Managing Integrated Project Delivery

CONCEPTS AND CONTRACT STRATEGIES

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This is a current working draft for review and criticism. Current plans are to add sections on Project Management Information Systems, Lean Processes, Design Assist and Subcontractor Selection, IPD Team Selection Procedures and the History of Alliancing and IPD. We will also continue to expand and improve existing content. I'm sure there will be other chapters as well. Please send your additions and corrections to:

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Mark R. Berry, Esq., was a great help reviewing this document and in particular the chapters on the *IPD Legal Relationships* and *IPD: Process or Product*. Mark is a partner in the Washington, DC office of Peckar & Abramson. He advises and represents contractors and construction managers in the public and private sector. He has served as the head of CMAA's legal committee and he is author of the book "Construction Management: Law and Practice." He is a graduate of the University of Maryland and the George Washington University National Law Center.

John M. McGinty, FAIA, president of McGinty Architectural Consultants, LLP, past president of the American Institute of Architects and a noted forensic consultant, contributed much thought for the chapter on *Standard of Care.*

The *IPD: Process or Product* chapter has also drawn extensively on conversations with Carl Sapers, Hon. AIA, and from his paper entitled "The Liability of Architects and Engineers in Nineteenth Century America," written by Carl and Penny Pittman Merliss. Carl is an adjunct professor of Studies in Professional Practice in Architecture at the Harvard Graduate School of Design and a specialist in construction law. Penny Merliss is a graduate of Harvard Law School (J.D. 1984), the Harvard Graduate School of Arts and Sciences (Ph.D. 1979) and the University of Cincinnati (B.A. 1972). Much of her practice has been concerned with design and construction law.

Kevin A. Delorey is a partner in the Madison, Wisconsin office of Quarles & Brady LLP. He was good enough to share his thoughts on

IPD, provide me with contract content from an impressive IPD project and comment on drafts of this article.

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THE IPD CONCEPT

Integrated Project Delivery is a new approach to agreements and processes for design and construction. It's conceived to accommodate the intense intellectual collaboration that 21st century, complex buildings require.

The inspiring vision of IPD is that of a seamless project team, not partitioned by economic self-interest or contractual silos of responsibility, but a collection of companies with a mutual responsibility to help one another meet an owner's goals. To support that vision, owners, AEs, CMs and their lawyers are crafting contract terms intended to align the interests of the key project team with the project mission, increase efficiency, reduce waste and make better buildings.

Of course, we will never eliminate self-interest, but many of these concepts are making meaningful improvements in forging agreements that produce more collaborative teams.

IPD is in an invention phase. It has not been around long enough to gain accepted definition or for the process to become standard. [1] That's as it should be.

[1] A lack of accepted definition for project delivery processes is hardly new. In the 70s, people were applying the term "Construction Management" to CM agency, CM-at-Risk, negotiated general construction contracts, general construction, Project Management, Construction Administration and in-house facility management staffs. Now we have worked out a little more agreement on those definitions but we still enjoy frequent debate.

Each owner develops an individual approach. The AIA and AGC have different terms in their initial contract offerings. Concepts of IPD, Alliancing, BIM, Design Assist and Lean Construction overlap as they are applied to projects and become a part of our vocabularies.

That's as it should be. We don't need, or want, standard definitions yet. We need debate and exploration—and continued invention. There's enough ossification in the construction industry.

COMMON THEMES

Strategies vary but there are common themes to motivate collaboration.

While strategies vary with the AIA, the AGC, each new owner and each new project, and while many projects employ only some elements of IPD, there are common ideas. Some or all may appear in an IPD contract. They focus on agreements among the key team members as much as on the agreement with the owner.

The fundamental concept of IPD is to maximize interdisciplinary collaboration. There are a lot of variations, but the basic ideas are:

- **A legal relationship** for the IPD Core Team that provides a sense of belonging to the same organization, eases barriers to communication, removes many of the troublesome legal hindrances to BIM and PMIS and potentiates the use of Lean Construction processes.
- **A management committee** that improves leadership, transparency, coordination and communication for the IPD Core Team and the owner.
- **An incentive pool** for meeting project goals to be shared by the IPD Core Team that has the potential to increase if everybody helps everybody else.
- **A no-blame working environment** to constrain litigation, solve problems quickly, eliminate energy spent on CYA activities and remove barriers to communication.
- **Design assistance** to bring knowledge of cost and construction technology from principal subconsultants, subcontractors and manufacturers into the design decision-making process.

LEGAL RELATIONSHIP

The IPD Core Team could be two organizations or many.

Key companies (often called the members of the IPD Core Team) combine to lead the project. The combination could be in the form of separate contracts, multi-party contracts, a joint venture or a

Limited Liability Company. The firms that form the Core Team typically have transparent cost-reimbursable contracts, often with target prices or GMPs.

The Core Team could be made up of two companies: an AE and a CM. Or it could be a larger group: an architect, one or more engineering firms, separate key consultants, a CM and perhaps key trade contractors.

There are multiple choices for a legal relationship

The IPD Core Team could use a multi-party contract, form a joint venture, or form a project-specific LLC. It is also possible to create some of the benefits of IPD with traditional independent two-party contracts with independent firms.

A single legal entity eases some of the problems with using web-based collaboration software—powerful tools for collaboration in design and construction. Project Management Information Systems (PMIS), Building Information Modeling (BIM) and IPD are synergetic. They potentiate one another.

Traditional multi-contract project delivery processes present troubling questions that hinder companies from exploiting the full benefits of collaboration technology. Many of these problems are relieved or solved with IPD.

IPD potentiates BIM and PMIS technology—and vice versa.

BIM focuses on the *product*; PMIS focuses on the *process*. And just as each enhances IPD processes, IPD relieves legal and perceived barriers to the use of BIM and PMIS. For instance:

State laws require AEs to supervise and be responsible for drawings they sign. When design teams work within contractual silos, they produce and sign independent drawings for their piece of the project. When information has been contributed to a BIM model from multiple organizations, there are concerns about responsibility for the design. There are also questions about who owns the model, who controls the copyrights, who has the intellectual property rights or who controls proprietary designs. IPD eases these problems. Since IPD reduces contractual separation and creates shared responsibility, it reduces barriers to collaboration and opens doors to the development of integrated documents.

Companies performing their work in contractual silos are reluctant to share financial information in a comprehensive and owner-transparent information system. They tend to hold financial and management information close to their chests in case of claims or litigation. Or they just may feel reluctant to share business information. Integrating the financial interests of the parties and

placing restraint on litigation increases project transparency and facilitates a PMIS.

Because IPD tends to remove the contractual silo walls that separate the key participants, many protectionist and redundant processes that do not add value can be eliminated. IPD potentiates Lean Construction processes.

Management Committee

Collaboration is coordinated by a management committee.

Each member of the Core Team typically appoints a senior executive to a management committee that sets policies for execution of the project. The owner attends the management committee meetings, participates in deliberations and is privy to the internal problems of execution. There may be an implementation committee that carries out the day-to-day operations of the entity, but it does not set policy or modify agreements.

Instead of the usual top-down pyramid management structure with fixed structural authority levels, guidance and control is assigned dynamically by the management committee to the IPD Core Team member best able to understand the particular issue or assume the risk.

Incentive Pool for meeting Project Goals

And incentive pool will define goals but can create conflict too.

The *sine qua non* of IPD is a pool of money to be shared by the Core Team with a predetermined formula. The characteristics of this pool vary with the predilections of the authors. It may be called a risk pool, a contingency, a pain/gain pool, a reward pool, a profit pool or a savings pool. The pool is established at the start with the potential share of the proceeds (or losses) predetermined. It may approximate the profit of the members plus a contingency for mistakes. It may be increased if the members execute their work for less than the budget; and it may be increased with bonuses from the owner for exceptional performance or meeting stipulated goals. Typically, the members share proceeds from the reward pool, pro rata to their economic interest in the project (normally their fee).

The project goals may be financial (for executing the work for less than the budget—similar to a Shared Savings clause) but may include schedule, quality and other goals. Some important goals may be difficult to measure so the final award may include subjective evaluations by the owner.

While such a reward pool may appeal to the venality of some of the IPD Core Team members, it carries a sense of higher purpose: by

attaching money to an owner message of collaboration. Since the members lose or earn the incentive pool together the implication is that they sink or swim together.

No-Blame Working Environments to Constrain Litigation

Reducing the specter of litigation increases collaboration and potentiates lean processes.

Typically, the Core Team members agree to a "no-blame" environment. The parties to the contract commit to notify each other openly of differences of opinion or conflicts of interest. They promise to work together for a resolution in open discussion in Management Committee meetings. And they agree to do it quickly. The members typically restrict their ability to sue one another—excluding willful neglect, intentional misconduct, egregious mischief, gross negligence or some other behavior as defined by the members' lawyer.

Mistakes are paid for out of a contingency pool that may accrue in part to the members if unused, placing an incentive on each member to check everyone else's work. If the contingency is exhausted, the members may agree to share the cost, further focusing the attention of the members on collaborative quality control.

Design Assist

Although it is not reasonable to provide scores of trade contractors or manufacturers with the same collaborative contractual envelope that the Core Team enjoys, the Team invariably looks for ways to include input from a wide industry base into the design process. The approach may use cost models or contracts similar to CM-at-Risk for trade contractors.

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Bob Fraga, FCMAA, puts it well when he points out that the construction industry is highly fragmented because it is highly specialized.

- Owners will usually have continuous building programs and a staff of construction professionals.
- Architects have in-house specialists in programming, design, construction technology and construction administration. They also have people who specialize in different building functions.
- There will be prime consultants in mechanical, electrical, plumbing, civil and structural engineering and subconsultants in BIM, sustainability, commissioning, information technology, automation, mechanization, data distribution, AV systems,

kitchen design, acoustics, lighting, wayfinding graphics, landscaping, parking systems—and on and on.

- The CM will have 50 to 75 subcontractors who will deal with multiple tiers of suppliers, distributors and manufacturers.
- There will be lawyers, insurance brokers for OCIP programs and entitlement and permitting agencies.

Our industry is experiencing challenges due to increases in regulatory requirements, changes in demographics, a global economy with global supply chains and a constant flood of new products and technologies.

So we are struggling to create project delivery systems to integrate the intellectual capital of these specializations so we can make better buildings. IPD is our best idea to date.

LEADERSHIP

Such a process requires leadership. It is not reactive management that directs, monitors and reports, but leadership that facilitates and supports the contributions of an extended project team. It is leadership that understands the sequence of decision-making and passes the baton of authority to the right person at the right time; leadership that understands the different work ethics and value judgments that have traditionally caused conflict between designers and builders and understands how to leverage the talents of each; leadership that knows collaboration, innovation and creativity require support. It is also leadership that understands the hard business of interlacing design and construction tasks, understands the business of companies that perform those tasks, understands how long their work takes, what it costs and how to select and contract for it.

First of all, you have to work the changes from all dimensions simultaneously. It doesn't happen without the courageous owner, it takes a smart program manager who has access to experts in the design of proposals, processes and contracts in an atmosphere that realizes that this is new ground and that everyone is a learner not an expert and that we are inventing a new world where the relationships and successes will outnumber the setbacks and where what might have been perceived as a failure is just handled as another opportunity.

…Dennis Dunne FCMAA

And it is leadership that requires a clear understanding of the new concepts necessary to make IPD work. So presenting these concepts is the purpose of this White Paper. It is a manual for leaders who want to understand IPD projects and programs.

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Our industry is changing. Owners are serial builders with construction professionals on their permanent staff and these owners are providing far more leadership than is traditional. Often they augment their in-house staff with CMs, PMs and AEs, beginning the integration process. They are using web-based information systems with open access for the extended project team so communication is efficient. And we are seeing the emergence of BIM, often with pressure from the owner that will allow us to test our designs in

electronic space before pouring concrete. And it will provide technology to allow these serial builders to develop continuous improvement programs for the similarities in their buildings.

As we begin to understand the new relationships, it's likely that IPD will gain acceptance. It appears to offer advantages for everyone.

- Architects, who have developed astonishing expertise in understanding the programmatic requirements of increasingly complicated buildings, have often been marginalized by CMs or by the owner's facility officers when construction technology and cost are the issue—often rupturing a design. With IPD, they have a seminal opportunity to once again provide intellectual leadership in delivering buildings.
- CMs, who have contributed management acumen, procurement wisdom, insight into construction technology and financial responsibility, have often been absent from the table early in the project when key decisions were made. Too often, they have been unable to adequately influence the design. With IPD they get to help make the bed they sleep in.
- Subcontractors, manufacturers and fabricators, who have important insight into the most cost-effective construction technology, will be less frustrated with their lot in life.
- Owners, who more often than not have construction professionals on their staff and frequently understand their requirements better than anyone, now have the opportunity to participate more closely in the detailed decisions that influence their projects.

The results will be better buildings, faster, for less.

Our delivery teams—the people that plan, design, equip, approve, finance, build, commission and operate these buildings—need to be organized differently. New roles and relationships need to be established and made functional. Forms of contracts and other legal documents must be re-thought and re-written.

…Don Russell, CCM, FCMAA

Even one-off owners will benefit from an integrated team that is committed to a collaboratively planned, designed and constructed project rather than one that is fragmented by traditional roles.

…Kevin Delorey

IPD: Process or Product

Is Integrated Project Delivery a form of design-build—gathering architects and engineers into the traditional builder's sphere of legal responsibility to deliver a product? Or is it the reverse—a process that brings the builder into the architect's professional responsibility to exert a Standard of Care and operate in the interest of the owner?

A look back at some of the legal history of our industry will help illuminate this question.

Defect-Free Building

Most buildings in Early America were built by craftsmen. Only a few men assumed the role of a full-time architect before the mid 19th century.[2] Builders, typically masons or carpenters, called themselves architects.

Early American tradesmen were required by common law to produce "workmanlike" results. As loose groups formed under the leadership of entrepreneurial craftsmen to build a building for a price, 19th century judges made the logical assumption that a builder architect should guarantee the work to be correct.

In Ohio in 1834, an owner hired a "mechanic" to design and build a house. The chimney flues smoked and the house had to be rebuilt. The court stated that the law required the "mechanic" to build in a

[2] Notable examples are Charles Bulfinch (1763-1844), Richard Morris Hunt (1827-1895) and Benjamin Henry Latrobe (1764-1820).

workmanlike manner.[3] In another case in 1841, a builder who had designed and built a defective sawmill explained that he had done the work "to the best of his knowledge, skill, and ability."[4]

The court said:

> *"…when a party contracts to do a certain piece of work in his "trade", he is presumed to be both able and willing to do it in a workmanlike manner…the very offer to do the work, presupposes capacity. To say that a builder, after the destruction of the materials, and the expenditure of his employer's means, should be permitted to shield himself from damages, upon the ground that he only contracted to the best of his knowledge, skill, and ability, and that he is not responsible if the work is not done in a workmanlike manner, would be a fraud which the law will not countenance."*

PROFESSIONALISM AND THE STANDARD OF CARE

But when the craftsman/builder/architect moved out of the mud and rain, obtained degrees from universities, established associations like the AIA, obtained licensing and sought professional status, a new concept, the Standard of Care, emerged.

As the number of architects grew in the 19th century, they sought and obtained the status of other professions: law and medicine. They argued that to err is human and their responsibility should not be perfection but instead their work should meet the standard of their peers. Although circumstances, jurisdictions and the predilection of judges differed, most courts agreed that an architect did not guarantee perfect plans, a perfect building or perfect supervision that would deliver a defect-free project.

Both principles were analyzed and clearly stated by the end of the 19th century.

In a famous New York case[5] in 1888, a three-judge panel, reviewing a previous decision, stated that an architect when overseeing construction is:

> *…bound only to exercise reasonable care, and to use reasonable powers of observation and detection in the supervision of the structure. He might direct during one of his site visits that portions of the plumbing work be packed in wool, but he would not be required, upon his next visit to the building, to tear apart any brick work that*

[3] Somerby v. Tappan
[4] Manuel v. Campbell
[5] Hubert v. Aitken

> *might by then have covered the pipes in order to see whether his directions had been attended to. An architect is no more a mere overseer or foreman or watchman than he is a guarantor of a flawless building."*

However, "Hubert" gave new emphasis to the architect's responsibility to stay abreast of emerging technology—a responsibility that is on steroids as we enter the 21st century. The justice who first heard the case emphasized that the reasonable skill and knowledge required of an architect should include design documents which incorporate technical learning reflecting:

> *"…new conveniences such as steam heating that becomes the customary means of securing the comfort of the unpretentious citizen. The architect is expected, as a professional, to keep himself abreast of such developments, and as a professional he is not permitted to avoid liability for ignorance of new technology by throwing the responsibility of any errors committed upon the contractor or the owner."*

The words *"would not be permitted to avoid liability for ignorance of new technology"* are galvanizing in light of the technologies that present themselves to architects in the 21st century—an abundance of technical knowledge light years beyond the ability of a single person to absorb. And it is not only the technology of construction but the technology of collaborative design that must be understood.

The Standard of Care concept doesn't establish a metric to define an acceptable tolerance for defects. It addresses process. It is a legal term defined in most jurisdictions as:

> *"that same level of care employed by reasonably prudent professionals practicing in the same field in the same area."*

Standard of Care does not speak to the notion of defect-free buildings. Rather it is the recognition under common liability law that professionals (doctors, lawyers and architects) are in the business of exercising learned judgment, based on experience with a body of knowledge, and upon situations and decisions not totally knowable or under their exclusive control. For instance, a doctor may use the best known treatment and still lose a patient. Likewise, an architect may specify the correct soils tests, hire good geo-technical and structural consultants and the ground may still heave and displace the foundation. If the architect can show "that same level of care employed by reasonably prudent professionals practicing in the same field in the same area" he or she may avoid responsibility for the cost

of the repair. The concept is that professionals are to be held accountable for process, not results.

The Standard of Care is not intended to protect professionals by establishing a threshold of error, allowing minimal defects. Rather it is recognition that because buildings are so complex and unique, design professionals cannot guarantee defect-free buildings. A professional design does not require that every element of construction, down to the location and length of each nail, be specified in the design documents. Such details are often best left to the skill and discretion of the builder, whose expertise is found in converting a design to the physical conditions of the real world. Buildings, unlike automobiles, are not mass-produced products that present an opportunity to eliminate flaws in subsequent editions. Therefore, architects and engineers, when designing a unique structure, are not subject to product liability laws. Instead the law places a duty to follow a process based on a body of knowledge and experience. And that process constantly evolves as knowledge grows.

But the basic concept of a professional that is not expected to be perfect remains. In the words of a twentieth century court,[6] architects:

> *" deal in somewhat inexact sciences and are continually called upon to exercise their skilled judgment in order to anticipate and provide for random factors which are incapable of precise measurement. In such circumstances, certainty as to the exact result to be obtained by relying on an architect's plans or supervision is impossible, and perfection is to be neither anticipated nor expected."*

THE SPEARIN DECISION

Meanwhile, contractors sought the protection of the law to deliver what the plans and specifications called for even if the result did not suit the owner's purpose.

Early in the 20th century, the United State Supreme Court held that since a builder agrees to build according to plans and specifications furnished by the owner (and it can't be shown that the contractor knew that the plans and specifications would produce a defect), the contractor is not responsible for the consequences of defects in the plans and specifications. [7]

[6] City of Mounds View v. Walijarvi (1978)
[7] United States v. Spearin (1918)

THE OWNER'S RESPONSIBILITY

If a builder builds a flawed design as defined in the plans and if the architect could demonstrate that he or she had used the "*care employed by reasonably prudent professionals practicing in the same field in the same area,*" the owner is left with the cost of correction. Even though there is a mistake, the AE is not liable, the builder is not liable and the owner must pay.

Initially, all risk on a building project lies with the owner. A risk not allocated to professionals or builders remains with the owner. Try as they might, owners cannot allocate all risk for building defects or unanticipated conditions to others. Given the inherent common law limitations on liability for both builders and AEs, the owner must assume liability for defects occurring under the Standard of Care concept and the Spearin doctrine. A wise owner will know that we don't live in a perfect world and will have contingencies to protect against the unpredictable.

In most IPD projects, there is a pool of money that recognizes this reality. It is used to pay for the mistakes of the members (just as the contingency in standard cost-reimbursable CM-at-Risk contracts may be used for mistakes). It may also be used for economic efficiency: it may be cheaper for the owner to not pay for a near perfect design when the cost of proceeding with a sufficiently complete design yields sufficient savings to cover any extra costs the builder may incur in overcoming missing design information. If unused, the contingency may be returned to the owner or shared. That motivates everyone to participate in checking everyone else's work.

Traditionally, as recognized under law, builders have not been seen as professionals since the craft of building is not assumed to include the level of uncertainty that architects face (a 19th century assumption that has proved increasingly incorrect in the 21st century). The traditional attitude of society (no longer valid) has been that architects are responsible for defining the best construction technology. Therefore, if a contractor builds a building exactly as designed and it leaks, it is not fair to hold the contractor liable. However, in the real world, on an almost daily basis, builders see errors in the plans and work out solutions with the architect. One pundit[8] said, "The dirtiest trick a contractor can play on an architect is to build a building exactly as designed!"

[8] Attributed to Jack Hartray, FAIA, a well-respected Chicago architect.

As our industry has developed, manufacturers and trade contractors often know more about component design than do architects and engineers. So, when there is a problem, owners not knowing who to sue, usually sue everybody involved, including subs.

Centralizing responsibility for results has been a driver for design-build and Bridging. But in many cases, the owner, in spite of lack of contractual privity in a design-build project, can sue the architect directly because of an implied duty based on professional licensure.

It is yet to be seen if the courts consider IPD to be a design-build process, obligated to deliver a defect-free building, or a professional service expected to provide judgment, wisdom and experience. And it is unclear how Spearin and the Standard of Care concepts will work with IPD contracts. Certainly, there will be a variety of IPD agreements that may shade decisions differently.

It is possible that a trade contractor under contract to an IPD Core Team[9] would be able to use Spearin and claim successfully that the IPD Core Team had an implied warranty that the plans and specs were correct.

However, if a CM working under a multi-party IPD contract held the trade contracts the CM would be unlikely to derive protection under Spearin since the CM had a duty to evaluate the design as it developed.

However, assume that the CM and the AE form an IPD Core Team that is an LLC or a joint venture or operates under a multi-party contract, and assume that the subcontractors are under contract to the IPD Core Team. If there is a flaw in the design, does the IPD Core Team have a duty to deliver a defect-free building or do they operate under a Standard of Care? Are they delivering a product or a service?

If the agreement implies the delivery of a product, the AE may owe a traditional Standard of Care to the IPD Team, but the IPD Team may commit to delivery of a defect-free building. However, if liability for project problems is shared among the members, the AE will share its proportion of the liability for a defect and so will share financial exposure for their mistakes anyway.

[9] Whether incorporated, a JV or simply under contract to the CM working under a multi-party contract.

A key benefit of the IPD process is that this sharing of responsibilities can be defined among the parties by the project participants, thereby establishing at project inception the expectations and Standard of Care each of the team members owes to the other.

The owner is usually a part of the IPD team and can participate in crafting this agreement that spells out the duties of the IPD Core Team members to one another. So the question becomes what does the IPD enterprise agree to deliver—a defect-free building, or a building of a quality which meets the Standard of Care (or some higher level defined by the IPD agreement itself)?

This collaborative design effort, at the heart of the IPD concept, blurs the line of demarcation between the multiple authors of the design. Since the CM and key subcontractors participate in the development of the design documents, they are unlikely to have any protection under Spearin. Indeed, since the owner is intimately involved in the process and influences many decisions, the owner also assumes some ownership in the design.

Undoubtedly some owners and their lawyers will fashion agreements with integrated teams that include fixed prices, GMPs and defined results. Based on the specific language in the agreement such a contract may be interpreted as a design-build agreement to deliver a defect-free product. But certainly others will fashion agreements that define the process and professional responsibilities, and the IPD team will be expected to deliver a Standard of Care.[10] And there will be substantial gray areas for the courts to deliberate.

However, both AEs and CMs argue that the driving ethos of IPD is professional and that the AE and the CM may both owe the owner a Standard of Care—but not perfection. If history is a guide, that's a likely outcome. CMs appear to be repeating the evolution to professional status that characterized the emergence of architects. Consider this:

In the mid 19th century, architects separated from the physical act of construction, formed associations (such as the AIA), were hired on the basis of qualifications rather than price, obtained licensing, and by the end of the century the "Standard of Care" concept was in place, firmly cementing the role of architects as professionals with professional, not product responsibility.

In the late 20th century, construction managers separated from the physical act of construction, formed associations (CMAA), were

[10] Already, Standard of Care clauses are appearing in IPD contracts.

hired on the basis of qualifications rather than price and at least one state requires CCM certification to assume the title of "Construction Manager." And a "Standard of Care" clause is surfacing in some IPD contracts.

History appears to be repeating itself.

However, even with a Standard of Care applied to the agreement between the IPD Team and the owner, it is likely that the standard will be very high. Since BIM models can be reviewed by the extended project team, the team will be expected to do so. And since physical conflicts can be discovered by clash detection routines, that will be expected as well. So it is likely that if a Standard of Care becomes part of an IPD contract with an owner, the standard will approach "defect-free" anyway.

Goals and Incentive Compensation

The IPD concept seeks to align a project team with the owner's goals—by stipulating them, defining the metrics for measuring them and providing incentives for achieving them. Incentive rewards (or penalties) are typically shared by the IPD Team proportionate to their participation in the project.

IPD is a good idea. It works because it causes the owner to focus on a clear statement of goals and sends strong, clear messages. Attaching money to the message makes it infinitely more convincing. Incentive compensation amplifies the message.

However, it is crucial for managers of IPD Teams to realize that these incentives have the potential to create conflict as well as alignment. Every action has a reaction; every goal that affects incentive compensation is a potential source of disagreement. If goals are set or managed ineptly, they have the potential of driving a wedge of discord between the owner and the IPD Team—the reverse of what is intended.

For instance, if there are goals of cost and schedule, and if there is a change in scope during the project, the IPD Team and the owner must negotiate a change order that may cause traditional unspoken feelings of adversarial relationship to surface. An incentive to save money may create a perception of self-interest and distrust when the IPD Team suggests an economy. The owner may feel that the IPD Team is being rewarded to cheapen the project—again weakening the collaborative trust that is fundamental to IPD.

A project will have many goals. In addition to the classic trio of schedule, quality and scope, goals might include safety, sustainability, HUB participation, local business participation, minority hiring. Some goals will be particularly hard to measure, such as consideration of users, community relations and management response to unpredictable events.

Incentivizing some of these goals may cause the IPD Team to neglect others. Think of the classic child's toy that is a small plank on legs with pegs that protrude vertically. There is a little hammer that a child can use to beat a peg down into the plank. But as one peg goes down, others go up. Rewarding goals on a project has the same characteristic. You can't reward one goal without affecting others.

THE COST GOAL

Probably the most common goal focuses on meeting the budget. It is also the one with the greatest potential of serious unintended consequences.

An IPD contract is likely to be cost-reimbursable with a target price or a guaranteed maximum price (GMP). An incentive clause may stipulate that the IPD Team will share in the savings (the difference between the final cost and the target price or GMP). It may also stipulate that the IPD Team must pay a part or all of any overrun. (If the contract is a GMP contract, the IPD Team must pay *the entire* overrun.)

In a lump-sum contract with a GC who has bid a fixed price on a complete set of plans and specs, a Shared Savings clause makes sense. It is an agreement to compensate the GC for initiative in finding something that doesn't meet the current plans and specs but would be acceptable to the AE and the owner and would save money.

But a Shared Savings clause with a cost-reimbursable target price or GMP contract may have undesirable results. Here's what can happen:

The owner typically selects the IPD Team based on qualifications and fee before the project is designed. The owner agrees to reimburse the IPD Team for design, management, General Conditions cost, subcontractor costs and in some cases self-performed construction. The IPD Team controls the cost and the scope of these items. The IPD Team may bid some of the subcontracts, estimate the cost of the un-bid contracts, estimate the General Conditions and add a contingency. They must manage the whole to come within the target price or the GMP—and produce an incentive reward.

Construction company estimators will not intentionally jeopardize their firm if there is a GMP and will certainly be aware of the incentive if there is a target price. Knowing that prices always have an unpredictable element, the estimate of the un-bid contracts and the General Conditions will be conservative—there will be a pad. So in most cases the "savings" are likely to come from the contingency, from the conservative pad built into the estimate for the un-bid subcontracts and from the conservative estimate of General Conditions construction. So the larger the pad, the greater the incentive reward to the IPD Team. That is hardly in the owner's interest.

So a Shared Savings clause holds the seeds of conflict. If the budget is set before design, it is a clear incentive to cheapen the design and reduce scope. During design, the IPD Team will be motivated to estimate subcontracts and the General Conditions conservatively. That might cause the owner to reduce the project scope—perhaps needlessly. Then the project may eventually be delivered well under the budget. The IPD Team receives the reward and the owner receives less scope.

Of course, scope can be one of the goals too. But then the IPD Team may put pressure on the owner to reduce the quality of systems and materials.

Absolute Goals

Some goals may be a matter of degree. Safety targets, minority hiring or sustainability may be measured in degrees. An owner may want a building "as soon as possible and as economically as possible."

But the same goals could be absolute. There may be a date certain for occupancy, such as the opening of a school semester. Or there may be a fixed appropriation for cost so the project can't exceed the budget, but the owner would like to use all of the money that's been appropriated for the project.

If that is the case, those goals must be contractually absolute. If the owner has a fixed budget and a date certain, the IPD Team must have a contractual obligation to meet them. These hard things always have undesirable consequences, but when they are part of an owner's reality they must be part of the IPD Team's reality as well.

The Contingency

There must be a contingency to cover unpredictable events. Some IPD projects have a contingency fund that if unused is shared by the

owner and the IPD Team. The convincing thought behind that arrangement is that the IPD Team will treat the project budget as its own money—as indeed it is.

However, it is an asymmetrical alignment. The owner has two opposing incentives to balance—the desire to save money and the desire to have a quality project. If there is only a cost goal, the IPD Team is incentivized for only one.

On a cost-reimbursable project the contingency should also be available to pay for mistakes made by the IPD Team. Inexperienced owners will do a double take on this point—*"Why should I pay for mistakes?"* But if an AE negotiates a lump sum contract for services or if a GC bids a lump sum on a design-bid-build project, they will include a contingency within the lump-sum for mistakes they know will occur. So in a cost-reimbursable contract, such a clause is common because mistakes are common.

The contingency may be outside of the incentive compensation pool. If the IPD Team gets to keep part of the unused contingency, an owner is reluctant to let it be very large. Yet a small contingency creates risk for the IPD Team—particularly if the contract carries a GMP. If there is risk, candor is driven underground—project transparency is clouded. Team members are driven to their corners.

One good approach is to give the IPD Team time to take bids on most of the work, provide an adequate contingency and require that the entire unused contingency be returned to the owner and that it be set outside of incentive formulas.

SATISFACTION FEES

So the incentive compensation should be for meeting broad project goals and may have a bonus for exceptional performance.

The best approach is for the owner to establish a broad, prioritized list of goals. They may then be periodically reviewed (and may be modified) with the IPD Core Team. Then the owner reviews the IPD Core Team's performance in reaching the goals.

Too often owners fail to review performance with the project team during the project. They realize they must get along with the team members so they don't want to alienate them by criticizing them. Likewise, the project team doesn't want to criticize their client. So embedded, reoccurring problems don't get fixed. But reviews happen if they're contractual and if money is attached.

The review should be reciprocal. The IPD Team should be asked to review the owner's performance. Mutual criticism should be expected and solicited.

When? Although it may be argued that it's not clear that the goals are met until the end of the job, it doesn't make sense to wait until then to review performance. Holding periodic reviews during the project is important. It's smart to have feedback when the team can respond. Nobody can change the past. The meetings should include the project managers from the owner and the IPD Team, along with the principal executive management of each organization. Developing a brass-to-brass relationship is crucial.

The incentive fee should be parceled out and awarded to the IPD Team periodically, perhaps quarterly, based on the owner's review of goals. The owner grades the IPD Team and distributes the fee for that period. A good approach is to parcel out a portion of the fee as the project progresses and indicate what portion will be earned at the end of the project if the project finishes with current performance.

For instance, the distribution of the award fee might be as follows:

- 10% at the start of construction
- 10% at topping out
- 10% at completion of building envelope
- 60% at substantial completion
- 10% at punch list completion

A project team might be only slightly ahead of schedule and earn only part of the award for a given period (say 5% instead of 10%). However, if they pick up the schedule and meet the criteria for exceptional performance at the next milestone, they may recover the lost 10% and get 25%. Conceivably, they could fall short throughout the program but finish in a blaze of performance and collect the entire fee.

How Much? Normally, the incentive fee should not be large. Large amounts, particularly in a large owner bureaucracy, will attract attention from multiple sources, draw significant pressures to justify paying it and force the owner's management team to justify some subjective decisions.[11]

A small amount will have a good effect. The people working on the project are now conscious that there is a report card. If they earn the

[11] This is not always true. Lee Evey used a significant incentive fee in motivating the program manager and the design-build contractor to finish the reconstruction of the Pentagon after 9/11. The team earned 100% of the fee.

bonus, there is clear evidence of their good performance within their organizations. They can tell their top management that the client clearly likes their performance.

❖

Some of the most important aspects of performance can't be measured. An owner who sets an incentive fee for meeting goals must stipulate that there is a subjective element in the evaluation and that the owner's decision is final.

THE BIGGEST INCENTIVE

Cost incentives—indeed all of the incentivized goals—often work well despite the negative, unintended motivations to cheapen work, pad estimates, negotiate change orders unfairly—or whatever. Of course, professionals will object stridently to these "unintended consequences." They will claim that they are professional and will not interpret a Shared Savings clause as a "bribe to cheapen the building," etc., and that they will do the right thing. Indeed they are right: most CMs and AEs are staffed with good people who make responsible decisions in the owner's interest. But then the question arises: "If everybody will do the right thing, why have incentives in the first place?"

It's a good question. The clearest answer is that it causes the owner and the IPD Team to clarify the goals and discuss them. That causes integration.

The answer is that defining incentives defines goals and defining the goals produces good results. Attaching money to a goal makes it serious and not just cheap talk. The money is the message.

The other reason it works is that good people have been selected on the basis of qualifications. Good people want repeat work and will work to build or uphold their reputation. The most important issue for any organization is survival. Since the IPD Team is selected on qualifications, they know they can be selected again if they do a good job or that a reputation for collaborative response to a client will be enhanced by their good performance. Their primary motivation will be future work. Good references and an opportunity for repeat work are far more valuable than a killing on incentive compensation.

So the most important incentive that an owner has is the promise of repeat work and their testimony to the IPD Team's good performance. But since repeat work and testimony are unlikely to be

a matter of contract, there must be a strong perception that repeat work will follow good performance.

An owner's biggest form of incentive compensation is a carrot.

IPD Legal Relationships

How do you make multiple companies work like one?
…Bruce D'Agostino, President, CMAA

The IPD premise is that design and construction will improve if the designers and constructors align their interests and remove legal barriers to collaboration. And so, as an IPD project begins, thoughts immediately turn to legal structures to support this hypothesis.

If a single company executes a project, and if there is a problem, one part of the company doesn't sue the other. Their financial interest is the same and they find it easier to access material or intellectual resources from within the company that to contract for them from another company. Although a profit center in a company may be inclined to make self-serving decisions and although a person in one part of the company might get cross at another, employees of a single company are more closely aligned than employees of independent companies working under separate contracts for the same project. When conflict surfaces within a company, an executive steps in and makes decisions without costly recourse to litigation.

So in organizing an IPD team, a common intention is to simulate the collaborative and litigation-free characteristics of a single company.

Of course, it can't be done completely. As long as multiple organizations have interests in the IPD Team and those organizations are doing at least some of the work independently, unaligned self-interest will exist. There will never be a contractual vehicle that will replace the need for professionals who have their hearts in the right place. But gains can be made.

At the heart of IPD is the IPD Core Team. It's assembled from the key organizations who band together to share the risk and reward of executing a project (or a program). The IPD Core Team can be two organizations (an AE and a CM), or it could include many: the prime subconsultants and major subcontractors.

PARTNERING: PRELUDE TO IPD

Traditionally, a project is created by an ad hoc assembly of many specialized organizations, each operating with its own prejudices and self-interest. Each works on its own turf: economically, legally and culturally. Each views the world from its own corner.

Our management practices have viewed organizational authority, precise contracts, detailed schedules and legal recourse for non-performance as the appropriate tools for knitting together such ad hoc organizations. The theory is that if each does its work satisfactorily, as specified and scheduled, the result will be OK.

It's a logical theory but often disappointing. The problem is that we live in an imperfect world and everyone makes mistakes. That breeds conflict and legal action. Legal action ricochets. If one party sues another, the defense is to find the plaintiff's mistakes and counter sue. The conflict spreads from there. Since everyone has made mistakes, everyone is open to blame.

During the 1980s, many leaders in the construction industry began to add management philosophies that invoked the soft but essential spirit of collaboration. They recognized that if people on a project team want to help one another, they'll help the project.

Partnering emerged—a process that focuses on building a team, opening channels of communication, installing systems to anticipate and resolve problems and defining project goals for those who must work together. Partnering *does* improve collaboration.

But when problems come up, there are no contractual teeth preventing partners from divorce. So one can see IPD as a logical evolution—a means to add contractual structure to the spirit of Partnering.

A word of caution is appropriate at this point. This document is not intended to be a do-it-yourself legal guide. Departures from the norms of practice require rigorous examination by experienced construction lawyers conversant with the details of applicable state laws. For instance, depending on the state and the nature of the legal relationship, the IPD Core Team may have a licensing obligation. In

Collaboration is hardly a new idea. In 1427, when Brunelleschi was constructing the Cathedral in Florence, tensions became so great among the artisans that they were made to take an oath to "forgive injuries, lay down all hatred, entirely free themselves of any faction and bias, and to attend only to the good and the honor and the greatness of the Republic, forgetting all offences…"

Such a clause might be useful in an IPD contract.

Georgia, for example, if construction is held within a joint venture, the JV must hold a contractor's license.

CHOICES

At the start of an IPD project, the owner and the IPD Core Team members must choose a legal structure. The choices are plentiful.

Normally, in choosing a legal structure, the considerations to ponder are those of liability, taxes and administrative cost. However, in choosing a legal structure for an IPD project, an overarching consideration is the effect of the legal structure on the culture of the team. The salient question is: what form of contract maximizes collaboration?

The owners or members of the IPD Core Team may choose:

1. multiple independent contracts
2. a single multi-party contract
3. a joint venture
4. a limited liability company

MULTIPLE INDEPENDENT CONTRACTS

An owner could choose to use a traditional approach contracting with designers and builders independently but still use some of the IPD themes mentioned above.

Liability: Each company is liable for its own work and the responsibility is compartmentalized in its own silo of contractual risk and responsibility. However, each member of the IPD Core Team would agree to constraints on litigation—to not sue other members of the team (with exceptions for such acts as willful misconduct).

Taxes: Each company pays its own taxes using its own accounting policies.

Administrative Cost: Each member manages its own operations with its existing overhead staff, policies, systems and insurance. Since there is no overarching organization binding the team together, there is no additional administrative cost. The owner or an owner's representative or one of the members of the IPD Core Team would call the group together for periodic coordination meetings but there would be little change from traditional project administration.

Culture: This multiple-contract structure does not go far down the path of integration. However, an owner could establish a shared incentive pool for meeting project goals that would be earned or lost, multi-laterally, by the team, and could hold team meetings to review

everyone's performance. The incentive rewards would be distributed to the IPD Core Team based on an initial agreement and might include some or all of the profit of each team member, a contingency, an incentive for meeting goals and a pain/gain sum that may be adjusted based on performance.

Although each party has an independent contract, a shared carrot provides a unifying incentive: each team member profits by helping the others. Perhaps the most effective part of an incentive pool is that it carries a clear message from the owner that collaboration is expected and rewarded.

SINGLE MULTI-PARTY CONTRACT

The next step in contractual integration is a single, multi-party contract. It is signed by the owner and the IPD Core Team members. The contract defines the duties of each party to the owner and to one another. The owner pays each party. The payment terms could be lump-sum or cost-plus, and there could be a target price or GMP for each.

Liability: In such an agreement, it's possible to define and stipulate the responsibilities and liabilities of each party as an independent entity in the contract, compartmentalizing liability. But a third party that felt damaged might claim that such an agreement was a joint venture and hold the members jointly liable. In the spirit of shared responsibility so prevalent in IPD, it is likely that there would be much in the language of the agreements and the actions of the parties to support such an allegation.

Taxes: Each party will pay its own taxes based on its income and following its standard accounting policies.

Administrative Cost: A multi-party contract is likely to be an efficient choice. Each member will manage its operations with its existing overhead staff, policies, systems and insurance.

There must be a management committee to coordinate the project or adjust the duties and compensation as the project unfolds. The owner, as a signatory of the multi-party contract, would participate as a member.

Culture: A passionate IPD advocate would argue that such an arrangement does not go far enough to remove the independent silos of risk and responsibility and that a legal structure that provides a more cohesive organization would be more "integrated." While there is a unifying management committee and a unifying reward pool, the independent silos remain. The advantage of the multi-party contract

that compartmentalizes risk and responsibility is a disadvantage to performance and leaves the silo walls intact.

The counter argument is that any organization, short of an independent, fully staffed multi-disciplinary single company, will have independent silos. Even when companies form project-specific corporations and become shareholders, they typically subcontract design and construction management to member companies—again keeping the silos intact.

JOINT VENTURE

"Joint venture" is a broad term with shaded nuances in different industries. In the construction industry JV normally implies a partnership between two or more organizations that combine their resources to do a specific project or program. Normally, there are two contracts. The JV has a contract with the owner that spells out the duties and responsibilities of the JV to the owner. And the members of the JV have a JV agreement among themselves that spells out their individual duties and responsibilities. The owner pays the JV for the work. The JV pays the members—after deducting JV costs (if any). The terms of payment in the JV agreement should reflect terms of payment in the owner/JV agreement. (For instance, if the owner/JV agreement is cost-plus, the JV can pay the members on a cost-plus basis. If the owner/JV agreement has a GMP or target price provision, the individual members of the JV should probably have GMPs or target prices in their agreement with the JV.)

Liability: Normally there is "joint and several" responsibility stipulating that each member of the JV is responsible to the owner for the entire work. If one party defaults, the remaining partners must assume its responsibilities. Consequently, the total assets of each member are on the line for the successful execution of the agreement.

Theoretically, a JV agreement with an owner could compartmentalize responsibilities, limit joint and several responsibility and place limits on the liability of the individual partners, but it would be uncommon. And a third party might well hold the JV responsible despite the internal agreements.

Taxes: In a partnership, income flows through the partnership to the partners and the partners are taxed as individuals. Although in many states a JV must file a tax return, profits are normally passed through to JV partners and the JV has zero income. The members of the JV would then file their own tax returns based on their usual accounting policies.

Administrative Cost: Although it is possible to distribute all the expenses of the JV to each of the member companies, it is not uncommon for a JV to develop a little overhead cost of its own for accounting, entertainment, legal representation, perhaps office space and supplies, etc. So there is usually a minor increase in overhead. It is rare for a JV to have its own employees and to create its own overhead staff, policies and management systems but it is sometimes done.

A JV must have a management committee to direct the organization, make major project decisions, modify the duties, adjust the compensation or handle other administrative or operational decisions as the project unfolds. The JV may invite the owner to participate as an ex officio member from time to time.

Culture: The passionate IPD advocate would feel that while the "joint and several" responsibility exposes the members to inclusive liability for the entire project, it benefits the project because the members share inclusive responsibility for the result. Collaboration is likely to improve when each partner is responsible for the work of the other partners.

It's also possible for the JV to develop an integrated team, staffed with employees of the JV member companies, to manage a PMIS and a BIM model. While the AE would sign a sub-set of the drawings, the JV could own the model and assume responsibility for the integrated set—easing some of the concerns that exist with PMIS and BIM integration when there are separate contracts.

LIMITED LIABILITY ORGANIZATION

In the 18th century, organizations with limitations on investor liability didn't exist. If a person invested in an enterprise they were a partner and personally liable.

But the growth of industrialization in the 19th century brought the need for capital. It became evident that an economy would grow if companies could attract funds and it was clear that to do that, it would be necessary to limit the liability of investors to the extent of their investment. The concept of a limited liability corporation emerged and flourished.

However, the philosophy of limited liability didn't immediately apply to professionals (architects, engineers, lawyers, doctors). For most of the 20th century, state statutes required professionals to be liable for their work as individuals and precluded them from practicing as a limited liability company. That changed in the last half of the 20th

century and a number of limited liability concepts emerged in the statutes.

C Corporations: Until the late 20th century the C Corporation was the only form of a limited liability company. The C Corporation is a business entity that limits the liability of the shareholders to their investment. The number of shareholders is unlimited. Other companies can be shareholders so there can be holding companies and tiers of subsidiaries. C Corporations can be private, controlling the number and selection of owners and the value of their shares, or they can be public with their ownership and the share value controlled by the market.

The C Corporation is an entity and must pay income taxes on its profits. The owners pay individual income tax only on money they receive from the corporation as salary, bonuses or dividends. The shareholders are then taxed for the income produced by the dividends. Although C Corporations are taxed at lower rates than individuals, this double tier of tax will usually take a larger bite out of the shareholder's eventual after-tax rewards from the enterprise than most other forms of business organization. (That may depend on the current tax laws and the tax brackets of the shareholders, and while usually the case, there may be exceptions.)

Some C Corporations routinely bonus all of their profits to owners, using debt to capitalize the business, thus avoiding taxes on profits. It is a practice that may be examined by the IRS

S Corporations: Frustrated by the double tier of taxation, businessmen and professionals persuaded lawmakers that there should be a form of corporation that limited the liability of its investors but avoided taxation cost of the C Corporation. S Corporations are regular corporations that have elected S Corporation tax status. An S Corporation lets the shareholders enjoy the limited liability of a C Corporation but pay income taxes on their personal returns as a sole proprietor or a partner.

The profits of an S Corporation are distributed to the shareholders as cash and/or increased share value, and the shareholders are taxed on the sum of both at ordinary income rates. (If the shareholders leave the money in the company to capitalize operations, increasing share value, it is still considered personal income and taxed.)

Most states follow the federal lead when taxing S Corporations by taxing the business's profits on the shareholders' personal tax returns. However, a few states tax an S Corporation like a regular corporation.

S Corporations impose some limitations. Shareholders must be individuals (not a company) and a U.S. citizen or resident. There may not be more than 100 shareholders. An S Corporation shareholder may not deduct corporate losses that exceed his or her "basis" in corporate stock.

Limited Liability Partnership (LLP): And then, after creating an S Corporation that was taxed like a partnership, our states created a partnership that had the limited liability of a corporation. The Limited Liability Partnership was created primarily for professionals like lawyers, architects, doctors. It is a partnership, but one that limits the liability of the partners to their current equity participation in the partnership.

Limited Liability Company (LLC): Not long ago, an S Corporation was the only limited liability organization that did not have the double layer of taxation. But in the late 20th century, the choice was expanded by adding LLCs. A Limited Liability Company is like a C Corporation in that it limits the liability of its owners, but like an S Corporation, it can pass income through to shareholders. (However, an LLC or may also elect to pay taxes like a C Corporation.)

LIMITED LIABILITY COMPANY

C Corporations, S Corporations, LLPs and LLCs allow the owners to limit their liability to the extent of their investment. However, the members of an IPD Core Team are apt to be companies, not individuals. That excludes LLPs and S Corporations. The C Corporation has a double layer of taxation so that is a discouraging characteristic. That leaves the common choice to be an LLC.

The ownership of the LLC may be distributed to the IPD Core Team proportionate to the level of effort and cost of the services that each member of the IPD Core Team might provide—and therefore proportionate to the potential profit (or loss) of members.

The members would agree to divide the work and subcontract it among themselves. The AEs design, the consultants consult, and the CMs manage. Each prime company is reimbursed at cost or at any reasonable predetermined arrangement for their work. At the end of the project the profits are distributed based on the division of ownership.

Liability: While owners of limited liability organizations do enjoy limited liability for most of their business transactions, the protection is not absolute. An owner (either an individual or a company) can be

held personally liable if he or she: injures someone, guarantees a bank loan or a business debt, fails to manage employee withholding taxes properly, is intentionally fraudulent, illegal, or reckless or treats the LLC as an extension of his or her (or its) affairs. This last exception requires attention. If owners don't treat the company as a separate business, a court might decide that the LLC doesn't really exist, and the owners are doing business individually and are therefore liable for their acts.

Taxes: The profits of the LLC are passed through to the shareholders. In the context of this paper, the shareholders would be the members of the IPD Core Team. They could distribute shares anyway they agreed to, but one likely approach would be to distribute shares proportionate to their potential risk and economic interests (e.g. their overhead and profit, or their fee) in the project.

Administrative Cost: An LLC will require a full set of administrative resources: legal, accounting, human resources, etc., although it's possible for one of the IPD Core Team companies to do these jobs. Nevertheless, there will be additional cost.

The LLC will need to carry its own property and liability insurance. Even though the LLC shields the member companies from liabilities, it must stay in business to execute the project.

Culture: Many IPD ideologues believe that the culture of a single corporation provides the best integration. If the project is large enough to warrant a staff of LLC employees, that might be true. The members might hire or second full-time employees to the IPD Core Team. That, of course, is a clear idea and it helps approach the single company ethos, but it takes time and money to create the administrative systems and bureaucracy, and many employees will be hesitant to leave the ladders of their own organization's advancement programs. Such an approach would be easier for a construction team that might require a full-time project manager, superintendent and field staff for several years. But the design function typically has more specialized talents that move in and out of the project for shorter periods of time.

However, in most IPD projects, the more practical approach will be to simply subcontract the required tasks of management, design, construction and administration to member companies. The IPD Core Team could contract with the subconsultants and subcontractors, or the individual organizations could contract with the appropriate subconsultants and subcontractors. That approach

A co-located full-time project team is a good choice for some projects. The additions, the seismic retrofit and the renovation of the Utah State Capitol, winner of the CMAA project award for remodeling over $50 million, was an 8-year program. Two buildings were added to the capitol, the foundations were replaced, the interior was completely remodeled. The elected and staff government that included several hundred lawyers never left the premises. It is hard to imagine a project more likely to be rife with claims and law suits. Yet there were none. There was an on-site office that housed the project team. Although the designers and the CM were under separate contracts, the co-location of the key companies did much to increase collaboration and enhance the teamwork.

would allow the existing accounting and contracting staff in the key organizations to do the administrative work.

The LLC would have two unifying characteristics. Shared responsibility to the owner and the incentive pool would be the basic elements that motivate alignment of the IPD Core Team. Those same characteristics exist in a joint venture.

So there is much to debate about the value of an LLC for an IPD Core Team. In most situations, owners don't want their service providers to have limited liability. They will want the companies they choose to have their assets at stake—their skin in the game. If the IPD Core Team members form an LLC an owner may be inclined to require personal or corporate guarantees—negating the value of limited liability as far as the owner is concerned.

The limitation of liability might still be of some value in a suit instigated by a third party (a slip-and-fall suit, for instance) but the injured party, in spite of a lack of privity might be able to litigate against the architect or other team members anyway.

Most states have extensive regulations covering the bylaws and governance of a corporation that may limit the freedom of the IPD Team members' ability to set up unique management procedures. The partners in a joint venture have the broader opportunities to invent their own rules of governance and operation.

BIM

Look inside a construction trailer. There's a plan rack with separate drawings for architectural, mechanical, plumbing, electrical and civil. There are special sets of drawings for landscaping, lighting, security networks, wayfinding graphics and so on. Shop drawings are in racks, buckets or drawers. Book shelves hold loose-leaf notebooks full of RFIs. Other drawings reflect a change in requirements or corrections to the initial drawings.

There is not an integrated set of drawings to build from. The architectural and engineering drawings are separate.

Each of these documents describes a piece of the project. None describes it all. Few people have access to a central collection of documents. Information entered in one place may not be replicated (or accurately replicated) in the other places it is needed.

The multiplicity of documents is produced by the multiplicity of contracts. It reflects the many organizations—architects, engineers, consultants, subcontractors and manufacturers—that contribute to the work. And it reflects the sorry fact that our industry has great difficulty integrating these work products.

And shop drawings abound.

Building Information Modeling (BIM) promises to bring huge improvements to the construction industry. There is no technical reason that the sets of design drawings and shop drawings couldn't be integrated into a single electronic model—updated with RFIs and change orders as the project progresses.

What if the movie industry treated its customers that way? Assume that you went to Blockbuster to rent a movie and got separate DVDs for the parts of the heroine, the hero, the villain, the bit players, the sound track, the scenery, the special effects—and so on. Then you go

home and you discover the program is out of sync: the hero swings a punch at the villain and the villain isn't there. Something hasn't been coordinated. So you send Blockbuster an RFI. Blockbuster's policy is to turn it around in three weeks. Then the movie producer changes the plot and distributes updated DVDs.

BIM is a documentation tool, replacing legacy drafting procedures. But BIM it also a technology for collaboration, an integration tool for our fragmented and specialized building industry and a vehicle for an IPD Team to pool its intellectual capital. As we approach a robust implementation of BIM, it will let us build virtually, before building physically, uncovering problems of sequence, interference and constructibility that trigger change orders and RFIs.

EVOLUTION OF BIM

Vector CAD: The first generations of CAD represented buildings with geometry—vector based lines, arcs and circles. A CAD drawing was easy to modify and replicate. It also provided greater precision than pencil on paper. But it was dumb: lines drawn with a computer instead of a pencil.

Object CAD: Then "smart" objects with properties were added. Objects like windows, doors, walls, roofs or stairs had properties that governed their behavior. A window could be pulled from a resource file into a drawing and stretched to fit the required opening. As it was stretched, the panes would grow but the jamb section would not. A user could associate information to the object such as the supplier, part numbers, the finish, the warranty and so on. The drawing objects were "smart." They knew how to behave and what they were.

BIM: From that point, it was a logical step to envision an entire building as a smart object with endless possibilities for algorithms that govern its behavior and associated information. BIM emerged. It's an awesome vision.

BIM CHARACTERISTICS

A BIM model is a digital description of a project. It may include information such as the physical configuration, programmatic requirements, functional characteristics, specifications, systems performance, supply chain threads, construction sequence, cost or any other information that might be useful.

Plug-ins: Specialized software may be "plugged in" with algorithms that can adjust related building systems if there is a design change. These "plug ins" can include programs for structural and mechanical

design. For instance, if a room is enlarged, the size of the structural members can be automatically recalculated and resized. The model adjusts itself. If the building is rotated on the site, the heat gain and loss may be recalculated. Other plug-ins may focus on energy analysis, LEED certification, cost estimating or construction scheduling.

Reports: BIM ideologues will quickly tell you that BIM is not drafting software. It is a database. Drawings are simply one form of report. Like any digital database, a BIM model can produce reports—subsets of information for special purposes. These reports can be in the form of 2D or 3D drawings or an infinite variety of custom alphanumeric reports. The IPD team can tailor reports for specific purposes instead of grappling with a large set of 30" x 40" construction drawings and a fat set of specifications that obscures required information.

For instance, architects can produce a report in 3D and in color, rendered for comprehension by non-technical people. They can deliver drawings for review by entitlement agencies (building permits, accessibility requirements, environmental concerns, aesthetic compatibility or whatever) that address the agency's specific requirements. Assembly details can be produced on site for current construction challenges. Facility managers may access life-cycle, maintenance and replacement information.

4D and 5D models: BIM can have sequence and construction duration information attached to drawing elements that represent the building systems (4D modeling). A computer program can animate construction progression. A user can input a date to observe current state of completion. The builder can analyze on-site material staging problems, develop phasing plans, improve the sequencing of trade contractors or analyze the cost of construction delays. Cost can also be attached to drawing elements that represent building systems (5D modeling) for estimating and value engineering. The estimate can progress in lockstep with design.

Clash Detection: At the simplest level, pasting shop drawings into a CAD drawing quickly indicates a misalignment or a poor fit. Even in a 2D model, it is obvious if a window doesn't fit between a pair of columns. However, problems are not always that obvious in 2D models. Conflicts are often caused when a building system designed by one consultant interferes with a system designed by another consultant on separate drawings. For instance, if a lighting consultant locates recessed light fixtures on an architectural reflected ceiling plan without checking beam locations on structural drawings, the recessed

can may poke into a beam. And we have all experienced a mechanical engineer plotting duct runs that pass through the structural engineers' beams. BIM software provides sophisticated "clash detection" routines that indicate when two systems or products occupy the same space.

Direct fabrication control: Traditionally, fabricators develop shop drawings based on their interpretation of the plans and specifications. They are checked by the AE. Errors occur at each translation. By pasting shop drawings directly into the BIM model, errors and conflicts are more apt to be detected. Ultimately, a BIM model may include algorithms for CNC[12] direct fabrication of building systems, such as ductwork, curtain wall, millwork. While there are still opportunities for error in these automated processes, they are reduced and often eliminated. Precision is increased and supply chain workflow is shortened.

Facilities Management: An integrated BIM model is a good bit more valuable to facility managers than typical "as built" drawings. It may contain warranty data, spare parts lists and sources, useful life expectations and maintenance recommendations. It may contain original layouts as well as remodeling and renovation documentation.

BIM as a contract tool: Although IPD may minimize the contractual silos between the members, it is unlikely that an IPD team will include 50 to 75 subcontractors. Contractual separation will remain for most of the design and construction team. Multiple customized reports from a BIM model will assume important roles as contractual tools. The tools will work both ways—clarifying agreements with both the owner and with subcontractors.

The initial agreement with the owner will likely be a written document, perhaps with some simple diagrams to describe the intended result. As the project progresses, printed reports from the BIM can then augment that original agreement, defining the work for staged approvals just as traditional CD, DD or CD documents have done. However, rendered 3D reports from the model will do a better job of ensuring a meeting of the minds with the owner or users who may lack experience with technical Construction Documents.

The BIM will then become the framework for describing the work to subcontractors. As the design develops, subs will be asked to propose or bid on aspects of the work. When selected, aspects of their

[12] Computer Numerical Control refers to computer instructions that drive machine tools used to fabricate components. The technology is labor efficient, accurate, repeatable and facilitates complex forms.

technical proposal may become part of the BIM—to be augmented or replaced with shop drawings as their work is developed.

MANAGING A BIM MODEL

Managing the assembly of a BIM model is analogous to managing the assembly of a building. Consider this analogy. A construction manager must understand the technology of construction. But the more crucial job is orchestrating the work of hundreds of organizations—coordinating the assembly of materials on-site with decision-making, sequencing, and supply chain management. Most of a project is built off-site. If the on-site management team doesn't manage the off-site activities there will be delays. Managing the interrelationships is as important as understanding the technology of the work. In the simplest sense, it doesn't do any good for a construction superintendent to know about forming and finishing concrete if the concrete truck isn't scheduled for delivery at the right time.

A BIM model has similar requirements. Managing the development of a virtual construction model requires skills that are similar to managing the real thing. Too often BIM production is staffed with people who understand BIM technology but don't understand how to manage the workflow from multiple sources.

The management job requires setting BIM standards, understanding constructibility and construction sequence, evaluating supply chain data and vetting information that is submitted to be input into the model. But most of all, it requires understanding how to suck this information from multiple sources into an integrated model. The manager must have clout in the organization to get the attention of the extended IPD team to schedule information flow, analysis and problem solving. And since inputs to a BIM model may ricochet through the model, the manager must review and evaluate the accuracy of inputs—just as a CFO ensures that there are procedures to evaluate the inputs of financial information before they are posted to a general ledger.

A BIM model manager requires the support of the IPD management committee who must set policies to adopt the technology, buy and install the software for members who do not have it, train the team, champion the use. Finally, they will need to establish workflows for a BIM process that may be developed by the BIM model manager.

An IPD team needs a BIM manager and an interdisciplinary BIM team staffed with people from member firms. The BIM team integrates drawings from the AEs, subs and manufacturers. They

develop 4D and 5D models. They detect coordination problems with clash detection routines. Constructibility reviews trigger design adjustments—made with the collaboration of the AEs. RFIs are anticipated and if collaboration ongoing, should be minimal. In developing the model, questions surface before construction.

The BIM model manager must be a person with good interpersonal skills to build the collaborative culture required to produce an integrated BIM model. The manager must build trust and networks of personal communication within the contracting team. As with real construction, the more personal contact and the more trust, the more collaboration. BIM allows trust to be built early, well before construction begins. There's an opportunity to allocate model space to each subcontractor to give them confidence that the process will not only find clashes in their systems before they get to the field, but that the sub will have the ability to model the clearances and working space needed to install their work.

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Architects have typically been the primary source of BIM models, fulfilling their traditional role in developing the drawings and specifications that document the *product*—the description of the design, the intended physical result.

CMs have usually taken the lead in providing project management information (PMIS) systems—gathering and integrating data from the extended project team. These systems have concentrated on *process*—tracking contractual matters such as cost, schedule and quality control; RFIs and change orders.

But now CMs are developing in-house BIM teams and are developing BIM models prior to construction.[13] BIM is not the exclusive territory of the AE—nor should it be.

Ultimately, the IPD Core Team will likely build integrated groups to produce integrated documents.

Eventually, it is likely that an IPD Core Team will build integrated groups to produce integrated documents. Clearly, managing virtual construction will require technical knowledge of both *process* and *product*. Virtual construction will require AEs with product expertise and CMs with process expertise. It will require effective collaboration. IPD will provide the platform.

[13] AGC has published *A Contractor's Guide to Building Information Modeling, Edition One*, that guides contractors in the use of BIM.

Dynamic, Living and Incomplete Model

An idyllic vision of BIM is that of a fully integrated and complete BIM model—a virtual representation of the building, available for study before construction begins. It would include construction details, specifications, cost, schedule, warranties, products, systems, construction sequences, off-site fabrication schedules and shop drawings. It would contain 4D schedule data and 5D cost data and be enabled with CAD-CAM instructions for driving machine tools in off-site shops. Wow!

Then, to continue the idyllic vision, the extended IPD Team (AEs, CMs, subs, manufacturers and fabricators) could pour over the model and find construction problems in electronic space before entering the costly physical space of the real world. They would get the change orders and RFIs out of the way before construction begins and they would validate the workflow and supply chains.

It's not entirely a foolish pipe dream. Many owners have continuous building programs. They may have prototype designs or at least projects with many similarities. They may have BIM models of building models that can be assembled in various ways for variations in their project needs. They may have in-house staff or continuous relationships with AEs, CMs, subcontractors and suppliers. They can develop continuous improvement for feedback after each project into a prototype BIM model to further refine its value. It's conceivable that these owners could approach that vision.

However, consider the realities of a more typical project. AEs avoid including final details in the Contract Documents so they can maintain competition among multiple manufacturers. Subcontractors, manufacturers and fabricators don't detail their systems until they are under contract. Final construction details aren't available until after products and systems are purchased. And if a project uses fast-track scheduling, complete coordination can't be done in electronic space before construction begins because the design is incomplete.

Furthermore, many subcontractors and suppliers are not BIM literate and those who are may use incompatible software. So the BIM model will be incomplete, augmenting the electronic database with legacy CAD or paper products.

Always limited: For the foreseeable future, a BIM model will be less than ideal. It must be a living, dynamic thing, accepting additions and changes throughout the project's life—continuing to grow after occupancy.

All the vision of a complete model for virtual construction is possible, and all the capabilities mentioned above are within our technological reach, only some are implemented on any project. A BIM model manager must then decide, given the sophistication of the project team, how far to go.

BARRIERS TO BIM

The ultimate objective is to build an integrated BIM—a virtual building before we make expensive mistakes with concrete, glass and steel. But tradition, contractual separation, archaic laws, technical limitations, interoperability problems and culture hinder us.

Software and hardware constraints: A BIM model theoretically has unlimited ability to hold information. But any practical project model will fall short of what is theoretically possible. Despite faster and faster computers and more efficient software, the model slows down as it enlarges.

Cost practicalities: At some point, it becomes impractical to add detail to the model. We still assume the builder will use some judgment in the field. A drawing doesn't need to show all the nail locations in a wood frame.

Universal adaption: The fruition of BIM will depend on widespread use by designers, contractors and manufacturers. But until trade contractors and manufacturers are operational with BIM, we will limp along with incomplete integration.

Interoperability: Any CM or PM that has managed a program that included multiple architects and multiple CMs has faced the frustrating problems of interoperability in trying to integrate data from different project management information systems. It is hard to share data between Autodesk's Constructware, e-Builder and Meridian's Prolog. The same problem exists with BIM software.

A fully integrated BIM model is a vision, not a reality. At current levels of development, architects engineers, consultants, builders and fabricators may have independent BIM models, legacy CAD systems and legacy paper systems. Those who use BIM software may not use the same programs.[14]

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[14] The International Alliance for Interoperability (IAI) (www.iai-international.org) functions as a council of the National Institute of Building Sciences (www.iai-na.org) to improve interoperability. The National Institute of Building Science (NIBS) is defining BIM standards. The Facility Information Council (FIC), a NIBS Council, (http://www.facilityinformationcouncil.org/) "provides support for the development, standardization, and integration of computer technologies and

Document signing: The largest part of an architect or engineer's fee is compensation for producing Construction Documents. Then 40-60% of the Construction Drawings are discarded and replaced with shop drawings—about 1-3% of the project cost is wasted.

Integrating shop drawings in a BIM model eliminates this time-consuming and costly redundancy. It also solves problems. If fabricated products don't fit in the 3D space properly, the problem is likely to surface and get fixed.

However, most state laws stipulate that architects and engineers must only sign drawings done under their supervision. So AEs are properly reluctant to sign documents that include drawings prepared by others.

The typical solution for this annoying problem is for an IPD Team to simply produce a sub-set of the BIM model that has been produced under the AEs supervision for the designers to sign. Then the IPD Team calls the integrated BIM model a constructibility set, shop drawings for the building, a quality control document or whatever.

Although BIM software is useful in documenting the work of a single company, its greater value is that of integrating the work of multiple companies—sharing designs, specifications and information among the extended project team. But sharing blurs authorship and blurred authorship blurs responsibility for the design.

The process of assembling companies necessary to design and build a structure has assumed separate contracts, responsibilities, scopes, liabilities—and separate but clearly allocated and defined risk and responsibility. Statutes, case law and insurance products reflect these contractual silos.

The traditional assumption is that the AEs are responsible for the drawings and specifications. If shop drawings are integrated in BIM the AEs are concerned that they will assume responsibility for their accuracy and the performance of the product. So in project delivery processes with separate contracts, the AE is circumspect about integrating shop drawings. Practitioners and their attorneys partition responsibility by partitioning drawings—balking the development of integrated drawings and crippling the benefit of BIM.

One approach has been to add shop drawing to the BIM model clearly identified in the model as the sub's work. The sub would

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software to ensure the improved performance of the entire life cycle of facilities from design, engineering and construction through operation, maintenance and retirement phases."

retain responsibility. However, if the AE and the sub collaborate (a desirable activity) the responsibility becomes unclear.

Until the licensing laws and the insurance industry catch up with technology and practice, it will be necessary for the AE team to print a report from the BIM model that depicts design work that they can comfortably claim has been produced under their supervision. Then they can sign the drawings and obtain required permits. Then the IPD Team can move ahead and integrate drawings as extensively as possible. The BIM can be characterized as a "Quality Control" or a "Virtual Construction" document.

WHO PAYS FOR BIM AND WHO BENEFITS?

A BIM model improves the design, improves coordination, reveals construction problems and helps the IPD team optimize both product and process. Savings in time, money and grief more than pay for its cost.

However, in traditional processes the cost of a BIM model is borne by the AE, but the savings benefit multiple sources—the AEs, the CMs, subs, suppliers, manufacturers and, of course, the owner. The cost of building an integrated model surpasses the usual cost of producing typical Construction Documents and so, in projects where AEs are paid a traditional fee, the AE objects to the idea of assuming the total responsibility of managing and developing an integrated model. However, in an IPD project, the management committee can agree to fund and staff the required effort and the extended IPD Core Team can contribute resources. Since the benefit is to the project, it can be paid for by the project—not by a single project participant.

LEGAL CONUNDRUMS

Intellectual property: Traditionally, AEs have attempted to retain ownership of the construction documents, although owners, particularly serial builders, have challenged that with increasing frequency.

In a traditional process with separate contracts, the ownership becomes murky. But with IPD, it is likely that the members of the IPD Core Team will argue that since the BIM model is a collaborative work, it belongs to the members. It can be argued that each of the collaborators has an interest represented by their contribution. They can share it among themselves in parts or in whole—however they agree.

But since the BIM will morph into a useful tool for the facility managers, owners will also want ownership—and in those legal relationships where the owner is a member of the IPD Core Team, they will likely have ownership.

However, it is likely that the IPD Core Team will want a contractual restriction on the owner's ability to use the model for future construction—or permission with indemnity of the IPD Core Team.

Digital information in a BIM Model can be easily copied and reused. Subs, their manufacturers and suppliers may provide proprietary designs to the BIM and may require agreements that prevent fabrication or reuse of the design by others. Confidential processes may be used that must be protected. Access and use of the model must be defined—either in the contracts that form the legal relationship of the IPD Core Team or as BIM management procedures.

THE AGC BIM ADDENDUM

The AGC has issued a BIM Addendum to their ConsensusDOCS 301. It is a thorough document, clearly written by construction professionals and lawyers who understand BIM and have thoughtful approaches. It's educational and informative. The concepts should be understood by any construction professional involved in a BIM initiative.

The Addendum is designed for traditional processes such as design-bid-build or negotiated GMPs and avoids rupturing traditional legal relationships among the owner, architects, engineers, GCs, subcontractors, suppliers and manufacturers. It is designed to be attached to any project contract including subconsultant and subcontractor contracts.

It defines a model as a "Contribution" from one of the project participants.

- There are multiple models for analysis, preliminary design studies or renderings.
- A *Full Design Model* includes architectural, structural, MEP and other design phase models and is analogous to traditional Construction Documents.
- A *Construction Model* includes shop-drawings and related information. It might include information imported from a Design Model or from traditional Construction Documents.
- A *Federated Model* is an assembly of models. The models must maintain their authorship and remain separate. The models can't

be interactive: one model must not be affected by a change in another model. They can be linked so they can be used for approvals, coordination, quality control, clash detection, estimating or, ultimately, facility management. However, no one can change another's model so clear responsibility may be maintained.

To maintain authorship identify and responsibility the Addendum assigns tasks and responsibilities to *The Information Manager* who must control access to the model and record each input, deletion or change with the author's contact information, date, time, etc., and maintain an audit trail of such modifications.

The BIM Addendum also:

- States that if there is a software malfunction, the owner bears most of the risk and that a party to the BIM Addendum may be entitled to a time extension or other requirements.
- Requires that each party agree to waive claims against the other parties to the agreement for consequential damages.
- Requires model users to minimize claims and liability caused the models, by quickly reporting errors or omissions that it discovers.
- Provides rights to the owner to use the model depending on the agreement between the owner and the design professionals.

Each party to the BIM Addendum warrants to the other parties that it has rights to the copyright of its Contributions and agrees to indemnify and hold other parties harmless for claims of third parties claiming a copyright infringement. And each grants the other parties a limited, non-exclusive license to use that party's Contributions.

The melancholy aspect of the AGC Addendum is that, despite the wisdom of the authors, it is predicated on using powerful integration software for a non-integrated process. Keeping design and construction models separate is inefficient and neglects useful collaboration, construction feedback to designers, quality control and value engineering initiatives. The need to maintain model separation precludes interactive relationships and thereby gives up much of the potential power of BIM. The contractual separation of the key team members creates much legal boilerplate and procedural documentation. It is not a Lean process. But that's not the fault of the AGC or the authors of the Addendum. Its our industries burden of tradition.

The BIM Addendum falls short of envisioning an integrated, seamless design and construction process that allows us to build virtually before we pour concrete. But it wasn't intended to do so. And we all recognize that vision is at the top of a long hill to climb. It will be wonderful when we can watch the technical understanding and intellectual energy that went into the AGC BIM Addendum applied to that vision—unfettered by our industry's creaky traditional processes.

WHAT'S THE DESIGN? WHO'S THE DESIGNER?

The very concept of Integrated Practice distributes the creation of a design across a number of organizations.

- Most owners are serial builders. They create standards and prototypes that they give to AEs and CMs to implement.
- CMs participate in the development of design concepts and affect the design with their recommendations for materials and systems. Constructibility and value engineering studies often have substantial affect on the design.
- Manufacturers and specialty subcontractors produce shop drawings that are intended to implement the design intent.
- Manufacturers and software vendors provide 3D or BIM "content" that describes their products over the Internet for insertion into construction documents.
- Design Assist strategies involve trade contractors in the design process.

The design: A singular advantage of digital files is that they are easy to modify and update. So BIM models tend to be living documents—growing through the evolution of the project as the design develops, as clash detection uncovers problems, as field conditions develop, as changes are made and final configurations are adjusted during construction.

And yet designers need to know what they have designed and are responsible for, owners need to know what they approve, contractors need to know what they agree to build, approval agencies need to know what they have approved and inspectors need to know what to accept. The moving train of a BIM model is a problem when there is a static document required for an agreement with a contractor, and approval from an owner or permission from an entitlement agency. Consequently a BIM model must produce reports that define and freeze these categories of documentation.

In 1857, Otis installed an elevator in a building, something that the manufacturer knew more about than the architect.

The designer: Ironically, in 1857, the year the AIA was founded, Elisha Otis installed a "safety elevator" in a New York building. A manufacturer put something in a building that the manufacturer knew more about than the architect. Since then, industrialization and a competitive environment have driven manufacturers to develop more and more sophisticated building products. The result is that architects and engineers include more and more in their design that they did not design and do not fully understand. They rely on the representation of someone else that a product, a material or a system will perform properly.

In 1857, it was an exception to have industrialized products (like the elevator) in a building. When the professions of architecture and engineering emerged, AEs designed building systems: heating, enclosure, partitioning, roofing and millwork systems. Today, most of a building is manufactured off-site from designs produced by manufacturers. Increasingly, AEs design buildings that include technology that the AEs do not understand as thoroughly as the manufacturer. The AE's job has changed. It is to evaluate and integrate systems and products designed by others.

Recently, the AIA distributed an on-line survey to measure the desire for BIM content provided by manufacturers. They asked for interest in partitions, doors, windows, floor coverings, ceiling systems, kitchen equipment, elevators, furniture, electronics, casework, furniture systems and equipment of all kinds for single family residential, healthcare, commercial/retail, multi-unit residential and hospitality, Lab/Hi-tech/Research, K-12 and "other" kinds of projects. This plentiful and commonly used BIM content, available from the manufacturers, contains algorithms and other properties, developed by the manufacturer's designers that may adjust the object as it is installed to a design.

Software companies are working on BIM software that will adjust related building systems to design changes. For instance, if window areas are increased (increasing heat loss and gain) the ducts will automatically be resized. If floor plans change the software will check code compliance. If a room is enlarged, the beams will get bigger.

"Smart systems" and "smart objects" may not be created by licensed architects and engineers. However, AEs will use increasingly sophisticated software tools and embedded objects downloaded from manufacturers. The design may be distributed to different computer systems and used by different participants.

Conceivably, there can a dispute over the cause of a malfunction in an elevator system. (For instance, did the rails move because the structure deflected or were they improperly aligned during installation?)

However, as industrialization and information technology continue to make more sophisticated systems available to architects and engineers, and present them to the industry over the Internet as smart self-adjusting objects, the problem of tracking responsibility for design components will become more difficult.

Most software contains licensing agreements that protect the software author from liability in its use. While AEs and CMs may place responsibility on manufacturers for the performance of their physical products, they will be unlikely to deflect responsibility for errors produced with the software they use—any more than a taxpayer could blame TurboTax for underpaying income tax.

The responsibility for the elevator problem is far easier to track than a system problem that was designed with smart content downloaded from a manufacturer, adjusted by a CAD operator, modified by owner standards, value engineered by a CM and interpreted in shop drawings by a subcontractor.

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Architects and engineers have traditionally been responsible for the design. At a high level of conceptualization, that will remain true with Integrated Practice. But more often, owners who are serial builders will influence not only design requirements, but design solutions. As the intellectual capital of CMs, trade contractors, manufacturers, suppliers and consultants is added, is it possible for the AE to assume full responsibility for the design?

Or do we need an integrated team to participate in that responsibility?

A Personal Note

In the 1980s, our company added CM-at-Risk to our CM and Design Service. While we usually provided CM and design services separately, we occasionally combined them (often with the addition of other companies to the team). We found great advantages in doing so. We called the package "Integrated Services." In the 1990s we met with Ellerbe Becket to compare and benchmark our firms. We found they were doing the same thing with the same name and were equally pleased with the result.

Clients were less enthusiastic. Perhaps it was an idea whose time had not quite come. But now, with the larger chorus of voices, Integrated Services appears to be gaining acceptance.

For a half century, I've debated project delivery concepts and vigorously marketed new approaches to prospective clients. My presentations were characterized by reciting the flaws in current processes and explaining new approaches that would correct them. In the process, I've had hands-on roles in design-bid-build, design-build, Bridging and the various forms of CM. I've been on the ground with projects in 20 foreign countries, and companies I've led have taken roles of designer, CM, PM or contractor.

Out of boredom with tradition, love of innovation and enthusiasm for experimentation, I typically embraced new ideas with more conviction than they deserved. Carl Sapers, my longtime friend and legal guru to the construction industry, once stated that I never saw a future I didn't like. He was right. And I like this future best of all.

However, as a septuagenarian, I have become more circumspect about breakthrough ideas that will fix our complicated industry. There is no doubt that good people have made all the other processes work—and no doubt that inept people will cause IPD projects to fail.

However, the IPD process provides owners with the ability to choose good people (if they know how to do it). Moreover, no capable designer or builder is going to join an IPD team if it has incompetent members, so there is an element of self-correction in the system. Most of all, the process broadens the avenues for multiple talents to collaborate.

Typically, contracts have focused on defining processes and products. They have described services and the desired result. IPD contracts also describe culture. That's a refreshing addition.

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