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INSIDE THIS ISSUE

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Interview with Dennis Shelden, Chief Information Officer, Gehry Technologies

By Louis J. Dennis, Esq.

LJD: Thank you for sitting down with me today. Gehry Technologies (GT) is certainly one of the forerunners in the world of Building Information Modeling. What is BIM?

DRS: From my perspective, it's a common integrateable set of information organized in part by three (and other) dimensional spaces. That's the short version. I think there is a lot more to it than that. The three-dimensional information serves as an intermediary between potentially all design and construction information. It's based on the simple idea that if you share common spatial conventions, you have the potential to bring information together in a way that allows coordination on a level not possible in conventional two-dimensional drawings. There is absolutely the potential of this being more than just three-dimensional geometry because there is semantic information and that can be associated with a unique piece of geometry or construction in space and there are ways of semantic models generating spatial configurations. So the great thing about using "BIM" is not so much just that it has a third

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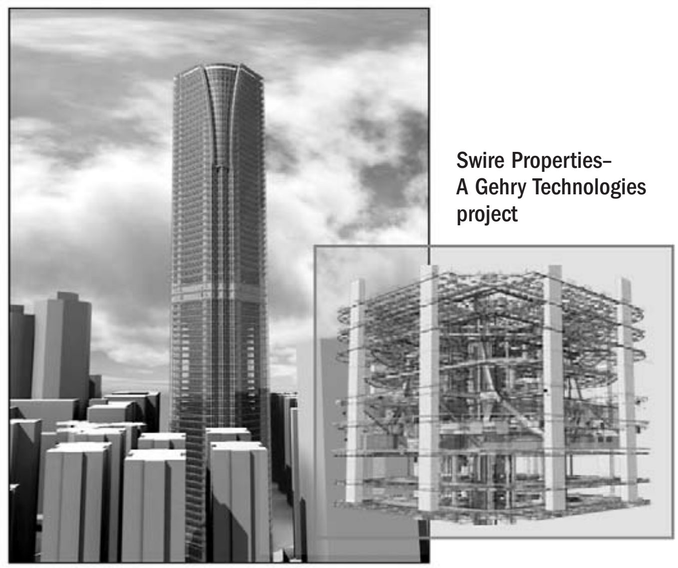

Swire Properties–
A Gehry Technologies
project

Digital Design and the Age of Building Simulation

**Paul Seletsky, Director of Digital Design,
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We are entering an age of comprehensive, pervasive, digital simulation of the physical world as we know it.

The first manifestation of this digital transformation encompassed matters relative to the gathering of *explicit knowledge*. More simply put: the digital re-presentation of book information; physically tangible, published matter readily found in academic research papers, encyclopedia, maps, dictionaries, etc.; information commonly accepted and disseminated based on documented evidence or experience, adhering to agreed-upon standards and definitions.

The second manifestation—widely recognized and ongoing—encompassed the digitization of network communications, cultural and

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Recent Legal Updates

Subcontractor's failure to properly mix and pour the concrete foundation for a four-story building was not a policy "occurrence" under a commercial general liability policy. *Amin Realty v. Travelers Property Casualty Co.*, 2006 WL 1720401 (E.D.N.Y June 20, 2006).

New York City denied immunity from September 11th lawsuits. Court finds that "emergency" situation only present in initial hours after attacks, cleanup efforts in the weeks thereafter were not under "rush of emergency," thus no immunity. *In re World Trade Center Disaster Site Litigation*, No. 03 Civ. 00007 (S.D.N.Y. October 16, 2006).

In California, after January 1, 2007, no contract with a public agency for design services may require the design professional to indemnify or defend the agency for any claims except those arising from the negligence, recklessness of willful misconduct of the design professional. Any provision purporting to require a broader indemnity will be unenforceable. Cal. Civil Code §2782.8.

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dimension, it's that there is a singular object that has, perhaps, multiple ramifications – and all of the information is in one place. Compare that with the paradigm of two-dimensional profession instruments, and associated conventions or practice, the notion of integration of description is at the heart of how we see BIM.

LJD: How did it all start for your firm?

DRS: Gehry Technologies has its roots in Gehry Partners' practice over the past 15 years. GP started using "BIM like" methodologies in the early 1990s and one of the earliest projects was the fish sculpture in Barcelona, Spain. The sculpture is a wire frame with a flexible mesh cladding, but it has a complicated structure. A process was developed that paralleled the two dimensional drawing process, literally a CATIA expert working as an intermediary between architect and fabricator. This allowed the project to directly tie together design and fabrication information, with the required project documentation developing as a recording of decisions made in the 3D model. This project was really the very beginning for us. This process has been further refined on each subsequent project, and continues to evolve through today.

LJD: In the early days, was there skepticism about the relevance of this approach to mainstream architecture? Is that changing?

DRS: Absolutely. People used to say to us, "Gehry needs this because he designs these buildings that are impossible to capture in plans and specifications effectively," but that the benefit was isolated to this level of work. The perception has changed dramatically in the past 2 years. An incredible amount of rethinking of the practice is ultimately involved, but the advances are incremental and even small steps can generate big results. Even though the recent advances are astonishing, I think there are many, many more layers that need to be explored on the technology side, particularly because the horizon of untapped opportunity in building technology still seems so broad.

LJD: Years ago, architects – or maybe it was the lawyers – were reluctant to surrender AutoCad backgrounds in digital form. Are there similar concerns with the BIM database?

DRS: Exactly. Back even five years ago, the implications of providing a "live" version of a drawing seemed to be an unnavigable hurdle. These matters of providing live and, for that matter static versions of 2D digital documentation have been largely and reasonably addressed by the building professional and legal communities. This leap was not substantially "industry changing", although certainly efficiencies have resulted from digital communication including that of CAD documents.

LJD: What impact has BIM had on projects where you've seen it used?

DRS: At the minimum, the drawings are better coordinated, the process is faster, and the design team can iterate more. There is a definitely achievable reduction of errors. But BIM offers many other benefits, including the general sense that the team knows more about the project, to a higher level of detail and in a more clearly visualizable way, earlier in the process before critical commitments are made.

> *"The great thing about using "BIM" is not so much just that it has a third dimension, it's that there is a singular object that has, perhaps, multiple ramifications – and all of the information is in one place."*

LJD: What is the biggest concern associated with using BIM as a construction document?

DRS: One of the issues with the migration of practice to 3-D is that the description of intent is less symbolic and directly operative. It's less of a stand-in for a set of intentions as it is, potentially, capturing spatial intent in a more direct way. The geometry has the potential to be directly transferable from one profession to another, and the question of "how the intent flows" and who takes authority for what aspects in what context are being actively considered. There are simple models of practice where the BIM data can be directed to flow more or less as an extended part of the conventional paper trail and contract structure. However, it is not clear that this approach offers the same degree of potential as is possible by really rethinking roles and actions across the delivery process – who generates or consumes what knowledge in what form.

LJD: Does that suggest major changes are on the horizon in the architect's role?

DRS: I think the evolution is happening and there are great opportunities for architects and other professionals to consider new services and new roles in building delivery. I think there is an "evolving revolution" in terms of project organization, contracts, and professional identity. BIM can be a catalyst in some developments in building delivery and an opportunity for professionals.

LJD: How is Gehry Technologies organized?

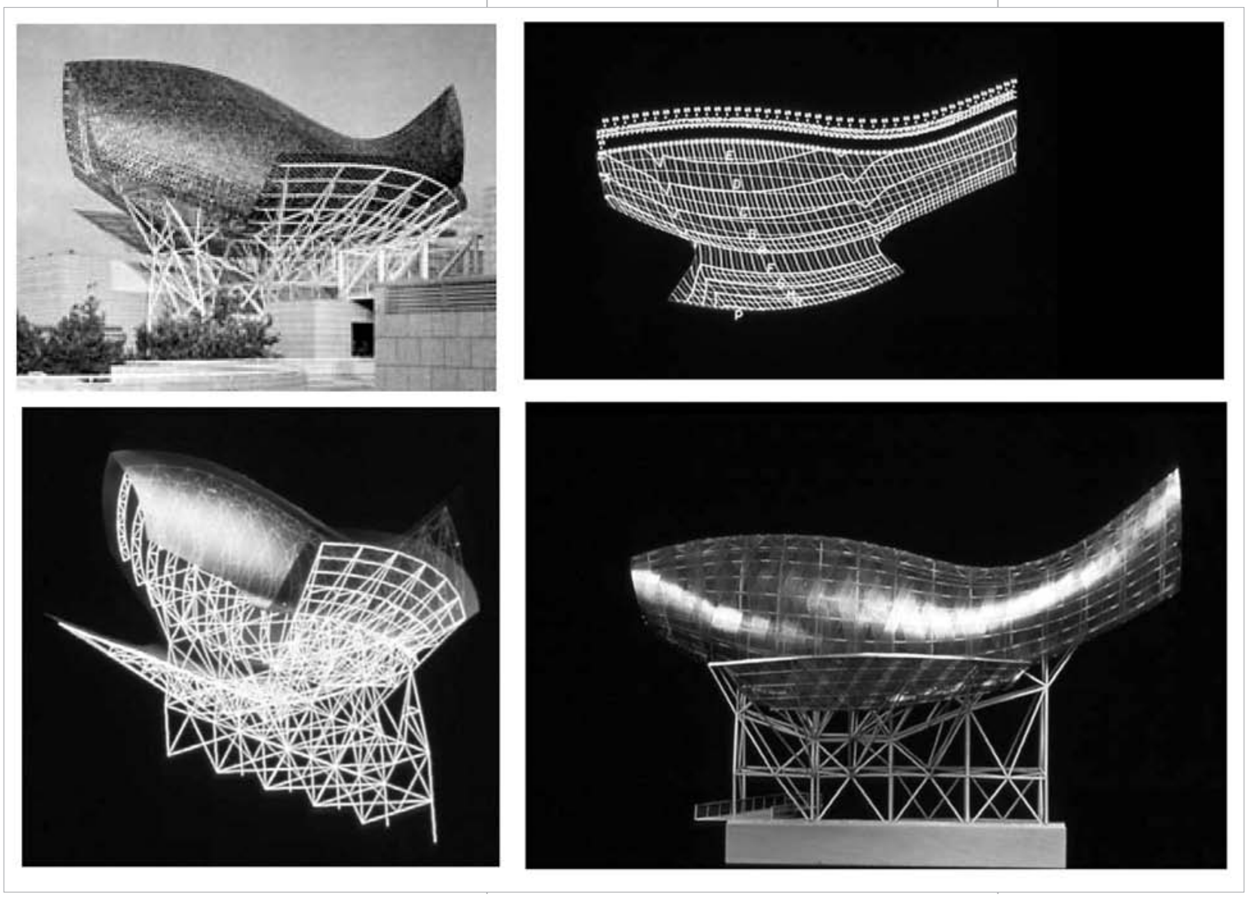
DRS: Gehry's practice has been using forward thinking technology and project delivery approaches for a long time. The processes continue to evolve and it's amazing how far things continue to develop and how much potential still remains. GT is now a fully independent company. We have a unique partnership with an aerospace software company which did most of the Boeing designs and actually almost all of the automotive and aerospace design. In our work we provide technology along with a host of services that include anything from actually building models to going into organizations and projects that are interested in BIM in order to provide consulting on reasonable, rational, and relatively safe ways to benefit from the use of BIM. There is now a lot of interest, and a lot of people are saying, "We understand the potential but we're not quite sure what this means for our practice or project."

LJD: Doesn't this type of change bring substantial additional risk?

DRS: The risk seems to be more in the process of taking a chance and the fact that the precedents are still emerging. But there's no question that BIM addresses much of the risk associated with routine errors and omissions. Silly errors get caught in 3-D during the design process that otherwise, with two-dimensional construction documents, may not become apparent until a condition is being constructed in the field. In addition, with a properly structured model, and where people understand who's doing what and what needs to get done, the process runs more smoothly.

LJD: Is the 3-D design model leading to contractors getting more involved during the design process, at least with respect to constructability issues?

DRS: Yes. That's starting to become more prevalent, or at least it seems like it is. We are often seeing contractors or subcontractors performing design services – particularly the fabricator. The architect, as part of the design development, can incorporate construction and pricing knowledge into the design development process. With many of the geometries and building systems of interest in contemporary architecture, this degree of knowledge is imperative to arriving at a design that is buildable within budget. So this suggests, again, that we are headed toward the point where you actually have to know how something is going to be built in order to describe it in a contract document. BIM is a terrific vehicle for capturing that level of understanding.



The fish by Gehry is a landmark on the waterfront of Barcelona.

LJD: Functionally, how will BIM affect the coordination of the various disciplines through the design process?

DRS: The design process does seem like it's necessarily being sequenced differently. It's more about this morphing of the desire to have real design development, real construction information, and the ability, with techniques associated with 3-D, to populate design, schematic, and design development models with far more information and far more detail while still iterating. There are many projects, certainly in the Gehry world and also others, where you see a much deeper level of understanding of the detailing of the project much earlier. What would normally be shop drawing level information is being applied during the design development phase. And there are some interesting tricks and techniques about re-usability of that kind of information. For example, imagine that you write a script that will put every 2x4 into a wall; suffice it to say that computers can generate a good deal of the detail if the assembly is explained in terms of geometric logic. With these techniques, there is more detail level information that can be repurposed and developed a lot earlier in the process.

LJD: Are insurers and lawyers ready for this?

DRS: I'm not sure. I've heard discussion that insurers are expressing the most concern about using information differently, but they will probably wind up being the people that will require BIM once the benefits have been established through precedent. There could be a tipping point, when lawyers and insurance companies, once they find out what BIM does to reduce risk, will accept, encourage, or demand the additional information of BIM models, and this will be a loud signal that the change in the industry has occurred.

LJD: Dennis, thanks again for your time. I look forward to seeing what the future brings in the BIM world. ■

Digital Design and the Age of Building Simulation

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entertainment media, email and telephone communications, and art, music and film.

The demand for these communications, along with the economic desire for ever-lower production costs, can be seen as having led to yet a third manifestation—the digitization of the manufacturing sector. This encompasses tools developed for and incorporated into the world of mechanical engineering, enabling a resultant computer-driven, robotically mass-produced world of cars, planes, and myriad electronic gadgets; and delivering newly digitized media, along with newly digitally-designed and fabricated products, to an increasingly global audience of listeners, viewers, and consumers.

A fourth manifestation, one enabling advancements in medicine and the physical sciences, was initially achieved utilizing visible waveform technology, followed by more recognizable, graphic, 3-D modeling. Used in disseminating exploratory medical findings, this modeling is similar to what architects use today, albeit on a level of far greater geometric complexity and an altogether entirely different scale. The most dramatic advancements, however, have evolved and continue to evolve within the realm of research involving geometric representation of known chemical and physical components, combined with the simulation of those components' respective behavioral patterns (both known as well as potentially unknown). This research synthesizes super-computational number-crunching with *tacit knowledge*—that is, knowledge not readily documented, knowledge based on one' s experiences or instincts, more intuitive in nature, and as such more difficult to codify. (For more on this examination of knowledge, see the writings of John Seely Brown, former Director, Xerox PARC.) To this author, this type of knowledge extraction can and should be applied to the world of architecture and construction—embodying yet a fifth manifestation. Let us now examine to what extent the significance of such simulation would be.

In the world of architecture, the first instances of digitization occurred with the advent of (CAD) electronic drafting—a progressive step up from manual drafting, certainly, but essentially a substitution of one representational methodology for another. A more significant transformation is now occurring as electronic drafting evolves into what has been commonly referred to as Building Information Modeling (BIM), whereby a model of a building' s physical components is constructed digitally, while simultaneously (and inextricably) linked to a report-generating (database) engine, essentially producing what one might call "smart geometry."

This transformation—one still mostly operative in nature despite BIM's greater visual legibility—will remain incomplete until one begins to see it beyond its current public recognition as a type of enhanced CAD documentation management solution, and over to a more important strategic positioning, one covering a broader range of requirements. The Building Information Model can be the main vehicle of production, or hub, by which a variety of analytical and simulation tools are either applied onto, or directly assimilated into, its "smart geometry," thus transforming the Building Information Model into a predictive disseminator of a building's known (or potentially unknown) behavioral patterns. A virtual embodiment of all accumulated explicit knowledge relative to design and construction methodologies that, combined with the architect's tacit knowledge of design, establishes the correlation that specific designs lend themselves to specific types of building conditions, along with an assortment of associated quantifiable environmental, financial, and performative results (which can also be re-conditioned post factum). Therefore, let us now name this broader vision and call it "digital Design," defining it hierarchically as follows:

ENVIRONMENT OF DIGITAL DESIGN

Vision	Description
Conceptual Model	Building Requirements: 'Blocking & Stacking'
Building Information Model	Geometry Development / Data Production Hub
Visualization Model	Presentations / Renderings / Animations
Analysis and Simulation	Environmental Prediction and Behavior
Enabled Design	Applied Knowledge, Building Codes, Specs
Documentation	2-D Drawing 'Extraction' from BIM Model
Building Information Model 'As Built'	Construction Sequencing & Management
Building to Model Feedback	Live Environmental Report (Building to BIM)
Model to Building Feedback	Live Environmental Change (BIM to Building)
Robotic Construction	"Architecture is a Machine for Living In"

New computationally-driven simulation methodologies being developed both within academia and commercially, can (and will) virtually simulate everything from basic lighting, energy, wind, and pedestrian circulation conditions to more advanced construction, fabrication, code, material, and security conditions. Easily misunderstood as supplemental engineering data—the mundane, statistical information, commonly applied after-the-fact to design projects—the new digital Design argues that digital building simulation will embody the future of architectural practice; that those practitioners seeking a wider role beyond that of form-giver will be significantly empowered by the use of tools generating such analytical information, applied before- and after-the-fact, from the project's conception, into its design and construction phases, and then well beyond, into its occupancy and lifecycle management stages. Properly understood and utilized by the profession, this entails a significant rise in the architect's stature, as the advantages of informed, rather than speculative, decision-making become self-evident. Properly ignored, the results may very well promote Construction Managers into a lead decision-making role, whereby architectural design is subsumed as a service within the construction firm. And in instances where more recognizable architectural talent is desired, it can be readily licensed. Witness the session description to an upcoming building technology conference:

"There is a new professional title percolating up through the ranks in construction—the 'construction modeler.' This new breed of construction professional is creating 3-D models—with or without input from the architect—specifically for construction purposes. Come explore how these new professionals are using 3-D models for constructability analysis, better estimates, sequencing and procurement optimization, and increased data flow to fabrication."

The very use of Building Information Modeling implies a radical re-thinking of the design process itself, and the deliverables typically associated as being produced by architects, either as individual practitioners or within firms. Reviewing new BIM tools in the mainstream architectural press and even attending recent industry gatherings on BIM, one observes scant discussion paid to the tremendous cultural shift that must necessarily occur as architectural design teams adopt the technology and begin producing digital building components, then start assembling those components into digital buildings, much as one would physically assemble and construct a building in actuality. This is a complete cultural and procedural shift from the process of producing CAD drawings that few seem to understand, one analogous to participating in the creation and assembly of a large-scale, complex, 3-D jigsaw puzzle in which all the players' pieces must fit together exactly—or not be used at all.

The significance of this cannot be underestimated and should be repeated—the current architectural production methodology (and all associated deliverables) is about to be completely turned on its head. Architects (and newly hired design school graduates) will now have to think in terms of producing and assembling building components, as opposed to sheets of drawings or seductive renderings; they will have to shift their thought processes away from one of representational geometry to one of component objects, their assembly, and an understanding of actual construction and fabrication.

Furthermore, architects will now have to adjust their understanding of collaboration as one occurring synchronously (in real time) within a team creating and assembling an interrelated set of building components, versus occurring asynchronously (at staggered times) with a team creating and assembling a loosely interrelated set of drawings. Now digital components will be saved back to a central building model, with confirmation immediate as to their integration, versus CAD drawings stacked in a pile or folder; loosely aligned relative to line weights, layers, sections, and details, and 'fudged' when things don't quite line up. There will be complete propagation of BIM design changes versus painstakingly laborious manual CAD changes.

This is a radically different notion of collaboration as understood and commonly played out in professional practice and academia (see Figures 1 and 2). Confusion and common mislabeling as to what constitutes digital Design, for example, can be found equally in both camps. This is to be expected, especially given centuries of architectural culture exalting the individual as a lone, supreme, inventor of form; the means of production defined as an assembly of representational drawings produced by individuals working in tandem.

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FIGURE 1: CAD: Design + Documentation + Communication

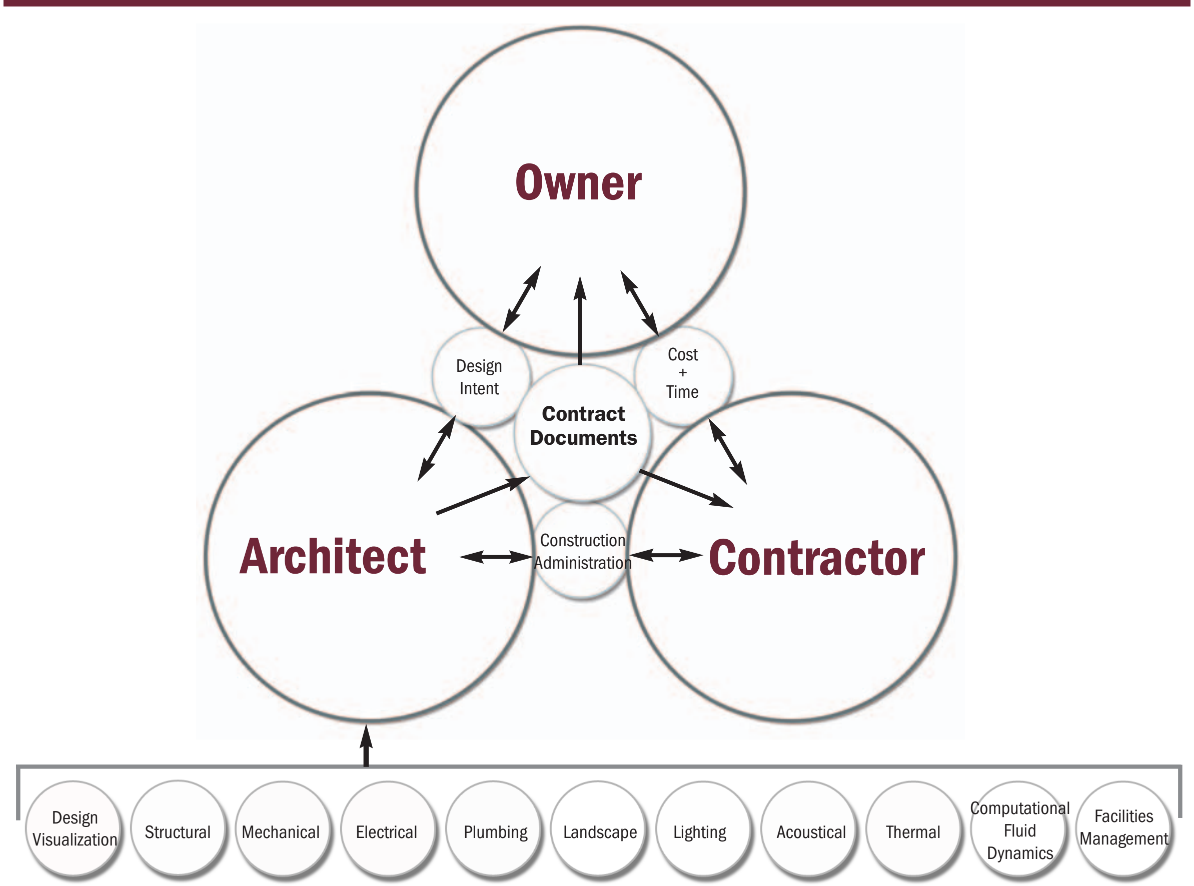
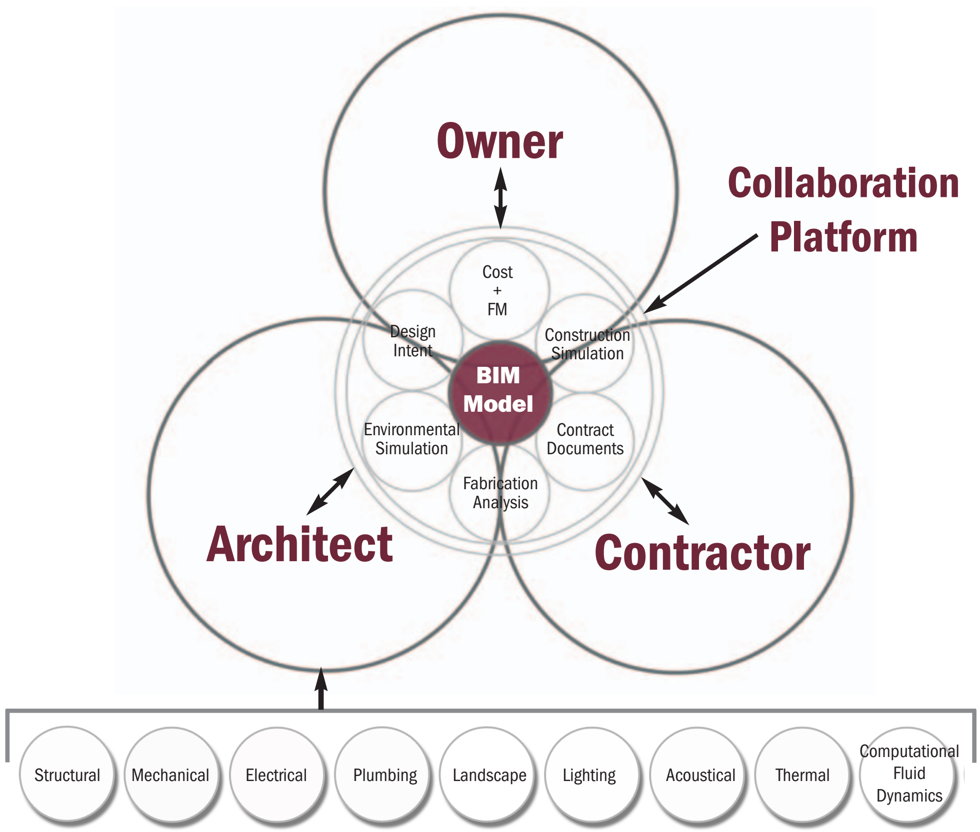


FIGURE 2: Digital Design: Model + Analysis + Simulation + Communication



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This then begs the question, "Does the use of simulation and analysis as applied within the context of digital Design suggest that artistic license or one's inherent creativity must now fall by the wayside?" Quite the contrary: One could reasonably argue that any new architectural design—however esoteric in nature or capricious in appearance—produced using these tools could now be validated, held accountable, be justified by the resultant quantitative analysis data engendered. Rephrased: Architects will now be able to present quantifiable, environmental and engineering data as an inherent, essential part of their design rationale, or partí. This information will be displayed simultaneously from one central source, as opposed to a collection of reports provided by a variety of specialists over a given period of time. All imaginable conditions would be on display and seen within a singular environment, allowing their relationships and inter-relationships to be thoroughly examined. Nothing would be left to chance.

A century-and-a-half back in time, it was not uncommon for doctors to be referred to as "quacks," their methodologies frequently based on speculative guesswork, unaccompanied by any scientific research or analytical data to back up their ideas. Indeed, medical science did not evolve (and the medical profession did not get taken seriously) until academia, fending off great public disdain and apprehension, began to study the human body in actuality and transpose those observations into illustrative drawings, then into operative diagrams. This, in order to better understand the relationship of the body's various components relative to its structural and circulatory systems. One would not go to a doctor today without possessing the subconscious knowledge that the practitioner is well-versed in codified knowledge—received through an accredited medical school—and is not someone running a practice based on "gut instincts," or "an intuitive search for new languages in medicine."

In the design and introduction of any new car today, we take for granted that the car possesses a modicum of logical, environmental, and functional engineering, and is not just "thought out" but its components and conditions are thoroughly "computer-designed." Its features are formulated, analyzed, and simulated. Moreover, we expect that the car's interior shell, while perhaps not possessing the most luxurious of materials available, will at least enjoy the proper amount of heating and cooling conditions, fresh air circulation, noise reduction; that its windshield glass will reduce glare and not shatter; that its dashboard controls will accurately register and report the proper amounts of fuel, security, and safety conditions; that there will be an owner's manual in the glove compartment for future reference to replacement parts and long-term care; and that there will be a mileage estimate sticker at the dealership, so that one can determine beforehand how much the car will cost to operate. Indeed, we no longer demand that new cars possess these conditions and that all known possible functions and malfunctions be understood and addressed through simulation before purchase or occupancy. We unequivocally expect that flawless engineering will be an integral part of every new car—from design through delivery.

All arguments comparing life-safety, mass-production, and economies of scale aside: if we expect our medical professionals to perform their duties properly, have their professional credentials validated through successful implementation of well-researched and well-documented procedures; if we expect that automobiles will successfully meet the extensive performance and environmental criteria required of them, *before going into production*; and if we understand that both of these sets of expectations are being successfully met through the incorporation of knowledge-driven research, analysis, and digital simulation tools, should we not then expect the same from our architects and our buildings? Indeed, we should expect them to live up to the same high standards, employ the same advanced technologies, utilize the same simulation and analysis methodologies, and incorporate the same tacit and explicit knowledge into publicly-accepted, digitized, procedural methodologies as would be expected from any other profession. Their expertise on the built environment should then, in turn, be more widely recognized and respected.

As we move forward it will become clearer that the incorporation of knowledge-driven analysis and digital simulation tools into the architect's world will not only validate their design intent but, in so doing, validate their role as one singularly understanding of the direct linkage between design intent and building performance. This will also provide their clients with access to construction costs, environmental considerations, and a harbinger of long-term maintenance costs (before they occur), at a level of immediacy and detail they simply have not had access to before. It would not be unreasonable for an owner to expect a digital "owner's manual," as with new cars, when occupying a new home, office tower, or hospital—a Building Information Model encompassing more than just geometric considerations, loaded with all manufacturers' component serial numbers, their unit costs, and perhaps online ordering capabilities. It is highly unlikely that consumers would accept the idea of purchasing an automobile whose costs had increased 25% upon travel from the assembly line to the dealership. Building clients should not have to endure the same.

If these comparisons and questions seem simplistic and their arguments dismissed outright, then one might ask to what purpose, exactly, does technology serve architects and their clients? The digital Design tools now entering the market perhaps seem primitive (as hopefully they will in time) but they are just starting to provide motivated professionals with the ability to study, observe, analyze, formulate, automate, simulate, and derive predictive, results-oriented decisions and benefits. These benefits do not have to be limited to architects' and engineers' means of production alone. In an age dominated by skyrocketing health insurance and malpractice premiums, consumed by homeland security, it would make sense for the insurance carriers to require or create incentives for large firms to have quality assurance procedures in place that include the use of Building Information Modeling. They would encourage the predictive benefits offered by digital Design, the opportunities for safer construction sites, improved indoor environmental health, quicker emergency evacuation procedures, and increased building security, all viewed centrally via the Building Information Model.

Architects employing digital Design would also be able to offer their clients—and themselves—better opportunities in their compensation and fee structures, as billings would no longer be based on calculating (CAD) labor over time but a (BIM) deliverable supplied en masse. Clients could opt for a larger lump sum fee payment up front, in return for an overall lower cost. (Imagine, architects no longer waiting to receive payment on their final billings!) The Building Information Model's delivery mechanism and its ability to govern, regulate and modify the environmental conditions of the physical building it is simulating will raise issues as to ownership rights and ongoing facilities management services. This, too, will present opportunities for architects and their clients to sustain ongoing relationships beyond physical c ompletion of their projects, and provide revenue for architects to underwrite their business operations when work opportunities become lean. It will become possible to deliver simulations as "electronic deliverables," for example, energy/daylight simulations for energy code compliance and the CORENET simulations developed in Singapore for local building code compliance.

The movement toward digital building simulation will re-instill the understanding that architects indeed play a vital, central, and pivotal role in the design and construction processes; that enabling the virtual embodiment of their tacit and explicit knowledge into codified, digitized, simulated and predictive behavior carries with it certain responsibilities demanding their forthright attention and should also, therefore, confer their leadership status on the process. These are responsibilities that have, over the last century or more, been progressively shunned or legislatively whittled away due to liability concerns. It will require that the various professional architectural associations and institutional bodies—who claim to be in touch with the future—re-examine contractual agreements written over a century ago. It will require these associations to seize the day, and take a more proactive stance on legislating architects' ownership of the digital Design process, as a right of the profession; to cease all inane chattering while others take on the responsibilities—and enjoy the benefits—of digital Design. The focus must go beyond providing contractual documents online, discussions of unenforceable national BIM standards and data exchanges, and toward legislative assurances that architects will govern and lead the digital Design process, much as medical professionals govern their destiny. A good place to begin would be in fostering a national educational campaign—for architects and the public—as to the advantages that architects possess in using digital Design. A second important step would be in the creation of a certification program engendering the sustained implementation of digital Design into professional practice, recognizing those individuals and firms actively using the current crop of Building Information Modeling tools, in much the way LEED certification has fostered greater participation in green building design. A third step would be for these organizations to financially endow the National Science Foundation and other government underwriting research bodies, enabling them to pursue ongoing research and development which advances analysis and simulation tools specifically geared for architects. These initiatives must then lead to a revitalized, more meaningful, licensure (and licensure maintenance) process.

The movement toward digital building simulation will also require that the current educational process be re-evaluated and re-engineered, and begin to address not only the development of the individual student's design talents but his or her ability to engage in new collaborative methodologies heretofore unaddressed, let alone understood. A need to understand and employ these new methodologies will arise regardless of whether the student pursues an individual path of practice or within a firm. Thus, the recommendation is that a dual curriculum core, one encompassing design and theory as well as one focused on collaborative project means and methods, should be developed. Exploring new forms relative to syntax will always be important but so will an understanding that architectural projects do not just begin and end with

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Digital Design and the Age of Building Simulation

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architects; that any given project environment extends to a larger collaborative core team comprised of structural, systems, and construction management engineers. The ability to suitably integrate their BIM models into one cohesive model governs the very heart of what digital Design, analysis, and simulation is all about. As the production methodology shifts away from representational drawing to one of component modeling and assembly, architecture students need to possess, at minimum, an ability to comprehend materials assemblies, integration of BIM structural and MEP systems (with particular emphasis on conflict detection), fundamentals of project staging and site logistics, impact of weather conditions, and so on. Much as pilots are now trained to fly using flight simulators, architecture and engineering students must now begin to do the same; and they must train to work interactively with one another, much as they would do in actual professional practice.

Deans of architecture schools should embrace, rather than withhold, opportunities to give their students greater flexibility in developing their talent and skills: digital Design will not lead to muddying the creative waters, or a vocational bent, any more than acquiring new techniques or applying new ideas has ever stifled creativity or imagination. Architecture students need also explore a variety of programming languages to hone their ideas, as opposed to relying only on commercially-available software tools. This should be followed by exposure to new rapid-prototyping equipment, thereby familiarizing students with enhanced fabrication methodologies and the opportunities they afford.

An awareness of programming and its complexities should also the lead the profession to re-examine its posture on the ability of the commercial software industry to provide architects with the digital Design tools they believe they need. Architects must begin to abandon unrealistic expectations by offering these developers, instead, a sustained financial framework (guaranteeing revenue and seat commitments) that will target development of specific digital tools with financial reward, delivering new tools to organized firms or consortia based on specific requests. This is common practice in almost every other commercial industry, except for architecture! The predominant wait-and-see attitude, deriding software programs that must necessarily address as broad a market sector as possible (and thereby cater to the lowest common denominator), stifles creativity and satisfies no one.

> *"No sound architect should dismiss the opportunity to implement a more legible dissemination tool into theconstruction process."*

Finally, the incorporation of digital Design into the world of architecture will help establish the principle, once-and-for-all, that it is not enough to *"just design,"* or *"just construct"*—just as it is not enough to *"just perform surgery."* Perhaps it is not a matter of life and death, but if architecture is the blending of science and art, how much more rewarding and satisfying it will be for architects to finally be able to conceive and develop their ideas—however far-fetched or esoteric—and then explain their motives not only through artistic treatise or philosophical, mathematical, or linguistic manifesto but with building simulation data that irrefutably validates design intent, performance conditions, and all other areas of concern; that they have all been put into action and are known to work; that the building is not only stimulating visually but actually "performs well," as witnessed through all its digital simulation modes leading to digital fabrication and construction. No sound architect should dismiss the opportunity to implement a more legible dissemination tool into the construction process if it guarantees that their designs would no longer be inadvertently altered or cheapened at the last minute, and that it not only leads to a significant improvement in the realization of their work but also enhances the value and stature by which their clients view them. The ability to take advantage of this new technology can only come from those who are (and will become) fluent, conversant, knowledgeable, and certified in the use of digital Design, its tools and methodologies and integration into the practice of architecture.

The age of digital Design and digital building simulation is now upon us. It is more than just the introduction of a new set of computer tools that architects can use to better coordinate their construction documents. It belies the future of the architectural profession itself.

About the Author

Paul Seletsky, Associate AIA, is the recently appointed Director of digital Design for Skidmore Owings and Merrill's New York office. In this role he coordinates the strategic implementation of technology as defined by digital Design, encompassing greater understanding and utilization of Building Information Modeling as well as building the cultural foundations necessary for such change. His goal is to foster discussion on a variety of advanced software and hardware topics, leading to greater adoption of these design tools and their processes. A 1982 graduate of the Irwin S. Chanin School of Architecture at the Cooper Union for the Advancement of Science and Art in New York, he is also the chair of the AIA NY Chapter's Technology Committee, and a member of the AIA's Technology in Architectural Practice (TAP) Committee. He has been managing technology in both its operational as well as strategic capacities for the last sixteen years. He can be reached at Paul.Seletsky@som.com.

Founded in 1936, Skidmore, Owings & Merrill LLP is one of the world's leading architecture, urban design, engineering, and interior architecture firms. SOM has designed many of the world's major buildings, including the Lever House in New York, Sears Tower and John Hancock Center in Chicago, and Jin Mao Tower in Shanghai. The firm has been an innovative leader in the development and implementation of building technology as well as digital Design technology. SOM maintains offices in Chicago, New York, San Francisco, Washington DC, London, Hong Kong, and Shanghai. ■

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BIM: The Professional and Legal Ramifications — A Voyage into the Unknown

By: Michael K. De Chiara, Esq. and
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The era of BIM (an acronym for "Building Information Modeling") is arriving. Although not yet a formal part of the traditional design process, the inexorable advance of technology is bringing this dramatic design and construction tool closer to daily reality. Industry experts have opined that within 10 years, BIM will be the principal construction delivery tool. The GSA, for example, has stated that "for all major projects (prospectus-level) receiving design funding in Fiscal Year 2007 and beyond, GSA will require spatial program BIMs be the minimum requirements for submission to OCA for Final Concept approvals by the PBS Commissioner and the Chief Architect." The GSA has also articulated that it is "committed to a strategic and incremental adoption of 3D-4D-BIM technologies." <u>See</u> www.gsa.gov. The commitment of the GSA to BIM and the desire of other owners to utilize it may ultimately press design professionals into the BIM future faster than expected.

WHAT IS BIM?

BIM, in its purest form, is a model-based technology that utilizes one database for all design and construction elements and processes. This single database could conceptually be accessed and utilized by dozens — and perhaps hundreds — of personnel during the life of a project. After the project has been completed, the database could be used by the owner of the building during the life of that structure.

Design information from all disciplines are fed into the BIM database — from architectural designs and specifications to structural and mechanical systems information such as HVAC ducting, piping and structural slabs, columns and shearwalls. The database contains and connects all elements of a completed building to one main database of linked project information. Thus, for example, if a change were made to one element of the design, the sophisticated BIM database would automatically reconfigure all related elements embedded in the interrelated database. A BIM database will go well beyond the traditional use of 2-D modeling and will have the capacity to work in 3-D, 4-D (construction scheduling) and even 5-D (cost-flow analysis). The database could dramatically reduce waste in construction, including time delays caused by RFIs and change orders. It would also detect design errors and omissions in early stages of a project.

The proponents of BIM claim that it will seamlessly incorporate and integrate the input and flow of information between design and construction professionals. This, it is claimed, would naturally streamline the entire process, reducing delays and cost overruns. The potential of BIM is clearly immense, but at what risk? What precautions have to be taken when embarking upon a BIM project?

THE NEW BIM PARADIGM

BIM technology is already being utilized by some design professionals, including those working on the World Trade Center Freedom Tower. However, BIM technology today is largely being used in a non-collaborative manner, in which the models are designed solely in-house by one design team. The shift to a collective BIM database, accessible and utilized by the spectrum of design and construction professionals, raises a multitude of potential professional and legal issues that, at this early date, cannot be fully realized. However some issues that have been readily identified include:

- How can design firms successfully transition their professionals into using BIM programs? When should this start taking place?
- Will the use of BIM alter applicable standards of care?
- Who will manage the model? Should different professionals exchange management responsibilities as the project progresses?
- Who will have access to the database? Who will be responsible for managing the data that is entered? How will the database be protected from damage from unauthorized access (from, for example, sophisticated computer hackers)?
- Can different BIM programs used by various project parties be successfully integrated?
- How can BIM utilizers accurately verify information entered into the database? Who will bear the risk in the event that incorrect information is transmitted? How will risk be assigned if the originator of a particular item of information cannot be determined?
- Who will own the information on the database? Who will own the copyrights to the database and the designs therein?
- How will the design process be resequenced? Will this impact upon the areas of responsibility for all participants?
- How will utilizing the BIM database alter project communications between design and construction professionals?
- What is the design team's obligation for coordination when the BIM process is fluid?
- What information must be exchanged by parties in order to meet their respective responsibilities?
- How will the "frontloading" of information in the BIM process reflect upon design professionals' compensation and risk allocation?
- Do standard contracts (such as the AIA standard contracts) sufficiently address potential BIM-related exposure?
- Should risk be allocated across the entire design and construction team, including the owner who may have required the use of BIM?
- Does the design professional's insurance adequately cover potential BIM and other technology-related exposures?

PROTECTING YOURSELF IN THE NEW BIM WORLD

Although BIM may ultimately save time and expense in design and construction processes, making it appealing to owners, issues such as those raised in the questions above must be adequately and fairly resolved in order to ensure that all professionals on such projects are protected and rewarded for their efforts. Not surprisingly, these protections will be overwhelmingly dependent upon the contract terms agreed upon between all parties to a project.

At a minimum, design professionals must encourage their counsel to draft provisions which will place a realistic limit on their liability for any BIM-related issues, as well as all liability which may generally arise in the

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BIM: Voyage into Unknown

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context of a professional's involvement in a project. While design professionals and their counsel should always fight for limitations of liability in their contracts, such limitations become critical in the context of BIM.

A second major issue which must be addressed by design professionals and their counsel is the ownership of the design. Regardless of the medium or the delivery method (conventional plans and specifications, or BIM), design professionals must be diligent in protecting their intellectual property. In a BIM environment, this becomes even more critical since there may be multiple parties claiming ownership of a portion of the final BIM generated product.

There are, of course, many other legal issues raised by BIM. Before entering into a BIM project, the design professional is strongly urged to seek out and retain qualified counsel to advise on all potential issues and draft appropriate contractual language.

Take the time to educate yourself about BIM, and take the necessary steps to secure necessary legal protections. In doing so, you, as well as your clients, may quickly reap BIM-related rewards and successfully propel yourself to the front of the cutting edge of design and construction. ■

Columbia Announces Graduate Program

Columbia's new graduate construction program will examine the increasingly complex commercial and residential building industry, from design through build. Courses include in-depth analysis of key topics such as cost estimating, project financing, construction techniques, human and material resources, construction law, conflict resolution, environmental safety and conservation. **This is the first graduate construction program offered by an Ivy League university.**

A New York Construction and Engineering Law course will be offered as part of the graduate program's curriculum. **Both Michael Zetlin and Tim Hegarty will serve as adjunct professors beginning in January.**

"It's a BIM New World"— The Next Revolution in Design & Construction Technology

By Tara B. Mulrooney, Esq.

On October 13, 2006 Zetlin & De Chiara LLP and McGraw-Hill/*New York Construction* in collaboration with the New York State Chapters of the American Institute of Architects and the American Council of Engineering Companies held a symposium on Business Information Modeling ("BIM") entitled "It's a BIM New World – The Next Revolution in Design and Construction Technology." Several distinguished panelists provided an overview of BIM and its impact on the design and construction industries.

Presentation of Philip G. Bernstein

The symposium commenced with Philip G. Bernstein, FAIA, LEED AP, providing an introduction to BIM and and explanation as to why the construction industry is moving towards implementing BIM on an increasing number of projects. Mr. Bernstein is the Vice President of Industry and Strategy Relations for Autodesk, a leading provider of software for architecture and engineering. At Autodesk, he is responsible for charting the company's future vision and strategy for technology serving the building industry. Mr. Bernstein explained that traditional two-dimensional, orthographic drawings are inadequate for the complexities of today. In his opinion, although technology is the catalyst behind the move towards BIM, other factors are also driving the industry to implement BIM.

According to Mr. Bernstein, the demands of today's world are increasing architects' responsibilities on projects. For example, design professionals must now address such issues as green building standards, smart buildings and building security concerns. These issues drive the need for BIM as they require integration between the various phases of a project which is lacking under the traditional scheme of two-dimensional drawings. Under the traditional scheme, construction and design are isolated and there is very little integration between the two as architects do not think about construction aspects of the project and contractors do not think about design or building needs. According to Mr. Bernstein, BIM facilitates redirection toward the integration between design and construction throughout all phases of a project from design and bidding through construction and use of a building. Specfically, it is BIM technology which provides a single database for all building information in a single location. This one database can be used by all the players on a particular project. It provides a digital simulation of a building which, according to Mr. Bernstein, puts architects back in the driver's seat in the building process.

Presentation of Dennis Shelden

The next speaker, Dennis Shelden, is the Chief Technology Officer of Gehry Technologies, a building industry technology company formed in 2001. Mr. Shelden's presentation centered on the broad potential for BIM and the effect it will have on all players in the building industry.

Mr. Shelden pointed out the important collaborative aspects of BIM. He explained that BIM is a tool which provides three-dimensional models incorporating a single locus of quantity and dimensional control information. In addition, BIM technology enables traditional cost expense analysis to be done in three-dimensional models. Through BIM, the architect's models and shop drawings can be integrated back into one coordinated model and used as a collective source of information. A user also has the ability to move between various models, such as from a structural engineering model to a structural detail model. This will greatly enhance project coordination. BIM allows the players to discover and address conflicting information early on in the process. This ability leads to cost savings and promotes efficiency as it prevents the need for value engineering later on. Mr. Shelden fur-

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ther pointed out that, by using BIM, a budget can be established over the course of the project rather than at succinct phases, which creates another way to establish cost savings. Another practical benefit cited by Mr. Shelden is that BIM enables users to directly use three-dimensional models onsite in the job trailer.

Mr. Shelden also discussed the value BIM brings to owners. He explained how owners often do not realize the value of all the information they receive when traditional two-dimensional drawings are used. In contrast with BIM, information that would typically be contained in stacks of two-dimensional drawings are brought together in a single model or series of models making the information easily accessible and usable to owners. A final benefit cited by Mr. Shelden was the cost savings that BIM can yield. One example of how BIM reduces costs on projects is that by having all project information available and easily accessible the variability of bids goes down. The end result is that a quality bidder rather than a low bidder gets the job, which leads to cost reduction of as much as ten percent, as well as a reduction of risk. Thus, Mr. Shelden expressed that BIM' s important collaborative aspects offer a wide range of potential for all users which will greatly benefit the final product.

Presentations of Carl Galioto, FAIA and Paul Seletsky

Carl Galioto, FAIA and Paul Seletsky gave presentations which focused on BIM as a process that will greatly enhance construction/development. The first of the two presenters, Mr. Galioto, a partner at Skidmore, Owings & Merrill LLP ("SOM"), is in charge of the firm's Technical Group, which consists of approximately two hundred architects. He has been in digital design for over 25 years and recently has been leading SOM's BIM initiative.

Mr. Galioto set forth the following three principles regarding BIM: (1) BIM is a process not a product; (2) BIM is a toolbox that has many different tools for different tasks; and (3) BIM will greatly enhance the construction process.

Paul Seletsky is the Director of Digital Design for SOM. Mr. Seletsky is extremely knowledgeable about BIM, as he presides over SOM's research and development efforts in the use of BIM as a strategic design process. He explained how BIM enables architects to do more than just supply documents by providing them a process by which they can study every aspect of a building. BIM enables an architect to understand the conditions and environmental factors affecting a building. He explained how buildings do not exist in a vacuum, but how they are affected by external factors such as wind and sun. Through slides, he demonstrated how BIM can be utilized to study the effects of these conditions and how this information can be used to influence the design of the building. For example, BIM can be used to determine how the sun will penetrate the building's surface and what kind of conditions it will create in regard to glare, temperature and lighting. The architect is then able to incorporate such information in the project's design.

Mr. Seletsky showed the audience how the BIM process was used for a recent project in Seoul, Korea known as the Lotte Tower, which is the second tallest building in the world. Through slides, he demonstrated how information provided by the structural engineers was incorporated into various models such as an illustration of the façade and curtain wall, a model of the core showing egress conditions and a model of mechanical conditions. Thus, he advised that BIM enables all the players on a project to look at the same building in a variety of ways and under various conditions. He also demonstrated how BIM allows an owner to quantify with certainty the costs of running the building from year to year. In conclusion, Mr. Seletsky demonstrated that BIM is more than just a rendering of models. The process enhances the ability of architects to understand the buildings they are designing.

Presentation of James Brogan, AIA

The next speaker was James R. Brogan, AIA, Senior Associate Principal and Director of Information Technology at Kohn Pedersen Fox Architects PC ("KPF"). Mr. Brogan oversees all aspects of technology for KPF's three locations in New York, London and Shanghai including software strategies for performance based 3-D modeling tools and BIM/CAD technologies. Mr. Brogan's presentation focused on KPF's use of BIM on several projects all around the world.

Before discussing specific projects where KPF is using BIM technologies, Mr. Brogan gave a brief overview of BIM. He reiterated that BIM is more than modeling. It is primarily a set of tools for the management of information, which enables architects to make better, more efficient designs.

He then presented slides to demonstrate how KPF has used BIM on various projects around the world. The first project discussed was Magnolia Towers in Shanghai. Slides of the building's models showed real time data which demonstrated how BIM can be utilized to educate the architect at the front-end of the project. Mr. Brogan stressed that one of most critical components of BIM is that it provides the architects with the ability to understand and manipulate project data at the beginning of the process, which helps them avoid taking a static or reactive approach to building design. Next, Mr. Brogan showed how BIM was being utilized by KPF for the design of a project known as Bishop Gates Tower in London. He displayed various parametric models of the project to show how BIM can update project data on the models in real time. Other projects discussed included the Pershing Square residential tower in Los Angeles and a hotel in Phoenix, Arizona. Through his discussion of these projects, Mr. Brogan demonstrated how the various parametric models of the buildings could be used and shared throughout all stages of the project.

Presentation of Michael K. De Chiara, Esq.

Michael K. De Chiara, Esq., a founding Partner of Zetlin & De Chiara LLP, discussed the legal implications of BIM, focusing on what will happen legally when the building industry embraces this burgeoning technology. Mr. De Chiara briefly presented an overview of the evolution of the design and construction industry and the introduction of BIM. He explained that BIM allows a fully-integrated five-dimensional design, which consists of three-dimensional plans, a fourth-dimension real time construction schedule and a fifth-dimension cost flow analysis. The primary question Mr. De Chiara posed is what effects will this new technology have on the legal obligations and liabilities of design professionals, owners and contractors.

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One aspect of this legal change is the standard of care to which design professionals will be held. On the one hand, early access to project-wide information and voluminous detail regarding every aspect of the project will lead to enhanced design, more efficiency and greater coordination among players; on the other hand, this access to information may impact the standard of care to which the design professional is held. Currently, design professionals are liable for their own negligence and this standard of care requires them to exercise the same care and competence exercised by a reasonably skilled member of the profession within the community. The advent of BIM will raise the bar significantly, and, according to Mr. De Chiara, may even push the requisite standard to a level of perfection. Concluding that an increased standard of care is inevitable, he stressed the importance of negotiating strong contract language to clarify expectations and protect the design professional. Another legal issue that will have to be addressed in contract negotiations is ownership of documents. With all the various contributors to the BIM model, the question of who owns the copyright to which documents will arise. Mr. De Chiara stressed that, in order to protect themselves with respect to liability and ownership issues, design professionals must negotiate strong contract language to safeguard their interests.

Moderated Panel Discussion

Following the presentations by the speakers, Mr. De Chiara moderated a panel discussion. The panel consisted of the earlier speakers, plus the following presenters: John Marinello, Allan Paull and Robert Schubert. Mr. Marinello is the Vice President of the Information Systems Department of Flack + Kurtz. Mr. Marinello has over 14 years experience in information system services with regard to specifying and deploying networking equipment such as enterprise services, work stations, switches, cable management and VPN and VPLS solutions equipment. His experience encompasses all areas of information system design and support services, as well as project management of cable plant installations and large scale equipment procurement. Allan Paull is the First Vice President of Civil and Structural Engineering at Tishman Construction Corporation of New York and has over 26 years experience in the structural engineering field. Mr. Paull is responsible for the overall review of structural design and construction for all Tishman projects in the region, which include such recently completed projects as 7 World Trade Center, the Whitney Ferry Terminal, the Borgata Hotel, Casino and Spa and the Westin New York at Times Square. He is also responsible for assisting in the resolution of construction issues on ongoing projects, especially those issues relating to material and labor shortages and union labor relations. Robert Schubert is the Senior Vice President of Construction for Boston Properties, Inc. In such capacity, he is responsible for the construction activities for the New York region of Boston Properties. Mr. Schubert has recently overseen the successful completion of 5 Times Square and 7 Times Square, and most recently managed the design and construction program at 90 Church Street for the United States Postal Service.

The first question posed by Mr. De Chiara to the panel was where they see BIM heading in the next five to 10 years. Mr. Bernstein responded that he believes it will take five to 10 years for BIM to establish itself as the norm on construction projects. Mr. De Chiara opined that it will really be the developers that will drive the future of BIM over the next 10 years since they, as financers of projects, will be making the decisions as to whether BIM will be required on a particular project. An alternative view is that insurance companies will be the ones driving whether or not BIM will be implemented on future projects. Some members of the panel were skeptical about owners' and contractors' understanding of BIM, how informed they were regarding BIM, and their readiness to adopt the new technology.

The next question was what effect BIM would have on the shop drawing process. Referring to shop drawings as a necessary evil, Mr. Schubert responded that, although he would love to see shop drawings earlier in the process, he does not believe the shop drawing process will be going away or radically changing anytime in the near future. He said that what may change in the next five to 10 years is the line between design and fabrication. It will become grayer and lead to opportunities as well as increased risks for all players. This concept of boundaries between disciplines shifting led to a discussion regarding frontloading of design. It was noted that the use of BIM and computer deliverables has started to blur the lines between the various stages of a project. The sentiment was expressed that owners will have to be more willing to fund the design aspect of projects. BIM will present the opportunity to have the consultant and project team more involved in the design process of projects. Due to these shifting boundaries and a potential for new liabilities and risks to all parties, especially the design professionals, negotiating strong contract language at the outset of a project becomes imperative. For instance, it will be important for design professionals to draft language that protects them from liability in situations where they are just studying the model for information and not contributing information.

An audience member posed a question concerning whether BIM could be implemented on smaller scale projects and how to go about implementing BIM on a project. A panelist responded that it is not the size or scale of the project that should drive the decision of whether to use BIM. Examples of various smaller scale projects where BIM was successfully implemented were discussed. The panelist concluded that the key to deciding whether BIM may be beneficial to a project is to start a dialogue with all key players right at the outset of a project. ■

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