January 2010

Integrated Project Delivery

Integrated Project Delivery: Case Studies

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A Joint Project of AIA California Council
Integrated Project Delivery Steering Committee
AIA National Integrated Practice Discussion
Group".

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For more detailed background information on IPD, visit www.ipd-ca.net and refer to *The Integrated Project Delivery Guide*, jointly developed by the AIA's Integrated Practice Discussion Group and AIA California Council, and *Integrated Project Delivery: A Working Definition*, published by AIA California Council.

For information on existing project delivery methods, see the AIACC's *Handbook on Project Delivery.*

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Integrated Project Delivery (IPD) is a project delivery method distinguished by a contractual agreement between a minimum of the owner, design professional, and builder where risk and reward are shared and stakeholder success is dependent on project success. *- Draft definition of IPD from version 2 of the AIA / AIACC Integrated Project Delivery Guide, anticipated in 2010*

Introduction

These case studies examine real-world, completed building projects that used Integrated Project Delivery (IPD) in as pure a form as possible. The projects studied show the successful application of IPD in a variety of building types and scales and in diverse regions of the country. This is the first installment of an ongoing process of evaluation and it will be supplemented as additional IPD projects now underway are completed.

In each case we collected relevant data to measure the completed project against the stated goals of the project team. Through interviews with project participants we also attempt to tell the story about how each project was conceived and carried out.

For the purpose of this study, IPD is defined by the following characteristics:

- **Early Involvement of Key Participants**
- **Shared Risk and Reward**
- **Multi-Party Contract**
- **Collaborative Decision Making and Control**
- **Liability Waivers Among Key Participants**
- **Jointly Developed and Validated Project Goals**

"Key Participants" includes the owner, architect, and builder who entered into the primary contract, as well as design consultants and subcontractors who sign "joining agreements" and are included in the shared risk and reward structure. Disciplines and trade contractors whose input has the most impact on project design and costing are considered the most valuable early participants.

The following additional characteristics are considered highly desirable for IPD:

- **Mutual Respect and Trust Among Participants**
- **Collaborative Innovation**
- **Intensified Early Planning**
- **Open Communication within the Project Team**
- **Building Information Modeling (BIM) Used by Multiple Parties**
- **Lean Principles of Design, Construction, and Operations**
- **Co-Location of Teams ("Big Room")**
- **Transparent Financials (Open Books)**

METHODOLOGY

The case study projects were selected based on their compliance with the criteria stated above. In addition, projects had to be completed and located in the USA. The researcher visited all of the case study projects and interviewed at length all of the major participants, including one or more representatives of the owner, the architect and the builder, and in most cases the major engineering consultants, specialty subcontractors, building users, and other stakeholders as well.

Project data was self-reported by project participants.

CHANGING ROLES AND RELATIONSHIPS

IPD should be understood as a comprehensive process which addresses the entire sequence of programming, design, construction and building operations. Within the industry, there is a fair amount of confusion about the difference between lean construction and IPD and between IPD and BIM. Lean construction is a production control system that seeks to apply principles of the "Toyota Way" of manufacturing to the construction process. Just as BIM is a tool that is useful, but not in itself sufficient for implementing IPD, lean construction is a set of tools in support of IPD but is not the entire process.

These studies show that IPD is most successful when owners, architects, engineers, and builders step outside the boundaries of traditional roles into a more fluid, interactive, and collaborative process. What impact does this have on the principal participants?

Owners were all asked if the IPD process demands more from them than traditional methods of project delivery. All agreed this was not for passive owners and that it requires a level of sophistication and a willingness to "get your hands dirty," but none could point to any additional resources required beyond what would be needed for a similar project under a traditional procurement process.

For architects, IPD is a change in the boundaries of the work and the sequence in which it is done. "If the owner's going to get the early cost insight," says architect Tom Van Landingham of Christner Inc., "then more design time has to be spent up front to generate the information for the builder to provide that insight. We've changed the way we do work plans so that time is pulled from the construction documents and

IPD and Lean Construction

"IPD is a clever solution to the tough organizational and contracting problems faced in today's market. It relies on careful participant selection, transparency and continuing dialog. It is hard to imagine a better internal contractual relationship for applying lean construction. Construction consumers might consider rethinking their contracting strategies to share more fully in the benefits."

-Owen Matthews and Gregory A. Howell, Lean Construction Journal, *April 2005*

contract administration phases – and the bidding/ negotiation phase completely goes away– then we add those hours to early design." Value engineering is continuous – it doesn't come as an unwelcome surprise at the end of design.

For builders, early involvement in design and transparency of the collaborative process overcomes much of the uncertainty in correctly pricing projects. As Tocci Construction's Jack Short said, "As builders we're used to doing very well on seven projects and getting killed on three. We'd much rather make our clients happy and earn a reasonable profit on all ten."

One of the recurring themes of these projects is the blurring of lines (or the breaking down of silos) between design and construction and among the traditional phases of design. Instead of issuing packages of documents – schematics, design development, construction documents – designers involved in IPD are issuing documents on a "just in time" basis, and in a collaborative relationship with builders and suppliers. Decisions are made when they need to be made, and in many cases redundant work is eliminated. Documents generated from a single BIM model may be used for permitting, analysis, bidding, fabrication, and more. Appropriate information for the task is exported from the model as required and when needed. Architects are able to informally convey design intent without having to draw or model details that will be drawn or modeled again by fabricators. Builders and suppliers are able to share their knowledge and expertise when it is most valuable in the design process. And owners are able to participate in a more involved and "hands-on" fashion than is usually the case with traditional project delivery. Many participants in these studies found such a blurring of roles to be empowering and even exhilarating.

Case Study Scorecard

Showing the extent to which each case study project embodied the six characteristics identified as fundamental to IPD.

	CASE STUDY PROJECTS					
IPD Characteristics	**Autodesk AEC Solutions Division Headquarters**	**Sutter Fairfield MOB**	**Cardinal Glennon Children's**	**St. Clare Health Center**	**Encircle Health**	**Walter Cronkite School**
Early Involvement of Participants	Yes	Yes	Yes	Yes	Yes	Yes
Shared Risk and Reward	Yes	No[1]	Yes	No	Yes	No
Multi-Party Contract	Yes	Yes	Yes	Yes	Yes	No
Collaborative Decision Making	Yes	Yes	Yes	Yes	Yes	Yes
Liability Waivers	Yes	No	No	No	No	No
Jointly Developed Goals	Yes	Yes	No[2]	Yes[3]	Yes	Yes

[1]There was a provision in the contract enabling participants to create a shared "pain and gain" scheme but it was not used.

[2]Project was underway when IPD was adopted. Budget and program were established by project team in earlier master plan.

[3]The original budget was established by an independent program manager. Subsequently the owner, architect, and builder developed and validated a new budget as part of IPD process.

CASE STUDY: AUTODESK INC. AEC SOLUTIONS DIVISION HEADQUARTERS

Waltham, Massachusetts

Project Description

Autodesk Inc., a company that creates design software for the AEC industry, wanted to highlight ways in which its own technology could support building information modeling, design-to-fabrication, sustainability, building performance analysis, and integrated project delivery. The company decided to put those goals forward with two of its own projects. The Waltham project is a 55,000 square foot, three-story interior tenant improvement that uses all of the space in a new speculative office building near Route 128 in Boston's technology corridor.

Program elements include offices, conference rooms, training facilities, a café, and a 5,000 square foot customer briefing center featuring an electronic gallery of design work done with the company's products. Requirements of the project included very high sustainability goals (LEED Platinum for Commercial Interiors.) Design and construction was accomplished within an aggressive eight and one-half month schedule.

Owner:	Autodesk Inc.	www.autodesk.com
Architect:	KlingStubbins	www.klingstubbins.com
Builder:	Tocci Building Companies	www.tocci.com

Photograph by Jonathan Cohen

Early Involvement of Key Participants

Autodesk conducted a selection process to find an architect/builder team willing to try Integrated Project Delivery. The RFP clearly stated the owner's direction in terms of scope, budget, sustainability goals and the mandated form of agreement. At first, another team was the front runner but their corporate leadership asked for fundamental changes in the proposed IPD arrangement which Autodesk declined to make. In the end, KlingStubbins and Tocci were chosen because of their qualifications, familiarity with the local market, BIM and LEED sophistication, and willingness to abide by a "true" IPD agreement. But another factor was their proposal to allocate fees and incentives within the fixed project budget. Three major subcontractors were also selected early and included in the risk/reward structure.

Shared Risk/Reward

The contract establishes an Incentive Compensation Layer (ICL) in which the architects' and builders' anticipated profit is put at risk. If specific goals are met, designers and builders receive their normal profit, but jointly, not separately. If they are exceeded in measurable ways the firms are eligible for additional compensation. The ICL could adjust from minus 20% to plus 20% depending on whether project goals were met or exceeded.

Multi-Party Contract

The Integrated Project Delivery Agreement (IPDA) is a three-way contract between the owner, the architect and the builder. Each party's success is directly tied to the performance of the others. Distinct roles and responsibilities are delineated in contract language and in a "responsibility matrix." Major subcontractors (mechanical/fire protection, electrical, and drywall) were also brought in to the agreement, worked at cost, and shared in the incentive program.

Autodesk's first experiment with IPD was a 16,500 square foot customer briefing center and 29,300 square foot office tenant improvement in downtown San Francisco. The San Francisco project was undertaken shortly before the Waltham project began. In this case there were separate architects for the briefing center (Anderson Anderson) and the office space (HOK) with one builder, DPR Construction. Both DPR and HOK were interested in "getting their feet wet" with IPD.

As with Waltham there was a hurry-up schedule: 3 ½ months for design, 6 months for construction. Unlike Waltham, however, no subcontractors were brought into the IPD agreement.

One of the "lessons learned" from San Francisco that was applied to Waltham was that for a project of this scope and a schedule this tight, it is preferable to find one architect to handle the entire project. Autodesk corporate real estate senior manager Gail Boettcher said, "With IPD it's a very dynamic process where you're designing and pricing in parallel - that creates challenges when you've got a short term project to do." Marc H. Flax, HOK's principal-in-charge agreed, and said "one of the lessons learned is that with IPD it's crucial to select your architect and builder as a team. There's a synergy that's just got to be there."

Boettcher said she would be more precise in defining "contingency" so that if money is left over there is no dispute about what can be added to the project and what can go into the incentive pool.

Collaborative Decision Making/Control

By contract, three levels of collaborative teams were established to manage the project. A Project Implementation Team (PIT) was set up to handle the day-to-day issues of the project. The composition of the PIT included project participants whose work at any given time could impact the project's outcome. A Project Management Team (PMT) with representation of the owner, architect, and builder, was established to manage the project and make decisions by consensus. If issues arose that could not be resolved by the PMT they were taken to a higher level for final resolution: a Senior Management Team, (SMT) again with representation of the three principal parties.

Liability Waivers Among Key Participants

The parties waived all claims against each other except those arising from fraud, willful misconduct or gross negligence. Disputes were to be resolved by mediation or, if necessary, arbitration. Each party was required to maintain typical insurance but with the provision that policies be amended so that no right of subrogation (the ability to gain the rights belonging to one party against a third party who caused a loss) existed against the other partners.

Jointly Developed/Validated Targets

The contract spelled out specific criteria that would be used to judge success. These included schedule and budget, sustainability, quality of craftsmanship, functionality, and design quality. Owner, architect, and builder jointly selected three comparable projects in the Boston area to serve as benchmarks against which these goals would be measured. It was agreed – after some hesitation from the team - that an independent evaluator (in this case an architecture professor) would be the arbiter of how successfully the project met the design quality criteria. There was a scorecard and the process was made as objective as possible.

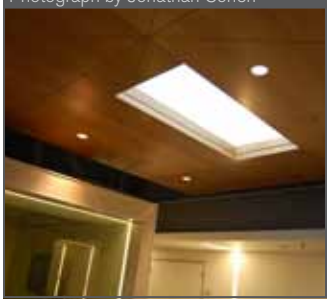
During the project, John Tocci, head of Tocci Construction, was worried about whether the design quality criteria would be met, and, in an interesting twist on what is usually expected from a builder, went out of his way to make sure that sufficient budget was allocated for quality materials and detailing. In the end, the team received high marks from the evaluator for exceeding design expectations and received the incentive money.

For San Francisco as at Waltham, existing projects were selected to serve as benchmarks for design quality. Flax said, "We wrestled for several days with that – finding projects with the quality the client wanted but at their budget."

Going forward, Flax thinks IPD works best when the project team is involved in setting the program and budget. HOK's standard procedure now calls for room data sheets to describe the functional requirements and finish quality for every space. He noted, "Lesson learned: do your program and make it very detailed, up front, before you start the project."

Photograph ©2009 Jeff Goldberg/ESTO

Photograph by Jonathan Cohen



Photograph ©2009 Jeff Goldberg/ESTO

Narrative

The project was the first IPD experience for the design and construction team. Autodesk had just completed its first IPD project: a 45,000 square foot corporate office and customer briefing center in San Francisco, also an interior fit-out (see sidebar.)

Autodesk management wanted the design and build team to self-select; they did not want to "mix and match" architects with builders. Within KlingStubbins there was initial hesitation by partners at the head office about using an untested IPD agreement, but the desire to try something new and exciting overcame the doubts.

Meeting the schedule was particularly important to the owner because they had to vacate their existing facilities by a date certain. The entire process of contract negotiation, design, construction and move-in had to be accomplished in 8 1/2 months, a schedule which would not have been possible with design-bid-build or CM-at-Risk, the delivery method typically used by Autodesk.

The design and build team was held to an overall budget, but was completely free to move money among line items. Money could be taken from carpeting and added to design fees, for example. Jack Short, Tocci's Director of Project Planning, estimates that 55% of the project value was added by lean, cost-plus subcontractors within the incentive compensation layer agreement and 45% was traditionally procured. One major advantage of IPD for the builder is the ability to enable early procurement of time- and cost-variable materials and services. The ability of the team to move money between line items also meant that savings could be achieved by pooling resources. For example, one lift could be used by multiple trades. Cleanup could be done by lower wage workers at night rather than by highly paid tradesmen during the work day. Savings from one line item could be placed back into the project in another area.

Tocci's local knowledge of the Waltham area made it possible to call on relationships with building officials to insure that permitting and inspections would not impede the schedule. Plan reviews that typically took 4-5 weeks after submission were done in three.

Photograph ©2009 Jeff Goldberg/ESTO

For the Autodesk Waltham project, the Incentive Compensation Layer (ICL) was structured as follows:

- *If the project cost is under budget, 60 percent of the saving is added to the ICL.*
- *If the project is over budget, the excess comes out of the ICL until it is exhausted.*
- *If the project runs over schedule, an amount per day is deducted from the ICL.*
- *There was no bonus for beating the schedule since this was of no value to the owner.*
- *The third-party quality assessment process balanced cost and time considerations with design goals.*

A Building Advisory Team was assembled early on to provide programming input from building users. There was a bit of struggle between Autodesk's software engineers, who wanted maximum privacy, and the goal of LEED Platinum which can only be achieved by allowing natural light to deeply penetrate the space. Ultimately the owner decided that sustainability, as well as a cultural desire for collaboration, trumped privacy. To address acoustical privacy concerns, sound masking and other noise mitigation measures were employed.

Photograph by Jonathan Cohen

A BIM execution plan set ground rules for who modeled what and when. Architect and builder both used Revit, but the large file size – over 100 MB – made remote access possible but slow. After design development, the model was moved from KlingStubbins' to Tocci's servers. During design, Laura Handler, Tocci's Virtual Construction Manager, spent two days a week at KlingStubbins Cambridge office. When the design reached the implementation phase, Sarah Vekasy, KlingStubbins' project architect, moved to the construction site. At-risk subcontractors were all BIM-enabled. They provided detailed unit costs up front and Tocci assumed responsibility for taking quantities off the model.

Photograph ©2009 Jeff Goldberg/ESTO

Scope changes totaling about 30% of the original budget were added by the owner during the course of the project. One was the build-out of 5,000 square feet of shell space to accommodate personnel from a small company Autodesk had just acquired. Another was to beef up the shell building's mechanical systems to accommodate cooling the "regression farm"; a room full of powerful computers doing automated software testing.

Another scope change was purely design driven. Phil Bernstein, Autodesk's Vice President for Industry Strategy and Relations, and himself an architect, decided that the design lacked a distinctive feature that would show the company's commitment to good design. He wanted to create a dramatic gesture by cutting a three-story atrium though the space. The decision had to be made quickly so as not to upend the schedule. KlingStubbins began modeling three alternatives and concurrently Tocci studied the impact on cost and schedule. Within a week the team presented the options, using BIM to allow the owner to

virtually "walk through" and get a feeling for the space. Thus, the integrated team was able to quickly and comprehensively address an owner request and provide enough information to make an informed decision. It was decided that Autodesk's business objectives were better served with the atrium and the team was instructed to proceed.

Design-to-fabrication was used for the customer briefing center's distinctive wood panel ceiling. The curved elements are described by a mathematical algorithm. They were shop fabricated using computer numerical controlled (CNC) machines driven by the design software. They arrived on site and fit together perfectly, thanks to tight BIM coordination of above-ceiling lighting and fire protection systems.

Lessons Learned

Fundamental to the IPD process, according to Bernstein, is that "the first step should be a scoping exercise taken to the level of conceptual design, in which everyone works at cost until a deep understanding of the project and a level of comfort around the program and budget is achieved by all parties. That's one of the lessons learned to apply to the next project. The other would be to eliminate the contingency. The IPD design and build team, because of the financial incentives, will want to treat every change as a scope change and not an item to be subtracted from the contingency. By doing that you create some sense of discomfort, and that discomfort is the team's obligation to design to the target cost." He felt that the financial incentives were causing unwelcome changes in behavior. That doesn't mean he would drop the incentives – he believes they are essential to support the right kind of performance. "I can see IPD projects in the future where incentives are paid as an annuity based on long term operational performance and user satisfaction."

Although all the major players used BIM, "interoperability of systems was a challenge," said Chris Leary, KlingStubbins' principal in charge, "because the mechanical, plumbing, and millwork subcontractors used specialized design-to-fabrication software rather than Revit."

Part of the promise of IPD is to deliver to the owner, at the end of the project, a comprehensive building model for use in operations. Charles Rechtsteiner served as Autodesk's owner's representative during design and construction. As a self-described "operations guy" he would like all of the building systems information to be more readily available for facilities management. He would like the ability to track actual performance versus specified, do real time energy monitoring and maintenance scheduling as well as other facilities management tasks enabled by BIM. A next step in BIM evolution might enable greater interoperability among design models, fabrication models, and facilities management systems.

KlingStubbins learned that close collaboration with builders made redundant detailing unnecessary. The process also freed architects to spend more time on site and much less time reviewing RFIs and submittals. In many cases shop drawings were eliminated altogether.

Project Data

Project name and location	Autodesk AEC Headquarters
Building type	Interior office fit-out
Owner	Autodesk Inc.
Year begun	May 2008
Year completed	January 2009
Form of agreement	Multi-party contract
Architect	KlingStubbins
Structural	Simpson, Gumpertz & Heger (not engaged in IPD agreement)
MEP	KlingStubbins
Landscape Arch	N/A
Lighting	LightTHIS! (not engaged in IPD agreement)
Builder	Tocci Building Companies
MP/FP	J.C. Cannistraro (IPD subcontractor)
Electrical	Interstate Electrical Services (IPD subcontractor)
Drywall	Tenant Systems (IPD subcontractor)
	(Other subcontractors were not part of IPD agreement)
Initial schedule	
Design	Start: 4/23/08
Construction	Occupancy: 12/16/08
Achieved schedule	
Design	Start: 5/1/08
Construction	Occupancy: 1/23/09
Programmed GSF	50,000 SF
Final GSF	55,000 SF (program breakdown and related $/SF changed)
Budget cost	
Design[1]	N/A
Construction[1]	N/A
Contract cost	
Design[2]	$1,231,000
Construction[3]	$12,223,000
Final cost	
Design[4]	$1,221,000
Construction[4]	$12,117,000
Scope changes	
Owner-initiated[5]	3
Other	0
RFIs	Procurement clarifications: 76 Construction detail clarifications: 49 Total: 125
Sustainability Goal	LEED-CI 2.0 Platinum Certified
Sustainability Achieved	LEED-CI 2.0 Platinum Certified

[1]Under IDP, programming and scoping were integrated into the overall project process as design proceeded. Therefore, there was no traditional "budget" for the project; a target cost was developed and converted into contract cost.

[2]Design budgets were originally set by traditional profit targets; this number includes all A/E fees at direct cost, plus incentive payments as targeted.

[3]As this was primarily an FF&E project with significant MEP and telecom infrastructure (and an atrium) under the IPD model this number included all costs not associated with design, including hard cost, furniture, fixtures, and equipment, construction management, and incentive payments made to the build team.

[4]Final design and construction costs at completion were below the contract target. A/E and Builder profits exceeded original projections, and final construction quality exceeded the base requirements, a "triple win" for the project.

[5]The "pure" IPD model had no provision for change orders, but there were owner-initiated scope additions.

CASE STUDY: SUTTER HEALTH FAIRFIELD MEDICAL OFFICE BUILDING

Fairfield, California

Project Description

The project is a three-story, 70,000 square foot medical office building housing primary care medical practices and laboratories, with pediatrics, oncology, rheumatology, and cardiology departments and administrative offices. The owner, Sutter Health, is one of the largest not-for-profit health care providers in Northern California. This project is the first built component of a $6.5 billion capital program of which, at the time of this study, several subsequent projects are in advanced stages of design. As such it gave Sutter the opportunity to test out a new process of collaboratively designing and building facilities in a relatively small project.

Owner:	Sutter Regional Medical Foundation	www.sutterhealth.org
Architect:	HGA Architects and Engineers	www.hga.com
Builder:	The Boldt Company	www.theboldtcompany.com

Photograph by Vance Fox

Early Involvement of Key Participants

The initial project team consisted of Sutter Health (the overall corporate entity), Sutter Regional Medical Foundation (the local Sutter affiliate,) HGA and Boldt. Sutter had issued a RFQ to select an architect in the Spring of 2005. HGA interviewed and won the job, in part because of a successful prior relationship with Sutter. Subsequently, Sutter asked HGA to meet with Boldt to see if the firms' cultures aligned. The firms had previously worked together on traditional design-bid-build projects in the Midwest. The principals met and decided it was good fit and to proceed. The three-way contract called for the core team of owner, architect, and builder to collaboratively select the main design-build subcontractors very early in the design process. Smaller subtrades were competitively bid with lump sum prices.

Shared Risk/Reward

The Integrated Form of Agreement (IFOA - a "relational" contract) creates a system of shared risk with the goal of reducing overall project risk rather than shifting it between parties. Contingency funds are jointly managed by the project participants rather than at the owner's discretion alone. The early version of IFOA used for this project allowed for a financial incentive plan but the participants elected not to implement it. "It was all so new," said Bonnie Walker of HGA, "We were still in the mindset of business as usual." Subsequent Sutter IPD projects have used incentives funded by project savings and pooled profits to reward designers and builders for meeting and exceeding agreed project goals. In these projects most subconsultants and subcontractors participate in the pool as well.

Multi-Party Contract

The IFOA is a three-way contract between the owner, the architect and the builder. Each party is held accountable to each other as equal partners. Architect and builder combine their contingencies and are jointly responsible for construction errors and design omissions. All books in regard to the project are open. This contract was the first of its kind to be used by any of the parties and may have been the first such agreement to be used on a construction project in the USA.

Relational Contracts

The Fairfield MOB was the first Sutter Heath project to use a three-way, integrated form of agreement as the basic design and construction contract. Attorney Will Lichtig, whose Sacramento firm has represented Sutter for 50 years, drafted the IFOA used for the Fairfield project and through several refinements since then. One of the most significant contract provisions has to do with trust:

> *"The Parties recognize that each of their opportunities to succeed on the Project is directly tied to the performance of other Project participants. The Parties shall therefore work together in the spirit of cooperation, collaboration, and mutual respect for the benefit of the Project, and within the limits of their professional expertise and abilities."*

Collaborative Decision Making/Control

An Integrated Project Team (IPT) composed of project manager level representatives of Sutter, HGA, Boldt, and the major subcontractors, Rosendin Electric and Southland Industries, met weekly throughout design and construction. The committee was augmented when appropriate by representatives of other trade contractors and stakeholders. A higher level Core Team, consisting of a senior representative each of Sutter, Boldt, and HGA met monthly to resolve issues passed up from the IPT. Any decisions that could not be unanimously agreed at this level could be referred to an Executive Level committee with higher level representation from the three partners.

Liability Waivers Among Key Participants

There was not a "no-sue" clause. The parties agreed to use alternative dispute resolution: first within the Core Team, then by agreeing to rely on an expert third party for resolution, and if necessary to mediation. The owner, architect and builder agreed to indemnify each other and to provide typical insurance, including architects' professional liability insurance, at limits established in the IFOA. The architect's liability for consequential damages was limited to the amount of its fee and the builder's liability for consequential damages was limited to an amount equal to its fee plus general conditions.

Jointly Developed/Validated Targets

Sutter's internal budget of $19 million was based on a very generic MOB project with little architectural amenity. Boldt's first estimate was $22,250,000. After an intense validation effort, a guaranteed maximum price (GMP) of $19,573,000 was agreed by the three parties. The final construction cost was $19,437,600 which included $836,500 of value-added, owner initiated scope additions.

Benchmarking of comparable medical office buildings was established. A finish date of December 2007 was set. In subsequent Sutter projects, specific metrics called Conditions of Satisfaction are negotiated for, among other things, improving operations, improving space efficiency, reducing time to build and reducing consumption of natural resources.

Narrative

Sutter Health, after having had its share of disputatious projects, was looking for a better way to build facilities. It hosted the Sutter Lean Summit in 2004, with help from the Lean Construction Institute. This three day event set forth a vision for transforming the way Sutter capital projects would be designed and built.

Room data sheets and narratives were used to definitively establish detailed requirements. Each room's equipment needs, finishes, utilities and special requirements were documented. This approach was used to document and preserve decisions made by stakeholders during programming and ensure that the final product met stated needs.

Sutter needed the building delivered in 25 months and that was accomplished despite a three month delay for reprogramming at the start of the project and with the addition of extra scope.

The extensive use of BIM was a new experience for architect, builder and owner, although the MEP subcontractors had limited prior experience. Live group modeling sessions around a projector were held every other week. Steel structure was modeled along with duct runs, cable trays, plumbing lines and sprinkler system. These sessions enabled the IPT team to identify over 400 systems clashes that, because they were discovered early, "provided significant cost savings due to increased field productivity, tighter schedule, more prefabricated work, and less redesign," according to Boldt's Jay Harris.

Later, BIM was used with GPS measurement to drop ductwork hangers into the metal decking before concrete was placed. Layout that normally would have taken 2-3 weeks was accomplished with greater accuracy in 2-3 days. The more accurate hanger placement allowed for much larger sections of shop prefabricated ductwork and less field labor.

The ability of the design team to work directly and interactively with subcontractors was appreciated by both sides and relieved the general contractor of always having to be the hub of information exchange. For casework, much less detailing effort was needed from the architect – with no loss of design and quality control.

Boldt's project web site became the repository of project information and the place where submittals were made and processed electronically. Over 50% of the submittals were processed by the architects without paper documentation.

Consideration of change orders was limited to the following categories:

1. Owner generated–requested by owner, owner's suppliers or consultants.

2. Unknown conditions–items which could not be anticipated during design or which builder could not have anticipated during pre-construction.

3. Design refinement–added value to the owner. Owner would have paid for work if included in bid documents.

4. Construction revision–no added value to the owner. Something had to be added, removed or reworked once it was installed as a result of design error or omission.

5. Governing agency generated–the result of unforeseen agency code interpretations, newly enacted codes or policies being enforced which could not have been anticipated during design or bidding.

6. Builder generated–the result of corrective work requiring documentation to record the change, owner accepted nonconforming work or builder-requested changes.

By the end of the project there were no change orders that had not been initiated by the owner.

"Last planner," "reliable promises," "pull scheduling," end-of-day "huddles," and other lean construction techniques were employed with success. Just-in-time materials management was not used in this project, in part because there were large areas available for staging.

Photograph by Vance Fox

Lessons Learned

Sutter was very pleased with the building and the process. The project was under budget and within schedule. Change orders were virtually eliminated.

Lessons learned from this pilot project have been applied to larger and more complex projects Sutter is currently undertaking, including California Pacific Medical Center's $1.7 billion, 555-bed Cathedral Hill Campus in San Francisco and the $320 million Sutter Medical Center in Castro Valley, California.

Subcontractors found that more intense effort is required up front than in negotiated or design-assist projects, but the payback comes later with rework almost completely eliminated. The early commitment inherent in IPD allows them to devote these resources to the preconstruction phase.

In future projects Boldt intends to provide field superintendents with BIM capability in the trailer.

In this project, a few of the subcontractors did not want their foremen attending the group scheduling meetings. Boldt now makes this a mandatory requirement.

The owner must be kept engaged from earliest design and throughout construction. In this case, during construction the owner's project manager was distracted with another, more troublesome project and the team felt that this may have slowed decision making.

Preconstruction design assist is vital for those trades that have the biggest impact on other systems. Mechanical, electrical and plumbing/fire protection certainly fall into that category, but Boldt learned that exterior glazing and skin should also be one of the early selected subtrades that fully engages in early design.

Boldt felt that financial incentives would have been a benefit to this project, with the incentives flowing down to the subcontractor level. All of the considerable project savings in this case went only to the owner. Boldt Group President Dave Kievet thinks the key is the alignment of commercial interests. “By aligning the owner’s commercial goals with those of the project team it is possible to create a win-win situation where any incentive payment becomes an acknowledgement of a job well done and not the driver of it.” He believes the way to do that is to put profit in a separate bucket from fee. ”One of the lessons learned is that the best way to ensure commercial alignment is to completely separate the cost of the work from the profit. That way, as the team continues to drive down the cost, the partners’ actual return as a percent of revenue goes up.” He would apply that thinking to every input from design services to structural steel.

By contrast, Bonnie Walker of HGA is unsure whether the existence of an incentive pool necessarily leads to project-centered behavior. For example, if the architect’s fee is a not-to-exceed amount based on a planned number of hours, any savings from hours not used are rolled into the incentive pool with the architect getting a smaller percentage back. “I like having control of our fees,” she says, “I believe that a lump-sum fee is a leaner approach. It doesn’t take an incentive pool to get us to behave collaboratively.”

Participants, when asked if IPD was applicable to all projects, felt that it is ideal for larger-scaled, complex projects and perhaps does not have proportionate value in smaller, simpler projects. This is perhaps more a reflection of the up-front time it takes to establish IPD standards and procedures rather than an issue of scale.

Participants reported a feeling of being respected as equal partners in a collaborative process in which everyone’s opinion was valued. In addition to the efficiencies gained from such a process, there was a sense of goodwill, trust and professional satisfaction.

Project Data

Project name and location	Sutter Regional Medical Foundation Medical Office Building #2, Fairfield, California
Building type	Medical Office Building
Project description	3 Story - 69,948 SF with clinical, administrative, and shelled space.
Owner	Sutter Regional Medical Foundation, Sutter Health
Year begun	July, 2005
Year completed	November, 2007
Form of agreement	Multi-party contract
Architect	HGA
Structural	HGA
MEP	Southland Industries Rosendin Electric
Landscape Arch	MTW Group
Other designer	HGA
Builder	Boldt
MEP	Southland Industries Rosendin Electric
Curtain wall	Progress Glass
Major subs	A & B Painting Air Systems American Tile & Brick Anning – Johnson Davison Iron Works Diablo Landscape Enterprise Roofing Forderer Ireland Interior Systems R E Maher B T Mancini Mission Bell Otis Elevator Systems Tech Top Grade Construction
Initial schedule	
Design	SD (2 months) 10/05 – 1/06 DD (3 months) 1/06 – 3/06 CD Phase I (3 months) 4/06 – 7/06 CD Phase II (6 months) 4/06 – 10/06
Construction	Phase 1 (4 months) 8/06 – 12/06 Phase II (11 months) 12-06 – 11/07 (15 months total)
Achieved schedule	
Design	SD (2 months) 10/05 – 1/06 DD (3 months) 1/06 – 3/06 CD Phase I (3 months) 4/06 – 7/06 CD Phase II (6 months) 4/06 – 10/06
Construction	(15 months total) 8/06 – 11/07 (3 month delay for program revision)
Programmed GSF	67,106 SF
Final GSF	69,948 SF
Budget cost	
Design[1]	Design information not supplied
Construction[2]	$19,017,180
Contract cost	
Design[1]	Design information not supplied
Construction[2]	$19,573,035
Final cost	
Design[1]	Design information not supplied
Construction[2]	$19,462,103

Change orders	
Owner-initiated	$836,528 (stair/canopy/connector/add sidelights, Mecho Shades, upgrade building management system, misc adds and upgrades)
Other	
RFIs	123
Sustainability Goal	N/A
Sustainability Achieved	N/A

[1]Total design fees including all subconsultants and owner-selected consultants.

[2]Construction hard costs excluding furniture, fixtures, and equipment (FF&E) but including general conditions, CM fees including preconstruction services.

Photograph by Vance Fox

CASE STUDY: CARDINAL GLENNON CHILDREN'S HOSPITAL EXPANSION

St. Louis, Missouri

Project Description

The project is a 138,000 square foot, $45.5 million children's hospital expansion consisting of a surgical suite, a 60 bed neonatal intensive care unit (NICU,) a central sterile unit, 10 new surgical suites, 10-bay post-anesthesia recovery rooms, a video integration system, and shell space for future relocation of radiology and laboratory functions. The operating rooms are designed to be reconfigured without demolition to accommodate future needs and may be reassigned among surgical specialties as service volumes increase or decrease.

Owner:	SSM Healthcare	www.ssmhc.com
Architect:	Christner Inc.	www.christnerinc.com
MEP Engineer:	McGrath Inc.	www.mcgrath-inc.com
Builder:	Alberici Constructors, Inc.	www.alberici.com

Photograph by Sam Fentress

Early Involvement of Key Participants

This was the first IPD experience for owner, architect, MEP engineer and builder. The decision to use IPD was made after architect, engineer, and builder were on board and design work had begun. Christner , McGrath and Alberici had prior working relationships with SSM and with each other. Christner had designed the Phase I bed tower for the hospital. Structural engineering was provided by Christner's consultant.

Shared Risk/Reward

SSM, Christner, McGrath, and Alberici were on board and the project was well into design development when the decision was made to switch to IPD. Christner was engaged under a typical owner-architect contract and Alberici was anticipating a typical CM-at risk arrangement.

SSM had conducted a "lean seminar" with guests from the Lean Construction Institute and partners from the St. Louis design and construction community. The Cardinal Glennon team was there and they challenged each other to try these ideas on their project. Tim Gunn, Project Director for Alberici, said "we raised our hand and said: this is a small project, let's try it." Donald Wojkowski , SSM's Executive Director Design and Construction, quickly agreed.

An Integrated Form of Agreement, (IFOA) based on the Sutter Health model, was negotiated by the team with assistance from SSM's attorney, Tim Thornton of Greensfelder. It is planned to be a model document for all future SSM work. Because the project was already under way with a traditional structure, it was too late to use some of the early steps encouraged by IPD. Nevertheless, and in contrast to the later St. Clare project, financial incentives for achieving project targets were used with the money funded from unspent contingencies. Tom Van Landingham, Christner's principal in charge, said "financial incentives are absolutely the key to the success we had. "

About $400,000 was saved out of the approximately $1 million contingency. The incentive pool was distributed as follows:

40% to owner
20% to design team
40% to builder and lean partners (MEP/FP and drywall)

With respect to incentive pools, attorney Will Lichtig observes, "There will always be carrots and sticks in the way we deliver projects. We can't always be smart enough to know that what we offer as a carrot or a stick will not have unintended consequences. We want to make sure that whatever economic system we put in place will not prevent a person from always doing what is best for the project and not any individual participant."

Photographs by Jonathan Cohen

Multi-Party Contract

The IFOA is a four-way contract among the owner, architect, MEP engineer and builder. Each party is held accountable to each other as equal partners. Architect and builder combine their contingencies and are jointly responsible for construction errors and design omissions. All books with regard to the project were open. “Lean partners” (i.e. subcontractors inside the risk pool) included MEP, wall and ceiling framing and finish, and fire protection subcontractors. Smaller pieces of the work were bid out with fixed prices.

Collaborative Decision Making/Control

The IFOA established an IPD Field team and a Core Team to manage the project. The Field Team brought together a rolling cast of mid-level project participants at frequent intervals to resolve routine issues. The Core Team, made up of the owner, architect, engineer, and builder, plus the ”lean partners” who had a stake in the incentive pool, met weekly to resolve issues and make most decisions. Above the Core Team level, however, decisions were made by the owner’s management team at their discretion, albeit infrequently and with great restraint.

Christner’s Tom Van Landingham felt that the Core Team was highly motivated to find the optimum solution for the project. “We supported each other and looked out for each other. ‘I win-you lose’ was not an acceptable outcome for this project.”

One interesting example tested the collaborative management concept and showed its validity. During concrete placement, the builder proposed that concrete maturity testing (CMT) be used to measure strength as opposed to the traditional method of successively testing cylinder samples. With CMT, sensors are embedded in the concrete and data is read from the outside. The advantage is that forms can be stripped earlier and time saved. Although this technique has long been used for pavement testing, it was a relatively new concept in structural concrete. Owner, architect, structural engineer, and builder discussed it, weighed the benefits and risks and ultimately decided against it. As Tim Gunn of Alberici said, “With this process, it’s important to reach consensus. You just can’t push people beyond their comfort level.”

Photograph by Jonathan Cohen

Liability Waivers Among Key Participants

There was not a “no-sue” clause in the IFOA. Each party carried typical general and professional liability insurance.

Jointly Developed/Validated Targets

The budget and scope had been established by the same project team as part of an earlier campus master plan. Since IPD was implemented after the project was well into design, this criterion does not strictly apply.

Narrative

Donald E. Wojtkowski, SSM Healthcare’s Executive Director Design and Construction, first learned of IPD and lean construction by attending the Sutter Lean Summit in 2004. After a long career developing healthcare projects he was particularly attracted to the notion of relational contracting. He felt that healthcare projects in particular were not well served by the traditional design-bid-build process due to their complexity, lengthy schedules and the need for flexibility. He felt that the traditional process was too much about risk-shifting to the detriment of project value. To that end, in late 2004 he invited lean construction advocate Greg Howell of UC Berkeley to come to St. Louis for a two-day seminar involving SSM and its partners, including architects, engineers, general and specialty contractors.

SSM Healthcare as an organization was already committed to Continuous Quality Improvement and it was a natural transition to apply “lean operations” principles to its capital programs. In 1989, CEO Sister Mary Jean Ryan began to adopt methods derived from the Baldrige Healthcare Criteria for Performance Excellence to apply whole systems thinking to hospital operations.

The NICU project needed to transition from a 44-bed open ward to 60 private patient rooms without increasing the existing staff. Christner led a highly interactive process with NICU staff to better understand the implications of this new nursing configuration. The design team built a full-scale room mock-up and simulated staff working conditions to be certain that everything in the unit would function as planned.

Photograph by Sam Fentress

BIM was not used extensively in design. In 2004, Christner and McGrath were still working in 2D AutoCad. There was a desire to use BIM to model building systems but there were incompatible software platforms all around the table. Much of the coordination was done by experienced field personnel and engineers poring over light tables. In spite of the low-tech approach, the incentive system gave the contractors nothing to lose and everything to gain by finding and fixing clashes as early as possible.

Lessons Learned

Christner is looking for the opportunity to use IPD again, but according to Tom Van Landingham "You need scale and sophisticated management. You need a self-selected team. You're challenging the owner to get deeper into their own project. In the field of healthcare there is a nice synergy between lean operations and IPD." Christner has since transitioned to BIM and expects it to support future IPD projects.

The owner felt that "relational" contracts based on the Sutter model try too hard to dictate behavior. SSM felt that similar results could be achieved through the use of standard contracts but with addendums spelling out expectations with regard to collaboration and lean methodologies.

Challenges that arose during construction could be dealt with more effectively with open and transparent, cooperative management. After the first elevated floor deck was in place, the field crew discovered a serious conflict between rebar in the flat slab and plumbing sleeves that needed to penetrate the slab to serve the NICU rooms. In the course of a "huddle" aimed at finding a solution it was realized that the conflict could be avoided by shifting the entire plan 3 ½" with respect to the column grid. "How likely are architects and engineers going to volunteer to make that kind of design change in the middle of construction?" asks Tom Van Landingham. But because the designers were incentivized to be part of the larger team they were able to make the necessary design and coordination changes in just three days. In the end, the project was occupied six weeks earlier than planned.

Photograph by Sam Fentress

Project Data

Project name and location	SSM Cardinal Glennon Children's Medical Center Surgery and NICU Expansion St. Louis, MO
Building type	Hospital expansion
Project description	The expansion included a central sterile unit, 60 neo-natal intensive care unit (NICU) rooms, 10 surgical suites, 10-bay PACU, PACs and a video integration system. 10 new operating rooms, an all-private room Neonatal Intensive Care Unit, new Central Sterile and shell space for future relocation of Radiology and Laboratory.
Owner	SSM Health Care
Year begun	October 2004
Year completed	August 2007
Form of agreement	Multi-party contract
Architect	Christner, Inc
Structural	Christner, Inc
MEP	McGrath, Inc.
Landscape Arch	N/A
Other designer	N/A
Builder	Alberici
MEP	Corrigan Co (M&P) Kaiser Electric.
Major subs	TJ Wies (Walls and Ceilings) Engineered Fire Projection (Fire Sprinklers)
Initial schedule	
Design	Design information not supplied
Construction	August 2005 to October 1 2007
Achieved schedule	
Design	Design information not supplied
Construction	August 2005 to August 2007 (NICU moved Sept 11, 2007)
Programmed GSF	
Final GSF	138,000 SF
Budget cost	
Design[1]	Design information not supplied
Construction[2]	$47,000,000
Contract cost	
Design[1]	Design information not supplied
Construction[2]	$45,572,449
Final cost	
Design[1]	Design information not supplied
Construction[2]	$45,572,449
Change orders	
Owner-initiated	0
Other	0
RFIs	63
Sustainability Goal	N/A
Sustainability Achieved	N/A

[1]Total design fees including all subconsultants and owner-selected consultants.

[2]Construction hard costs excluding furniture, fixtures, and equipment (FF&E) but including general conditions, CM fees including preconstruction services.

CASE STUDY: ST. CLARE HEALTH CENTER

Fenton, Missouri

Project Description

The project is a 430,000 square foot replacement hospital serving the growing I-44 corridor in suburban St. Louis. It is comprised of a six-story, 154-bed inpatient tower, an 85,000 square foot medical office building, and a 75,000 square foot ambulatory care center. The campus also includes an emergency room and other diagnostic and surgical components. SSM Healthcare sought to redefine the patient experience and worked with HGA to organize the program around a two-story "main street," with nodes that evoke "marketplace," "hotel," "factory," "healing garden," and "condominium."

Owner:	SSM Healthcare	www.ssmhc.com
Architect:	HGA Architects and Engineers	www.hga.com
Builder:	Alberici Constructors	www.alberici.com

Photograph by Jonathan Cohen

Courtesy of HGA Architects and Engineers

Early Involvement of Key Participants

The core team of SSM, Alberici, and HGA was in place at the start of the project. At the same time, a program manager was also engaged. The program manager, who was not familiar with IPD, advised SSM to establish a guaranteed maximum price (GMP) as soon as possible, and push the risk of cost overruns on to the builder and architect. He advocated using standard, separate design and construction contracts but with addendums mandating a lean construction process. HGA objected. Based on the experience in California, IPD had to be implemented in full for the process to work. "You could not cherry-pick some items and leave out others," said Kurt Spiering, HGA's principal in charge, "we're either going to use the whole agreement or none of the agreement." Alberici seconded the motion, and SSM subsequently agreed to move forward with an integrated form of agreement and without a program manager.

Courtesy of HGA Architects and Engineers

The mechanical, electrical, and fire protection subcontractors were contracted to Alberici and signed joining agreements prior to the start of design.

Photograph by Jonathan Cohen

Shared Risk/Reward

At the beginning, SSM felt that this project, with its significant scope, had to have an enforceable GMP. As noted above, the budget for the project had been set by a program manager prior to the engagement of HGA and Alberici. When the architect and builder began their work it quickly became clear that the budget did not match SSM's aspirations for the project. The owner was willing to defer the setting of GMP until the design was substantially complete and subcontractors were comfortable enough with their prices that they could eliminate most contingencies. But when all the subtrades' GMPs were totaled, the sum exceeded the overall budget. In the end no GMP was set, the architects and builders worked collaboratively to hold down costs but were not required to hold to a fixed price and were paid cost plus a fee. Because the builders' risk was thereby almost eliminated, financial incentives were not deemed by the owner to be necessary. Books were open and audited.

Multi-Party Contract

The three-way IPD contract, based on the Integrated Form of Agreement (IFOA) used by Sutter Health, was fashioned by SSM's local attorney for use as a model document for this and future SSM projects. By contract, each party is held accountable to the others as equal partners. Architect and builder combine their contingencies and are jointly responsible for construction errors and design omissions. "Lean partners," i.e. subcontractors within the shared risk/reward circle, included MEP, wall and ceiling framing and finish, and fire protection. Smaller pieces of the work were bid out in the traditional way.

Collaborative Decision Making/Control

A tiered decision making structure was established by the IFOA. The IPD Field Team, which included all participants active at a given time, met daily to review routine matters. The Core Team, with senior representation of the owner, architect, engineers, and builder, met weekly to collaboratively discuss issues and make the more difficult decisions. A senior Leadership Team convened monthly to resolve issues when consensus could not be reached in the Core Team. The Leadership Team included representatives of the interested parties - including SSM, Alberici and HGA.

Liability Waivers Among Key Participants

There was not a "no-sue" clause. There was a limitation on consequential damages.

Jointly Developed/Validated Targets

In this case the initial budget was established by a program manager without the involvement of architect and builder. Because this initial budget was not jointly validated, the owner had to supplement it with additional funds to satisfy programmatic goals for the project.

Besides schedule and budget, project goals included improved operational productivity. Specific metrics were not set, but the team was tasked with improving efficiency through design to the greatest extent possible.

Courtesy of HGA Architects and Engineers

Narrative

A local MEP consulting engineering firm, KJWW, working under the direction of HGA, developed 2D single line diagrams showing duct sizes and locations as well as performance specs. At the same time HGA was developing architectural and structural designs in their Milwaukee office with early input from the builders. Then all of this material was taken to the "Big Room" where the architects and engineers could collaborate with the design-build MEP detailers to model the design in real time and in 3D using Architectural Desktop. The "Big Room" was a triple-wide trailer set up on the site. Tim Gunn, Alberici's Project Director said "it was the first time for everyone with this kind of a process. Some things went more smoothly than others. But all the time spent up front in the Big Room was more than paid back later with substantially fewer coordination errors and RFIs." Kevin Kerschbaum, HGA's project manager said "We could have drawn it all but we wouldn't have known if there needed to be a joint here or a piece of unistrut there. You have a much higher degree of certainty that things will fit when the actual fabricator is doing the modeling. Everything should be drawn and detailed by the right person at the right time and then put together into the overall model." Virtually all systems including power, low voltage, lighting, mechanical and fire protection were modeled in detail.

The Big Room was augmented with a project management web site used to share design progress with team members who could not physically be present.

The owner learned from an earlier project, Cardinal Glennon, that a release from GMP

Photograph by Jonathan Cohen

was preferred by the builders over financial incentives. Donald E. Wojtkowski, SSM Healthcare's Executive Director Design and Construction, said "The only way you're going to get the complex design and construction resources needed for a project like St. Clare, to get them to change their behavior, is to remove financial risk. Whenever you have a GMP or stipulated sum, if you need to deviate from the schedule for the good of the project, you're going to get a change order and be arguing about it for the rest of the project."

This was SSM's and Alberici's first IPD project from conception. HGA had prior IPD experience with Sutter Health in California. But according to Wojtkowski, that previous experience didn't immediately transfer to the HGA office in Milwaukee. Over time, however, the Milwaukee office became more comfortable with this new way of working.

SSM Healthcare as an organization was already committed to Continuous Quality Improvement and it was a natural transition to apply "lean operations" principles to its capital programs.

In late 2004, Wojtkowski invited lean construction pioneer Greg Howell to come to St. Louis for a two-day seminar involving SSM and the partners with whom it did business, including architects, engineers, builders, and specialty subcontractors. SSM was encouraged to test the process on Cardinal Glennon Children's, a project then already underway. After Cardinal Glennon was completed, SSM decided to implement IPD and lean construction from the beginning with St. Clare. Advisors were brought in to help implement the Last Planner system, a construction planning methodology developed by the Lean Construction Institute.

One of the issues in hospital design is that, although designers and builders want owners to make decisions and stick with them, hospital operators always want their buildings to have the very latest in equipment and reflect the most up to date thinking in hospital operations and patient care. "There's always the desire to defer those decisions in case the next generation of cath lab or MRI or articulated arm in the operating room is coming down the road," said Wojtkowski.

At St. Clare, the owner decided to switch from back-to-back patient rooms to same-handed rooms even as structural steel was being erected. This decision came from studies showing that same-handed rooms promote operational efficiency and reduce the likelihood of medication errors. It was decided to make the change even though it increased cost. Such a major change so late in the process would have been extremely difficult for a traditional, fragmented design and construction team to handle efficiently, but the integrated team was able to meet the owner's wishes because of its inherent flexibility. The change was made without a major impact on cost or schedule. Tim Gunn of Alberici said "We like the ability to let the owner wait until the last responsible minute to make a decision, and sometimes even beyond that."

BIM was used extensively, not only to detect clashes between systems but to increase

the proportion of prefabricated assemblies with their greater tolerances and lower requirement for field labor.

Lessons Learned

Had the budget and program been collaboratively set between owner, architect, and builder at the beginning, it would likely have not been necessary to go "back to the well" for additional funds to square the budget with program.

The owner thought the process works very well for large and complex projects but is perhaps not needed for smaller (under $5 million) projects, in part because SSM tends to assign those projects to smaller builders, new firms, or firms without broad experience in healthcare.

The owner felt that it was unnecessary to model every pipe and conduit, and that in the future, modeling should be limited to major systems. But he did acknowledge that he was left with "one heck of a good set of as-builts."

"Most of our problems came from design-build subcontractors not having the patience to deal with the iterative nature of design. They want all the answers way too early," says Wojkowski. In this project the consulting engineers were essentially in design-assist mode to the subcontractors instead of the other way around. The owner felt this was backward. In addition, according to Tim Gunn, "Our MEP/FP subcontractors struggled at times with conceptual estimating. They sometimes fell back to the old counting light fixtures, counting toilets mode."

Kevin Kerschbaum of HGA, who has now worked on several IPD projects, feels that architectural work hours can be taken from the construction administration phase and shifted to schematic design. "There is an intense amount of work required of the designers at the beginning of the process but the time needed during construction to review RFIs, submittals, and substitutions is greatly reduced." There is no longer a defined "bidding/negotiation phase" so that time gets pulled forward as well. Kerschbaum learned that during construction more time is freed to actually spend on the job site and much less "busy work" is required in the office.

The owner felt that "relational" contracts based on the Sutter model try too hard to dictate behavior. SSM's Donald Wojkiowski wondered if similar results could be achieved through the use of standard contracts but with addendums spelling out expectations with regard to collaboration and lean methodologies.

Project Data

Project name and location	SSM St. Clare Health Center St. Louis, MO
Building type	Hospital
Project description	154 bed hospital (plus 20 shelled beds) • Outpatient/Inpatient Surgery • Cancer Center (Medical Office Building) • 5-Story Inpatient Tower • Medical Office Building • Emergency Services • Ambulatory Surgery Center
Owner	SSM Health Care
Year begun	2005 Design Start, Construction start 2007
Year completed	2009
Form of agreement	Multi-party contract
Architect	HGA
Structural	HGA
MEP	KJWW
Landscape Arch	EDAW
Other designer	Mackey Mitchell Associates
Builder	Alberici Constructors
MEP	Murphy Co (M,P) Guarantee Electric (E, LV)
Curtain wall	Missouri Valley Glass
Major subs	Niehaus (drywall, acoustic ceilings, interior framing), SLASCO (Fire Sprinklers)
Initial schedule	
Design	April 2005 thru August 2007
Construction	August 2007 thru Sept 2008 (with first patient at end 2008)
Achieved schedule	
Design	April 2005 thru October 2008
Construction	August 2007 thru January 2009 (with first patient March 30, 2009) Project schedule adjusted by owner due to start up of electronic medical records systems and re-evaluation of plan to move during holidays.
Programmed GSF	430,000 SF
Final GSF	430,000 SF
Budget cost	
Design[1]	$8,847,857
Construction[2]	$141,000,000
Contract cost	
Design[1]	$8,847,857
Construction[2]	$148,300,000
Final cost	
Design[1]	$8,947,000
Construction[2]	$148,300,000
Change orders	
Owner-initiated	Yes
Other	0
RFIs	278
Sustainability Goal	N/A
Sustainability Achieved	N/A

[1]Total design fees including all subconsultants and owner-selected consultants.

[2]Construction hard costs excluding furniture, fixtures, and equipment (FF&E) but including general conditions, CM fees including preconstruction services.

CASE STUDY: ENCIRCLE HEALTH AMBULATORY CARE CENTER

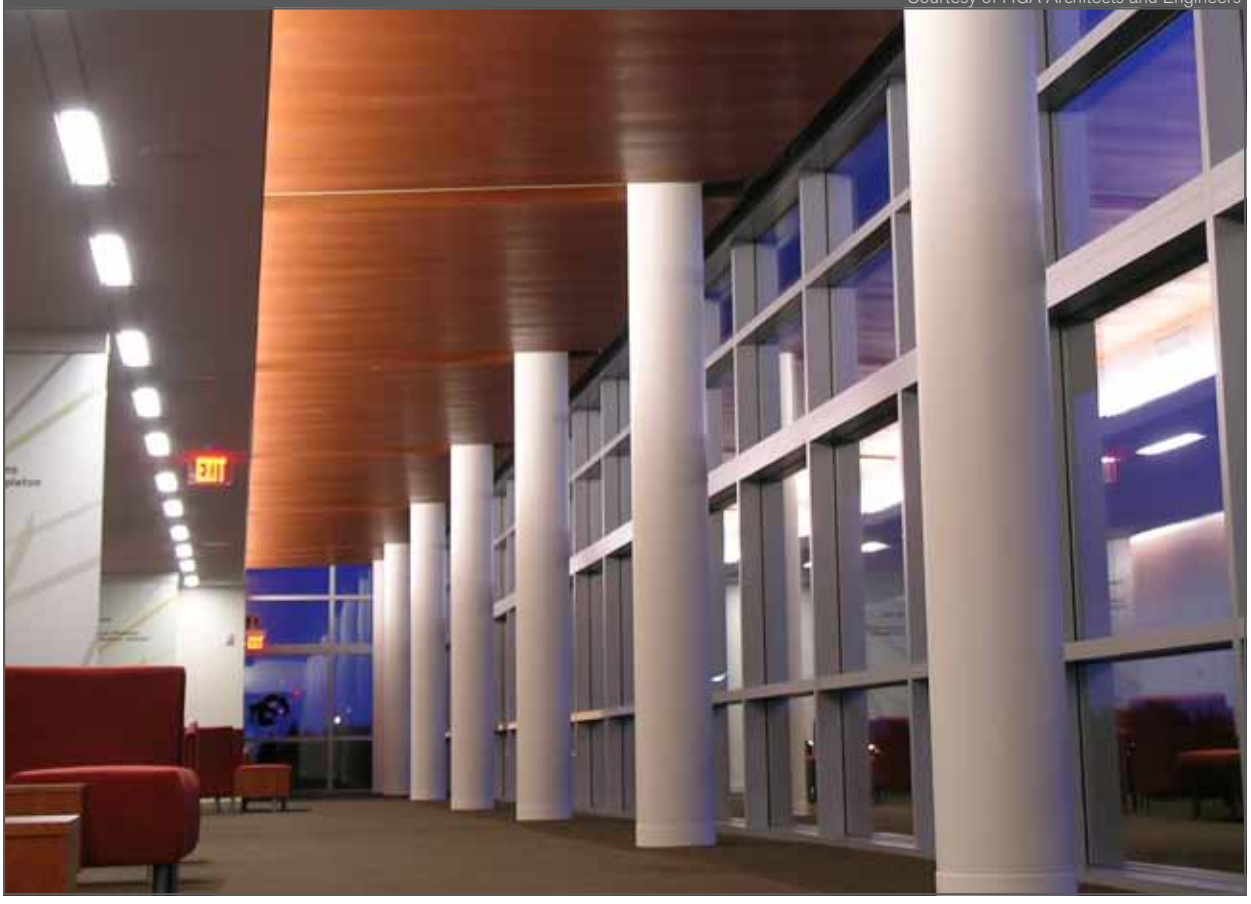
Appleton, Wisconsin

Project Description

Encircle Health is a three-story, 156,000 square foot ambulatory care center combining physician practices with ancillary diagnostic services, including imaging, radiology, endoscopy, pharmacy, and testing labs, each of which own an equity stake in the building. It is not a typical medical office building; the design is based on a "pod" concept, where related practices share flexible space and equipment and use a centralized reception office. The circulation system provides a "front stage" and "back stage" whereby patients in gowns are not exposed to public areas. The project was managed by its largest tenant, ThedaCare, a comprehensive regional healthcare organization with considerable construction experience, and a focus on lean operations. ThedaCare and its employed physicians occupy approximately two-thirds of the building.

Owner:	Encircle Health, an LLC composed of ThedaCare and independent physician groups	www.thedacare.org
Architect:	HGA Architects and Engineers	www.hga.com
Builder:	The Boldt Company	www.theboldtcompany.com

Courtesy of HGA Architects and Engineers



Early Involvement of Key Participants

ThedaCare, acting as owner and program manager, selected the core project team based on existing relationships with HGA and Boldt, and the IPD experience that both firms had acquired with Sutter Health. Mechanical, electrical, plumbing/fire protection, and glazing subcontractors were selected collaboratively by the core team from a short list of three candidate firms in each category. Selection was based on fee proposals and qualifications of committed personnel. All of the firms considered had previous working experience with Boldt. Each of the selected major subcontractors entered into a "lean partner" relationship with the core team through the use of joining agreements, and all were in place at the start of schematic design. Smaller subcontracts were procured in a traditional manner with hard bids.

Shared Risk/Reward

Architect and builder worked on a time-and-materials basis at a reduced billing rate, with a portion of anticipated profits placed at risk depending on project outcomes. The contract provides for a performance contingency, consisting of at-risk profits, plus typical contingencies, with a formula to split funds remaining in the pot at the end of the project. A scaling factor was used wherein the more that was saved, the higher the percentage of compensation to the non-owner participants. Additionally, there was an owner's contingency that was not shared.

Multi-Party Contract

An integrated form of agreement (IFOA) based on the Sutter Health model was signed by owner, architect, and builder. Prior to the start of schematic design, four of the major subtrades--mechanical, electrical, plumbing/fire protection and exterior glazing--signed joining agreements and participated in the financial incentives scheme. These subcontractors all provided design services and their engineers acted as the engineers-of-record for their respective disciplines. HGA provided full service architectural and structural design. These at-risk parties accounted for more than 60% of the work.

Collaborative Decision Making/Control

A Core Team met weekly to resolve routine issues. The composition of this team varied, sometimes including one or two of the owner/physicians, sometimes including administrators, but always with the owner, architect and

"Risk Pool"

Recent iterations of the Sutter model contract use "fee pooling," in which participants' costs are separated from their anticipated profit. Planned profits are placed in the "risk pool" for those inside the IPD agreement. That way, everyone's individual success hinges on the project's success. Profits are protected even when work (done at cost) is increased or decreased. Therefore no one is hurt if work is shifted from one party to another for overall project benefit. If a $1 increase in framing cost allows a $2 savings in HVAC, no one loses the incentive to put the project first.

Photograph by Jonathan Cohen

builder represented. Under the direction of the Core Team were specialized component teams including building enclosure, MEP, interior fit-out, and LEED compliance. The Core Team would resolve issues that arose between the component teams on a continuing basis. Above the Core Team was the Board of Directors of the LLC, but very few issues were passed to that level. The ability to perform to such a tight schedule required that decisions be made and not revisited.

Liability Waivers Among Key Participants

The contract did not contain a no-sue clause. It did contain a limitation on total liability and consequential damages for the architect and a mutual waiver of consequential damages between the owner and the builder. Each entity maintained typical insurance.

Jointly Developed/Validated Targets

Project goals, developed collaboratively by the core team, included budget, schedule, and a requirement to attain LEED Silver or higher, as mandated by ThedaCare's systemwide sustainability initiative. At the time of this study the LEED evaluation was not yet complete, but the team was confident of achieving LEED Gold.

The overall schedule as it was jointly prepared did not change during the project, although it was constantly and interactively adjusted in detail during weekly meetings.

Narrative

This was the first IPD project for ThedaCare; the architect HGA and builder Boldt Construction had prior IPD experience working together with Sutter Health in California. The three principal partners had worked together previously, as did most of the major subtrades, a factor that everyone believed contributed to the project's success.

The project was not self-funded by ThedaCare; a bank provided lending and it was necessary to persuade the lender and its attorneys that IPD was a viable form of project delivery. "It was unfamiliar territory for them," said Albert Park, ThedaCare's Director of Facilities Planning, "but when it was explained to them they agreed it made sense."

The project was completed from start to move-in in 18 months, including 13 months of construction. During five of those months, the coldest winter in recent memory compounded the difficulty of achieving such a compressed schedule.

A thorough programming process was conducted by HGA, consulting each of the tenant/owners on space and equipment requirements. Boldt and the subcontractors were in attendance at many of these meetings.

The design process was highly collaborative between designers and builders. The design-build specialty subcontractors provided design services and acted as the engineers-of-record for their respective disciplines. HGA and its consultants designed

systems as single line diagrams plus performance criteria which the subcontractors used as a basis for their designs. All systems were modeled in 3D.

Smaller subtrades were selected in the traditional manner with stipulated prices. Although the overall budget was fixed, the flexible process allowed money to be moved between line items, so that each of the major subcontractors' budgets was in constant flux and decisions could be made based on what was best for the project.

During design the architects were given a detailed spreadsheet of unit costs. They had the freedom to design knowing the real cost of tradeoffs between, for example, using one material over another in a particular space. Because cost information was provided early, architects could make design decisions based on reliable information and did not have to redesign later for value engineering.

In this fully integrated project, the boundaries between the phases of design sometimes became blurry. Just-in-time design meant some aspects of the project were still in sketch mode while others were already under construction. There was no traditional SD-DD-CD issuance of design packages. Delivery of design documents was continuous and directed at what the team felt most needed attention at a particular moment in the process. In addition, the severe weather during much of construction meant that the usual sequence of subtrades couldn't be followed and the designers were able to adjust.

At a defined point in the process it was agreed that design was finished. All parties and all stakeholders had been consulted and signed off. After that point any significant design adjustment was considered a scope change with an impact on the target cost.

Most costs were well predicted during design, but when the inevitable small surprises happened, as materials and smaller trades were bid, the team could easily adjust without adding to the overall cost. Only in the rare cases when items had to be subtracted from the performance contingency did it require a decision from the Core Team. Because subcontractors were on a fixed fee, but with flexible labor hours and materials at cost, there was no concern if hours had to be taken from one trade and

Photograph by Jonathan Cohen

assigned to another. That inspired some out-of the-box thinking for the benefit of the overall project. Costs such as material lifts and clean-up could be shared and those items could be taken out of individual budgets and the savings put into the incentive pool. This had the additional benefit of minimizing jobsite clutter because redundant equipment was reduced.

Photograph by Jonathan Cohen

The primary computer model was held by Boldt. Each systems subcontractor used its own preferred software platform, which in the case of the sheet metal subcontractor, was used to directly drive CNC fabrication equipment. Navisworks was used extensively and interactively to detect clashes between systems. By modeling everything, there was a much higher assurance that things would fit and therefore tighter tolerances were possible. Instead of a laborious shop drawing review process, the subcontractors were able to model their own work and build it. Trent Jezwinski , Boldt's project manager said "The money spent on building and maintaining the BIM was more than offset by less rework caused by coordination errors." In addition to BIM, Boldt maintained a project web site for information exchange open to all participants.

RFIs were essentially limited to documentation of decisions already reached in the field. This freed the architect to be more hands-on during construction because much of the tedious paperwork and tracking was eliminated. Representatives in the field were empowered to make decisions quickly. Participants at all levels tended to ask questions with a range of possible solutions in mind. It wasn't "your design doesn't work, fix it." The process tended to flatten the hierarchy and put everyone on an equal footing, which was empowering for all and a good stimulus toward creative problem-solving.

"With a traditional agreement the attitude is: if there is a mismatch or a problem, I'm not going to come back and change it – I'm done," said Boldt's Trent Jezwinski ."Instead of just looking out for your narrow business interest, people really act for the good of the project."

The shop drawing process became concurrent with design, saving time and duplication of effort. Kevin Kerschbaum, HGA's project manager, said "We drew 30% fewer window details, for example, because the curtain wall subcontractor was involved from the get-go and their

input was incorporated in the design drawings." Shop drawings were used for installation purposes only.


Photograph by Jonathan Cohen

A similar situation occurred with millwork. The architect, with the fabricator by his side, drew what was needed without having to extensively detail. In that sense, the architect could focus purely on design while allowing the fabricators to detail exactly what they were going to build.

Lessons Learned

Several of the participants wished that the major field foremen had been more completely integrated into the process. As a rule these field workers were the most skeptical of the new process.

There was a general consensus that a more precise method of distinguishing design refinement from scope change from contingency item was needed. Participants reported several instances in which there was disagreement about which bucket should pay for a particular item. But in the spirit of collaboration and feeling of trust that prevailed these were resolved with frank discussion and give-and-take. This supports the idea that a rigorous programming phase in which requirements are well defined must be part of IPD.

In some cases, the scheduling of trades such as fire protection had to be adjusted because things were happening so much faster than usual. Boldt has indicated that it will adjust its scheduling practices to suit this new process.

"I've never had a job run this smooth in 23 years," said Jezwinski ."There wasn't any of that silo mentality – and to be able to move that feeling into the construction site is huge. I've never seen a project work as a team like this one did, from the top down and including the installers and guys in the field. When you have a hand in establishing the schedule and see how your trade fits into the whole process, you tend to believe in it and act accordingly. Slack is greatly reduced. The interactive scheduling process showed you the logic of where everything had to go – you trusted it and had ownership over it, and if you didn't fulfill your promises you felt you had let down the team. If you have partners who are willing to change culturally then this process could work anywhere."

Project Data

Project name and location	Encircle Health Center Appleton, WI
Building type	Ambulatory Care Center, with Endoscopy center Imaging center Medical offices Pharmacy/Café/Conference area
Owner	NAACC Building Co. LLC and ThedaCare
Year begun	2006
Year completed	2009
Form of agreement	Multi-party contract
Architect	HGA
Structural	HGA
MEP	HGA/August Winter (M,P), Town and Country (E), Excellence Elec. (LV & Security), Ahern (FP)
Landscape Arch	Martenson and Eisele
Other designer	HGA (Interiors), Martenson and Eisele (Civil)
Builder	O. J. Boldt Construction
MEP	August Winter (M,P) Town and Country (E) Excellence Elec. (LV), Ahern (FP)
Curtain wall	Corcoran Glass
Major subs	O. J. Boldt, F.C. Dadson (Millwork), Builders Service (Door/Hardware), Nimsgern (Struct Steel), Macco's (Flooring), Omni Glass & Paint (Wall Finishes)
Initial schedule	
Design	May 2006 thru January 2009
Construction	July 2008 thru July 2009
Achieved schedule	
Design	May 2006 thru January 2009 (5 month delay due to formation of business model with physicians)
Construction	September 2008 thru October 2009
Programmed GSF	150,000 SF
Final GSF	157,000 SF
Budget cost	
Design[1]	$2,657,820
Construction[2]	$34,094,999
Contract cost	
Design[1]	$2,901,071
Construction[2]	$34,977,404
Final cost	
Design[1]	$3,185,917
Construction[2]	$35,408,131
Change orders	
Owner-initiated	$1,514,911
Other	-0-
RFIs	-0-
Sustainability Goal	LEED Silver
Sustainability Achieved	LEED Gold (not final as of this writing but team was confident it would be achieved.)

[1]Total design fees including all subconsultants and owner-selected consultants.

[2]Construction hard costs excluding furniture, fixtures, and equipment (FF&E) but including general conditions, CM fees including preconstruction services.

CASE STUDY: WALTER CRONKITE SCHOOL OF JOURNALISM, ARIZONA STATE UNIVERSITY

Phoenix, Arizona

Project Description

The Cronkite School is a build-to-suit venture by the City of Phoenix for Arizona State University (ASU) and financed by a city bond measure. ASU's new downtown campus is part of the revitalization of the Phoenix central business district. The six-story, 230,000 square foot project consists of academic classrooms and offices for the School of Journalism and Mass Communication, university-operated public television station KAET/Channel 8, general purpose ASU classrooms and ground floor retail intended to activate the street. The program required studios, control rooms, a master control room, editing suites, post production suites, computer labs, media-intensive classrooms, as well as other highly technical support spaces. A significant design feature is the "forum," a high-ceilinged, media-intensive, community activated space that is the central gathering space of the school.

Owner:	City of Phoenix	www.phoenix.gov
User/Occupant:	Arizona State University	www.asu.edu
Design Architect:	Ehrlich Architects	www.s-ehrlich.com
Executive Architect:	HDR Architecture	www.hdrinc.com
Builder:	Sundt Construction	www.sundt.com

Photograph by Bill Timmerman

Early Involvement of Key Participants

The designers and builders were selected as one team. The builder's preferred mechanical, electrical, and glazing subcontractors were introduced to the selection committee and began work simultaneously with Ehrlich/HDR and Sundt. HDR brought mechanical, electrical, and plumbing engineering in house. Sundt chose its subcontractors in a qualifications-based process, agreeing to fixed fees but with open book accounting of costs. Subcontractors were required to use BIM and were selected in part on a judgment of their preconstruction capabilities. All of the disciplines needed for a complete design were on board as the design process began.

Shared Risk/Reward

The project was obliged to follow the standard City of Phoenix design-build contract, which did not allow for a shared "pain and gain" mechanism. Money saved through efficiencies was put back into the project for value-add items. Nevertheless, many IPD features were put in place on a non-contractual basis.

The project had to be completed by a "drop-dead" date and for a sum set by the bond measure so the budget and schedule were absolute. But the project participants believed that their risk was reduced due to the completely transparent way in which the project was managed.

Multi-Party Contract

The contract was a two-way owner/designer-builder contract as prescribed by City procurement regulations, but the participants decided collectively that the only way to insure that the owner's budget, schedule and programmatic requirements could be met was to follow IPD principles in managing project delivery. The team made a conscious decision to sign the contract but not to let it dictate behavior. Sundt's project manager Terry Abair said: "The stuff that's written into the contract, such as submittal review times, and so on, had we followed that we would never have been successful."

Photograph by Bill Timmerman

Collaborative Decision Making/Control

Project oversight was managed by an Executive Committee meeting every other week with high level representation of all participants and stakeholders – frequently, even including the Dean of Journalism. Decisions were arrived by consensus and very rarely did issues have to go to a higher authority for resolution. This kind of collaborative, quick, and final decision making process was key to achieving such an aggressive schedule.

Liability Waivers Among Key Participants

The standard City of Phoenix contract contained a limitation of consequential damages provision but there was not a "no-sue" clause. The contract was so inflexible that even misspellings could not be corrected without action by the city council.

Jointly Developed/Validated Targets

Although budget and schedule were fixed by the bond financing, the program that ASU hoped to achieve was flexible. Owner, architects, and builder were able to collaboratively decide how to spend the funds for maximum gain. It seemed clear, early in design, that the budget would not buy the entire program the University desired, and ASU was able to find an additional $2 million from another budget to fill the gap. Even then, it was expected that a certain amount of space would be left as an unfinished shell. But in the end, efficiencies achieved during construction and buyout, allowed all of the program to be achieved and all the space to be finished without touching the extra $2 million.

Narrative

The downtown ASU campus, which will ultimately fill a nine block area, is an important component of the Phoenix redevelopment vision. Unlike its main Tempe campus where ASU builds for itself, the downtown campus will be owned by the City with ASU on a long term master lease. In effect it's a "public-public" partnership. As the first significant building and on the most prominent site, the Cronkite School was expected to set a high standard of design quality.

Both HDR and Sundt are headquartered in Phoenix and the opportunity to work for both the City and ASU was very attractive to both of them. The prime issue forcing an extremely tight schedule was the "drop-dead" date for move-in prescribed by the bond measure. A previous scheme for another downtown site had fallen apart, leaving the city with only 24 months to complete the project on a different site. Finding an alternative project delivery method was essential; there was no time for a design-bid-build scenario.

The City issued a public RFQ to select an architect and builder together, purely on the basis of qualifications with no price attached. 13-15 responses were received out of which a short list of three teams was chosen. State law required that an architect and builder be on the selection committee along with representatives of the City of Phoenix and ASU. Teams were selected on the basis of familiarity with the project type, experience working with public agencies, and the prospect of working well together. ASU in its own capital programs had been using CM-at-Risk exclusively for the previous five years.

HDR and Ehrlich applied together as a design team. They felt that their combined talents and experience would be a good fit for the project. The two firms had previously pursued work together but never landed a job, although key individuals at HDR and Sundt had prior working relationships.

Photograph by Jonathan Cohen

The University had programmed the project to fit the original site. When that first effort fell apart, many of the stakeholders were reluctant to go through another lengthy programming process. Although the budget was fixed, the program was flexible. The City and ASU challenged the team to give them the most they could get for the money. A prioritized list of add-ons was agreed, and in the end, almost all of them were achieved.

Ehrlich Architects began rapidly testing alternative schemes, always working in 3D, and always with the full participation of the builders. There were many constraints. For budget reasons it was necessary to stay under a height of 75', above which expensive life safety requirements would be triggered. ASU wanted about half the site to remain for a subsequent project. And schedule constraints meant it was not possible to consider major excavation even though elements of the program could have worked well underground.

A "Big Room" was set up at HDR's office. Howard Shugar, HDR's project manager said "If you didn't have the right people in the room you couldn't make the decisions when they needed to be made." Every Monday the latest design ideas were published as a set of 20 or more 11"x17" sheets.

"We do not provide quantity takeoffs in a design-bid-build project," said Mathew Chaney of Ehrlich Architects, "but in this project it was a daily occurrence. Because of the trust established we weren't afraid to get involved. We were constantly using the BIM model to test the cost of different design ideas." Howard Shugar said "We were really learning. As architects we never sat in a general contractor's office and understood what they do."

The City created a dedicated team of building inspectors for the downtown ASU campus, but the project still had to go through the City's full design review process. A site plan and elevations had to be quickly developed and approved. The City worked closely with the project team

and committed to reasonable turnaround times but did not cut short its normal review process. A number of variances were required, which extended the schedule with public review and comment periods.


Photograph by Jonathan Cohen

The tight schedule coupled with a lengthy review process meant that aspects of the design had to be fast tracked and accomplished out of normal sequence. One of the tenets of lean construction is "optimize the project, not the pieces." A structural and foundation system was designed that could flexibly accommodate ongoing design refinement. The foundation may have been a bit overdesigned, but early design enabled optimization of larger project goals. Flat, post-tensioned slabs were used to maximize flexibility as the detailed design proceeded.

Both the City and University had sustainability goals: The City wanted the project LEED certified, and ASU wanted it to be LEED Silver or higher.

BIM was used extensively through programming, design and construction, but there was no standardization of software platforms. Ehrlich had extensive experience with Revit, and discovered in the process of program validation that it was also useful as an interactive 3D programming tool in live user group meetings.

HDR's engineers developed single-line diagrams of systems which were turned over to subcontractors for detailed modeling. The transition from consulting engineers to design-build subcontractors was almost completely seamless. The two sets of engineers sat across from each other in the Big Room and designed collaboratively. Navisworks was used to stitch together models created in various software packages. The mechanical engineer led the clash-detection process.

Lessons Learned

"In order to be successful we had to change the behaviors we were used to," said Sundt's Terry Abair, "If everyone had

fallen back on their normal behavior we never would have gotten there." Compromises had to be made to accommodate the aggressive schedule. The team felt that although a hurry-up schedule can often be a productivity advantage, in this case another month would have been very useful. There was not enough time up front to engage in the kind of team-building that is needed in such an intense collaboration.

Michael Jackson, HDR principal in charge said "Co-location works because when you work that closely together you naturally develop a relationship of trust. When everyone is in their own office and using email and staying at arms' length it doesn't allow that to happen." As a result of the success of this project HDR has built out a new space in its office specifically for co-location.

When design began, Ehrlich was working in Revit. HDR, which at the time was still using Architectural Desktop, determined that there was insufficient time to train their personnel on new software. Translating the models back and forth turned out to be a cumbersome and problematic process and a major inefficiency. The firm has since transitioned completely to Revit.

Sundt now requires its major subcontractors to model their systems in 3D as a condition of working together.

Building erection had to begin before all systems were fully designed. Full BIM coordination was not possible until the 3rd floor was in place, and because old fashioned paper-based coordination had to be used some rework on lower floors was necessary.

Participants felt that design-build subcontractors are typically uncomfortable with the uncertainty and sometimes chaotic nature of early design and the iterative process that designers must follow to arrive at an appropriate solution. All felt this could be overcome with additional training and experience.

Most participants felt that some of the lean construction thinking is doctrinaire and inflexible.

Michael Jackson of HDR said "owners are not used to the level of commitment of taking responsibility equally with architects and builders and accepting some risk themselves. The owner has to be at the table. In the old fashioned relationships we're always thinking 'How can I shift that risk to the other two parties' but it's just pushing the shells around. The reality is when you're willing to take responsibility and provide the builder with those materials quantities the end result is the risk goes down for everybody."

Project Data

Project name and location	Walter Cronkite School of Journalism and Mass Communication – KAET 8 Phoenix, Arizona
Building type	Classroom / office building, on-air production public TV and radio station
Project description	The program was driven by the diverse needs of the School of Journalism, the university-operated public television station KAET/Channel 8, with the addition of general university classrooms and ground floor retail. Though served by a common lobby, each required its own distinct identity. In addition, the project needed to accommodate an electrical substation and internal delivery bays on the first floor. The School of Journalism and KAET/Channel 8 cameras each required super-flat floors in the studios and roof-mounted satellite and microwave dish arrays. KAET/Channel 8 and the Cronkite School each required studios, control rooms, master control room, editing suites, post production suites, computer labs, and television-ready classrooms, as well as many other technival support spaces. Components of the Walter Cronkite School of Journalism include:3,000 SF multi-level Forum with remote-operated cameras and HD rear-projection screen • 3 working newsrooms • 2 television studios with associated video production and audio control rooms • 23 TV edit bays • Radio studio and control room • 9 Radio edit bays • 7 digital computer labs • 150-seat, theatre-style auditorium with remote-operated cameras • 1,500-square-foot gallery dedicated to journalism history The Cronkite School occupies all of the second and third floors and a portion of the fourth and sixth floors. The newsroom and broadcast anchor desks are contained within one production space with views overlooking the city. Additionally, heavily mediated and camera-ready classrooms were required for distance learning. KAET/Channel 8 occupies the entire fifth floor of the building, a portion of the fourth floor and transmits from studios on the sixth floor. This top floor location uses long spans and high ceilings as required by the studios. Satellite dishes for transmission and reception are housed on the roof; they are not screened and serve to express the building's communication function. Components of KAET / Channel 8 include: • 1 – 5,400 SF and 1-2,400 SF television production studios with associated video production and audio control rooms • Master Control Room and equipment rack room • 4 edit suites and 2 post production edit suites • KBAQ radio studio and control room • 2 radio production edit suites
Owner	City of Phoenix – Owner/Developer
Year begun	2006
Year completed	2008
Form of agreement	Design-build
Architect	HDR Architecture, Inc. and Ehrlich Architects
Structural	CTS – Caruso Turley Scott, Inc.
MEP	HDR Architecture, Inc.
Landscape Arch	Ten Eyck Landscape Architects
Other designer	Dibble Engineering – Civil Engineers
Builder	Sundt Construction – Design Builder Self-performed civil and structural concrete work
MEP	University Mechanical & Engineering Contractors, Inc., Kearney Electric, Western States Fire Protection
Curtain wall	KT Fabricators
Major subs	Performance Contracting – Framing and Drywall Thyssen Krupp - Elevators Resource Flooring T-P Acoustics, Inc. – Acoustical ceilings Commercial Door & Hardware Elward Construction – Metal Panel System Schuff Steel – Structural Steel Ironco – Misc. & Structural Steel Rhino Masonry – Masonry RBG Construction – Site/Offsite Concrete

Initial schedule	Design and Construction – 21.4 Months
Design	Notice to proceed through tenant fit-up permit – 10.8 months
Construction	From 1st permit issued to certificate of occupancy – 16 months
Achieved schedule	Design and Construction – 19.8 Months
Design	Notice to proceed through tenant fit-up permit – 9.4 months
Construction	From 1st permit issued to certificate of occupancy – 15 months
Programmed GSF	200,000 to 260,000 GSF
Final GSF	230,000 GSF
Budget cost	Total project budget = $71,000,000 bond funded building plus miscellaneous bond funded offsite improvements and art projects.
Design[1]	Design, owner soft costs & owner contingencies - $16,022,000
Construction[2]	Construction - $54,978,000
Contract cost	
Design[1]	$7,910,994
Construction[2]	$57,957,728
Final cost	
Design[1]	$8,276,450
Construction[2]	$63,822,794
Change orders	
Owner-initiated	Total Added Scope from City of Phoenix Contingency - $1,351,334
Other Budgets	Total Added Scope from Other Budgets = $4,513,732
Added value changes	from design-builder contingency = $1,556,236 from owner allowance = $2,402,926
RFIs	454, of which about 25% were confirming RFIs for documentation purposes.
Sustainability Goal	LEED Silver
Sustainability Achieved	LEED Silver, 2 Green Globes Achieved

[1]Total design fees including all subconsultants and owner-selected consultants.

[2]Construction hard costs excluding furniture, fixtures, and equipment (FF&E) but including general conditions, CM fees including preconstruction services.

Photograph by Bill Timmerman

Conclusions

By examining only built projects, these case studies attempt to provide a "proof of concept" for this new method of designing and building. Most of the participants in the case study projects had enough bad experience with traditional delivery models to be willing to try something new. In every case these projects met or exceeded the owner's expectations with respect to budget, schedule, design quality, and sustainability and also met the financial expectations of designers and builders. Every participant interviewed was enthusiastic about IPD and eager to try it again.

A significant key to IPD's promise is its ability to manage and mitigate risk for the three principal parties: the owner, the architect/engineer, and the builder. By aligning the goals of these parties around what is best for the project and making each party responsible for the behavior of the others, all three parties gain more control of the overall process. Increased certainty means lowered risk.

In a typical construction project done in the traditional fashion, every participant relies on stated or hidden contingencies to cover foreseeable and unforeseeable risks. Often architects attempt to shift as much risk as possible to builders, builders to architects and owners to both of them. For owners, a "hard bid" represents a shift of the risk of cost escalation to the builder. Builders attempt to mitigate that risk through contingencies. For architects, the avoidance of risk is reflected in the number of drawings produced as if risk could be reduced by the sheer weight of the documents. Traditional design and construction contracts seek to manage risk by narrowly defining roles and responsibilities. Each participant must then be vigilant to limit the scope of their activities to prescribed parameters,

which reinforces isolating “silo” behavior, limiting collaboration and precluding an aligned focus on the good of the project.

The total of all these implicit and explicit contingencies represents an enormous amount of waste – resources that if saved could be used to add value to owners and better compensate the project team. Albert Park, ThedaCare’s Director of Facilities Planning, said “it’s all about managing risk. I don’t mind paying for labor and the cost of materials. What I don’t want to do is pay for your risk, and others risk so that all that money is sitting out there which I can’t quantify, when it could go toward the project. I can make better business decisions early in the project knowing what the real costs are.”

When additional waste can be removed through improved information exchange, streamlined decision making processes and a reduction in self-serving behavior, the outcome is even better. “How do you convince an owner that trust is actually reducing their risk rather than increasing it?” asks Mathew Chaney of Ehrlich Architects. These case studies provide insight that may help answer that question.

As these studies show, IPD is gaining particular traction in the healthcare field. This may be the result of these owners’ focus on lean operations and whole systems thinking now considered “best practice” in healthcare delivery. Healthcare providers may then look to their capital programs and ask why such a holistic approach can’t also be applied to design and construction of facilities. As Sutter Health’s attorney Will Lichtig states, “It makes it easy for those organizations that have enlightened management with respect to operations to recognize that there are significant

opportunities in the design and construction arena as well."

How might public agencies, whose procurement policies are often constrained, get some of the benefits of IPD? One of these case studies, the Walter Cronkite School of Journalism, was a public project and used most of the IPD methodology, but the contract didn't reflect it. New forms of public agency contracts should be explored, including modified design-build, contracts with single purpose entities, and public-private partnerships.

The blurring of boundaries mentioned in the Introduction is a challenge for some. In particular, "early involvement of key participants" means that major building systems contractors have to become comfortable with the messiness of design. Much of the efficiency that IPD brings is due to the early participation of mechanical, electrical, and plumbing contractors not used to the "what-ifs" and iterative thinking that is characteristic of early design. Perhaps a culture change is needed from both the consulting engineers and the design-build subcontractor community as integrated teams become more the norm. "You have to have people who can deal with a huge amount of ambiguity and not get nervous about it," said Michael Jackson of HDR.

The use of financial incentives to reward or punish is controversial. Some say they are essential to insure the alignment of goals around the good of the project, as defined by agreed objectives. Others see a danger of abuse or conflict of interest when incentives are based on exceeding budget and schedule targets. In the course of compiling these case studies, owners, architects and builders expressed strong feelings both pro

and con. Some felt that the reduced risk and increased certainty of outcome outweighed the value of additional compensation. Others held the opposite view. “I have a sense that incentives poorly structured can create non-collaborative behavior, but properly structured, they help,” said attorney Howard Ashcraft, who authored the Integrated Project Delivery Agreement used in two Autodesk projects.

One area of unanimity was the conviction that success depends on putting together the right team of people. Ultimately the success of any group undertaking depends on the integrity and commitment of the participants, and this is certainly no less the case with IPD.

With respect to insurance, many of the parties interviewed in these case studies felt that umbrella project policies are most appropriate to IPD projects. At present, these policies are expensive. Because of its collaborative nature IPD should decrease the number of claims among participants in projects, leaving only third-party claims to cover. It will be a challenge to the insurance industry to recognize the inherently lower risk profile of IPD projects and write affordable project policies for them.

It is still “early days” for Integrated Project Delivery. Not every case study met all of the desired criteria. Teams are experimenting and finding what works through trial and error. In many cases the participants are already applying lessons learned to new IPD projects now in the planning and design stages. This is not a “one-off” study; it is the start of an ongoing effort to document IPD as it grows and evolves.

Glossary

Big Room
A term derived from the Japanese "obeya." In the Toyota Product Development System, the obeya is a location in which interdisciplinary team members meet to brainstorm and resolve issues on the spot.

Building Information Modeling (BIM)
"A building information model is the digital representation of the physical and functional characteristics of a building from design through construction and operations. As such, it can serve as the shared information repository for collaboration throughout a building's lifecycle."

Construction Management at Risk (CM-at-Risk)
In this delivery method, the construction manager is hired at the beginning of the design phase to act as the project coordinator (not at risk) and general contractor (at risk). Later, if the construction manager serves as builder, he/she assumes all of the liability and responsibility of a general contractor.

Core Team
A team that collaboratively manages IPD projects from inception to completion and with equal representation of, at a minimum, the owner, the architect, and the builder.

Design assist: A process in which the architect and owner work use the expertise of specialty contractors to develop an optimum solution, material or construction application.

Design-to-Fabrication: A process in which building components are modeled in 3D software which is then used to control computer numerical control (CNC) machines for automated fabrication.

GMP: Guaranteed Maximum Price

Incentive Compensation Layer
The portion of the IPD parties' prospective compensation that exceeds direct costs of design and construction. Roughly analagous to profit, the ICL is reduced or augmented based on comparing project performance to agreed targets and distributed according to an agreed formula. In some projects, a portion of the ICL is distributed at milestones, in other projects the entirel ICL is distributed when the project is complete.

Integrated Form of Agreement
The multi-party IPD agreement developed by the Lean Construction Institute and Sutter Health.

Integrated Form of Agreement (IFOA)
A "relational" contract among owner, architect, and builder that creates a system of shared risk and reward with the goal of reducing overall project risk rather than shifting it between parties.

Integrated Project Leader/Coordinator
An individual or firm that assembles a multidisciplinary team tailored to each project, encompassing the organizational, legal, technological and communication skills required to successfully implement IPD.

Integration
The coming together of all key participants, at the beginning of a project, for the purpose of designing and constructing the project together, as a team.

Interoperability: The ability of two or more systems or components to exchange information and to use the information that has been exchanged. An example is two software applications that are capable of exchanging information with each other without loss.

Joining Agreement
A contractual amendment used to add a new party to an existing multi-party IPD agreement and include them within the risk sharing orother terms of the IPD agreement. For example, a joining agreement could be used to append key subcontractors to a MPA IPD agreement previously executed by owner, contractor and designer.

Key Participant
A person or organization whose contribution is critically necessary to achieve project goals.

Lean (design, construction, and operations): A production practice that considers the expenditure of resources for any goal other than the creation of value for the end customer to be wasteful, and thus a target for elimination. The term "Lean" was first used by Toyota to describe how its production system aims to eliminate waste in manufacturing. The ideal was to produce a car to the requirements of a specific customer, deliver it instantly, and maintain no inventories or intermediate stores. Lean construction applies similar principles to the construction process.

Liability Waivers
Contractual provisions in the IPD agreement that eliminate, or significantly reduce, the ability of the IPD parties to sue each other for losses related to the project. The level and comprehensiveness of liability waivers varies between contract forms.

Multi-Prime
A method of contracting for construction wherein an owner contracts directly with several (usually major) building trades under separate contracts to perform their work either simultaneously or sequentially. The owner may provide the management of the project, or hire a construction manager or general contractor (not at risk) to provide construction administration, coordination, and scheduling of the work of the different trades.

Relational Contract
Relational contracts, in contrast to traditional design and construction contracts, place greater emphasis on communication among the participants and encourage collaborative solutions to design and construction problems. The term encompasses a spectrum of contract approaches that range from nearly traditional to fundamentally different.

Risk Pool
In an IPD project, participant's cost of work is separated from anticipated profit. Planned profits are combined into a "risk pool" to be divided according to an agreed formula only if project goals are met or exceeded.

About the Researcher

Jonathan W. Cohen provides consulting services to building owners, architects, and builders seeking to implement IPD. He has been a practicing architect for more than 30 years, with senior design and management responsibility in a variety of building types both domestically and internationally, most recently with Skidmore, Owings, & Merrill LLP. He is past chair of the AIA California Council Integrated Project Delivery Steering Committee and the national AIA Technology in Architectural Practice Knowledge Community. Jonathan was the conference chair of "Connecting the Dots: Understanding the Emerging Digital Building Process," held in San Francisco in 2003. He has received design awards from the American Institute of Architects, AIA San Francisco, and the Urban Land Institute. A graduate of UC Berkeley, he has been a presenter at national and international conferences and an instructor in the Harvard Design School Executive Education program. He is the author of *Communication and Design with the Internet: A Guide for Architects, Planners and Building Professionals* (WW Norton, 2000) as well as articles for *Architectural Record, Urban Land,* and *Planning* magazines. He was elected to the AIA College of Fellows in 2004.

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Integrated Project Delivery: Case Studies is published by The American Institute of Architects, California Council in partnership with AIA.

Thanks to all the individuals and organizations who reviewed and contributed to this work. The following members of the design and construction industry served as authors and editors of this document.

Acknowledgements

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