Statutory definitions of responsible charge are out of step with the emerging practice and must be modified to support design collaboration while preserving public safety and confidence.[xlvi]

Finally, BIM affects the standard of care at several levels. At the most basic level, is it below the standard of care *not* to use BIM if using BIM can readily solve design issues that resist solution when attacked with traditional tools? Clash detection of complex structures is an obvious example.

BIM almost entirely eliminates coordination problems because it allows the designer, the contractor and the subcontractors to dimensionally check their respective work and assure that physical conflicts do not occur. Physical conflict issues can be eliminated during the design phase and confirmed with electronic submittals. Given the expense and disruption caused by clashes discovered during construction, and the ease with which this problem is solved, does the standard of care *require* that the designer use tools that eliminate this costly problem? In the author's opinion, traditionally coordinated 2D drawings are no longer sufficient for complex structures, particularly those with significant mechanical, electrical and plumbing systems.[xlvii]

There are also standard of care issues arising from *how* BIM is implemented. Although it is convenient to discuss *the* model used for a project, in practice, project design is an amalgamation of interlocking models created by different project participants. These federated models must be able to exchange information accurately–which requires forethought and discussion between participants. In addition, the designer needs to determine the model's granularity, i.e., the detail to which information is depicted as this affects the interface between the designer's and the implementer's responsibilities. Similarly, the designer needs to determine what information will reside in the model and what information will reside in specifications or 2D CAD drawings.

Finally, the process of collaboration raises questions regarding who owns the model or other collaborative work. As a general rule, the creator of intellectual property owns it. But if two or more parties contribute[xlviii] to the intellectual property, it be comes a joint work owned by all of them. In a BIM enabled collaborative project, ownership rights must be appropriately allocated by contract.

4. Conclusion

Using BIM to solve increasingly complex and sophisticated problems will naturally lead to its use in collaborative settings. Deeper collaboration will expose the limitations of current business and contractual structures and lead to exploration of project delivery methods aligned with collaboration, such as Integrated Project Delivery. IPD, which involves communication and collaboration between multiple participants, needs a common language and communication platform, which leads back to BIM. This reinforcing evolution requires development of project and contractual structures that intelligently allocate risk, reward, and control and which enhance efficiency quality and sustainability. Although the ultimate solution is not yet in sight, the journey has begun.

i *Interoperability in the Construction Industry*, McGraw Hill SmartMarket Report (2007) p. 11.

ii *Building Information Modeling,* McGraw Hill SmartMarket Report (2008) confirms an acceleration in BIM adoption, although the rate of adoption varies by discipline.

iii Most notably, the National Institute of Building Science's National Building Information Modeling Standard V. 1.0, http://www.facilityinformationcouncil.org/bim/publications.php. At this paper is being written, ConsensusDocs is circulating a draft BIM specification that should be issued in 2008.

iv American Institute of Architects Document E-202, Building Information Modeling Protocol Exhibit; ConsensusDOCS Document 301, Building Information Addendum; Autodesk, Building Information Specification.

v The National Institute of Building Science is currently developing a National Building Information Modeling Standard. See www.nibs.org/newstory1.html. The International Alliance for Interoperability has long been working on standards for data exchange between modeling software. See www.iai-international.org.

vi There have been and continue to be commercial, technical and legal barriers that impede BIM adoption. See, Ashcraft, H., *Building Information Modeling: A Framework for Collaboration*, The Construction Lawyer, Vol. 28, No. 3, Summer, 2008.

vii As noted recently, "While modeling tools provide significant benefits for individual users, leveraging BIM just to produce "silos of excellence" minimizes the greater potential for large-scale improvement of the entire industry." *Building Information Modeling*, supra, at 23.

viii "A building Information Model, or BIM, utilizes cutting edge digital technology to establish a computable representation of all the physical and functional characteristics of a facility and its related project/life-cycle information, and is intended to be a repository of information for the facility owner/operator to use and maintain throughout the life-cycle of a facility." www.nibs.org/newsstory1.html

ix *Optimizing the Construction Process: An Implementation Strategy*, CURT WP-1003 (July 2006) and *Collaboration, Integrated Information and the Project Lifecycle in Building Design, Construction and Operation,* CURT WP-1202 (August 2004).

x WP-1202, *supra,* at 7.

xi WP-1202, *supra,* pp. 7-10.

xii Informative Appendix G, BSR/ASHRAE/USGBC Standard 189.1P *Standard for the DEsign of High-Performance Green Buildings Except Low-Rise Residential Buildings* (IESNA 2008 Review Draft) Note that ASHRAE interchangeably uses Integrated Design and Integrated Project Delivery. See also, Krygiel, E and Nies, B, *Green* BIM, Sybex (2008) particularly Chapter 3, Integrated Design Team; and U.S. Department of Energy, *Greening Federal Facilities* 2nd Ed., Part 4.1 Integrated Building Design, U.S. Department of Energy and *Integrated Building Design for Energy Efficiency*, http://fac.usu.edu/departments/d&c/HPD/EERE%20Integ%20Design.pdf.

xiii Andrus, B. *et al.*, *The Economic Loss Doctrine in Construction Cases: Are the Odds for Design Professionals Better in Vegas?* 2 J ACCL No. 1, p. 53 (Winter 2008).

xiv Restatement of Torts Second, Section 522.

(1) One who, in the course of his business, profession or employment, or in any other transaction in which he has a pecuniary interest, supplies false information for the guidance of others in their business transactions, is subject to liability for pecuniary loss caused to them by their justifiable reliance upon the information, if he fails to exercise reasonable care or competence in obtaining or communicating the information.

(2) Except as stated in Subsection (3), the liability stated in Subsection (1) is limited to loss suffered:

(a) by the person or one of a limited group of persons for whose benefit and guidance he intends to supply the information or knows that the recipient intends to supply it; and

(b) through reliance upon it in a transaction that he intends the information to influence or knows that the recipient so intends or in a substantially similar transaction.

(3) The liability of one who is under a public duty to give the information extends to loss suffered by any of the class of persons for whose benefit the duty is created, in any of the transactions in which it is intended to protect them.

xv This traditional approach is still seen in the Engineers Joint Contract Documents Committee Doc. 700, General Conditions for Construction which states, in section 3.06:

3.06 *Electronic Data*

A. Unless otherwise stated in the Supplementary Conditions, the data furnished by Owner or Engineer to Contractor, or by Contractor to Owner or Engineer, that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.

B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party.

C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

[xvi] This is a classic risk management dilemma. Are you better off by isolating yourself from a risk or assuming responsibility for the risk and preventing its occurrence? Contractually limiting risk reduces the exposure, i.e., the number of ways you could get sued. Legal risk management generally focuses on reducing exposures. For example, the effect of a loss can be lessened by contractually limiting responsibility. But this may be counterproductive. If the loss occurs, the person disadvantaged by the contractual terms will try to overturn or limit their applicability. Litigation becomes an essential tool for enforcing the contractual risk allocation, with significant social and practical costs. But real risk is not the sum of potential exposures, but is the product of loss severity and likelihood of occurrence. Thus, risk can be lessened if the parties work to eliminate or reduce the cause of losses even if, by accepting responsibility, their exposure has increased. This strategy seeks to solve the problem rather than redistribute it. I many instances this will be a more effective strategy because the most successful battle is one that is never fought.

[xvii] AIA Document C106 (2007).

[xviii] AIA Document E201 (2007).

[xix] E201, §2.4.

[xx] ConsensusDOCS 200.2 (2007).

[xxi] For a detailed discussion of the ConsensusDOCS and AIA approaches, see, Hurtado, K. and Ashcraft, H., *Saving The Trees And Managing The Paper: Developing Meaningful Contract Terms For Construction Project Electronic Communication Protocols*, American Bar Association, Forum on the Construction Industry (Sept. 2008) [to be published in The Construction Lawyer in 2009.]

[xxii] ConsensusDOCS 301 (2008).

[xxiii] AIA Document E202 (2008).

[xxiv] The *BIM Addendum* uses a more detailed approach to mechanics, but a broader brush regarding how the information will be exchanged and used and the level of detail required in the BIM. In contrast, the *Building Information Modeling Exhibit* uses a very powerful tool, the *Model Element Table* to define who is responsible for information, who can use information, and the level of detail of the information on a phase-by-phase basis. The *Model Element Table* is an extension of the *Model Progression Matrix* developed by the Technology Committee of the AIA California Council's Integrated Project Delivery Taskforce. See, http://www.ipd-ca.net/IPD%20Technology%20Issues.htm.

[xxv] These processes, in conjunction with other influences, have resulted in declining labor productivity. According to research by Dr. Paul Teicholz at the Stanford University Department of Civil &

Environmental Engineering, construction labor productivity has declined by approximately twenty percent between 1964 and 2004, whereas industrial productivity has increased approximately two hundred percent during the same period. (Teicholz, P. as reported in AEC/Bytes Viewpoint No. 4, April 14, 2004 and elsewhere.) Estimates of waste in construction are similarly alarming. The Construction Industry Institute estimates that 57% of all construction activity does not add value. (Construction Industry Institute 2004) An earlier study concluded that 30% of project costs were wasted because of mismanagement caused by the division between design and construction. (C. Ibbs, et al., *Determining the Impact of Various Construction Contract Types and Clauses on Project Performance*, CII (1986)[xxv]

[xxvi] Consider, for example, a "modern" project delivery approach , such as Cost Plus/Guaranteed Maximum Price contract with Pre-construction Services and Shared Cost Savings. This is intended to be an efficient project delivery approach that includes contractor expertise through pre-construction costing and constructability reviews and creates an incentive for reducing cost below the GMP target. But the contract structure actually impedes this goal. First, an economically rational contractor should try to avoid cost saving suggestions during the pre-construction phase. Smart ideas that occur before design is advanced merely lower the GMP. Smart ideas after the GMP is set, go straight into the contractor's pocket. The designer has little incentive to design inexpensively, as it doesn't share in any savings and runs risks if problems occur during construction. The economically rational architect should design defensively and attempt to transfer responsibility to the contractor. Once construction commences, the situation deteriorates. If an event occurs that might affect project cost, such as an arguable increase in scope or cost due to an alleged design error, the economically rational contractor must demand a change order to cover these costs. At the time of the event, the contractor cannot know how many additional "events" will occur on this project and whether the total project cost will be within the GMP. Thus, the prudent contractor must claim additional compensation or time, because if it doesn't, it may have waived its rights to the change and not be able to increase the GMP when it really needs relief. Almost immediately, the project devolves into claims and finger-pointing. Although many projects have been successfully completed using this and other equally non-collaborative project delivery approaches, their success is a testament to the professionalism and selflessness of the participants, not a commendation of the project delivery approach.

[xxvii] An excellent introduction to Alliancing is the *Project Alliancing Practitioners' Guide*, Department of Treasury and Finance, State of Victoria, Australia (2006).

[xxviii] http://ipd-ca.net/IPD%20Definition.htm.

[xxix] http://www.aia.org/ipdg.

[xxx] AIA Policy Statement 26 (2007). The prior policy statement on project delivery concluded that many different project delivery methods were acceptable and showed no preference for collaborative processes.

[xxxi] "*It is understood that integrated project delivery and building information modeling (BIM) are different concepts – the first is a process and the second a tool. Certainly integrated projects are done without BIM and BIM is used in non-integrated processes. However, the full potential benefits of both* IPD *and BIM are achieved only when they are used together".* Explanatory Note, *Integrated Project Delivery: A Guide*, p. 20.

[xxxii] AIA Document A195.

[xxxiii] AIA Document B195.

[xxxiv] AIA Document A295.

[xxxv] AIA Document C195.

[xxxvi] The issues discussed are a sampling of new issues raised by collaboration. For additional discussion of legal issues in BIM enabled collaborative projects, see, Ashcraft, H., *Building Information Modeling: A Framework for Collaboration,* The Construction Lawyer Vol. 28, No. 3 (Summer 2008).

[xxxvii] United States v. Spearin (1918) 248 U.S. 132.

[xxxviii] See, e.g., Hercules Inc. v. United States (1994) 24 F.3d 188, 197.

[xxxix] The *Spearin* doctrine does not apply to performance specifications (because the contractor is not being told how to accomplish the result) unless the desired outcome is impossible to achieve, or in some jurisdictions, commercially impracticable.

[xl] Austin Co., 314 F.2d at 520.

[xli] Hammersmith, H. and Lozowick, E., *Can the Spearin Doctrine Survive in a Design-Build World: Who Bears the Responsibility for Hybrid Specifications?* J ACCL, Vol. 2, No. 1 (Winter 2008); Ashcraft, H, *Building Information Modeling: A Framework for Collaboration,* The Construction Lawyer, Vol. 28, No. 3 (2008), at 7.

[xlii] O'Brien, T., *Successfully Navigating Your Way Through the Electronically Managed Project,* The Construction Lawyer, Vol. 28, No. 3 at 31-32. O.Brien also concludes that the warranty is weakened in collaborative projects.

[xliii] In California, for example, architects must be in "responsible control" (Cal. Bus. & Prof. §5531.5 and engineers must be in "responsible charge" (Cal. Bus. & Prof. §6703). These requirements reverberate through many other statutes and regulations.

[xliv] This recently occurred in a Northern California hospital where the final mechanical drawings were prepared by the mechanical subcontractor, but stamped by the mechanical engineer (who had worked collaboratively with the subcontractor and could be said to be in responsible charge).

[xlv] In the early days of the author's litigation practice, engineers would occasionally be required to produce the programming code used to analyze an engineering problem and explain to a confused court and jury, how the program was constructed and why it was reliable, before introducing the results. This requirement has largely evaporated as analysis software has become commonplace.

[xlvi] On October 31, 2008, a National Council of Architectural Registration Boards task force held hearings regarding professional responsibility in collaborative environments and has made recommended modifications to NCARB's *Legislative Guidelines and Model Law* for Board consideration in June of 2009. NCARB Press Release, January 29, 2009.

[xlvii] The author represented the owner of a university laboratory where a partially diagrammatic design was used for the MEP systems. When the systems were modeled, many conflicts were found supporting the contractor's argument that it had to "redesign" the systems, not merely coordinate them.

[xlviii] The contribution must be more than just offering ideas or editing. Part of the joint work must have been created by the person claiming ownership. However, the author is aware of a project where the contractor and the architect each worked in the same digital model providing content that was embedded in the model. Absent contract language granting title to the owner, both would have had ownership rights to the BIM.