IPD CASE STUDIES

AIA, AIA Minnesota, School of Architecture – University of Minnesota

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This document incorporates case studies originally documented in the 2010 publication, "Integrated Project Delivery: Case Studies" by the AIA / AIA California Council

Table of Contents

About this Study

Definition of Terms

National Map of IPD

Degree of IPD

Case Studies

About this Study

Introduction

This study is a revision of our report published in February 2011. It advances the previous study with the inclusion of one new case study (University of California San Francisco, UCSF), report of the survey results and addition of the six cases documented in the 2010 AIA/AIA-CC publication of "Integrated Project Delivery: Case Studies." Whereas previous case study efforts were limited to the handful of projects executing IPD, this effort is framed broadly, choosing projects of various program types, sizes, team composition and locations. Additionally, this set of case examples documents a wide range of team experience, from teams with quite a bit of IPD experience to those who are using their project as a learning experience. The level of experience of the teams is shown graphically in the at-a-glance pages of the matrix. Unique to this study is the opportunity to study projects from early phases through completion. Following projects over time, we hope to gain insight on the evolution of each project, its collaborative culture and areas of success and challenge. This document is focused on project activities that lay the foundation for collaborative practices in IPD.

Executive Summary

IPD is being implemented in increasingly diverse settings, allowing us to better understand where it is most effective. By studying a range of projects, we can better understand how IPD compares with traditional project delivery methods for different project and team types and envision its continued development. Documenting how IPD has been adapted and applied to each of the projects in this study demonstrates that IPD is a method that employs multiple strategies to achieve high performing, collaborative teams and cannot be reduced to a contractual structure or management formula. By comparing this set of projects according to how they followed or adapted IPD contractual and behavioral strategies, we can see how some aspects of IPD have had greater impact than others. The degree to which projects implemented IPD strategies, from contractual terms to management, social, environmental and technological strategies, is documented in a chart "Degree of IPD."

Since IPD is a relatively new delivery model, it is not surprising that participants have had less project experience with IPD than with traditional or design-build delivery models. Project participants with even one or two IPD experiences can greatly influence the team. As one might expect, for first time IPD teams, they are encountering a steep learning curve. However, the curve can be made less steep by pre-existing professional relationships and relatively straightforward projects. For the relatively experienced teams, IPD continues to be fine tuned and adjusted to meet specific project and team needs.

Survey results of 127 participants confirm some expected hypotheses but also yielded some surprises. For example, as expected, a more experienced team has stronger understanding and value of IPD principles. However, while anecdotally, co-location is strongly valued, it was not significant factor in the perception of open and effective communication. This somewhat contradictory evidence indicates that the future study is needed to better understand which factors are most relevant to the success of a collaborative project focused on the activities that lay the foundation for

By juxtaposing AIA/AIA-CC 2010 cases to the projects documented in 2011-12, we can see the rapid pace of change from 2004 to 2012. Sutter's Fairfield Medical Office Building, begun in 2005, is considered one of the first "true" IPD projects in America, and several others around that time are obviously meeting the challenges of creating new strategies for what was then a very new project delivery type. In spite of many years of experience with collaborative or even integrated team delivery (usually in the form of Design-Build but sometimes found even in Design-Bid-Build settings), IPD in its pure form required significant rethinking of many core processes.

The later projects, along with the rest of the building industry, clearly benefitted from the early projects and their "lessons learned." Equally clearly, there is more room for learning and current projects must adapt to meet new demands and project specific challenges.

IPD Definition - AIA

It is becoming clear that there are very few "pure" IPD projects. The survey response shows that the majority of projects pursuing IPD are using custom IPD agreements. Even those

using standard multi-party agreements, such as the AIA C-191 Standard Form Multi-Party Agreement for IPD, customized the contracts to eliminate certain aspects of liability or shared risk/ reward – components previously defined as critical to achieve "pure" IPD. As the industry struggles to define IPD in the ideal world, the messiness of the real world continues to shape our understanding of integration and collaboration. We found that although several of the case examples did not meet all of the contractual principles listed below in Integrated Project Delivery Defined: AIA/AIACC, 2010, they met all of the behavioral principles and offered insights into the ways IPD can be adapted. See also the graphic representation of the projects' in "Degree of IPD."

Integrated Project Delivery Defined: AIA/AIACC, 2010
IPD is a method of project delivery distinguished by a contractual arrangement among a minimum of owner, constructor and design professional that aligns business interests of all parties. IPD motivates collaboration throughout the design and construction process, tying stakeholder success to project success, and embodies the following contractual and behavioral principles:

Contractual Principles
- Key Participants Bound Together as Equals
- Shared Financial Risk and Reward Based on Project Outcome
- Liability Waivers between Key Participants
- Fiscal Transparency between Key Participants
- Early Involvement of Key Participants
- Jointly Developed Project Target Criteria
- Collaborative Decision Making

Behavioral Principles
- Mutual Respect and Trust
- Willingness to Collaborate
- Open Communication

IPD Definition - This Report

Through a workshop process led by Professor Paolo Tombesi, Chair of Construction at the University of Melbourne and Markku Allison, resource architect for AIA, we adapted the contractual and behavioral principles above to more specifically define IPD for this study. We rearranged the characteristics to into two categories, IPD "markers" and IPD "strategies." This helps to distinguish between the characteristics unique to IPD projects and the tactics or strategies employed, either commercial, social, environmental or technological, to support the IPD process.

For our study, we considered a project to be following IPD if they embodied the markers listed below. Variations were seen in strategies, tactics and contractual principles.

IPD Markers
- Relational Contracts
- Protection from litigation
- Aligned project goals (Jointly Developed Project Target Criteria)
- Informed and balanced decision-making (Collaborative Decision Making)
- Open Communication
- Risks Identified and Accepted Early

IPD Strategies
- Key Participants Bound Together as Equals (Multi-party Agreement)
- Budget & create team for design intensive work
- Early contribution of expertise (Early Involvement of Key Participants)
- Pre-existing relationships between parties
- Champion/ Facilitator (Leadership by All)
- Shared Financial Risk and Reward Based on Project Outcome
- Liability Waivers between Key Participants
- Fiscal Transparency between Key Participants
- BIM - virtual rehearsal of construction and ongoing constructability reviews
- Lean Construction processes
- Co-location

IPD Motivations

IPD offers many potential advantages over a tradition design-bid-build delivery model, but each team needs to determine why IPD is appropriate for them. The workshop also developed a method to profile each case in terms of their motivations for using IPD. As we follow-up with the second phase of this case study effort, we may find that there are certain projects better

suited for IPD. For example the Technical Complexity of the project might be high, therefore requiring earlier involvement of trade expertise. Even in this early stage of the study, we have seen teams find their initial reasons for choosing IPD are evolving as they better understand IPD's benefits and challenges. In some cases, great value has been found in unanticipated areas.

Motivations for selecting IPD fall into five categories:

1) Market Advantage:
Choosing to use IPD can give market advantage. IPD may give the firms valuable experience upon which to market themselves as industry leaders. Improving the delivery may also be a market advantage if measureable results can be attained. For serial owners, savings on one project done in IPD can be leveraged across many buildings. The healthcare sector trends show that IPD may become an expected standard delivery method.

2) Cost Predictability:
All projects would like to meet budget, however, for some the predictability of cost is a notably driving factor.

3) Schedule predictability: Similar to cost, all projects share the goal of meeting their planned schedule, but for some projects this is a major factor.

4)Risk Management:
Reducing or managing risk can be tied with cost or schedule, but also may include transactional risk inherent to project type, site or other conditions. If risk management is a critical factor, the increased communication in IPD may be of particular advantage.

5) Technical Complexity:
A high degree of complexity will usually demand integration of expertise and require a level of coordination that is achievable in an IPD environment.

The tactics for achieving the goals in each of these areas may or may not be exclusive to IPD, however, for projects that have strong motivations in several categories, IPD may offer an advantage over traditional delivery. Collaboration and integration can occur in any project delivery method, however, IPD sets up structures that make it more likely to occur than not. In particular, study participants noted good collaboration in design-build is raised to an even higher level in IPD. This improvement can be credited to a variety of sources, but most cited was the early involvement of a larger and more diverse set of expertise areas, including trade contractors.

Several of the cases have developed metrics and have preliminary results to measure. However, at this first phase of the study, it is too early to begin to draw conclusions on the successful results of any decisions related to IPD.

The earlier projects, originally documented by Jonathan Cohen for AIA/AIA-CC, did not directly request information regard motivation for selecting IPD. Our research team felt it was helpful to have an IPD profile for all the cases in the matrix and so, for the purposes of comparison, interpreted the interview information to create profiles for those cases.

Study Summary

This report presents data collected from an electronic questionnaire that surveyed five Integrated Project Delivery (IPD) teams as part of the larger case study effort. The goal of the questionnaire was to measure individual team members' perception of how IPD tactics affected the desired behavioral and relational characteristics.

Questionnaire Distribution and Response
The questionnaire was sent electronically to five teams in October 2011: Cathedral Hill Hospital (n=64), Lawrence and Schiller Remodel (n=6), SpawGlass Regional Office (n=9), Mercy Medical Center (n=12), and Edith Green Wendell Wyatt Federal Office Modernization (n=36). Team sizes varied; therefore some projects may have a sample population too small to be meaningful. Overall, the response rates were good, achieving at least 50% on all of the projects.

Summary of Preliminary Findings
Highlights of the findings summarize initial trends. They are not exhaustive, but focus on five primary areas of interest: effects of 1) IPD contractual principles, 2) use of a Lean construction system, 3) co-location, 4) use of team building facilitators, and 5) collaborative project delivery. The following reports findings of hypotheses that were/were not supported; however, those hypotheses that were not supported offer equally important data. Further investigation is needed about both conditions.

1) IPD contractual principles (multi-party agreement):
IPD provides several benefits to participants. Based on

findings from analysis of projects, shared financial risk and reward incentives, use of liability waivers, and fiscal transparency had a positive effect on the teams' perception of trust and respect for project partners.

2) Use of a Lean construction system:
Overall, participants perceive that use of a Lean construction system has a positive effect on several critical areas: sharing project information with all team members, sharing ideas and opinions with team members, and on project efficiency. However, Lean did not seem to have an effect on respect of the participants' contributions indicated by listening and giving fair consideration to the participants' ideas.

3) Co-location:
Most surprisingly, an examination of co-location revealed mixed results. Co-location was perceived as positively affecting participants' ability to communicate with team members from other contracting parties, the efficiency of the work process, and their direct interaction with team members who work for the other contracting parties. However, co-location had no effect on participants' perception of open and effective communication. Furthermore, participants did not perceive that co-location (to any degree) had an effect on indirect interaction with team members who work for other contracting parties.

4) Use of team building facilitators:
An examination of use of facilitators revealed mixed results. Team building facilitators triggered a positive effect on participants' perception of sharing of project information with all team members equally, their understanding of team members' roles, and effective communication between team members. However, participants did not perceive a positive effect of a facilitator on how the participants share their ideas and opinions with their team members, or team members' respect of participants' contributions by listening and giving fair consideration to their ideas.

5) Collaborative project delivery:
The perception of a positive effect of collaborative project delivery on project efficiency varied according to contract party. All parties perceived it as having a positive effect, however the contractors (general contractor/construction manager) perceived collaborative delivery as significantly more positive (Mean = 2.79, n=33) than engineers whop viewed the effect only somewhat positively (Mean = 1.82, n=17). All parties also perceived a positive effect of collaborative project delivery on the quality of design - interestingly, the architects rated this effect to a lesser degree (Mean=2.08, n=26) than all other contract parties: contractor (general contractor/construction manager) (Mean=2.63, n=32); contractor (trade) (Mean=2.53, n=40); and engineer (Mean=2.13, n=16).

Limitations of the Study
The imbalance in sample populations (n) between projects within this study and missing data could have skewed the study's results, compromising the findings. Also, the study's sample size limits generalization of the findings from one project to another within the study; it also limits generalization of findings from this phase of the study to projects outside this study.
Analysis of data was primarily descriptive (means, percentages) Missing data were the result of some variation in the questions asked of participants and can also indicate an issue with understandability of the questions.

Project Specific Data
Detailed questionnaire results for each project can be found within the matrix under the "Survey Data" category.

Selection of Projects

Case projects were selected after applying several filters to a survey conducted by AIA in September 2010. The survey was sent to all those who had downloaded the 2007 AIA/AIA-CC publication, "Integrated Project Delivery: A Guide," and asked respondents to identify their use or likeliness to use a multi-party or IPD agreement. Over 1,400 individuals responded, 25% indicated they were using or intended to use IPD on a project. This group was sent a second, more detailed survey asking specific information about their project. Since this case study effort was planned to have several phases, projects currently in their early phases of delivery were chosen. A further selection was made to ensure diversity of project profiles and a willingness to share information for the study.

AIA/AIA-CC cases were chosen using a very different process that reflects the extremely small number of projects that had been completed when that report was begun. For that report, projects were chosen that had been successfully completed, balanced with a desire to have some diversity of geography and project type.

Credits

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AIA/AIA-California Council Study:
AIA/AIA-CC 2010 "Integrated Project Delivery: Case Studies" was written by Jonathan Cohen, the six projects documented in that publication have been adapted for inclusion in this case study matrix.

Photo Credits:
Autodesk Inc. AEC Solutions Division Headquarters, photo by Jonathan Cohen

Sutter Health Fairfield Medical Office Building, photo by Vance Fox

Cardinal Glennon Children's Hospital Expansion, photo by Sam Fentress

St. Clair Health Center, left photo by Jonathan Cohen, right photo courtesy of HGA Architects and Engineers

Encircle Health Ambulatory Care Center, photo courtesy of HGA Architects and Engineers

Walter Cronkite School of Journalism, Arizona State University, photo by Bill Timmerman

Acknowledgements

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Randall Von Ryan, Array HFS
Ray Corby, Array HFS
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Chuck Caye, Smith & Obey
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SpawGlass Austin Regional Office
Patrick Williams, SpawGlass, Contractors
Bob Farmer, SpawGlass Contractors
Mark Harrington, SpawGlass Contractors
Tommy Kosarek, BGK Architects
Art Arredondo, BGK Architects
Rick Moore, BGK Architects

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Pat Brunner, GSA Region 10
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Jennifer Taylor, SERA Architects
Troy Dickson, Howard S. Wright

UCSF Mission Bay Medical Center
Stuart Eckblad, UCSF
Laurel Harrison, Stantec
Osman Chao, DPR
Ray Trebino, DPR
Durga Saripally, DPR

AIA-CC Study Participants:
Autodesk Inc. AEC Solutions Division Headquarters
Owner: Autodesk Inc., Architect: KlingStubbins, Builder: Tocci Building Companies

Sutter Health Fairfield Medical Office Building
Owner: Sutter Regional Medical Foundation, Architect: HGA Architects and Engineers, Builder: The Boldt Company

Cardinal Glennon Children's Hospital Expansion
Owner: SSM Healthcare, Architect: Christner Inc., MEP Engineer: McGrath Inc., Builder: Alberici Constructors, Inc.

St. Clare Health Center
Owner: SSM Healthcare, Architect: HGA Architects and Engineers, Builder: Alberici Constructors

Encircle Health Ambulatory Care Center
Owner: Encircle Health, an LLC composed of ThedaCare and independent physician groups, Architect: HGA Architects and Engineers, Builder: The Boldt Company

Walter Cronkite School of Journalism, Arizona State University
Owner: City of Phoenix, User/Occupant: Arizona State University, Design Architect: Ehrlich Architects, Executive Architect: HDR Architecture, Builder: Sundt Construction

Resources

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Definition of Terms

A3
A one-page (11x17) report form that guides problem solving and decision making. The A3 includes the background, problem statement, analysis, proposed corrective actions (and the action plan), and the expected results, often with graphics.

Last Planner System
A collaborative, commitment-based planning system that integrates multiple elements (pull planning, make-ready look-ahead planning with constraint analysis, weekly work planning based upon reliable promises, and learning) to produce predictable work flow in construction and commissioning of projects.

Lean Construction
Lean Construction extends from the objectives of a lean production system– maximize value and minimize waste. It uses specific techniques, such as the Last Planner System, Target Value Design, and applies them in a building project delivery process.

Plan Percent Complete
Calculated as the "number of assignments completed on the day stated" divided by the "total number of assignments made for the week".

Reliability Metric
The extent to which a plan is an accurate forecast of future events, measured by Percent Plan Complete. Example: If your weekly work plans have a 60% PPC, they accurately predict completion/release of 60% of the tasks represented as weekly assignments.

Target Value Design
A disciplined management practice to be used from definition through construction to assure that the facility is designed within budget and meets the operational needs and values of the users. The process goal is to increase value and eliminate waste (time, money, human effort).

Visual Management
Production activities, plans, schedules, measures and performance indicators are displayed in plain view. This assures that the status of the system can be understood at a glance by everyone involved and actions taken are in support of system objectives.

Source for Definitions
Lichtig, W. and G. Howell. (2011). *LCI Lean Project Delivery Glossary. Lean Construction Institute: Building knowledge in design and construction.* Retrieved March 13,2012. From http://www.leanconstruction.org/glossary.htm

Acronyms

AIA	American Institute of Architects
BIM	Building Information Modeling
CIFE	Center for Integrated Facility Engineering
CM	Construction Manager
GC	General Contractor
GMP	Guaranteed Maximum Price
LCI	Lean Construction Institute
LPS	Last Planner System
IPD	Integrated Project Delivery
PPC	Plan Percent Complete
TVD	Target Value Design
VDC	Virtual Design and Construction

Helpful Links

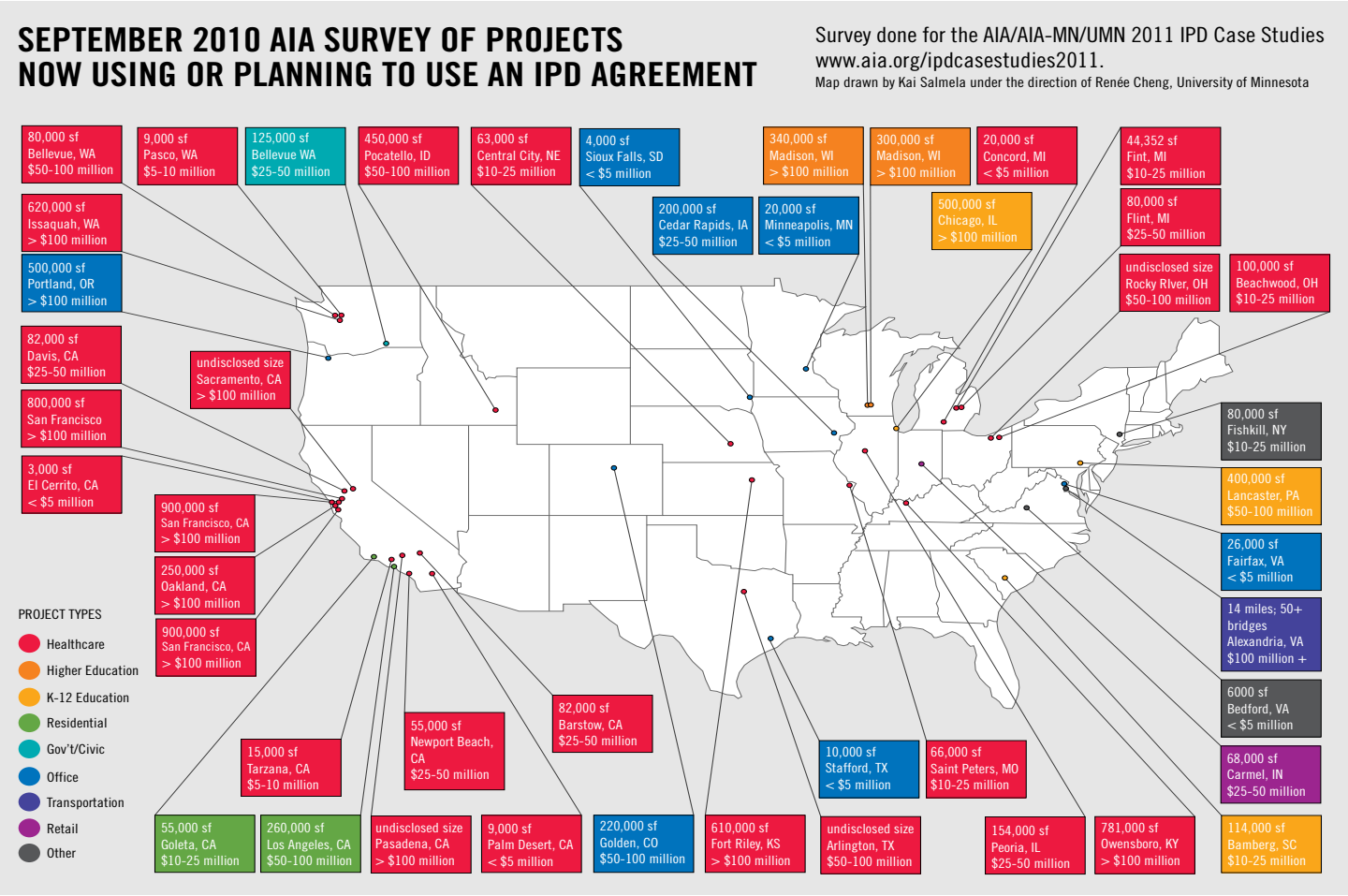
AIA Center for Integrated Practice
http://network.aia.org/centerforintegratedpractice/home/

AIA Programs & Initiatives: Integrate Practice – Integrated Project Delivery
http://www.aia.org/about/initiatives/AIAS078435?dvid=&recspec=AIAS078435

Lean Construction Institute
http://www.leanconstruction.org/index.htm

Center for Integrated Facility Engineering
http://cife.stanford.edu/

National Map of IPD



Degree of IPD

	Overview					Legal and Commercial Strategies						Managment Strategies					Social Strategies		Workplace and Technological Strategies			
	Market Sector	Location (state)	Team Size (individuals)	Building Size (sf)	Project Cost ($ millions)	Multi-party contract	Liability Waivers	Integrated project insurance	Shared risk/reward	Financial Incentives tied to goals	Fiscal Transparency	Strong Leadership	Intensified planning/ team building	Mutually defined/ aligned project goals	Inegrated team structure	Implementation Tools (i.e Lean)	Early involvment of key players	Collaborative decision making	Co-location	BIM	Networked sharing/ communication	Interactive artifacts (Smart board, visual mgmt. tools)
Cathedral Hill Hospital	Health	CA	123	858,000	1028.5	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
MERCY Master Plan Facility Remodel	Health	OH	60	94,439	19.4	●			●		●	●	●	●	●	●	●	○		●	●	●
Lawrence & Schiller Remodel	Office	SD	10	7,000	.5	●			●			○	○	○	○		●	○				
SpawGlass Austin Regional Office	Office	TX	16	15,370	2.8	●	●		○	○	●			○	○			○		○	●	
Edith Green Wendell Wyatt Federal Building	Office	OR	114	525,421	123.2				●	●	●	●	●	●	●		●	●	●	●	●	●
Autodesk Inc.	Office	MA	-	55,000	13.4	●	●		●	●	●	●		●	●		●	●	○	●		
Sutter Health Fairfield Medical Office Building	Health	CA	-	69,948	19.5	●			○		●	●	●	●	●	●	●	●		●	●	
Cardinal Glennon Children's Hospital Expansion	Health	MO	-	138,000	45.6	●			●		●	●			●	○	●	●				
St. Clare Health Center	Health	MO	-	430,000	157.2	●					●	●	●	●	●	●	●	●	○	●	●	
Encircle Health Ambulatory Care Center	Health	WI	-	157,000	38.6	●			●	●	●			●	●	○	●	●		○	●	
Walter Cronkite School of Journalism	Edu	AZ	-	230,000	72.1						●			●	○	○	●	●	●	●		○
UCSF Mission Bay Medical Center	Health	CA	-	878,000	1300.0					●	○	●	●	●	●	●	○	●	●	●	●	●

Cathedral Hill Hospital

Overview

Project Description

Location	San Francisco, California
Type	Healthcare - New Construction
Contract	Single Multi-party Contract – IFOA
Owner	California Pacific Medical Center, A Sutter Health Affiliate
Architect	SmithGroup
Contractor	HerreroBoldt – A Joint Venture
Project Start	August 2007
Est. Completion	March 2015

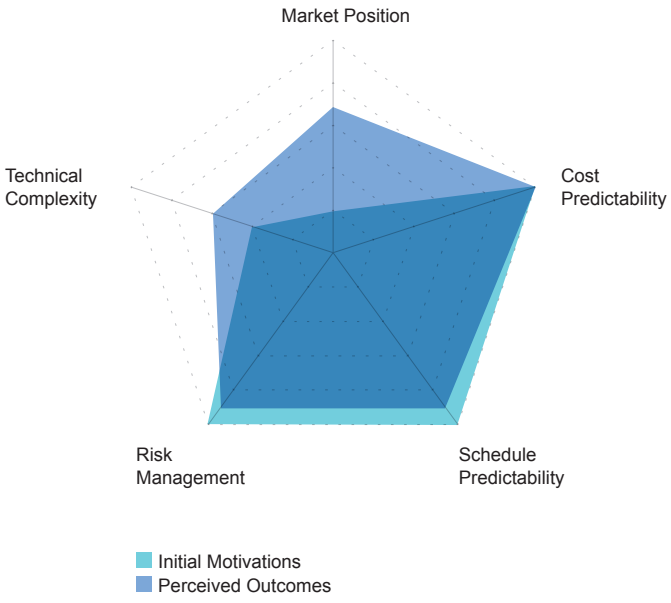
In 2000, California Pacific Medical Center (CPMC), an affiliate of Sutter Health, hired the architecture firm, SmithGroup/SOM, a joint venture, and SMWM to design the consolidation of two acute care facilities on one of CPMC's existing campuses. There were concerns about maintaining operations during expansion, so in 2002 when a property became available within the San Francisco metro area that was well suited for a new medical center, CPMC reconceived the project as a new hospital facility, the Cathedral Hill Hospital. After several years of planning, the project ran into budget and entitlement timing concerns and was put on hold in 2005.

At this time, Sutter began to broadly address problems of budget and schedule overruns occurring in many of their projects, eventually adopting Integrated Project Delivery and Lean Construction as their new method of project delivery.

In 2007, SmithGroup was invited to continue working with CPMC to design the new 860,000 sf, 14 level hospital to house 555 beds, under the condition that they enter into Sutter's version of a multiparty contract, Integrated Form of Agreement (IFOA). Although relatively new to IPD, SmithGroup, and several of their design consultants, were interested in pursuing the project. Shortly after SmithGroup committed, Sutter brought in the contractor HerreroBoldt, and immediately thereafter, primary trade contractors were engaged.

Construction was originally scheduled to begin in 2010, however due to entitlement challenges with the city, construction was put on hold. This added two years to the design phase; the flexibility of IPD enabled the team to slow down the pace of production without claims or added change orders to the owner. Resources were shifted from an anticipated 40-50 detailers to maintaining 16 detailers over a longer period of time. The focused effort with fewer people actually resulted in a higher productivity rate, likely due to the continuity of team members and intimacy of the team, and avoided the inefficiencies of coordinating within a large team. The additional time also allowed the team to more fully coordinate the drawings prior to agency approval, an opportunity anticipated to significantly reduce field changes and subsequent agency review. At the time of follow-up, construction was anticipated to begin in April 2012.

IPD Profile



Market Position was not a motivator for the owner. However, California Pacific Medical Center created a market by making IPD a requirement for the commission. For the architect, this project allowed them to enter the IPD arena. For the constructor, a new joint venture was formed specifically for this project.
Perceived Outcome: Both the contractor and architect have noticed increased market opportunities due to their experience with IPD. The contractor started using principles of IPD and Lean Construction prior to this project and had a hard time selling it to customers. Now more owners are becoming aware of IPD and looking for firms with the experience, benefiting this contractor. For the architect, this was their first IPD project and they have seen significant benefit from this project; although most collaborative projects the firm has won since this experience are smaller projects that employ only some IPD tactics such as co-location and collaborative relationships.

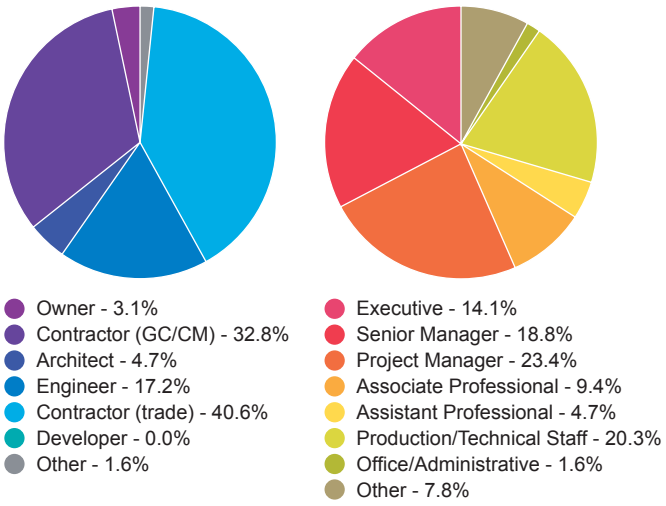
Cost Predictability was Sutter's primary driver for using IPD as a company. Enterprise-wide they were highly motivated to keep project costs reasonable.
Perceived Benefit: The team has tracked metrics and found that the owner has earned a 400% ROI on the costs invested beyond typical design to bring trades on early. They provided valuable ongoing cost estimating as part of the Target Value Design process.

Schedule Predictability was an important driver of using IPD because of several critical variables bearing on the project. California instated a 2013 deadline for meeting seismic and seismic retrofit requirements (California State Senate Bill 1953 and 1661). The complexity of the building and permitting process in San Francisco will make that deadline difficult to meet. Aging current facilities for CPMC demand investment to keep them functional, creating additional financial incentives to complete the new facility quickly.
Perceived Benefit: This project is on hold due to entitlement delays with the site and they are not in construction, this made evaluation of this topic difficult. IPD has allowed the team to design the production delivery. They are trying to make this project as efficient as possible and anticipate it will significantly reduce issues in the field and make the schedule much more predictable

Reduced Risk was a major motivator for the owner to shift to IPD. Sutter realized that their capital investments in construction could be better protected from risk with IPD.
Perceived Benefit: IPD has significantly improved trust between trades and eliminated contingencies.

Technical Complexity was not a primary motivator for the owner to pursue IPD. Although a hospital is a complex building type, the owner has experience achieving complex projects with traditional delivery.
Perceived Benefit: IPD has allowed the team to design to a very fine level of detail on a highly complex building type. IPD was a change for the architects, who, on other delivery types would be on the outside trying to defend the design from changes made in detailing phases. The architect felt the technical aspects of the project have benefited from the integration.

Survey Data



BIM Experience
BIM was implemented to an advanced degree, see BIM. Model management was shared by the architect and the contractor. Participants that interact with BIM in a technical way represent 39.1% of participants; the majority are contractors (trade, 52.0%; and GC or CM, 38%), followed by architects (12%). Most were production/technical staff (40.0% this includes detailers and trade coordinators) or project manages (36.0%). The technical ability was evenly distributed between participants self-identifying as expert ability, intermediate ability, and fundamental ability.

Previous Experience
Participants overwhelmingly indicated (92.2%) that their organizations had previous working experience with each other.

Furthermore, 60.9% of individuals had previously worked with other team members. This past experience was likely a factor in organizations' willingness to embark on an integrated, collaborative delivery model, still a very new model with several unknowns.

Multi-party Agreement

This project used a multi-party agreement, see Contract. While 60.9% of survey participants were aware their firms entered into a multi-party agreement, 26.6% were unsure. Also important to note, 12.5% responded incorrectly that the project did not have a multi-party agreement. Of the 60.9% who were aware, they perceived that the contract positively affected (Mean = 2.67, where 3=positive effect, -3=negative effect) their trust and respect for project partners.

Of the 26.6% that were not sure if the project had a multi-party agreement, 64.7% represent the contractor (trade) and 23.5% represent engineers. Generally those unsure were in lower level positions including project production/technical staff (41.2%) or field and labor managers (17.6%).

The 12.5% of participants that incorrectly answered represented the contractor (trade; 75%). Surprisingly, of those that incorrectly responded, 87.5% were at or above the project management level (Executive 37.5%; Senior Manager 12.5%; Project Manager 37.5%). Given that many represented trade contractors, it could be that these representatives were not included in the 9 party IFOA but there is no data to verify that possible explanation.These findings may also indicate a lack of communication to the larger team, particularly to the trade contractors.

Risk/Reward

This team had a shared risk/reward pool on this project, see Risk/Reward. An overwhelming majority of participants were aware of this strategy, with 94.8% aware, only 5.2% not sure, and none answered incorrectly. This indicates that this strategy was widely and effectively communicated, more than any other contractual term. Survey participants perceived that the shared risk/reward incentives positively affected (Mean=2.4, where 3=positive effect, -3=negative effect) their trust and respect for project partners.

Liability Waivers

This team had waivers on liability, see Liability. This strategy was not well communicated to the team with 58.6% of participants unsure and 10.3% incorrectly answering that there were no limits on liability. Only 31% of participants were aware of this strategy and were broadly distributed among contract parties. They perceived that the liability waivers positively affected (Mean=2.24, where 3=positive effect, -3=negative effect) their trust and respect towards the other contracting parties.

The majority of participants (58.6%) were unsure of this strategy and primarily represented the contractor (trade, 44.1%; GC or CM, 32.4%), engineers (14.7%), and the owner (5.8%; note this represents 100% of the owners surveyed). The 10.3% of participants that incorrectly answered there was no limits to liability represented the contractor (GC or CM, 50%; trade, 50%). These results indicate these questions were unclear or the limits to liability were not well understood among the participants, regardless of contract party or job level.

Fiscal Transparency

This project was fiscally transparent between contracting parties, see Transparency, and widely displayed visual metrics of cost targets throughout the workplace, see Implementation. Survey data indicated that 67.2% of participants were aware of the fiscal transparency, while 27.6% were not sure and 5.2% answered incorrectly that there was no fiscal transparency. Of the 67.2% that were aware of the transparency, the majority represented the contractor (GC or CM, 43.6%; trade, 38.5%) and they perceived the strategy to have a positive effect (Mean = 2.34, where 3=positive effect, -3=negative effect) on their trust and respect towards the other contracting parties.

Of the 27.6% of participants that were unsure of this strategy, the majority represented the contractor (trade, 37.5%; GC or CM, 25%), followed by engineers and architects (18.8% each).

Legal and Commercial Strategies

Contract

Single Multi-party Contract

- Integrated Agreement for Lean Project Delivery Between Owner, Architect & CM/GC – also referred as Integrated Form of Agreement (IFOA)

Contract Issued

- August 1, 2007

In 2007, California Pacific Medical Center (CPMC) made the decision to use an Integrated Form of Agreement (IFOA) to deliver the Cathedral Hill Hospital in San Francisco. By then, Sutter was fairly experienced with IPD and Lean Construction having completed the Fairfield Medical Office two years before. On Fairfield, Sutter used an innovative IFOA agreement created for them by attorney William A. Lichtig, see more in Sutter Health Fairfield Medical Office Building. The IFOA used on this project, Cathedral Hill Hospital, evolved compared to the Fairfield agreement, particularly refining the definition of shared risk/reward terms. Due to the entitlement delay, the IFOA was renegotiated in late 2011, again revising the shared risk/reward terms to reflect further evolution of Sutter's IFOA, see Risk/Reward.

The IFOA addressed collaborative commercial terms, relational expectations, and the use of specific implementation processes, such as Lean Project Delivery tools, to support the relational expectations.

Commercial Terms

The Sutter IFOA included well-known collaborative commercial terms such as: shared risk/reward, performance incentives, compensation incentives, waiver of liability, and allowance for an Owner Controlled Insurance Program (OCIP) or project specific insurance.

Relational Expectations

The agreement included some soft language defining the relational and behavioral expectations, for example Article 3.3 Trust states, "Parties shall work together in the spirit of cooperation, collaboration, and mutual respect for the benefit of the Project."

Social Strategies

A large proportion of the IFOA defined tools and tactics to achieve relational expectations and processes to perform the design and preconstruction work. Many of the tools implemented on this project were based on Lean Construction practices, such as reliable promising, pull-based design production, Target Value Design, and the Last Planner System. Meeting frequency requirements were clearly defined for the Core Group, the executive level leadership, as well as their responsibilities in terms of developing work procedures for leading the Integrated Project Delivery Team.

Goals

According to this team, one of the most critical components of goal development and alignment on an integrated team is having an actively involved owner.

Goals

The process started with the list of owner's design goals:

- Excellence in clinical care
- Education
- Community service
- Patient satisfaction
- Family involvement with the patient
- Private rooms

As the project evolved, the owner identified several additional items they wished to add, the team referred to these as Value Added Items and tracked them on a separate budget line since they were not planned or funded in the original program or estimated maximum price. As the team reduced costs through collaboration, innovation, and coordination, they were able to include some of the value added items the owner desired, see Culture for specific cost saving innovations.

Communication and Alignment

These goals were clearly communicated to the integrated team. Active involvement from the owner helped to reiterate, on an ongoing basis, what was of greatest value to them. Additional reminders were printed at large scale for posting in prominent locations around the co-located office. The posters acted as a constant reminder of client expectation to the team.

Risk/Reward

The IFOA established a risk-pool that the architect, CM/GC, primary design consultants and primary trade contractors were bound to. In this case, the IPD team members participating in the pool put a percentage of their profit at risk to partially fund cost overruns or other project liabilities if any occurred. As a positive incentive, this pool would provide payments if the team achieved actual costs below the estimated maximum price.

The architect and CM/GC placed 25% of their preconstruction and construction fixed fee profits at risk. At the time the contract was executed, the following additional parties were included in the Risk Pool IPD Team:

Architect's Consultants: Degenkolb Engineers (structural), Silverman & Light Inc. (electrical), Ted Jacob Engineering Group Inc. (M/P),

Trade Contractors: Rosendin Electric (electrical), Southland Industries (mechanical), Charles Pankow Builders, Ltd. (concrete)

In late 2011, the team went through a process of renegotiating their IFOA to be consistent with changes Sutter had implemented in recent IFOA projects. One of the revisions Sutter had made to their standard IFOA was the elimination of risk sharing and incentives for pre-construction. Instead of putting 25% of preconstruction profits at risk, they shifted to a 100% construction profits at risk model.

These revisions did not change the risk profile or actual financial numbers much for the CM/GC. The architect, however, is concerned that these changes will negatively affect the target value design process. With the original model, the team was incentivized to reduce costs below the estimated maximum price during the design phase. The shift to construction-phase-only incentives may result in the team holding onto cost savings ideas until construction starts. At the same time, the architect believed that the risk/reward incentives were not the primary motivator for team members to successfully collaborate and take ownership of the project. He felt the financial incentives primarily function as "bait" for the firms at an executive or VP level.

Liability

Sutter's IFOA Article 33.1 explicitly limits liability between all Risk Pool IPD Team members (see Risk/Reward) and the owner. Any liabilities that arise related to the agreement, work or project would be satisfied exclusively from the At-Risk Pool Account. Exceptions to these limitations contain specific insurance-related conditions and include liabilities arising out of willful misconduct or intentional abandonment.

Furthermore, the agreement protects the architect and architect's consultants if a government agency requires them to over-stamp a sub-contractors equivalent of a shop drawing. The contract states, "neither the Architect nor Architect's Consultants shall assume any responsibility and/or liability for authorship or technical aspects of those documents."

Dispute Resolution
Should any claim arise in connection with the agreement, the Parties, including all consultants and sub-contractors, are required to follow the dispute resolution procedure defined in Article 41 of the IFOA. The dispute resolution procedure sets out rigorous internal review processes following submittal of a Notice of Potential Claim to the Core Group. First, the owner, architect and CM/GC would hold a "Special Meeting" and attempt to resolve the issue through reasonable negotiation. If unresolved, the Claim would be elevated to the Core Group (made up of senior members of each major stakeholder). If the Core Group cannot reach resolution, the Claim elevates to the Senior Executives of each respective organization, who would meet, exchange information, discuss candidly and reach a reasonable compromise. Before entering non-binding mediation, an independent expert would be brought in to review the Claim, the cost of which would be shared among the Core Group members. Should the internal process not result in resolution, any party has the option of initiating confidential and non-admissible mediation procedures using a third party mediator. The cost of such would be borne by only the parties in dispute. If the claim reaches an "unresolved impasse," the parties have the option of pursuing the "legal and equitable remedies available to them."

Insurance

At the time this case study was conducted, the Cathedral Hill Hospital IPD Team was still determining how the project specific insurance would be handled. This project will be one of the first to use an insurance product designed specifically for Integrated Project Delivery. Two major insurers visited the project site to familiarize their understanding of the processes and will be presenting IPD insurance options to the team in January 2011.

General Liability and Professional Liability insurance is required for the architect and the architect's consultants. The contract requires standard CM/GC insurance, however as noted above, the team will be using an IPD specific insurance product. It is yet to be determined if this will be an owner or contractor controlled policy.

Management Strategies

Leadership Organization

Champion

- Owner
- CM/GC

Team Structure

- Core Group
- Cluster Groups

California Pacific Medical Center (CPMC) is an affiliate of Sutter Health, a large healthcare owner that has pioneered IPD since 2005 (see Contract). Sutter and Boldt have experience with IPD and Lean Construction. Together they have been championing the process on this project team, although the owner primarily operates at the executive (Core Group) level.

Owner involvement is one of the key differences between IPD and design-build, see Goals. The owner's ongoing input was critical to inform the team of items most valuable to them as the team went through the process of Target Value Design (see Implementation).

Team Structure

As defined in the Integrated Form of Agreement (IFOA), the Core Group provides primary leadership. The Core Group consisted of a senior representative from Sutter Health (specifically from their division of Facility, Planning and Development – referred to as the FPD), California Pacific Medical Center (owner), SmithGroup (architect) and HerreroBoldt (CM/GC). The Core Group was responsible for project coordination, management and administration consistent with principles of Lean Project Delivery. Sutter's representative from their FPD division facilitated and coordinated the activities of the Core Group. CPMC's representative was responsible for coordinating activities between the project participants and ensuring that decision makers on the owner's side are available as needed.The team discovered a deficiency in owner involvement as they worked through the value added list (a list of items identified as desirable by the owner but not previously budgeted). The team realized they needed more input at the user group level, specifically clinical operations, to better prioritize those items. The owner addressed this by bringing a representative from hospital operations onto the project team.

Leadership was further distributed into a series of Cluster Groups, which are interdisciplinary groups comprised of architects, engineers and trade partners. Cluster Groups were assigned to specific design areas, for example, structural, exterior, interior, and medical equipment. Each cluster was responsible for designing their assigned segment within the Target Value (see Implementation and
Early Involvement) using whatever resources required.

Champion

Each of the three parties, owner, architect and CM/GC, championed the integrated delivery process in different ways. Members of the Core Group occasionally dropped into Cluster Group meetings to observe the process and offer suggestions. In the beginning of the project, Sutter's Facility, Planning, and Development (FPD) representative regularly attended the Target Value Design and Last Planner meetings to help coach people through the cultural and behavioral expectations of IPD and Lean.

After several years of working together, the team's culture did not need extensive oversight. However members of the Core Group continued to engage the team to stay up to date of progress and to observe team performance, making adjustments and improvements when needed. For example, leaders noticed that visual metrics were prevalent around the office, but metrics and formats were not standard between cluster groups. In preparation for construction, leadership requested cluster group leaders coordinate one set of graphic conventions so that a viewer could immediately comprehend the status of each team and the project as a whole, a rule referred to as "30 seconds at 3 feet."

Boldt, with their extensive experience and history with the Lean Construction Institute and real commitment to continuous learning, served as a mentor to educate the Integrated Project Delivery Team on Lean. Specifically, Boldt appointed one individual as the Value and Lean Process Manager, responsible for incorporating Lean Construction practices into the IPD Team. This individual trained team members in Lean practices and task management tools through regular Study Action Groups. All team members, regardless of experience level, participated in these groups.

Firm Selection

Architect
SmithGroup was one of the firms originally contracted with California Pacific Medical Center (CPMC) for the original Cathedral Hill Hospital design. That project was put on hold and restarted 2 years later using Sutter's Integrated Form of Agreement (IFOA). Based on SmithGroup's past experience with CPMC, the architect and several of their consultants were invited back to work on the restarted Cathedral Hill Hospital project.

The architect observed that SmithGroup has been trending away from the traditional design-bid-build to alternative delivery models. They discovered that the IPD arrangement used in this project is far superior to the other delivery models and they intend to identify appropriate clients who agree to work this way in the future. They found that the team relationship formed through the IPD process allows for a better design process.

Contractor (CM/GC)
Sutter and Boldt both studied IPD and Lean Construction for over seven years and had formed key relationships through that mutual interest. Furthermore, both entities have strong relationships with the Lean Construction Institute and Glenn Ballard. Given this shared history and mutual respect, Boldt was well aligned with CPMC and Sutter's values and goals for the project.

HerreroBoldt is a joint venture firm between Herrero Contractors Inc. and The Boldt Company. The two contractors formed this partnership in response to the Cathedral Hill RFP. Herrero Contractors is a local firm familiar with the San Francisco market and Office of Statewide Health Planning and Development (OSHPD) requirements, while Boldt is experienced in large-scale healthcare projects and Lean Construction and had a long-standing relationship with Sutter.

Design Consultants
Many of the design consultants working on the original renovation project carried over to the Cathedral Hill Hospital project. For consultants, previous experience in IPD or pre-qualifying their ability to collaborate was secondary to the continuity gained by building on previously established goals, values and ideas. A few consultants were not comfortable with the collaborative process set forth for Cathedral Hill and declined to participate. All consultants that committed to the project went through the Study Action Group training to educate them in the philosophy of IPD and Lean Construction.

Trade/ Sub-Contractor
In contrast to the selection of the design consultants, trade partners (or sub-contractors) were subject to a thorough selection process specifically targeting their collaborative experience or demonstrated ability to collaborate. Three primary trade partners who had established relationships with Boldt were brought onto the project very early. Each had already incorporated Lean Construction practices into their organizations and demonstrated willingness to pursue Integrated Project Delivery.

An extensive and collaborative review process was used to select additional trade partners. Cluster Groups generated the initial list of potential trade partners and the CM/GC pre-qualified the list before presenting to the Core Group. These pre-qualified firms were required to respond to an RFP presenting typical budget and profit margin information as well as their experience with or willingness to be a part of an integrated project delivery process. Shortlisted firms were interviewed by a cross section of the IPD Team, including someone from the CM/GC, design firm, design consultants, the owner and other trade partners. These team members provided their recommendations to the Core Group who made the final selection.

The most highly prized characteristic was the willingness to collaborate. This was particularly critical for this project since full participation by trades was required during the Target Value Design process and there was no intention for any hard bid or lump sum sub-contracts.

Team Selection

According to the contractor, the type of individuals they selected were innovative thinkers with an entrepreneurial spirit and an element of leadership. Because everyone on the team had the ability to influence the design, confidence to offer input was crucial. A "top down, central command approach does not work on this project," so along with the characteristics above, a humble and collaborative style was just as important. In an IPD project, there is a great deal of uncertainty and each individual has to have the ability to adapt daily, sometimes following and sometimes taking the lead.

The architect formed a team with a variety of experience levels and technical abilities. They felt there was no special experience or skill requirements unique to IPD since the process provides excellent opportunities for mentorship and learning at all phases. They did however observe that IPD was a challenge

for individuals who have been practicing a certain way for many years. Shifting their familiar roles and responsibilities to take input from non-designers was uncomfortable for some.

Project Planning

Resources Referenced

- Experienced IPD Team Members (Owner Organization, CM/GC Organization)
- Sutter Health IFOA
- Lean Construction Institute

Compared to a traditional project delivery, there is a great deal more time spent planning out the process in IPD. Because IPD was new for a large number of individuals on the team, the project moved intentionally slow in the beginning. This allowed team members to develop and learn new processes while getting to know each other. There was a great deal of time spent on planning before design work began.

Of great value to this project was past experience in IPD and Lean Construction by Sutter, Boldt and many key individuals of the IPD Team. The team leveraged their experience and resources, which allowed them to further refine previously developed IPD process, such as the Target Value Design plan and the Last Planner Process, for the Cathedral Hill Hospital project (see Implementation and Early Involvement).

The strong relationship with the Lean Construction Institute (LCI), who is partnered with UC Berkeley, was an asset for this project. The project benefited from regular visits by Glenn Ballard of LCI, an expert in Lean Project Delivery, and graduate students who observed and reported their observations of the project team. Students reported on different areas of their practice, such as the Last Planner System, change order processes, and accounting practicing, which helped the team evaluate and improve their own performance.

Budgeting Team Effort

Each organization has had to remain very fluid in terms of staffing, especially given the delay due to entitlement challenges. Additional time during preconstruction was compensated based on time and materials, consistent with the terms of the IFOA.

Accurately budgeting for effort proved to be difficult for the architect. SmithGroup anticipated additional effort, but assumed, while it would be more than traditional delivery, it might be similar to design-build. Based on the bell curves of effort often cited for IPD projects, they expected most of their effort to be expended during schematic design and design development before handing off much of the work during construction documents to the contractor and trade partners. With this IPD project, effort required in the early phases was as expected, but the biggest surprise was the sustained high level of effort required during detail design. This was opposite of what they expected, as the architect stated, "we are designing how we are going to build the building."

Late in the pre-construction phase, the team found that the distinction between documentation and construction activities was blurred. Documents are significantly more coordinated on an IPD project than on traditional projects, and it is expected that the architect's involvement in the construction phase will be less demanding than early phases. The architect also anticipates that their increased involvement in the coordination activities will lead to additional efficiency, reduced waste in the field and a return to the risk pool.

Rethinking Staffing

Typically the architect would spend 75% of their fee producing the documents for agency review, greatly reduce their staff and then ramp back up to respond to comments. CA would be completed with the fee remaining. In that scenario, there is incredible pressure on the architects and consultants to put more people on the job at the documentation production stage.

On this project however, the integrated team agreed, "the best way to save money on this project is to spend money on the architects and engineers and the rest of the team to be working on those documents." Team members observed that early and continued involvement by consistent team members reduced the number of handoff points, thereby maintaining project knowledge and reducing disconnects between designers and contractors.

Another difference on an integrated project is the investment in process management staff. This project employed individuals at multiple leadership levels to manage the integrated team performance through education of the team on information exchange and process management tools, planning of design and production sequencing and supporting continuous improvement ideas.

Implementation

Tools

- Multiple Lean processes
- Target Value Design
- A3 and A4 Reports
- Choosing by Advantages (CBA)
- Co-location
- BIM

The Integrated Form of Agreement (IFOA) stipulates that the IPD Team use the Last Planner System (a Lean Construction tool) for planning and scheduling of design coordination and implementation. As part of the Last Planner System, the IFOA requires, at a minimum, the development of "a milestone schedule, collaboratively created phase schedules, 'make ready' look ahead plans, weekly work plans, and a method for measuring, recording and improving planning reliability." The IFOA describes each one of these Last Planner System tools and processes in detail.

To implement the design, the IPD team organized into interdisciplinary Cluster Groups. These groups were separated by design area, for example exterior architecture, interior architecture, structural, medical equipment, etc. Each group was responsible for coordinating their design area both internally and between other Cluster Groups or design areas.

Work within each Cluster Group was facilitated using the Last Planner System. The Last Planner system required each group to work backward from the milestone and phase schedules to develop their weekly work plan. Work plans in conjunction with detailed weekly look-ahead schedules identified activities required to meet schedule and any constraints in the way of those activities. Activities were converted into commitments, which were assumed by individuals who promised to fulfill them within a week or two week time period. By tracking commitments, groups were held accountable by a reliability metric that was measured on a weekly basis. The Last Planner process not only helped individuals become more reliable, it also improved their ability to identify and communicate what they need to achieve their commitments. The goal on the Cathedral Hill Project was to maintain 90% reliability in each Cluster Group, a significant improvement from the 50% average estimated by the CM/GC's project executive for a traditional delivery process.

Regular meetings were set up for formal cross-Cluster coordination. These meetings occurred on bi-weekly basis during the intense design phases and shifted to a weekly meeting as the design was finalized. These meetings provided a forum for teams to report on their Last Planner commitment status and score each group's reliability, helping hold Clusters accountable for their goals and commitments.

Each Cluster Group also followed a Target Value Design (TVD) process, which designates value, cost, schedule, and constructability as basic components of the design criteria, see Early Involvement for advantages of TVD. This process required the CM/GC and trade contractors assigned to each Cluster Group to provide ongoing cost information and estimating. This input was intended to help shape the design, especially informing system selection and detail development, thus ensuring the design met the value targets established by the Core Group. This is one of the key reasons owner involvement is critical, they provide ongoing feedback to prioritize items of greatest value to them. Target Value progress and target achievement was also reported in the weekly IPD Team meetings, another tool that helped hold each Cluster Group accountable for meeting value targets.

Increased collaboration and coordination inherent to IPD resulted in an increased number and frequency of meetings. This fact made using tools such as BIM and the Last Planner System, more critical to ensure meetings were effective, short, and directed towards solutions.

Specific process tools were used to facilitate coordination and decision-making among the IPD team members. An A3 report and the Choosing by Advantages (CBA) system was used to formalize the project decision-making process, see detailed information in the Decision Making section. An A4 report embraced a similar strategy that assisted the BIM design and detailing coordination, see BIM.

Lean was an integral part of this integrated project; it was the organizing operating system. Once the design matured to a level of certainty, the design detailing process embraced the Lean production line philosophy. They employed ideas like the workable backlog; if an issue caused the production line to halt, they found ways for the majority of the team to continue working on areas unaffected by that issue.

Lean tools such as Target Value Design were used in conjunction with the budget flexibility provided by the IFOA agreement. Cluster Groups could make trade-offs between building systems, i.e. spend an additional $1 million on electrical but save $5 million on mechanical. A non-integrated contract would require contract renegotiation, reductions in scope, and other time consuming obstacles.

The use of BIM coupled with co-location facilitated informal and formal Cluster Group interactions and had significant positive impact on team relationships and design coordination and implementation. BIM coordination happened in real time and provided an accurate picture of each Cluster's status and co-location allowed many issues to be resolved within minutes.

Social Strategies

Early Involvement

CM/GC

- Validation (Feasibility/Programming)

Trade Contractors

- Validation (Feasibility/Programming)

The contract required the CM/GC, trade partners and suppliers to provide input early, during the validation and preconstruction phases of the project.

The owner, California Pacific Medical Center (CPMC) and Sutter Health paid a premium for the early involvement of team members to supplement the A/E team. Involving the contractor and trade partners from the very beginning of the project was a significant investment, but at the time this study was conducted, had yielded measurable savings. According to the contractor's project executive, the owner had already achieved a 200% return on investment (ROI) for the additional cost of IPD pre-construction services. The return comes from savings in project costs. The initial target cost developed by the team early in the project was approximately 14% or $80 million below market average. At the time of this report, the team estimates an additional $22 million dollars will be saved below the market average. The team is continuing to track this ROI throughout the process.

These significant savings have been primarily attributed to the Target Value Design (TVD) process. This process held all team members accountable for designing the most value within the target cost. Cost information was collaboratively developed before the design was fixed, allowing cost to influence design instead of applying value engineering to revise a completed design.

Early involvement was essential to the Target Value Design process. For example, each Cluster Group had an estimator who provided cost feedback to designers on an ongoing basis. By feeding information into an iterative design process, design ideas can be tested against costs. Besides controlling costs, the TVD provided an important benefit by placing control of design and its cost with the architect; this ensured design ideas were not unreasonably diluted or compromised.

Complementary to the Cluster Group estimators, trades involved in early decisions brought detail and accuracy to the design. Additionally, as trade partners became more familiar with the project, they gained greater confidence in their ability to estimate costs, helping to eliminate inflation of prices and costly contingencies.

The team primarily focused on maximizing the value of the design, however information gained through the involvement of the trade partners brought a level of detail to the BIM model that the team believes will reduce material waste and construction time. The team cited a $400,000 savings gained by eliminating continuous backing for handrails. The BIM model accurately located each metal stud, so that backing was made redundant. Team members noted that in a traditional delivery method, the BIM model is rarely used to control construction costs at this level of detail.

It's important to note that while early involvement contributed expertise, the structure of the risk pool, see risk/reward, provided incentive for the IPD Team to reduce costs.

Transparency

All parties, including the architect, architect's consultants, CM/GC and trade partners were paid on a time and material's basis for the work performed during pre-construction services. Profits were based on a fixed fee with 25% of the fee exposed in the shared at-risk pool. This structure makes project finances transparent and ensures that all estimates are based on cost. According to the team, there have been no hidden contingencies or hidden allowances.

Construction services will be paid on a fixed fee, based on an agreed upon estimated amount of labor, to be determined in the Work Plan.

Decision Making

The primary vehicle used to formalize, document and evaluate project decisions is called an A3 report, named after the size of the piece of paper upon which it's printed. The team borrowed this tool from the car company, Toyota who uses it to evaluate complex decisions. The standard form A3 facilitated consistent problem identification, analysis, assessment and solutions. A3's could be initiated by anyone on the team and cover a range of issues; the criteria for its use was intentionally left undefined to give IPD Team members the ability to follow their own intuition and take initiative.

Once an individual formally initiated an A3, the form was submitted to the Core Group for review and final decision. The benefit of A3 reporting is that it documents the problem, records the involved parties, and establishes the assumptions for consideration. This provided the Core Group with a holistic understanding and created a consistent and effective format for them to evaluate the situation and make a final decision.

At the time of this report, over 300 A3's had been generated and more than 200 had reached resolution. So effective has the formal A3 process proven, Cluster Groups began to use informal A3 processes to work through routine problems.

The team also implemented the Choosing by Advantages (CBA) decision-making system. CBA a rigorous methodology for evaluating complex decisions with multiple stakeholders by identifying the relative advantages and importance of each option. The CBA method complemented the Lean A3 tool.

Culture

A number of factors contributed to breaking down traditional barriers and shifting traditional roles. The contractual arrangement, management tools, early involvement and co-location all contributed to the creation of a learning environment. For example, the Cluster Groups create highly collaborative interdisciplinary teams that might include two plumbing trade detailers, one HVAC trade detailer, and a technical architect – all sitting and working together. As the contractor described it, "that is unique because that would never happen on a traditional project." The architect observed that IPD allowed them design to a much higher level of detail than in a traditional project. The process provided them greater knowledge of construction assemblies and cost and thereby gave them more control of the design outcomes.

In general, team members adapted easily to the collaborative and integrated work style of IPD. Even though the team included well over 100 people, the project executives could identify only a handful of people who did not fit the culture and were removed from the team. IPD is difficult for individuals who have worked a certain way for many years and feel strongly that certain roles are sacred. For these people, it was difficult to change and relinquish some control. Given the nature of the Cluster Groups, those individuals quickly became apparent and typically were removed. While the learning curve varied, the vast majority of team members found IPD to be a very different but very rewarding way of working together.

At the time of this study, Boldt's project executive observed that after 3 years of co-location and collaborative working, the cultural shift to collaboration, innovation, and integration had become ingrained in the team's work habits. He commented, "I think people have just learned to work together. It has become more of an enterprise here; it's not separate companies as much as it is an enterprise trying to build this project." In his experience, this has not been the case on smaller projects where people go on and off the project at shorter time increments; they require much more continued and sustained leadership and guidance in the principles of IPD.

Benefit

One of outcomes of the integrated, collaborative culture was a team that was willing to question almost anything. According to the project architect, "you don't have to listen to the people who say, 'you know we've never been able to do that so let's not do it. '" An example of benefit from the interdisciplinary cluster group approach was a new design for patient lifts. The owner decided late in the project that they would like to have a patient lift in every room, however this was not feasible given the structural bracing, space and coordination requirements of the standard system. A junior level project engineer from the contractor asked why they couldn't use the booms already required for the medical monitoring devices. The boom manufacturer agreed it might work and this solution is currently under study, illustrating the team's willingness to explore ideas from any member.

Environmental and Technological Strategies

Workplace

Co-located – full time

At the time of this study, the team had been co-located for 3 years. They used space provided by California Pacific Medical Center (CPMC), which was located in a former a bank building. Given the previous use, the space had many cubicles that are not ideal for the collaborative intentions of IPD. According to the Boldt project executive, "people keep taking partitions down. We don't need them."

The office space included an abundance of publicly shared information to help communicate status, report on Last Planner System metrics, identify process issues, and remind individuals they are part of an Integrated Team (see Implementation and Information Sharing). Information and educational materials about Lean processes, learning resources, and Last Planner metric reports by Cluster Group were posted along a main central corridor within the office. Each Cluster Group was provided pin up space where images, diagrams, outstanding design issues and Target Value Design status were posted to help inform other groups of their status or coordination items needed.

Other protocols and tools, such as decision-making pyramids, were posted in multiple locations, such as conference rooms, to keep team members aligned with the design and team performance goals of the project. These visual reminders encouraged the team to embrace the Lean Culture, facilitate the integrated philosophy, and continue to serve as "advocates of the client" when making project decisions.

Co-location, coupled with early involvement greatly supported the relationship-building mission of IPD. These strategies allowed the team to become quickly acquainted with each other, build familiarity and trust that supported open communication and transparency.

Information Sharing

Tools

- SMART Boards
- BIM
- Face-to-face exchange – co-location
- Autodesk Buzzsaw
- Shared server (at co-located site)

Many of these tools were leveraged by co-location.
See greater detail on how information was shared publicly in workplace.

Meeting Frequency

- Weekly Core Group Meetings
- Bi-weekly/weekly IPD Team (Cluster Group Coordination) Meetings
  - Target Value Design
  - Last Planner System
- Daily Cluster Group Meetings
- Detailer Meetings
- Specialized as needed

With the increased planning and collaboration required in IPD, meeting frequency increased. It was important to incorporate tools to maintain meeting efficiency and effectiveness, (see Implementation).

BIM

Model Manager

- Shared between Architect (SmithGroup) and CM (HerreroBoldt)

Management Protocol

- Custom Virtual Design and Construction (VDC) – Issued November 12, 2010, replaced originally developed BIM Standards Book

A custom Virtual Design and Construction (VDC) document was developed that clearly articulated the procedures and responsibilities for modeling, coordinating and sharing the BIM model. BIM use was required of all IPD team members,

including trades. Primary management and coordination of the BIM was shared between the architect, SmithGroup and the CM/GC, HerreroBoldt.

On this project, they set a goal to have the BIM fully describe 4D (time), enabling the IPD team to simulate the construction process and virtually test construction alternatives to find an optimal method. The team also used BIM for 5D quantity take-offs on a weekly basis. The trades tracked their virtual construction production and were able to compare their weekly production in linear feet to their estimates.

Each company/trade participating on the IPD team was responsible for modeling the scope of their work in BIM. A Cluster Group assembled to manage BIM resources was comprised of a BIM champion from each company. The role of a BIM champion varied depending on the size and risk of each company's scope of work. For example, the BIM champion for a large company with a major investment in the project would fill a management role and delegate day to day execution to others, while a smaller company could appoint a BIM champion to serve as both manager and modeler. Each BIM champion was responsible for training their respective organizations in the Virtual Design and Construction (VDC) process.

The VDC document allowed each company to select the software and authoring tools with which they were familiar, with the caveat that their choices were clearly communicated to all BIM champions and were compatible with Autodesk Navisworks Manage. Any changes to BIM software were made following the A3 decision-making process (see Implementation) and required consensus of the BIM Champions.

Hardware selection was also addressed in the VDC. Before any project-wide implementation of hardware or software, stress tests were required. The stress test ran the systems loaded with an equivalent amount of 3D objects and data as the intended scope. The results of the test informed A3 decision making, provided feedback to software vendors, and informed decisions on how the model would be divided into specific design areas (e.g. exterior, interior, floor level).

Frequent sharing of progress models was encouraged. Progress models could be shared in their draft form as long as the file content and degree of completion was articulated and a File Sharing Checklist had been completed. Progress models could be posted for use by other IPD team members without requiring tedious "clean up."

Design and detailing in the BIM was guided by a Coordination Master Process. The goal of this process was to create a detailing environment and workflow that ideally eliminated all construction issues and conflicts before construction. An important tool used in this process is called an A4 report. The A4 is a standard one-page form that allowed the BIM Cluster Group to identify and record the detailing issues, identify the root cause of each issue in order to prevent future problems, prioritize issues to maintain streamlined production, and ultimately plot a path of resolution.

For each area of the building, a detailing schedule defined the sequence that trades would add their information. Sequencing trades to avoid model clashes required frequent progress updates and communication between IPD team members to ensure systems were populated in an orderly way. For example, the team discovered the designed ceiling height in the cafeteria and the size of the mechanical systems were in conflict. The issue was resolved, but the BIM team realized that a change in their process would have been allowed earlier discovery of the problem. The initial BIM process started with the first trade through a building area. The team revised the sequence to start with ductwork and sloping systems, which are the largest systems and ones which typically reveal conflicts with the architecture immediately.

Detailing was executed in two phases. Phase 1 modeling was done at a macro scale that followed a modeling sequence that mirrored construction installation. Phase 2 was done at a micro scale to meet the final construction level of detail (LOD). LOD was defined in a matrix form, similar to the AIA E202 document. The matrix identified the LOD of each building system or component for Phase 1 and 2, the responsible party, and the software platform used. Following a common LOD scale, most of the building systems were specified to reach 400, defined as 3D actual objects modeled for use in fabrication and assembly.

To ensure the Virtual Design and Construction (VDC) process was followed, Sutter Health regularly reviewed the team. Sutter had high expectations that this team address the virtual design lessons learned from Sutter's previous projects using BIM, IPD and co-location.

MERCY Master Plan Facility Remodel

PROJECT
MERCY Facility Master Plan Remodel

OWNER
Mercy Health Partners Regional Medical Center

ARCHITECT
Array HFS

CONTRACTOR
Donley's Inc.

Overview

Project Description

Location	Lorain, Ohio
Type	Healthcare - Renovation
Contract	Single Multi-party Contract – AIA C-191
Owner	Mercy Health Partners Regional Medical Center
Architect	Array Healthcare Facilities Solutions, Inc.
Contractor	Donley's Inc.
Project Start	February 2010
Est. Completion	January 2013

In fall 2009, the architecture firm Array HFS submitted a strategic facility master plan to Mercy Health Partners, a regional healthcare provider. The plan included a series of renovation projects within Mercy's Regional Medical Center in Lorain, Ohio. A short time after the plan was submitted, Mercy's board voted to proceed with the project and awarded the work to Array. After receiving Board approval, Array proposed an Integrated Project Delivery approach for the project. Mercy agreed to use IPD and to accept Array's recommendation of Donley's as the General Contractor. Array and Donley's, worked together to develop a custom IPD contract agreement to present to Mercy.

In spring of 2010, after several months of contract negotiations, the owner acknowledged that their understanding of IPD, particularly with regard to the legal terms, was not aligned with the architect and contractor. To facilitate resolving these differences, the owner brought in an IPD consultant. The owner's IPD consultant suggested using the recently released AIA C-191 Standard Form Multi-Party Agreement for Integrated Project Delivery as the basis for agreement. All parties felt the AIA document represented the majority of what they were trying to do with their custom agreement; however the contract continued to be negotiated for an additional 8 months until November 2010. During this negotiation period, the entire integrated team, which included the owner, architect, contractor, design consultants and first tier sub-contractors, was committed to the IPD process, worked (and were compensated) as if there was a contract in place.

IPD Profile

"I think in the end, the owner gets the most for their money. They get long-term reliability. Maintenance issues are addressed during construction that normally aren't, so they get a building that is more economical to maintain and get the features that they truly need based on what their budget could afford."
-Project Architect on the benefit of IPD to the owner

"There have been bigger projects, but this one is complex and we are dealing with unforeseen conditions everyday. It is good to have a team approach."

- Owner's consultant

"Even though from a cost standpoint $20 million is not a lot of money, we now realize we took on one of the toughest projects for Integrated Project Delivery [due to the complexity of renovating an older building]. The advantage is that we are learning the most about IPD and had to do it well with this tough project."
– Principal Architect, Array

Market Position was important for all parties involved. Array works exclusively in healthcare and recognized IPD was where their market was headed. They made the strategic decision to gear up their multiple offices and worked to prepare their regional partners for the shift to IPD. They had been looking for an opportunity to fully execute an IPD contract and Mercy Health Partners was the first to agree. As a large healthcare system, the owner has multiple healthcare facilities and was interested in finding a project delivery method that would be flexible, give them more control and better value.

Cost Predictability was not identified as an initial motivator for selecting IPD, but the team has already recognized the cost management advantages of the process. With a limited budget, cost was of "paramount importance." Having a team set up to work collaboratively and solve problems creatively has given everyone more control of cost containment.

Schedule Predictability was not identified as an initial motivator for selecting IPD, but the team discovered the scheduling advantages of having all the team members (owner, architect, contractor) coordinating. Given that the project is within an existing and operating facility, logistics and scheduling are both complex and critical to maintain hospital operations. The integrated nature of the team and close coordination with the owner allowed all of the activities occurring on the medical center campus, including activities internal and external to the project, to be combined into the team's construction schedule. This allowed the team to accommodate all of the owner's other initiatives, avoid conflicts, and better achieve the owner's goals

Reduced Risk was a long-term motivation for the owner. As a healthcare system they wanted to find a better way to manage projects. There was not necessarily a clear understanding of this advantage going into IPD, but the team has discovered that having an integrated and consistent team through the duration of the project significantly reduces risk to the owner. This is primarily due to the fact that the entire integrated team (owner, architect, consultants, GC, and subs) is responsible for addressing schedule, constructability, and cost; one discipline can't deflect issues to another. Positive or negative, the integrated team has to solve problems together.

Design Complexity was not an initial motivator for selecting IPD, but the team has recognized that the collaborative nature of the process coupled with early involvement has been a significant advantage, especially for a hospital remodel. Design and construction were happening concurrently for a significant portion of this project. With a 60+ year old medical center, there were many unforeseen conditions discovered during renovations that allowed the field team to provide detailed input to the design team to make better design decisions and avoid issues in the field.

Legal and Commercial Strategies

Contract

Contract Type:
- Single Multi-party Contract – AIA C-191 Standard Form Multi-Party Agreement for Integrated Project Delivery

Contract Issued:
- October, 2010

Array completed a Master Plan for Mercy Hospital and received approval to move forward with the project in fall 2009. Upon approval to proceed, Array proposed to the owner to follow an Integrated Project Delivery model, new for Mercy. After several educational presentations, Mercy Health Partners agreed that IPD was an appropriate delivery method for this project. The owner asked the architect to propose a contract for IPD. Array was inexperienced with IPD but had been researching the method for some time. The contract Array proposed was a custom agreement they developed based on other models, such as Sutter's Integrated Form of Agreement (IFOA). After reviewing the agreement, the owner realized their expertise

did not grant them a high level of comfort with the contract. In spring 2010 Mercy hired an independent consultant, an architect with experience in AIA contract documents and familiar with Lean Construction. The IPD consultant recommended using AIA C-191 Standard Form Multi-Party Agreement for Integrated Project Delivery in lieu of the custom agreement proposed by Array. All parties agreed the AIA document aligned well with what they were trying to develop in their custom document, so the owner opted to use the AIA C-191.

After the AIA C-191 was chosen, it took the owner, architect and contractor almost 8 months to negotiate and revise the document to develop an agreement with which all parties were comfortable. This time period was difficult but the entire integrated team, including the owner, architect, contractor, design consultants, and first tier sub-contractors, remained committed to IPD throughout the negotiations and continued work without a contract in place.

As a standard form multi-party agreement, the AIA C-191 contract incorporates the common range of IPD strategies, covering the areas of commercial terms, relational expectations, and implementation tools. There were a number of changes that had to be negotiated to reach consensus; most of these changes were regarding the commercial terms.

Commercial Terms

The standard contract language on compensation, risk, and reward incentives had to be modified to satisfy the owner, architect and contractor, see more in Risk/Reward. Limitations on liability were agreed to between the A/E and contractor, but the owner did not agree to waive liabilities, (see Liability) The insurance section was also edited; the owner wanted to follow a more traditional bond approach with conventional professional liability insurance for the architect and engineers. And finally the ownership and use of documents had to be negotiated to reach a compromise that protected both the architect and the owner.

Defining the contingencies was another significant addition to the standard form contract. Contingencies were critical on this project because they were operating with a very tight budget and multiple risks due to the high number of unknown conditions inherent to any renovation project. Two contingencies were established as part of the Target Cost breakdown, a Design and Construction Contingency and an Owner Contingency. The Design and Construction Contingency would cover "reasonable refinement" of design details within the original scope of the contract documents, and changes required by code officials. The Owner Contingency would cover owner scope changes, extraordinary events or circumstances, and unforeseen construction conditions that could not have been reasonably determined prior to work.

For any issues caused by errors or omissions in the documents, the team would be held responsible, but was given the option to use their profit pool, pay out of pocket or to use insurance proceeds.

Relational Expectations

There were also several modifications that redefined responsibility for particular contract requirements from "Parties" or "Team," in the collective sense, to one party in particular, such as the architect, contractor or owner. These modifications may seem to compromise the collaborative intent of the contract by putting in place traditional, isolated decision-making; however, interviews with the team indicate that these contractual definitions have not negatively affected collaboration.

Implementation Tools

The AIA C-191 includes several exhibits that help the team collaborate and align goals such as the Target Criteria Amendment and Target Cost. The agreement also recommends the use of collaborative technologies such as BIM.

Goals

Process

Goals were established with collaborative input from the team. The owner's IPD consultant developed and led the process of defining goals. Special effort was dedicated to this process, because lessons learned from other IPD teams warned that a lack of goal definition and alignment at the beginning of a project caused serious problems later. Compared with the long and difficult contract negotiation, consensus on goal definition was very easily reached.

Goals

Six goal categories were developed. They were:

1. Cost
2. Schedule (early start/finish)
3. Quality (such as meeting hospital and accessibility codes and standards, team performance, and zero complaints from staff/patients)
4. Diversity (workforce firms to include minority, female and local)

5. Sustainability
6. Implementation (team responsiveness)

Communication and Alignment
From this list, a scorecard was created to measure achievement. The architect's profit and contractor's fee earned were tied to goal achievement. According to Article 4 of the contract, Compensation, goals are to be reviewed at monthly increments to determine what percent of profit would be paid.

All team members, including consultants and subcontractors, were informed of the project goals and received a blank copy of the scorecard to reiterate the goals and metrics for which they would be held accountable.

Risk/Reward

One of the modifications made to the AIA C-191 was the elimination of the Goal Achievement Compensation, which are payments made to the team for achieving project goals developed according to the Target Criteria Amendment process and are not contingent on the actual costs of the project, even if they exceed the target cost. According to the modified contract, the architect and contractor waived the rights to the Goal Achievement Compensation; however, revisions to Article 4, Compensation, established a compensation structure similar to the Goal Achievement Compensation, but puts the architect's profit and contractor's fee at risk. Payment is contingent on points earned for each goal as defined by collaboratively developed metrics, tracked using the project goals scorecard. (Also see Goals).

The team agreed to the AIA C-191 standard Incentive Compensation. This compensation is paid if the actual costs are less than the target costs. As per contract, the owner would retain 50% of the cost differential with the architect and contractor each receiving 25%. The project budget was incredibly tight and at the time this case study was conducted, the team had not realized any savings. They are closely tracking costs, taking advantage of the open book transparency and ongoing cost estimating.

Liability

The standard AIA C-191 contract waives claims and liability between all contracting parties under Article 8, Risk Sharing; however, in this case the document was modified to waive claims only between the architect and contractor and their respective consultants and sub-contractors. The owner declined to waive claims or liability. The waivers are general, but also include specific waivers of claims for consequential damages and subrogation. Other exceptions generally included issues arising out of "willful misconduct," unfulfilled warranty obligations, or failure to procure insurance.

Dispute Resolution
Any claims permitted under Article 8, Risk Sharing are required to follow procedures defined under Article 9, Dispute Resolution. Should a dispute arise, the issue is first to be addressed by the Project Executive Team or the Project Management Team. If an agreement cannot be reached, the AIA C-191 standard contract outlines internal resolution through mediation between a predefined "Dispute Resolution Committee," which would be made up of a group of representatives from each party, and a neutral party. However, in this case, the team intentionally omitted the internal Dispute Resolution Committee and its mediation process. The process described in Article A.15 of the modified agreement resolves issues through "unanimous decisions of the Project Executive Team or the Project Management Team." For any issues that cannot be resolved by those teams, resolution would be reached through arbitration with the American Arbitration Association, in accordance with the Construction Industry Arbitration Rules.

Any claims permitted by the risk sharing and dispute resolution articles are limited to "no more than 10 years after the date of substantial completion."

Insurance

The AIA C-191 standard contract, Article 7, Insurance and Bonds, recommends hiring an insurance consultant to assist in obtaining integrated insurance products. This might include "Owner or Contractor Controlled Insurance Programs" or the "individual insurance requirements for the Parties and other Project Participants."

In this case, the owner preferred to follow a conventional insurance and contractor bond approach and struck the reference above from the agreement. The architect and contractor carry standard Professional Liability insurance, specifics of which were attached in a detailed schedule of requirements.

Management Strategies

Leadership Organization

Champion
- Architect
- Owner's Representative (IPD Consultant)

Team Structure
- Project Executive Team
- Project Management Team
- Implementation Team

The architecture firm Array championed the use of Integrated Project Delivery from the start of the project. As Array and the contractor, Donley's, attempted to negotiate the terms of the contract with the owner, the owner realized their company needed internal support and expertise to help advise them on IPD. The IPD consultant brought on board by the owner was experienced with fast track projects, Lean Construction techniques, and early involvement. The consultant became integral to the project, coordinating with the owner's legal team through the contract negotiation as well as facilitating the IPD process and eventually serving as the Owner's Representative.

Team leadership occurs at three levels: Project Executive Team, Project Management Team, and the Implementation Team. As outlined in the AIA C-191 contract Article 2, Management of the Project, the Executive team is responsible for major decisions and is comprised of one high level representative from each contracting party. The Project Management Team is also made up of one representative from each party and is responsible for execution of project decisions and directives given by the executive team. The Implementation Team is the group responsible for executing the design, documentation, and fieldwork. The Project Management team was tasked with educating, training and managing the Implementation team, ensuring that the entire team adhered to the principles of Integrated Project Delivery.

The owner's IPD consultant led the process of forming and coaching the Executive and Project Management teams. The owner's IPD consultant characterized the underlying values of an integrated team as, "everyone steps up when they need to step up; whether it is a foreman, project manager, estimator, project engineer, or project architect." Essentially, the Project Management team needs to set up an environment that allows team members to take leadership as needed and create a culture of distributed leadership and ownership.

Firm Selection

Architect
Array was selected to do a facility master plan for Mercy Health Partners and went through a conventional interview process; IPD was not a consideration at that point. Once Array completed the facility master plan, the hospital board elected to move forward with Array as the architect for implementation, no additional criteria or qualifications were required. It was after Array was approved to move ahead on the project that they proposed using an Integrated Project Delivery approach. Once the owner agreed to try IPD, Array took the lead on the selection process for the design consultants and contractors.

Contractor
The architect drove the selection of the contractor without much participation by the owner. Array sent a Request for Qualification (RFQ) to six general contractor firms requesting information in the following categories: general company information, regional experience, healthcare experience, and IPD knowledge and experience. Array developed a scorecard that guided their evaluation of each RFQ response to create a short list of firms. Shortlisted firms were interviewed in detail on topics such as: relational aspects of project delivery, budgeting process, and logistical strategies specific to healthcare and IPD environments. After the interview stage, Donley's was selected. Donley's and Array had previous shared project experience, including a $30 million parking garage for a University hospital that was ongoing during the selection process for this project. After going through the RFQ evaluation, Array felt confident that Donley's would be good partners in a collaborative endeavor.

Design Consultants
Array put together an RFQ survey that they sent to a dozen engineering companies. The survey questions related to the

firm's experience with and commitment to IPD, Revit/BIM experience, general technological capabilities, and degree of integration in house (i.e. number of disciplines under one roof). Like in the contractor selection, Array used a scorecard to guide their evaluation of the potential firms' responses and did an interview with shortlisted firms. Mercy Health Partners and Donley's also did independent reviews and gave their top two recommendations to Array. Array maintained final decision-making power since they were the party contracting directly the selected firm. The owner and contractor agreed with Array's selection of the engineering firm Osborn. Osborn was selected primarily because their firm housed all their engineering disciplines in one location: structural, electrical, mechanical, plumbing, fire protection, and technology and data. The co-location of engineers was attractive for ease of communication and coordination.

Subcontractors

The prime contractor went through a similar selection process for the primary sub-contractors as the architect did for primary consultants – an RFQ survey and interview. They broke the project up into three main sub-contracting packages: interior demo and finishes package, general trades package, and a MEP/technology package. For each package, Donley's selected 4-5 qualified companies that they had positive past work experience. Qualified sub-contractors were sent a qualifications survey that asked about experience with IPD, experience with other technologies that would be used on the project, and financial background. The architect and owner reviewed the survey responses and provided feedback to Donley's. The three major sub-contractors were selected by Donley's and brought on board at the start of criteria design.

Team Selection

In general, team members were selected based on their past ability to work collaboratively in a team environment. Individuals who tended to push their point of view without considering others were not selected for the team. Other criterion important to selection included experience working in healthcare facilities and experience with design-build.

In the case of Osborn, there were two key engineers that the Executive Team identified as highly desirable for the team and whose inclusion positively influenced the selection of their firm. Osborn's Mechanical Engineer had a hospital facilities background and their IT professional had excellent experience with certain technologies important to the project.

Early Planning

Resources Referenced

- Experienced IPD Team Member (Owner Consultant)
- Sutter Health IFOA
- Boldt Lean Construction Practices
- AIA C-191 Standard Form Multi-Party Agreement for Integrated Project Delivery
- Various online resources

The team had a difficult time finding resources to help them prepare documents and management strategies for the IPD process. Without references, they had to invent new ways of doing things. For example Array put a great deal of effort into strategizing the RFQ process for selecting the engineer consultant, which was different than their previous practices (see Firm Selection). Jointly there was additional effort in developing the metrics scorecard (see Goals) and embellishment of AIA exhibits.

To supplement the scarcity of IPD resources, the owner's IPD consultant contacted other companies experienced with healthcare and IPD. The contractor Boldt was willing to share resources and advice based on their experience integrating Lean Construction with IPD in the healthcare sector. Because of conversations with Boldt and others, this project has incorporated Lean Construction techniques, such as the Last Planner System, in the belief that Lean helps to facilitate the IPD process.

Team members struggled through the early planning process, but felt the tools they invented and lessons learned through conversations with others were good investments preparing for future IPD projects.

Implementation

Tools

- Last Planner System (Lean Tool)

The team adopted the Last Planner System to help facilitate communication and track reliability of committed actions. Initial training was required to encourage team members to be open and transparent and to take initiative to raise issues. The Last Planner System also helps to monitor the effectiveness of the team. According to the owner's IPD consultant, a University of Pennsylvania study reported that a traditional project delivery approach typically achieves 50% reliability of work completed and that last measurement recorded for this IPD team was 80%.

For fieldwork, the team used a Lean tool called "daily huddles." Donley's superintendant and project foreman led these huddles. Participants included the trade workers, the owner's facility personnel, and sometimes hospital nurses and staff. These short 15-20 minute meetings, held each morning, have been very effective in communicating the daily activities and ensuring the team is aligned in their goals for the day. This has been especially valuable for daily logistics, coordinating security and scheduling shutdowns, all critical to keep the hospital functioning during construction.

Social Strategies

Early Involvement

Early Involvement (early contribution of expertise)

CM/GC	Criteria Design
Trades	Criteria Design

The architect, engineers, and contractor were very experienced with the design-build delivery approach, which typically involves the contractor much earlier than in a traditional design-bid-build model. Unique compared to the team's previous design-build experience was that sub-contractors were on board during criteria design, only a month after the prime contractor was brought on. With early involvement of both the contractor and sub-contractors, everyone started when the project was still in development; this allowed for creation of aligned goals, a sense of ownership, and eliminated the knowledge disconnect during project handoff points.

Early involvement helped build trusting and respectful relationships between the designers, engineers and builders. The sub-contractors expressed that they gained a much broader perspective of the process by witnessing the challenges the architects, engineers and prime contractor had to face in the development of scope of work, schedule and budget. Sub-contractors reported that they avoided getting wrapped up in their own isolated issues because, by working closely with other team members early on in the process, they were able to see how each discipline was inter-dependant. This built respect and helped motivate the team to be more responsive and better support other disciplines.

In this case, one of the biggest benefits of having the sub-contractors on board during criteria design was the information gained through their access to the facility. They were able to look behind ceilings and walls, discovering conditions that normally would not have been known until construction. Having that information early allowed the design team to make better design decisions and develop strategic construction phasing solutions. Sub-contractors also provided valuable feedback based on their expertise. For example, there was a condition where the mechanical engineer recommended the removal of a section of the ceiling. Sub-contractors pointed out that removal would require both an inspection and upgrade of the area to bring it up to code. To avoid these additional costs and delays, an alternate solution was found.

Another benefit of early involvement was an increased accuracy in estimating. The sub-contractors had to revise their typical estimating procedures because criteria design required early estimation to be done without detailed information. But because sub-contractors were involved in design decisions that influenced cost and provided them with more intimate knowledge of the project as it evolved, they were able to arrive at more accurate estimates when establishing the Target Cost.

Responsiveness, enabled by early involvement, has provento add significant value to the owner. Early involvement may be particularly advantageous for renovation projects, where unknown conditions are routinely discovered and benefit greatly from fast collaborative response by an integrated team. As the owner's consultant commented, "there have been bigger projects, but this one is complex and we are dealing with unforeseen conditions everyday. It is good to have a team approach."

Budgeting for Early Involvement.
For typical design and construction projects, the majority of fee expenditures occur during the construction document phase; in IPD the largest expenditure of fees occurs in the criteria design phase (similar to schematic design phase in traditional project delivery phasing). Based on their research, the team anticipated

their effort to be front-loaded, however in spite of their planning, fees exceeded estimates.

There were several factors that contributed to extra time spent in criteria design. The first had to do with time required to reduce the scope and achieve the $20 million budget (estimates for the original scope was $40 million). The master plan project consisted of 9 separate remodel projects, so establishing scope and budget allocation was extraordinarily complex. Second, was the nature of remodeling a 60+ year-old building. There were renovations in the 1960s, 70s, and 80s that were not documented. Unexpected early fee expenditures were triggered when contractors in the field made discoveries and needed answers quickly. The IPD process is beneficial in these situations because the team is able to coordinate and develop solutions rapidly, but it also requires time and effort.

Transparency

The AIA C-191 contract supports transparent sharing of all project information.

Contract Section 2.4 Team Meetings, Communication and Recordkeeping empower team members to share relevant project information directly with one another, eliminating contractual hierarchy and pre-defined communication channels. This allows all team members, including design consultants, sub-contractors, advisors and agents to communicate directly with one another.

Contract Section 4.6 Recordkeeping and Owner Audit Rights requires that all parties maintain detailed accounting records of all finances related to the cost of work. The contract language was modified to specify that only the architect and contractor be required to maintain these records, releasing the owner from this obligation. The open book contract language gives the owner the right to audit or review any information relating to accounting records and business methods used to determine costs. The contract excludes open book access for any agreed upon fixed dollar amounts.

Decision Making

The Project Management and Implementation Teams have met weekly for 3-4 hours since the project began. Meeting efficiency has improved as the teams have learned how to have the right people there at the right time. The meetings became more effective by splitting the time into two halves. The first half of the meeting includes the entire team and typically focuses on the Last Planner Schedule, discussion of field issues, and communicating relevant information to the foreman. The second half of the meeting is only for those who need to be there and is focused mostly on project costs, schedule and design progress under review.

Communication and decision-making also occurred outside the weekly meeting schedule. When team members judged an issue arising in the field too urgent to wait for resolution at the weekly Wednesday meeting, an ad-hoc conference call with the integrated team members would be assembled. Simply having a conversation among the diverse array of team members often resulted in a quick decision. Another communication tool, a SMART Board, was installed in a conference room within the hospital but at the time of this study has not yet been put into action. The Implementation Team believes the SMART Board will facilitate remote communication by allowing review and mark-up of photos or drawings that can be shared immediately with the off-site team members.

Culture

For this team, the biggest change from a traditional delivery was the elimination of silos. Team members observed that although some of their colleagues initially tried to stay within familiar roles, after a few meetings all team members became accustomed to sharing information and communicating openly. The trade contractors commented that IPD empowered them to work directly with the engineers to develop solutions together. Instead of just sending an RFI telling the designers and engineers to fix it, sub-contractors used their experience to help suggest solutions. According to one of the mechanical contractors, "typically decisions are one-sided, but in this case we have a real reciprocal working relationship."

Early involvement, aligned goals, and transparency were the primary contributing factors in creating an effective collaborative culture. As the owner's representative said, "The team worked for months without a contract. The team got paid without a contract. The commitment, collaboration and communication were the outstanding pieces of this whole process." The team agreed that early involvement was one of the most important IPD strategies for achieving collaborative attitudes across the board.

The team refers to the resulting culture as, "everybody has some skin in the game."

Comments from several team members emphasize that successful implementation of IPD requires flexibility, adaptability to new roles, and evolution as an organization.

Architect

Infusing the IPD mindset throughout the organization was a challenge for the architect. For example, many experienced architects were accustomed to using "defensive detailing because you know in a traditional method, if it is not in the drawings and you go out for bid, you won't get it." Changing this behavior took time and required a shift to the realization that everyone is part of the same team. The architects also had to learn what level of detail was actually needed to communicate information to the integrated team members. Another challenge for team members new to IPD was abandoning the "cover your ass(ets)" or CYA mentality. For example in a traditional delivery method, if something comes up such as a change order, all work stops until the order is signed or a construction directive is given, but in this process the team reacts immediately and collaboratively. Any formal documentation is essentially done for recording purposes rather than following CYA or requesting additional costs.

Contractor

The contractor observed that early involvement created the biggest change, eliminating silos within the construction trades. In a conventional project, the key sub-contractors would be brought on late in the project through a competitive bid process. Shortly after award, they would be expected to put the work in place with limited time to familiarize themselves with the documents. The conventional bid process for sub-contractors often results in major challenges such as a significant breakdown or disconnection in project knowledge and lack of team building. The early involvement of key subs has had a tremendous impact on the culture of the team – it helped build trust and respect among team members, eliminated the knowledge transfer disconnection and achieved buy-in from the entire team.

Owner

To become an equal member in the IPD team, the owner had to adapt. As an organization, they had to transparently acknowledge their own strengths and weaknesses. To ensure qualified team members were present at the table, they modified roles for existing personnel and hired an IPD consultant to act as the Owner's Representative. Changes also had to be made to their in-house Quality Assurance and Quality Control (QAQC) processes, redefining the intentions for QAQC to align with the new delivery phases of IPD.

Some of the owner's facility managers had reservations going into IPD because it was new and required some changes in roles, but they have now fully embraced IPD. Construction in any working hospital environment has a significant impact on facility operations. Working as part of a transparent team has created the opportunity for the facility managers to provide input, greatly reducing their stress compared to previous renovation experiences, see Implementation for more information on Daily Huddles. Transparency provides a higher level of awareness and trust between the facility managers and the construction team. Plus, the increase in communication allows the design and construction team to plan work more intelligently and coordinate work with the facility managers, giving them more time to prepare the hospital staff for interruptions.

Environmental and Technological Strategies

Workplace

Not co-located - shared workspace available

The project team was not co-located. The option was discussed but the team felt they could coordinate effectively through regular team meetings. The team set up an easily accessible "hub" within the hospital. The team uses this space to review and work with documents and to conduct user meetings. The furniture is laid out in a doughnut configuration with pin-up space on three of the walls and a SMART Board, see Information Sharing, on the fourth. Network connectivity is also provided for individual laptops.

Information Sharing

Tools
- SMART Board
- Conference calls
- Emails
- Networked Project Management Site

One of the new technologies the team will be implementing to communicate with off-site team members and to conduct user meetings is a SMART Board. A SMART Board is a large-scale interactive tool that allows people in distant locations to look and manipulate the same document in real time. There is one located in the "hub," a conference room at the hospital.

Meeting Frequency
- Daily Huddles (Implementation Team and Project Managers as needed)
- Weekly Last Planner Meetings (Project Management & Implementation Teams)
- Weekly Cost Review Meetings (Project Management & Implementation Teams)
- Monthly Project Executive Meetings
- Conference calls as needed

When the team compared the project meetings for this project against their previous experience with non-IPD projects, they found a much more diverse group of people attended and the information shared was at a higher level. They also noted that project decisions were made immediately, whereas in their previous experience issues raised in project meetings typically took 2-3 days to resolve.

From the facilities management standpoint, the IPD process has increased meeting frequency and interdisciplinary communication. This has been incredibly valuable in terms of increasing the construction team's awareness of the special requirements of constructing within an actively operational healthcare environment. The daily huddles (see Implementation) have been instrumental in facilitating effective communication between the construction team, the facility manager, and hospital staff in order to maintain uninterrupted and safe hospital operations during construction.

BIM

Model Manager
- Architect (Array HFS)

Management Protocol
- AIA E202 Building Information Modeling Protocol Exhibit

AIA E202 BIM Protocol Exhibit was used in this project. According to the AIA E202 document, the architect was assigned as the manager of the model beginning at the inception of the project. This made Array responsible for establishing protocols for modeling standards, file storage, model access, and clash detection. They were also responsible for ongoing model management and maintenance.

For each project phase, the E202 requires the team to assign a five-level progressive scale to determine the Level of Development (LOD) of model elements. The scale moves from LOD 100, which is general massing, up to LOD 500, which requires accurately modeled construction assemblies. The team hoped to achieve LOD 400, which would include fabrication, assembly and detailing information. However, due to the lack of accurate as-builts of the existing facility the team realized the maximum they could achieve would be LOD 300. Therefore, LOD 300 was the highest level they specified in the E202 to be achieved by the Implementation Documents phase.

The team has spent a great number of hours modeling, but is not confident their efforts will pay off in the end. Many team members concluded that BIM may not be appropriate for complex renovation projects and Revit was the wrong tool for this project. They experienced difficulty accurately inputting complex existing conditions and excess rework due to in situ site discoveries. As the team struggled with BIM, they scaled back their expectations for the model's use. The model will be used for 100% of Detail Design and Implementation Documents as planned but other functions have been dropped. In particular, the contractor's use of the model for scheduling (4D) has become less important and the goal of sharing the model with the entire project team has been scaled back so that it is now only shared between the architect, Array, and engineers at Osborn. The goal of using the model for sub-contractor fabrication, LOD 400, has been abandoned.

Lawrence & Schiller Remodel

PROJECT
Lawrence & Schiller Remodel

OWNER
Lawrence & Schiller

INTERIOR DESIGNER
Canfield Business Interiors

ARCHITECT
RSArchitects

CONTRACTOR
Mark Luke Construction

Overview

Project Description

Location	Sioux Falls, South Dakota
Type	Office – Renovation
Contract	Multiparty - Custom series of contracts
Owner	Lawrence & Schiller
Interior Design	Canfield Business Interiors
Architect	RSArchitects
Contractor	Mark Luke Construction
Trades	Electric Supply, Midwest Mechanical
Project Start	August 2010
Est. Completion	Unknown

In spring 2010, Lawrence & Schiller, a marketing firm in Sioux Falls South Dakota, was seeking interior design services for the remodeling of their 7,000 square foot office. They had a relationship with an interior design firm, Canfield Business Interiors. Canfield identified the project as an ideal opportunity to test out an integrated delivery approach with several long-time collaborators. The project team partners that were assembled by Canfield worked through a limited liability company (LLC) company called Innovative Solutions Group (ISG) and together they proposed an Integrated Project Delivery approach to Lawrence & Schiller. The client agreed to support the team in this IPD endeavor because as a marketing firm, they felt an innovative, collaborative approach was well aligned with their values and identity.

ISG is a Limited Liability Corporation. Typically in IPD, LLCs are formed to join together the architect, contractor and owner for short durations, or one specific project. In this case the LLC is not project specific but rather a new company, formed and solely owned by the owner of Canfield Business Solutions, Larry Canfield. Lawrence & Schiller, the project owner, contracted with ISG. The integrated team partners included: Canfield Business Interiors (interior designers), RSArchitects, Mark Luke Construction, Electric Supply (electrical contractor), and Midwest Mechanical (mechanical contractor).

The Lawrence & Schiller remodel was the first IPD project for all of the parties involved, however they had all been working together for years following primarily design-build delivery.

IPD Profile

Because this is a delivery process there is no scale limitation [to the size of project appropriate for IPD].
– Interior Designer, Canfield Business Interiors/ Alliance Coordinator, ISG

Market Position was the critical driver for forming Innovative Solutions Group (ISG) and proposing an Integrated Project Delivery approach. In a tight economy, all parties determined that gaining experience in this fast growing delivery process would provide them a significant market advantage, allowing them to deliver a better product to owners.

Cost Predictability was a huge factor in deciding to try IPD primarily because they needed to reduce the original design estimate of $700k to $500k.

Schedule Predictability was not a critical driver of IPD. The owner had a great deal of flexibility and pushed back some deadlines. Finalizing the design was put on hold until after the November 2010 elections. May 2011 is the critical path deadline because that is when Lawrence & Schiller brings on new interns that will need workspace.

Risk was not a motivating factor for the owner to agree to IPD.

Design complexity of the design, a 7,000 sf interior remodel was not a driving motivator.

Legal and Commercial Strategies

Contract

Contract Type:

- Multiparty - Custom series of contracts between Lawrence & Schiller and Innovative Solutions Group, LLC

Contracts Issued:

- Phase 1 (Feasibility Study) – May, 2010
- Phase 2 (Design Development) – August, 2010
- Phase 3 (Construction) - TBD

On this project the contract did not play a central role in driving the integrated process. The team considered a standard form IPD contract, but for this scale of project and the clients they work with, all of the currently available standard documents seemed overly complex. According to the contractor, "the existing [AIA] contract is 120 pages long, put that in front of a client and they are going to laugh at you and walk away." The team agreed they are ideally looking for an IPD contract less than 20 pages.

On this project, in lieu of using a standard form agreement, the team developed proposals for each phase of work, broken down into three phases: 1) Feasibility; 2) Design Development; and 3) Construction. The owner signed off on each phase separately as the price became more defined. The team estimated that they would have the Guaranteed Maximum Price established at 75% DD and the signoff for Phase 3 Construction would occur before 99% deliverables were issued. At the time this study was conducted the final contract arrangement had not been decided.

Given the size of the project and abbreviated form of the custom agreements, the terms of the IPD process were not extensively defined.

Commercial Terms
The agreements for each project phase were between the owner and Integrated Solutions Group (ISG), tying all collaborating parties, except the owner, into one entity. The team proposed a shared risk and incentive structure, but this was not well defined in the agreements that had been issued at the date of this case study (see Risk/Reward). There were no references to limitations on liability or special insurance requirements.

Relational Expectations
The IPD approach was outlined in the Phase 1, Feasibility proposal to the owner that stated that this project would use "trust based relationships to design and Implement with better outcomes for all parties involved."

Implementation Tools
No unique collaborative tools were referenced in the custom agreements.

Goals

Process and Alignment
The programmatic and design goals for the project were relatively conventional compared to the innovation expected from an integrated delivery process. Some innovation was apparent in establishing project goals, through a collaborative programming session between the owner and the entire ISG team. This programming session included the GC and sub-contractors and helped ensure that everyone on the team was aligned with the owner's desired outcomes. See more about this in the Early Involvement section.

Goals
The design goals for the project were to achieve a work environment that supports creative collaboration and interaction between the Lawrence & Schiller marketing teams and for the aesthetics to reflect the identity of the owner as the "idea company."

Risk/Reward

Establishing the risk reward structure was the most challenging aspect of IPD for this team. The Innovative Solutions Group (ISG) Alliance Manager said, "as we are getting into the shared risk/reward, we are all are scratching our head. What does it mean and how far do we take it? We want to make sure we are not making decisions that ultimately will make this an unsuccessful project for us. There is no manual."

The owner had very little involvement with the incentive layer. ISG estimated their direct time and materials cost and put their profits at risk. This pricing structure was outlined in their fee proposal to Lawrence & Schiller. The proposal broke out each party's allowable cost (their direct compensation, materials and direct burden costs), and an incentive compensation cost (their profit). The fee structure was transparent; however metrics or goals tied to the incentive payments were not established.

To clarify the cost benefits of this delivery method, the contractor put together a cost analysis that estimated the owner would save 10% using IPD instead of design-build delivery. The contractor planned to validate these estimates as the process unfolds. At the time this study was conducted, the team attributed cost savings to the transparency gained through early involvement of sub-contractors, who were able to better understand the project and influence design and product/system selection decisions. This allowed cost estimates to be more accurate and product/system selection to be more thoroughly considered in terms of design, installation, and operation. The team expects this will reduce field coordination and construction time that in the end eliminate "headache money" and provide the owner better value.

The team anticipates that the completion of this project will give them a better understanding of the cost savings and value of IPD, which will help ISG better define a risk-reward structure and incentive criteria for future clients.

Liability

The contracts did not include a "no sue" clause, however the Phase 3 contract had yet to be developed at the time of this study.

Dispute Resolution
There was no Alternate Dispute Resolution procedure identified in the custom agreements.

Insurance

No unique characteristics, standard professional liability products used.

Management Strategies

Leadership Organization

Champion
- Integrated Team (not including Owner)

Team Structure
- Integrated Team (Innovative Solutions Group, LLC)

Canfield Business Interiors promoted the idea of IPD. The owner of Canfield, Larry Canfield, is involved with the collaborative project delivery movement. He provided Rex Miller with input for his book "The Commercial Real Estate Revolution," which became an influential resource for the ISG team. Canfield was also responsible for establishing the Innovation Solutions Group (ISG), LLC. The motivations for ISG were primarily from a business strategy and marketing perspective to separate Canfield Business Interiors, who are often referred to as the "furniture people," to a company that could manage the entire delivery process. From there they selected partners from the design and construction community in Sioux Falls to build the integrated

team. See more in Firm Selection.

The Innovative Solutions Group (ISG) Alliance Manager was responsible for facilitating the IPD process, however all members agreed that it was truly a team effort with everyone fully engaged, they speculated that this was perhaps because they were learning about the process together.

ISG parties had been working together in a collaborative capacity for six years and had done other projects as the entity ISG, primarily following a design-build method. ISG proposed the IPD process to several of their clients and Lawrence & Schiller (L&S) was the first to agree to be "guinea pigs" and "ride the ride" with them. Lawrence & Schiller is the marketing firm for Canfield, so they were familiar with the business goals of ISG and sympathetic to their philosophy. L&S was a seasoned client, familiar with the design-bid-build delivery. Some of their experiences had been successful and others not, so they were very interested in testing this new approach to better manage cost and schedule.

Firm Selection

Canfield Business Interiors and Innovative Solutions Group (ISG) had conversations with various members of the design and construction community in Sioux Falls. They selected partners who were willing to read "The Real Estate Revolution," embrace the collaborative aspirations of ISG, and were passionate about moving their respective practices in this collaborative and integrated direction. All the partner members had previously established professional and personal relationships.

Architect
The architect was selected because of an interest and philosophical alignment with IPD. The individual architect is employed at RSArchitects, but contracted separately with ISG for this project. The owner of RSArchitects signed off on this arrangement.

CM/GC
Mark Luke Construction was selected due to their pre-existing relationship with Canfield Business Interiors and strong interest in pursuing an integrated delivery philosophy.

Trades
Unique to the IPD process, the team selected sub-contractors based on expertise rather than initial pricing. Selection also came down to past working experience and trust.

Team Selection

Because the design and construction community in Sioux Falls is small, there was overlap in criteria for Firm Selection and individual team member selection (see Firm Selection).

In some cases individual team members were hand picked, for example the architecture firm was not selected for participation, but the individual architect within that firm working on the project has independently committed to the process.

The team agreed that selected individuals had to have the right attitude – one committed to change and learning from the process. Canfield Business Interiors had unsuccessfully attempted an IPD approach on other projects but found the team members were not committed and reverted to business as usual.

Early Planning

Resources Referenced
- "The Commercial Real Estate Revolution"
- Discussions with IPD Experts
- Various online resources

The team considered education to be critical to prepare for the IPD process. To define expectations of the process and align motivations, all partners of Innovative Solutions Group (ISG) were required to read "The Commercial Real Estate Revolution." Key members of the owner's team were also given a copy of the book.

To help the team better understand the process and discuss the team's comfort level with the project's shared risk/reward component, they held a round table discussion and brought in an experienced IPD professional for advice. All team members attended this meeting (the owner was invited but was not able to attend).

The contractor also developed a cost analysis of IPD vs Design-Build based on their experience over the past 8 years in conceptual estimating. This analysis was used to better understand the potential value of IPD and communicate with the owner. The analysis will serve as a benchmark for the team

to compare outcomes of the IPD process with anticipated timesaving, reduction of rework, and increased efficiencies.

Implementation

There were no unique IPD tools used in this project to facilitate collaborative behavior.

Social Strategies

Early Involvement

Early Involvement (early contribution of expertise)

CM/GC	Feasibility/ Programming
Trades	Feasibility/ Programming

The team found that early involvement by key players created enormous value. Cost model estimates indicating the integrated process would save 10% over design-build were greeted with skepticism since many felt the design-build delivery was equally collaborative and effective as IPD. But, as savings appeared attributable to earlier involvement of the subs, team members became convinced of the value of IPD.

There are several benefits of early sub-contractor involvement that translate to cost savings and better value for the owner. First, bringing the subs in during programming meetings helped them understand the goals of the owner and project. This deeper understanding helped them fully engage in the project and motivated them to work hard on reducing costs while still achieving the aesthetic goals of the project. Second, during an early programming meeting with the owner, the subs walked through the space and identified potential issues that may have previously been overlooked without their expertise. This made them able to participate in early design discussions where they asked questions and made suggestions to the designers that led to cost savings in system selection and coordination. And third, because the subs, who will be executing the construction, more fully understand the project, they expect to reduce construction time by 20%.

Officially there are constructability reviews at 40%, 75% and 99% construction completion, but issues are flagged and corrected on an ongoing basis within the team.

Transparency

The team operated in a very transparent manner, see Risk/ Reward.

Decision Making

The team felt that collaborative decision-making coupled with early involvement of contractors created the most valuable aspect of the IPD process: instilling buy-in from the team. As the contractor said, “all parties own this project.”

Most decisions were made during the weekly design meeting. The owner was brought into these meetings on an as needed basis to ensure design decisions aligned with the owner’s priorities. The process was more collaborative within the integrated team, but owner involvement was not significantly different than design-build projects the team had worked on previously.

Culture

The learning curve for the team was relatively conflict free, however cultural shifts were required to break free of ingrained roles and responsibilities. Some team members felt there was attitude differences between generations, the older generation wanted control and the younger generation recognized the advantages of collaboration. As the Alliance Manager stated, “A lot of times when you have been in the business for so long, you want the easy button – and this is not the easy button.”

One of the most difficult cultural changes was to move away from a hierarchical structure to a distributed structure where experts are utilized to lead the process as needed. There is no dictator, which has been a shift for team members accustomed to having a project manager (PM) in design-build delivery. Normally, the PM would identify conflicts, address complaints, and dictate the course of action. In the integrated approach, the team talks to each other and collectively identifies solutions.

Periodically team members had to remind their colleagues not to fall back into familiar roles. For example, there were instances when team members had to be prevented from making decisions in their individual silos apart from the team. Overall, the team was very successful at coming to the table and making suggestions.

Environmental and Technological Strategies

Workplace

Not co-located

The team was not co-located. Meetings were primarily held in Canfield Business Interior's conference room, which could be reached within a 10 minutes drive for all the team members.

Information Sharing

Tools

- Email
- Face-to-face exchange – weekly meetings
- FTP site

The contractor, Mark Luke Construction, has an ftp site to share plans, but most of the communication and coordination happened through email, phone or in the weekly design meetings.

Meeting Frequency

- Weekly design meetings

The project team was not very large, approximately 10 people including the architects, interior designers, general contractors, mechanical contractor and electrical contractor. Everyone knew each other well and were comfortable communicating as needed, often emailing in the middle of the night.

Formally, the team held a 2-hour weekly design meeting for the Lawrence & Schiller remodel project. Early on, meetings were formal with the Alliance Manager issuing an agenda and meeting minutes, but this quickly developed into a more casual structure with quick emails to notify the team of topics for which to be prepared.

Given the relatively small size of the design and construction community in Sioux Falls, team members often interacted three or four times per week throughout the course of normal business, providing many opportunities to discuss issues in-between the regular meeting time.

BIM

Model Management

- Not Applicable

Management Protocol

- Not Applicable

The architect used BIM software on this project, but primarily for executing work and visual communication with the owner, not as a collaborative working tool.

BIM has not been widely adopted in the Sioux Falls market and therefore, on this scale of project, it was cost prohibitive for the entire team to implement the tool. Everyone on the team recognized that this is where the industry is moving and are all working on preparing to transition to this tool.

SpawGlass Austin Regional Office

PROJECT
SpawGlass Austin Regional Office

OWNER
SpawGlass Real Estate

ARCHITECT
Barnes Gromatzky Kosarek

CONTRACTOR
SpawGlass Contractors

Overview

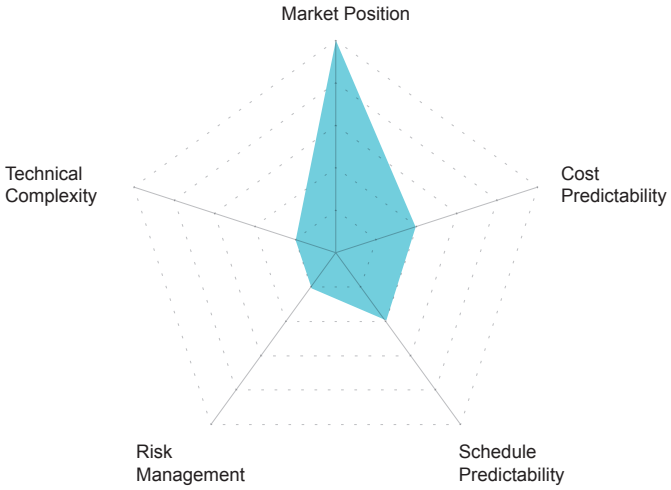
Project Description

Location	Austin, Texas
Type	Office – New Construction
Contract	Single Multi-party Contract – ConsensusDOCS 300
Owner	SpawGlass Real Estate
Architect	Barnes Gromatzky Kosarek
Contractor	SpawGlass Contractors
Project Start	April 2010
Est. Completion	Unknown

In early 2010, SpawGlass companies decided to build a new regional office for SpawGlass Contractors in Austin, Texas. The office was planned to be new construction and approximately 15,000 sf. SpawGlass Contractors acted as both the general contractor and owner, on behalf of SpawGlass Real Estate. They desired that the building have an "Austin feel" and began looking for an architect. They considered several architecture firms in the Austin area before awarding the design to Barnes Gromatzky Kosarek (BGK). BGK Architect's portfolio matched well with project design goals and SpawGlass had a positive relationship with BGK, based both on past professional and personal experiences.

After BGK was selected, SpawGlass was approached by a local attorney who introduced them to the concept of Integrated Project Delivery (IPD). SpawGlass decided to use the project as an opportunity to try IPD. They felt a completed IPD project could position them as an industry leader. After research comparing standard form IPD contracts, SpawGlass opted to use ConsensusDOCS 300, a tri-party contract for collaborative project delivery developed by the Associated General Contractors of America (AGC) and partners.

IPD Profile



"You never feel like there is an issue or an adversarial side of this process. Monetary rewards are fine, but at the end of the day, the biggest lesson learned is that we went through this process together. [We can] share the story and take away some ideas on how to communicate, work together and strengthen that [relationship]."

- Project Manager, SpawGlass

Market Position was the greatest motivator for SpawGlass to push for IPD. The contractor desired to be on the cutting edge with the "best tools, equipment and innovation." They saw there weren't many IPD projects being done in the market and decided they should explore the process on their own office building because it was a low risk way to test IPD.

Cost Predictability was important but not a major driver in the decision to try IPD.

Schedule Predictability was not a critical driver for this team to pursue IPD.

Reduced Risk was not a primary driver. Risk was relatively low on this project because the owner and contractor were the same entity. The owner already had a great deal of control of the project.

Design Complexity of the design, a 15,000 sf single level office building, was not a driving motivator in the selection of IPD.

Legal and Commercial Strategies

Contract

Contract Type:
- Single Multi-party Contract – ConsensusDOCS 300

Contract Issued:
- April, 2010

SpawGlass chose to use the ConsensusDOCS 300, Standard Form of Tri-party Agreement for Collaborative Project Delivery. They considered the AIA multi-party contract, but found the language in ConsensusDOCS more accessible. There was no negotiation or customization of the contract, they went through the form and checked the appropriate boxes. The contract was also used as the primary resource for educating the team on the process of IPD.

As a standard form, multi-party IPD agreement, Consensus Docs 300 includes the commonly references collaborative characteristics of IPD summarized below into three categories: commercial terms, relational expectations, and implementation tools.

Commercial Terms
Collaborative commercial terms were present in the agreement, such as shared risk reward, release from liability or "Safe Harbor Decisions," and the option to obtain project specific professional liability insurance. The contracting parties did agree to the shared risk/reward and release of liability, but opted to obtain traditional professional liability insurance products.

Relational Expectations
The standard form contract contains some relatively soft relational language under Article 3, Collaborative Principles. The agreement required that each party commit to mutual trust, good faith and fair judgment in their relationships with the other contracting parties. Expectations were that each party cooperates with each other to make decisions in the best interest of the project.

Implementation Tools
Several process tools and strategies are referenced in the contract such as Lean Project Delivery Strategies (Last Planner System) and Target Value Design; however actual implementation of these tools has yet to occur on this project.

Goals

Process
SpawGlass defined the goals of the project. Market positioning drove the innovation goals for this project.

Goals
SpawGlass, as the owner and GC/CM, had a great deal of control over this project, which made it an ideal opportunity to take some risks and invest in learning industry innovations such as IPD, Revit, and LEED.

SpawGlass would like to reach LEED Gold, but LEED Silver was stated as the contractual goal. Innovative use of BIM was another goal for the team because SpawGlass wanted to use this project to develop a proprietary facility maintenance program thats equipment maintenance and warranty information to the project's BIM model. They saw this as a product they would be able to offer future clients that would set them apart in the market place.

IPD became a goal for the team after the architect was selected, see Firm Selection.

As typical of most building projects, meeting budget and staying on schedule were goals for the owner.

Communication and Alignment
Some project goals were tied to financial incentives, intending to align the interests of the contracting partners with the Owner's goals. Team performance was not tied to financial incentives. Some additional education was needed to get the team on board and familiar with the ConsensusDOCS requirements.

Risk/Reward

ConsensusDOC's Article 11 defined the Incentive and Risk Sharing structure for the project and outlined the process for establishing the budget, cost models and a Project Target Cost Estimate (PTCE). The agreement required that the owner first establish a Project Budget, based on the Design Budget and Construction Budget as estimated by BGK Architects and SpawGlass Contractors respectively. The team was then required to use "diligent efforts to design the Project so that it may be constructed without exceeding the Construction Budget." Achieving this required ongoing Target Value Pricing and Cost Modeling by SpawGlass Contractors in collaboration with BGK Architects. Cost models were to be reviewed on an ongoing basis and when the models were not in conformance with the Project budgets, the Management Group was to determine the Collaborative Project Delivery (CPD) team's course of action. The PTCE was to be established "at such a time as the Management Group determines that the project design is sufficiently complete."

Although the contract outlined a Project Target Cost Estimate, the CPD actually followed more of a Guaranteed Maximum Prices (GMP) costing structure. An unforeseen site condition arose – too much fill on the site required mass amounts of excavation. The team didn't know how to adjust the PTCE to account for this unforeseen condition and for the sake of expediency, reverted to a more familiar cost model.

SpawGlass conducted regular cost reviews, providing the architect immediate pricing feedback on design decisions. The contract specified that the contractor should get cost modeling input from the trade contractors in the "Preliminary Cost Model," "Schematic Design Cost Model" and the "Design Development Cost Model," however, the trades were not brought onto the CPD team until Construction Documents. This is an indication that the CPD did not take full advantage of early involvement of expertise when feedback could have provided the maximum cost savings.

Liability

As a standard form contract, ConsensusDOCS Article 21, Indemnity, Insurance, Waivers and Bonds, includes provisions that limit liability, or indemnity, between contracting parties for claims that may arise in connection to the project, but "only to the extent caused by the negligent acts or omissions of the [owner, contractor, and designer] or anyone for whose acts or omissions [the owner, contractor, or designer] may be liable."

Dispute Resolution
Article 23, Dispute Resolution of the contract defines the procedures for resolving disputes or claims that may arise in connection with the project. The procedure follows four stages of resolution: 1) Direct Discussion and engagement of the project Management Group, 2) Mitigation with a Project Neutral mitigator, 3) Mediation and lastly 4) Arbitration or Litigation. The team opted out of litigation and agreed to arbitration should any dispute reach level 4.

Insurance

No unique characteristics, standard professional liability products used.

Management Strategies

Leadership Organization

Champion
- Owner/GC

Team Structures
- Collaborative Project Delivery Team (CPD)

In this case the person advocating for IPD was the Regional President of SpawGlass Contractors, who was periodically involved in the process. There was no real need for an IPD team facilitator or champion of the process as all parties felt their collaborative relationships were already well established. As the contractor's PM stated, "I don't know that there is one direct

person that is heading the IPD concept; it is all of us just working through it together."

The architect did have to invest effort in educating their consultants on IPD. Because of a lack of familiarity with the contract "there was some hesitancy on their part." Ultimately, the architect got them to agree, primarily based on their previously established relationships.

The Collaborative Project Delivery (CPD) team members did little to no preparatory research to familiarize themselves with the process, see Early Planning for more information.

Firm Selection

The firm selection process was not motivated by IPD. SpawGlass had not decided to use IPD when they issued the RFQ for the project. Although not motivated by IPD, the owner's selection of the architect was relationship-based, factoring their positive past working experience and trust. Austin is a small design and construction community and all parties assumed collaborative process would be followed regardless of delivery method. As described by the contractor's PM, "In the end it became more of a relationship thing than anything else; a comfort level with someone we had worked with."

SpawGlass discussed the BIM and LEED goals in the selection process. IPD was not discussed.

Team Selection

Like the firm selection process, team member and consultant selection was primarily based on familiarity and past working experience. When the idea of using IPD was introduced, there was some reluctance from the architect's consultants, but eventually everyone accepted this approach. The team held an all-project team member kick-off meeting where they discussed IPD and use of BIM. At that meeting all team members committed to the goals of the project.

SpawGlass did not have any specific team member criteria except to ensure their BIM manager was assigned to the project.

Early Planning

Resources Referenced

- ConsensusDOC 300 Agreement
- Discussion with IPD Attorney

A local attorney specializing in IPD introduced the idea of IPD to SpawGlass and helped to spur the initial IPD interest. The attorney offered to consult on the contract, but SpawGlass had a strong relationship with the architect and felt comfortable working through the contract with them without hiring an attorney.

In general, the Collaborative Project Delivery (CPD) team did not do any preparatory research to plan for differences in the IPD process as compared to more familiar methods such as design-build or design-bid-build. As one team member stated, "we did not sit down and lay out a plan based on the contract. We all just jumped in."

The team did not consider any kind of redistribution of project effort in anticipation of the IPD process. At the time this study was conducted the team, especially the architect, had found that more hours were required in schematic and design development phases. It was difficult for anyone to distinguish if the additional time and effort was attributable to IPD or the implementation of BIM, which was relatively new to both architect and contractor.

Implementation

Although the ConsensusDOC 300 makes reference to using Lean Construction processes, such as the Last Planner System, this team has not implemented unique IPD tools in this project to facilitate collaborative behavior.

Social Strategies

Early Involvement

Early Involvement (early contribution of expertise)

CM/GC	Feasibility/Programming
Trades	Construction Documents

The owner/contractor and architect worked together from the beginning of the project, with ongoing constructability and cost estimating reviews. Constructability reviews were done on a weekly basis with SpawGlass and BGK Architects from schematic design phase through construction documentation. Cost estimating occurred multiple times throughout the project at major phase milestones.

The MEP consultants and contractors were not brought on until construction documentation phase (CD), indicating that in this project their involvement was similar to projects using design-build delivery. However, unique to this IPD project, SpawGlass eliminated the bid process for selection of the MEP sub-contractors. The MEP consultants contracted during CDs will carry the project through construction.

Both SpawGlass Construction and BGK Architects agreed that in the future they would bring sub-contractors on earlier in the process, before the CD phase.

Transparency

Contract section 8.2.8 Accounting Records required the contractor and trade contractors to maintain cost accounting for all work performed under unit cost, actual costs for labor and materials. The agreement assured the Management Group access to the records.

Decision Making

The Management Team met once a week. The team consisted of two managers from SpawGlass, a manager and a principal from BGK architects, and occasionally the Regional President from SpawGlass who also makes decisions on behalf of the owner, SpawGlass Real Estate. During the times when the owner's rep was not available for the weekly meeting, the team reports that their decision making process is slowed. Depending on the issues discussed, other consultants were brought into the weekly meeting as needed. Because the owner and contractor were essentially the same entity, most project decisions could be made between the contractor and architect. SpawGlass had a Board of Directors responsible for approving final costs.

Culture

Early and ongoing constructability reviews between SpawGlass Contractors and BGK Architect provided opportunities for team members to understand each other's processes and hold discussions more detailed than any they had previously experienced. As the contractor's PM stated, "it forces you to go over ever little nook and cranny of what you are looking at to a certain degree and figure things out together."

Though the degree of interaction was intense, team members agreed that traditional roles remained unchanged compared to teams in conventional delivery methods.

Environmental and Technological Strategies

Workplace

Not co-located

The team was not co-located. The team used the weekly meeting (see Decisions Making) for face-to-face interaction. Shared BIM viewing was productive but limited by conventional arrangement of individual computer screens and lack of co-location (see Information Sharing).

Information Sharing

Tools
- Email
- Conference Calls
- Networked Project Management Site (document sharing)

SpawGlass maintained a project ftp portal that gave everyone access to the Revit model and information.

Meeting Frequency
- Weekly Team Meeting
- Topic meetings as required

In the weekly meeting, the team reviewed project drawings and addressed other issues and concerns as needed. Weekly meetings are not unique to the IPD process and the team commented that these meetings would have occurred regardless of delivery method. Some of the most valuable meetings were held around the computer screen of the project architect, which allowed the team to review in real time and assist with team design decisions.

In this project, similar to conventional projects, documentation of the meetings and distribution of minutes and action items was the responsibility of the architect. The weekly meetings were the most formal means of Collaborative Project Delivery (CPD) team interaction. Other interactions were informally documented and consisted of phone calls and email between all team members including design consultants.

BIM

Model Manager
- Contractor (SpawGlass)

Management Protocol
- ConsensusDOCs 301, Building Information Modeling (BIM)

This project used ConsensusDOCS 301, Building Information Modeling (BIM) Addendum, to allocate BIM responsibilities among the Collaborative Project Delivery (CPD) team. SpawGlass Contractors was identified as the BIM Information Manager, which made them responsible for regulating access to the model anding together individual models into a Federated Model. Each model provided to SpawGlass by consultants and trades wereed to the base model but each maintained it's own identity and integrity. Each party was therefore responsible for their individual contributions' to the Federated Model.

The CPD team used Revit. SpawGlass had been using Revit in exploratory ways in the 2 years preceding this project; this was the first project that they fully incorporated BIM. BGK Architects had used Revit on two projects before the SpawGlass Regional Office.

The BIM Execution Plan (BEP) was developed as a separate addendum as required by ConsensusDOCS 301, and it defined the modeling protocols for the CPD team. The BEP defined which models were needed and described their intended use. Certain design models were chosen to serve as contract documents, the expected level of detail (LOD) at various project milestones was outlined, schedule and procedures for delivering the models to the Information Manager were determined, and dimensional accuracy requirements established. The CPD worked through the development of the BIM Execution Plan and collaboratively established responsibilities, protocols, and deliverable requirements.

According to the team, the Federated Model will meet construction needs. They intend to use the model in construction for layout and the subs will use the model for production and fabrication. However, according to the contract, the individual model authors are not held to a certain level or accuracy and states that the "model can be used for reference only and all dimensions must be retrieved from the drawings."

At the time this study was conducted, the team had found the model to be most valuable for project visualization. It improved team communication and ability to make design decisions collaboratively. The team was not using the model for schedule, quantity take-offs or cost estimating at the time of this study. The CPD team planned to use the model for clash detection.

SpawGlass was also working to develop propriety building management software to assist in building operation. They intend for this project to be a test case they can use to demonstrate this software to future clients. The software will the BIM model to facility maintenance schedules, energy management, and equipment information to assist in facility management.

Edith Green Wendell Wyatt Federal Building Modernization

PROJECT
Edith Green Wendell Wyatt
Federal Building Modernization

OWNER
General Services
Administration (GSA)

ARCHITECT
SERA Architects &
Cutler Anderson Architects

CONTRACTOR
Howard S Wright (HSW)

Overview

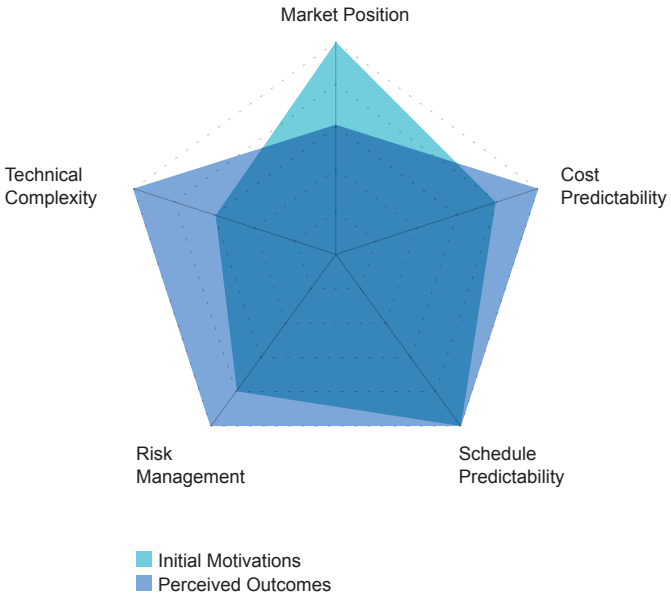
Project Description

Location	Portland, Oregon
Type	Office - Renovation
Contract	Multiple independent contracts – Custom (modified P-100)
Owner	General Services Administration (GSA)
Architect	SERA Architects
Contractor	Howard S Wright (HSW)
Project Start	December 2009
Est. Completion	May 2013

In 2003 GSA Region 10 hired SERA Architects for design services on an extensive modernization of an existing 18 level government building that houses 16 different federal tenant groups. The modernization project consists of two packages to be designed concurrently: 1) Base Building -Core/Shell and 2) Tenant Improvements. The original contract followed a traditional design-bid-build delivery model, but the project was not approved for funding and put on hold in 2007.

In 2009 the project was reinstated under the American Recovery and Reinvestment Act (ARRA also known as Stimulus Funding), which required the project be re-scoped to align with the High Performance Green Building requirements. In order to procure the ARRA funds, a Guaranteed Maximum Price (GMP) was required by September 2010. GSA renewed their contract with SERA Architects but to meet the 2010 deadline, GSA recognized they would not be able follow their traditional P100 contract process. SERA estimated it would take 27 months to use the P100, but a modified version using integrated delivery processes could achieve the required time frame. Howard S Wright Companies (HSW) was selected as the CMc (Construction Manager as Constructor) and was awarded the contract in December 2009, leaving approximately 8 months to re-scope, re-design and establish the GMP.

IPD Profile



"What is missing in the IPD narrative today, in all literature, is the whole issue of who is going to train people. The idea that you can take on IPD and the whole elephant in day one is not going to be successful. [We] have been talking about breaking down IPD in a series of pieces and having the owner digest features over a period of years because it is going to take a decade to get used to all the tools and aspects of IPD. It is not just a pick it up and go."
– Architectural PM, SERA Architects

Market Position was a primary driver for GSA to implement IPD on this project. GSA Region 10 is using this project to measure the advantages of the process in order to transition their organization to using IPD exclusively. There goal is to position

themselves as long-term leaders of innovation within the industry, helping to ensure that as the owner, they will have their pick of the best teams in the market.
Perceived Outcomes: The outcome is mixed. The architect experienced tremendous advantages in integrated practices such as co-location, BIM, and collaborative working. The contractor reports a continued lack of owners willing to pay for IPD, and expects that the situation is unlikely to change in the current market where some contractors are bidding well under the actual cost of work. The owner felt that, as an agency, GSA is not capitalizing on the value proposition of IPD. He is also concerned that when the market rebounds, the best firms will refuse to do fixed price contracts and GSA will be forced to work with second tier firms on complex projects, putting them at higher risk.

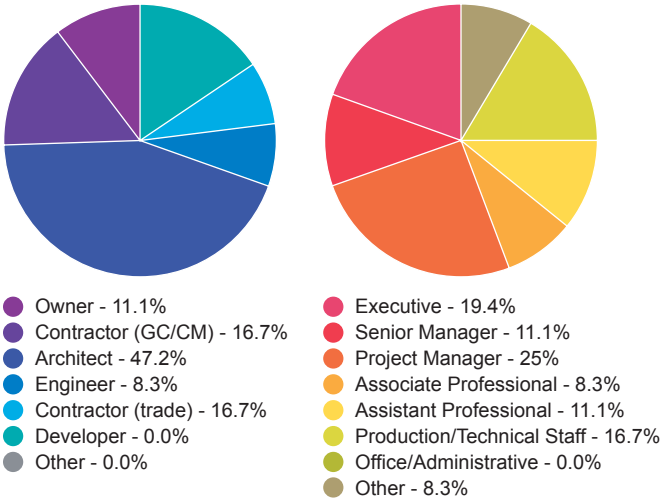
Cost Predictability was an important motivator in general for GSA to use IPD.
Perceived Outcomes: From the owner's perspective, this is one of the major benefits of IPD. Unlike fixed price contracts, IPD merges change order risk with the GMP management. This creates transparency where everyone has some "skin in the game," including the trades, giving the owner a clear view into their production. This allows the owner to identify where they are under-optimizing expensive resources, so adjustments can be made to meet cost goals. Open books also allows the owner access to internal contractor conversations related to the project. This gives the owner confidence in the numbers that are reported to him, and allows him to weigh in on cost decisions that affect the project daily.

Schedule Predictability was the primary motivator to pursue IPD in this project. The project needed to establish the Guaranteed Maximum Price (GMP) within an 8-month period. Achieving this required early input of expertise, including the CM and trade contractors; this deadline would not have been possible with a tradition GSA delivery approach.
Perceived Outcomes: Schedule is always important, but this team felt integration and collaboration improved the scheduling process significantly. The architect felt that with the accelerated schedule, integrated practices were required to achieve the schedule; the speed of work would not have been possible following business as usual. For the contractor, IPD changed the workplace culture; instead of pushing people out of the way to meet schedule, everyone moved along together. Schedule predictability remained important for the owner, meeting the schedule meant they fulfilled funding requirements, and could accurately coordinate tenant moves.

Risk Management was a primary motivator in general for GSA to pursue IPD. As a large government system with multiple facilities and building projects, implementing delivery processes that can be applied across multiple projects to reduce their risk exposure in terms of cost, schedule, and subcontractor claims is well worth the investment in IPD.
Perceived Outcomes: All team members agreed there are major benefits to managing risk on IPD due to the flexibility and transparency of the team. Compared to traditional delivery, the owner was more informed and aware of claims and change order risk at all levels, from the prime contractor to the sub-contractor.

Technical Complexity was a factor but not the primary motivator. As a modernization (renovation) of an existing building, the additional coordination between designers and trade contractors provided by IPD is considered a significant advantage and helps address unknown field conditions before construction.
Perceived Outcomes: The project benefited greatly from the integrated team. Some challenges that arose in the field would have been solved regardless of delivery type, however this team was able to address them without major interruptions, costs, or delays. The contractor felt integration made the most significant difference on time sensitive issues. A major issue arose due to ice concerns on the "reeds," an important design feature on the west façade of the building. The team had to redesign the west façade in 7 weeks, and they accomplished it because all team members were equally vested in the project and had to work together, the owner supported them. The team felt strongly that the outcome would have been much different (less successful) on a non-integrated project.

Survey Data



BIM Experience

According to interviews this project implemented BIM to a high degree and used the project to create lessons learned for future implementation, see details in BIM. The architect took the lead role in managing the model. Participants of this survey that interact with BIM in a technical way represent 30.6% of participants, while 69.4% of participants do not. Of those who engaged with BIM in a technical way, the majority were the architects (72.7%), who were either production/technical staff (62.5%) or assistant professionals (25%), which is consistent with their role as model manager. The remaining participants represent the contractor (general contractor or construction manager; 18.2%). The technical ability of BIM users is relatively high, with 45.5% self-identifying as expert ability all of who were architects (100%), 36.4% as intermediate ability who were both architects (50%) and contractors (GC or CM, 50%), and 18.2% as fundamental ability or not familiar who were all at the executive level (100%) and represented the owner (50%) and architect (50%).

Previous Experience

Participants overwhelmingly indicated (100%) that their organizations had previous working experience together. This also carried over to individuals, with 63.9% that had previously worked with other team members, although over a third (36.1%) did not have previous experience. This past experience may have been a factor in the organizations' willingness to embark on an integrated, collaborative delivery model, still a very new model with several unknowns. These finding identify an opportunity for future study.

Multi-party Agreement

This project did not use a multi-party agreement, see Contract.

Shared Risk/Reward

This team had incentives tied to the CMc, but did not have a shared risk/reward pool on this project, see Risk/Reward. This project was not asked if team members were aware of risk/reward incentives. Survey participants perceived shared risk/reward to have a somewhat positive effect (Mean=1.23, where 3=positive effect, -3=negative effect) on their trust and respect for the other contracting parties. This less positive perception is likely due to the fact that there was not a risk/reward pool and only the CMc had financial incentives. However, participants representing the CMc perceived only a slightly positive effect (Mean=1, where 3=positive effect, -3=negative effect) on their trust and respect for the other contracting parties.

Liability Waivers

Based on interviews and review of the contract, this team did not have waivers on liability, see Liability.

Fiscal Transparency

This project was fiscally transparent between contract parties, see Transparency. This project was not asked if they were aware of fiscal transparency requirements. Overall, participants perceived fiscal transparency as somewhat positive (Mean=1.55, where 3=positive effect, -3=negative effect). However there was variation in degree between contract parties where owners perceived this measure to have a positive effect (Mean=2.25), architects perceived a someone positive effect (Mean=1.93), and contractors (GC, CM) perceived there was only a slightly positive effect (Mean=0.66) on their trust and respect for project partners.

Legal and Commercial Strategies

Contract

Contract Type

- Multiple independent contracts – Custom (modified P-100)

Contract Issued

- May 1, 2009 - Architect/Engineer Contract Re-issued
- December 11, 2009- CMc Contract

Procurement Method

CMc (Construction Manager as (General) contractor) Guaranteed Maximum Price with Construction contingency allowance and option shared savings.

As a federal organization, GSA has strict requirements that all projects follow their standard P100 contract; this requirement created additional work for this team to be able to adopt an integrated approach. GSA issued separate A/E and CMc contracts that were adapted from the standard P100 agreement to include some reference to the integrated or collaborative process under the Scope of Work sections.

Commercial Terms

GSA's Contracting Officer feels strongly that tri-party arrangements are not necessary for Integrated Project Delivery, especially for public projects, which would require a change in legislation to move away from existing contract structures. He felt multi-party agreements are too much of a "quantum change" and that the financial incentives recommended for IPD can be done with existing contract forms by using award term and milestone payments.

The A/E's contract does not include any of the collaborative commercial terms common to IPD projects such as shared risk/reward, limited liability or special insurance requirements. The CMc's contract does however include financial incentives that would entitle them to a percent of the difference between the Cost of Performance (final sum of cost of the work and fee) and the Guaranteed Maximum Price (GMP). See more in Risk/Reward.

The owner believed that the separation of architect and contractor in this project provided a major benefit over design-build contract because of the collaborative tension between the architect and contractor. As separate entities, both the architect and contractor can passionately explain their position on certain decisions; this gave the owner the luxury of being the final arbiter and overall a better understanding of the consequences of decisions.

Relational Expectations

The A/E contract contains some softer language about the collaborative philosophy and behavior expectations. The contract describes the integrated process as relationship based as opposed to transactional (paper) based and also explains the dynamic nature of IPD, expecting parties to "redefine and reinvent the way work is done."

The CMc contract contains no reference to relational terms or the dynamic nature of the delivery process.

Implementation Tools

The A/E Contract states that this project is a test case for GSA to better understand integrated/collaborative delivery. The primary collaborative strategies referred to included early involvement of constructor (sub-consultants and sub-contractors) and collaboration with constructor to review cost, schedule, constructability and material selection. The contract also defines decision-making criteria to be in the "best interest of the project" and outlines tools for task management.

The CMc Contract, issued 7 months after the A/E contract, has more specific language describing tasks and commitments required, such as: attending bi-weekly design review meetings, ongoing constructability reviews, input on resolving issues identified through constructability reviews, advanced determination of procurement packages, ongoing value engineering, assistance with LEED certification, and development of shared project team management processes and protocols.

To more fully define the IPD process, a separate document was developed by the IPD team, called "CMc+6 Delivery." This document was not referenced in the original contracts but was adopted by the team in January 2010. To comply with the P100 requirements, the integrated team developed a "P-100 2009 to CMc+ 6 Deliverable Crosswalk" that line-by-line translated the P100 deliverable requirements to CMc+6 Integrated Delivery Equivalent.

The CMc+6 Delivery document incorporates AIA's definition of IPD, "an approach that integrates people, systems, business

structures and practices into a process that collaboratively harnesses the talents and insights of all participants to reduce waste and optimize efficiency through all phases of design, fabrication and construction." The "+6" refers to six collaborative strategies:

1. GSA providing on-site management
2. First tier subcontractors being on the team before contract documents are developed
3. Key first tier subcontractors were selected as part of the CMc solicitation process
4. Integrated document development
5. Shared collocation facilities
6. Optimized building information modeling.

Goals

Process
GSA took a leadership role in clearly articulating project goals and aligning team members with the goals.
The primary goals included both team and building performance goals.

Goals
This project had many goals from schedule, budget and building performance to federal contracting requirements and team performance. One of the primary drivers for using IPD was schedule in order to meet the March 2010 GMP deadline to secure funds for the project. The team was able to compress the schedule and achieve the schedule deadline, but were then faced with the challenge to design from the original $145 million GMP to a $125 million GMP.

The primary building performance goal was to address the High Performance Green Building design principles. This goal was clearly communicated during a two day High Performance Building Workshop. Attendees included the A/E team, GSA and interested contractors (workshop was held prior to CMc selection).

As a federal organization, one of GSA's public policy goals is to engage small businesses that include small disadvantaged, women-owned, HUBZone, veteran, and service-disabled veteran-owned small businesses, at both the prime and subcontracting levels. Integrated delivery allowed them to not only exceed their baseline goal of $22 million in contracts by $11 million, but also improved those agreements through strong partnership.

The owner considers change orders as strictly overhead expenses; so avoiding change orders was an important goal for the owner. Congress funded the project based on 9% change orders and 5% contingency costs. Late in the project, the owner was confident they would come in almost 5% below those estimates, which results in significant funds returned to the owner. These savings are the result of designing within budget and effectively managing scope growth.

Communication and Alignment
Because GSA Region 10 would like to move away from the P100 conventional methodology to an integrated delivery process, specific measures were developed to track throughout the process including: schedule, cost, constructability, document accuracy and reduction of design overwork and rework. These team performance goals were clearly articulated in the CMc+6 Document, see Contract and data will be used to both improve the process and document the advantages in order to articulate the benefits of this delivery method to congress.

Risk/Reward

Standard GSA contracts require quarterly performance evaluation reports that assess approximately fifty elements of effort. Coupling the performance evaluation with contract administration allows GSA to monetize performance.

The A/E team did not have any financial incentives tied to project metrics because the original design work was completed under the conventional P100 process. GSA clarified that if they could start this project from scratch they would have negotiated a fixed fee reduction with matched risk reward. For example, if the architect typically proposes a 15% fee, the owner would accept 7%, with 8% at risk. Incentive payments would be determined by mutually determined performance goals, tracked and measured throughout the delivery process.

Initially, the incentive structure for the CMc included a 1% fee incentive that would be tied to both a base team performance criteria as well as a percentage of their value added. Team performance would be evaluated based on the existing federal reporting criteria. Value added is based on the amount of value engineering the CMc identifies throughout the process up to a certain cap amount; typically this would be 25% of all value

created up to a cap of one million dollars.

On follow-up with the team, they reported that the 1% incentive fee was rolled into the CMc's base fee and was not based on the team performance or value added contributions. This was done in recognition of the fact that the CMc absorbed a $1.2 million liability for unforeseen site conditions and other latent defects without any additional funding from the owner. Their ability to absorb those costs in large part was due to their ability to manage the buy-out process, value engineer, and successfully work with the architect to keep designed scope within budget.

Other incentive strategies common on GSA projects include award term incentives and "Best in Class" recognition. The award term incentive ties into the performance evaluations monitored by the GSA representative. Anytime GSA initiates a change order they have the right to re-contract, reminding the contractors that they "have to earn their right to work." Additionally, GSA is currently developing a "Best in Class" sub-contractor process to evaluate and catalog sub-contractors that work over a hundred hours on the project and meet performance goals. The CMc does these evaluations according to a formalized process establish by GSA. The names of these companies are placed on a plaque in a prominent and accessible location in the building and are noted in their catalog, helping to secure future work with GSA.

Liability

There is no specific limit on liability or "no-sue" clause in the contracts.

Dispute Resolution
Both the A/E and CMc contract specify use of Alternate Dispute Resolution practices; these procedures include "negotiation, facilitation, mediation, fact-finding mini-trial, arbitration or any combination thereof." This is standard to GSA projects, but is similar the Dispute Resolution Processes required in standard form IPD contracts such as the AIA C-191, ConsensusDOCS 300, and Sutter's IFOA.

Insurance

No unique characteristics, standard professional liability products used.

Management Strategies

Leadership Organization

Champion
- Owner

Team Structure
- Executive Team (core team)
- Integrated Team
- Subject Matter Experts (SME)

GSA Region 10 (R10) is driven by the philosophy that that the owner needs to set the value proposition, in other words, "this is my project, my money, my problems and this is what I expect of you." The owner is ultimately responsible and therefore can't sit back in a typical role but needs to take an active role driving the process and managing risk.

To be an active manager of the process, GSA R10 in particular, believes the owner needs to be onsite, engaged in the integrative process and forming relationships, as opposed to hiring agents to be owner's representatives. Often this is a challenge, especially on the institution side where owners are operating in large bureaucracies who by nature are often risk adverse. GSA's officer was officially only half time with this project although spent closer to 75% time on site. He believes IPD should require the owner to be on-site full time due to the resource intensive nature of IPD. Investing in IPD is a strategic decision and the owner needs to be prepared to provide the resources around it.

Team Structure
Direction flowed from the executive team whose members consisted of very involved, high-level representatives and project managers from the owner, architect and contractor. The executive team has several lengthy meetings every week; project managers broke out from those sessions and distributed the message to the integrated team members. The implementation process on this project relied on the Master Schedule (MS) and mini Master Schedule (mMS) (see Implementation) to identify and communicate the priority tasks. The MS process was based on

an open source philosophy; everyone on the team had the ability to contribute to the mMS subtask list and take ownership of an item, effectively distributing leadership among the integrated team. These distributed leaders were referred to as Subject Matter Experts (SMEs) and ensured the person most qualified to bring an item to resolution was empowered to do so.

The project did not employ cluster groups, as used on other integrated, co-located projects (see Cathedral Hill Hospital and UCSF Medical Center), but did have a very active meeting schedule during design that focuses on specific sets of topics such as exterior, landscape, MEP coordination, and so on. Integrated representatives from all the primary contract parties as well as relevant trades attended each meeting and a point person was assigned to each topic so that first lines of communication were clear.

Lessons Learned

The CMc noted that one of the keys to making integrated delivery work is trust and continuity, particularly on the owner side. In this case, GSA committed to keep a team in place for the duration of the project. On the majority of the CMc's other work, the architect and consultants disappear from the project during the construction phase, spending only part time responding to field issues. This set up causes major latency risk for the contractor. Because of the commitment by the owner to support the project through it's duration, the CMc was more willing to partner with the architect and engineers to both prioritize work and let some work shift later in the process because they were confident the integrated team would be there "together feeling the day to day pains and rewards," for the duration of the project.

Firm Selection

Because of the start-stop-start history on this project and the compressed schedule, the team selection process was different than if GSA were starting the project from scratch. If GSA were to begin a new project, they would have hired the A/E, the builder and helped with the selection for the first tier sub contractors at the same time. GSA's methodology is to bring on the subcontractors as early as practical, using best value select.

GSA is in the process of writing criteria for successful team selection; they have identified a few they think are critical to IPD. One is familiarity with each other and an instinctual dynamic. Another is passion, a real desire and commitment to work together, learn and innovate for the good of the project.

Architect

SERA with Cutler Anderson Architects was selected because they had already done the initial design for GSA, had performed well and were committed to GSA's Integrated/Collaborative Delivery goals.

CM/GC

An RFP soliciting contractors for the project was posted to GSA's FedBizOpps (fbo.gov) website in late April 2009. The RFP invited contractors to attend the High Performance Green Building re-scoping workshop in May 2009 and indicated that the project would include a 9-month design phase contract with bi-lateral option for a construction phase contract. Unique to the RFP, contractors were required to submit recommendations for the five first tier sub-contractors. Thirteen construction firms participated in Early Exchange meetings with GSA Region 10 (R10) where they discussed the project history, design goals, and various site, budget and schedule constraints. The integrated delivery process was a key topic in the Early Exchange meetings; it was made clear all applicants had to strongly support a collaborative approach. The final selection of Howard S Wright (HSW) was based on their high scores on technical factors including qualifications, past performance, and key personnel. GSA also considered their conceptual cost estimate and pricing for design phase services.

Trades/Subs

HSW selected the five first tier sub-contracts, although GSA R10 wanted as much input as possible in the selection and had last right to refusal. GSA's source selection team had some reservations on HSW's evaluation and selection process; however, GSA awarded the contracts as recommended by HSW conditional on re-evaluation during the design phase. Design phase evaluation assured GSA that the subs selected offered the best value and had the technical capacities to put the documents together.

Benefit

One major benefits of integration that the team identified was the flexibility it provided. There were alignment issues with a primary design consultant; they did not understand the owner expectations. The team leadership had to make a decision to keep investing in a weak link or to let them go. The team decided to keep the consultant for the core and shell portion, but shifted the tenant build out scope to the contractor using a design-build contract. Because of the integrated team, the relationships and

technical support were in place to make this major change without delaying or otherwise negatively impacting the project. The team agreed that those challenges would have been devastating in another delivery method, leaving the owner open to claims risk, default and dispute.

Team Selection

The team observed that Integrated/Collaborative delivery is not an environment for everyone. Selection of team members is critical to IPD. For the architects, selected team members met two important criteria beyond the designated skill set: an ability to take input from multiple sources and individuals with an open mind.

When team members did not fit in with the culture, project leadership made the decision to replace them. GSA characterizes integrated delivery as a dynamic process that is not about solving one problem but rather a series of problems. "When issues arise, the problem may be with scope of the project or could lie within the team composition itself." The leadership was very deliberate in assessing team members and at the time this study was conducted had replaced the electrical designer, mechanical designer and landscape designer.

Technical Modeler Selection

BIM modeler team members needed to be technically adept; less emphasis was put on relationship building skills. Based on past experience, SERA found that modelers at different levels of experience and techniques created problems so they have since developed a bibliography of techniques and abilities required for each member of the team. They supplemented the selection process with training and orientation and developed rules and guidelines to help guide this process.

Once the primary technical team was selected, they were involved in selecting the partnering technical staff, ensuring that modeling techniques and skill sets matched those of the team.

Benefit

Some adjustments were required at the beginning of the project because traditional roles changed. However, the younger team members seemed to benefit greatly; co-location enabled them to learn from everyone around them and the integration required that younger staff really engage with other disciplines and forced them to ask more questions. As a result they gained experience more quickly than they would on a traditional project, they are in higher demand for other projects within their firms than one might expect for their experience level.

Project Planning

Resources Referenced

- Experienced IPD Team Member (Owner Representative)
- AIA IPD Resources
- Sutter Health IFOA
- Peer reviews of process by industry partners

GSA Region 10 (R10) has been maturing collaborative processes for the past 10 years with much of the philosophy and strategies rooted in process-based management, which focuses on designing outcomes, making tradeoffs to optimize time, and uses statistical quality control.

For this project, GSA R10 also incorporated IPD practices based on lessons from AIA and Sutter as well as inviting informal peer review. DLR and Mortenson were asked to review the team's practices and project execution, which infused the project team with new process ideas.

As noted in the contract section, additional effort was required up front to adapt the P100 process to align with this integrated/collaborative process. This required the team to review line-by-line the contract and identify conflicts in the contract and changes that needed to be made.

Team Building

One of the most unique aspects of this project was the intensified planning of the work and team orientation. GSA's officer found it challenging to get the team members (contractor, architect and consultants) to slow down and build the team before beginning the work. The team-building step was facilitated by the Master Schedule process, (see Implementation), which began shortly after SERA's contract was reinstated. The MS process continued for 4 months before the contractors were on board and 2 more months while the contractors went through the orientation phase. The six months of planning, identifying problems, analyzing issues and clarifying the goals was "excruciating" for some members of the team who wanted to begin designing sooner. However, most agreed that the longer process allowed the

right person to come in and be exceptionally effective at the right time, reducing wasted effort. The GSA officer commented that they "can get anybody to do the drawings" but they prefer to pay for a high performing team – one that can define the problems, find alternative solutions and affirm the owner's requirements.

Budgeting Team Effort

One of the challenges for any IPD project is budgeting for additional involvement and effort up-front. The IPD process is far more dynamic than GSA's typical projects. The conventional P100 contract lists tasks that the architect estimates hours and price for. GSA then has an impartial reviewer estimate following the same process. The two estimates are compared and price negotiated. IPD tasks and activities did not fit the P100 list and it was unclear how to budget.

GSA adjusted their budgeting process by converting the basis of the planning phases to time and materials (T&M) instead of their typical fixed price. This increased the risk to the owner, but since the technical requirements of the program were not completely understood, this was a more equitable way to budget. GSA increased meeting frequency to mitigate the team's performance risk. T&M reduced the team member risk since all their time was compensated. This reduced risk and the detailed Master Scheduling process allowed the team to develop very accurate proposals for the fixed price agreements in the Design Development and Implementation phases, ultimately reducing risk to the owner.

The team did not have a metric for additional cost related to increased team building activity, but each contract party felt the value was high. The additional time resulted in more alignment and trust, enabling the team to shorten the schedule, reduce costs, and deliver better value to the owner.

Rethinking Staffing

Staffing must be considered for all phases including early involvement during the design phase and during construction. To best support integrated delivery and new technologies (like BIM), investment in full time staffing for the duration of the project was identified as a key shift required in the industry. The architect called attention to the fact that on complex building types as much as 50% of the architectural fee pays for the consulting engineers. In most cases, the consultants' business models do not support full time staffing on one project; individuals typically work on multiple projects at the same time, meaning only a small percent of their attention is focused on your project. In that kind of model, problems that could be resolved in a 20-minute, three person conversation can take days or weeks to resolve. Another factor compounding that problem is that priorities and issues can change at a rapid pace during construction; if this is not effectively communicated to part time consultants, they may waste time and produce solutions to the wrong problem, requiring additional time and effort to resolve. The architect also noted that after experiencing co-location, their consultants now realize that they need to think differently about staffing to increase full time and focused staff in the future.

Implementation

Tools

- Custom
  - Master Schedule
  - miniMaster Schedule
  - Snap Shots
- Project Diary
- Co-location
- BIM

Central to process management this project was the Master Schedule (MS). The MS was created through a structured decision-making process that documented, sequenced and prioritized all the work and team protocols required to execute the project. Developing the MS also functioned as a team-building tool. Working through MS items, the team learned to cooperate with each other and gain a clear understanding of the team dynamic the owner required. This additional planning period provided the team the opportunity to work closely with the owner and each other, developing enough confidence and trust in the relationship to speak candidly about what was really important to the project.

Initially, the MS was developed by the core team. It continued to evolve through each design phase as the team further identified and delineated all the major areas of work. GSA recognized that identifying non-priority items was equally critical to the team's success as identifying priority items, because no project has the resources to do everything. Through bi-weekly review at the executive level, this tool helped the owner identify items in which they were willing to "disinvest."

From the Master Schedule a series of mini Master Schedules (mMS) were developed that detailed out how each task would be accomplished. After each MS meeting, the team reviewed

the mMS to identify any missing items and prioritize work. Developing the mMS created agendas for breakout meetings or identifying items that required additional meetings to be resolved. The MS and mMS were so effective in recording tasks and responsibilities traditional meeting minutes were not needed.

Part of the mMS process that helped foster a sense of ownership across the entire project team was the assignment an individual team member to certain task items. These individuals were identified as a Subject Matter Expert (SME) and were responsible for resolving their items through whatever means necessary. This created a system for decision-making and responsibility that led to distributed leadership. Creating multiple scales of project ownership ensured that healthy debate could lead to decisions made in the best interest of the overall project.

To help the management team work through the MS they developed a series of conventions such as a design issues log that everyone working on the team can contribute to – a subtask mMS.

Instead of traditional drawing packages (50% SD, 100% SD, 50% DD, etc.), drawing packages on this project were called Snap Shots. Snap Shots were taken at specific moments during design when the team literally printed drawing sets from the BIM. One of the most unique aspects of this project was the alignment of the Snap Shots with the CMc's buyout strategy, made possible by the back and forth coordination between the CMc and architect. According to the owner, it was important that the entire team acknowledge the purpose of the technical documents was to validate owner intent and provide the information necessary for the CMc to solicit subcontracts; the documents did not need to be complete. This philosophy allowed the prioritization within the design, delaying non-critical portions of design to later phases; this helped keep the aggressive schedule on track. It also helped focus the entire team on 1 or 2 priorities at a time. Subcontractors embracing this process were awarded design-build contracts so that trades who would build it, designed it. Essentially, this allowed the architect to complete the design through an "active listening process" engaging with the trades; efficient compared to designing without input and later reworking the design after the trades were on board.

Another tool implemented was a project diary which helped record information and manage communication. The diary was distributed weekly to the entire team, including all contract parties and all job levels, and highlighted major decisions and progress. The architect managed the diary, but the CMc and owner also contributed content each week. Development of this tool was partly in response to rumor control, see Workplace; the purpose was to keep everyone on the same page.

Co-location and BIM worked in tandem with the implementation process described above. Co-location of the team provided significant coordination benefit, enabling informal daily interactions. BIM, coupled with co-location, facilitated design and real time coordination that allowed issues to be resolved within a matter of minutes.

Lesson Learned

On this project there were no review standards in-place for the Snap Shot packages, but GSA Region 10 (R10) intends to revise this process for future projects to require a formalized "time out" after a Snap Shot is taken. A formalized review period after each Snap Shot would allow the team to focus on understanding the documents that have been produced, determine if varying level of completeness between disciplines will result in coordination issues, review any outstanding engineering required for custom elements, and take time to redefine deliverables for subsequent Snap Shots.

Social Strategies

Early Involvement

CM/GC

- Criteria Design

Trade Contractors

- Criteria Design

According to GSA's officer, "one of the real values of integrated delivery is the ability to get each team member oriented and saturated before we start building. The more we can front load the schedule and the more we can allow team members to influence the project when we are still on paper, the greater impact we get as owners in terms of change control -- cost, budget etc. Even the tradeoff we made, allowing HSW to pick the first five subcontractors, the value of having those people follow the same orientation track as our prime, we felt was a legitimate tradeoff to waiting and hiring subcontractors."

The architect, SERA, was re-contracted almost 7 months before the CMc was brought onto the project. The CMc, Howard S Wright (HSW), was involved in early meetings and followed the progress of the project prior to being contracted. Toward the end of criteria design, HSW, along with five trades, were brought onto the team, which allowed them to participate in detail design and later phases. GSA appreciated the value of involving the contractor early; eliminating the buy out effect of bidding gave GSA better control over performance, cost and schedule risks. They estimated that by bringing on the subcontractors early, over 60% of the owners cost exposure was known before construction started.

Once the team was in place, GSA's priority was to align the team's goals, build relationships and the team's supporting infrastructure. The GSA officer stated, "I am buying that high performing team work." GSA facilitated the orientation and relationship building of the entire team by using several strategies, many of which are rooted in process-based management such as: designing outcomes, eliminating waste and making the system as efficient as possible.

Benefits

There were several innovations attributed to early involvement and the integrated make-up of the team. One example was the idea to design a model unit for the 16 inbound tenant design work. Because of the strong partnerships, the owner was open to this idea, which significantly improved the team's ability to meet the building's energy performance goals. The model unit established a base design concept that optimized the building's energy profile and incorporated cost and constructability input from the CMc. Armed with this information, the architects could explain to the tenants the science behind the design and the cost implications of design changes to the base design. In the end, all the models were modified to meet each tenants' specific program requirements, but in general they followed the basic layout concept because the tenants had a clear understanding of the overall building goals, reasons behind the design, and implications of change. It also eliminated the time consuming and costly cycle of designing and redesigning.

Transparency

The CMc's contract specified "open book" access to any and all records maintained by the contractor relating to the project, including all subcontracts. This also gave the GSA the right, but not the obligation, to attend all project meetings.

GSA also followed a "reverse open books" strategy. GSA showed their budget and planned allocation to the team. The openness of this communication set an example for the transparency the owner expected from each team member and set a realistic view of where GSA expected the resources to be distributed.

Decision Making

GSA wanted roles and responsibilities to emerge through the development of the Master Schedule, see Implementation. At first, this caused confusion as team members tried to work in their traditional roles. Core areas of responsibility were not assigned until the Master Schedule was complete and scope was clearer.

GSA followed the philosophy of "intentional maturation" of the team. Team members who came on board with different expectations based on the way they've done it previously had to adapt and adjust to others; it required team calibration. It was particularly difficult for those team members who have been in the project management role, or sole decision maker, because the integrated team was all about distributed decision making and exploited multiple areas of expertise. Distribution of leadership was facilitated by the Master Schedule process; team members best suited for a particular task item or issue were assigned as Subject Matter Experts (SMEs) and were responsible for bringing the item to resolution and closure, see more in Leadership and Implementation.

Owner involvement and early involvement of expertise coupled with co-location (see Workplace) and clear expectations (see Leadership) were key to quick decision-making and, according to the owner, exponentially reduced latency. An example is the successful resolution of an error in the fire system identified by the electrical contractors. Because the issue was brought to the owner immediately, a decision was made in 3 days as opposed to months of debate. Changes only had to be made to the first floor and incorporated in progress work, whereas in a more traditional delivery method, the issue would not have been identified until late and would have required rework to all floors. Important to note, utilizing the integrated team for quick and effective decision-making is dependent on the ability of every team member to influence the outcome. This behavior and willingness to engage was strongly influenced by clear communication by the owner; everyone was expected to take ownership of the project.

Culture

In this project, the team believed that the IPD process reinvented how they thought of the work and redefined their relationships to create a team synergy. They concluded the goal and value of IPD is innovation, which invigorated their team and kept the energy level high.

The team commented that the best value comes out of IPD when team members free themselves from their traditional roles and responsibilities. To do this, the team requires at least one member to bring energy and passion, breaking others out of old routines and preventing them from slipping back in to traditional roles. In this project, the owner filled that role, acting as a champion for the IPD process. Because of the time committed to team education and relationship building, GSA's leadership methods rubbed off on the entire executive team and create a distributed network of champions throughout the project team.

Constant reminders were required to eliminate biases formed by past experiences in the design and construction industry. To establish new team norms, the owner create a controlled tension that kept team members off guard.

GSA representatives understood that this way of working required significantly more senior and highly qualified people than would typically be used on a traditional project. These staffing decisions did not lead to a scripted top-down project but created an atmosphere where the team scripted the project throughout the whole process. To facilitate the scripting process, expertise needed to be gained incrementally, allowing the members to evolve alongside the process.

The executive and management team used several management and social strategies to achieve the value proposition of IPD. See more about these under Leadership, Implementation, and Early Involvement.

Environmental and Technological Strategies

Workplace

Co-located - full time

During design, the integrated team was co-located on the project site, in existing offices of the federal building they were modernizing. In order to assess the outcomes of co-location, GSA periodically required that team members rate their experience compared to previous projects and typical work environments. Members rated: physical plant, team spirit, professional development, productivity, innovation/ improvement, and integrated BIM.

Results from the first survey showed very positive evaluations of co-location in terms of professional development, team spirit, and the use of BIM. The majority of the team felt innovation and improvement was equivalent to non co-located experiences, though only 2% felt it was worse while 17% felt co-location improved innovation. Productivity had the least consensus, with 14% of team members ranking productivity in the co-located office worse than non co-located experiences, 28% felt productivity was the same, and 18% felt it was better. Consistently scoring low was the physical work environment itself. The survey process also revealed that certain individuals consistently evaluated their experience as worse. GSA speculated that age and those coming from private office cultures might have been factors indicating that some personnel do not thrive in a co-located environment.

In general, the integrated team benefited from co-location, however the team identified some nuances that need to be considered regarding the co-located space. Because the team took over existing office space, they had to work around the existing layout and space available. This meant the CMc was on one floor, the owner and major subs on another floor, both mainly in private offices, and the modelers and engineers were in one big space on another floor. One team member from the architect felt having the team separated on different levels of the

building hindered effective communication, he commented, "at one point we were joking about starting a rumor smartsheet so we could keep track of all the rumors that were or weren't happening. Getting everyone into a cohesive space gets you, at least perception-wise, closer to feeling like you're in the know." On the other hand, a representative from the CMc felt there should be some departmentalization between contract parties to help control the flow on information. Co-location increases the amount of information available to team members, whereas in a more traditional setting project managers would filter what individuals needed to know. The increased flow of information can be paralyzing for some roles; to help counter that effect, the team emphasized the need for some protocols that provides some guidance. On this project, the Snap Shots (see Implementation) were evolved out of that need; they provided baselines for team members to work from so that individuals did not have to adapt to every new bit of information they heard.

Once construction started in October 2010, the CMc, architect, owner and the electrical detailer relocated to office space 1 block from the job site. The mechanical detailer worked remotely from Seattle and the architect team significantly reduced in size during construction but maintained key staff members.

Benefits

The team felt that co-location was a significant factor in avoiding change orders. As the architects worked on the design, co-location gave the contractor "early line of sight" to what they were working on. Early communication, estimating and budget verification of the architects' "fat line drawings" kept the team on track, saved man hours in rework and ensured the design was appropriate to the budget.

Co-location also played a significant role in reducing latency on the project and helped eliminate rework, see Decision Making. The owner commented, "by the end of the job, there are thousands of decisions that need to be made, they need to be made every week to continue progress." The owner described an experience on another job where the architect did not co-locate, "one day a superintendent threw down his notebook in a meeting and said, 'I'm not in the position to schedule my problems' and walked out of the room." The owner felt this illustrated the value of co-location well, because you can never predict all the issues that will arise and not having the experts you need in the room can be frustrating and slow down the ability of others to perform. Co-location provides context and nuance to the project and relationships. It helps each party understand how their actions affect the other members of the team; it allows them to read between the lines. The team felt the dependency and trust established by co-location yields significant payback in latency reduction.

Information Sharing

Tools

- BIM
- Face to face exchange – co-location
- Networked document management site
- SmartSheets (cloud based document sharing)
- Living Calendar

Meeting Frequency

- Weekly Coordination Meeting
- Monthly Clash Detection and Energy Model Verification Meetings
- Monthly Project Executive Meeting
- Monthly BIM Review Meetings through Criteria Design
- Daily BIM Meetings from Detail Design into Construction
- Daily Information Coordination Meetings
- Specialty Meetings as needed

BIM

Model Manager

- Architect (SERA)

Management Protocol

- Custom Building Information Modeling/ Management (BIM/M)

GSA would like to push the use of Building Information Modeling (BIM) to it's fullest extent but actual implementation lags behind expectations. The architect and contractor worked to add the schedule dimension (4D) to BIM, however incorporating knowledge from trades prefabrication schedule to cost models proved difficult.

SERA took the lead role in putting the model together. They spent a great deal of time working out the different deliverables

for all the major disciplines, architecture, structural, mechanical, electrical, plumbing. Hand off to the builder occurred at logical points in the process. Because of the early involvement of many trades, the architect only had to model enough to facilitate normal conventions of coordination of shop drawings.

GSA is monitoring and measuring the advantages of BIM and will continue to monitor change order reduction and constructability issues throughout construction, see Goals. To help make the case for IPD to congress, GSA Region 10 (R10) has a target change order rate of less than 3%; typically congress would fund a renovation project at a 9% change order rate.

BIM Use

This project used the BIM model for coordination, clash detection, constructability reviews and scheduling. To advance the use of the model in design and construction, GSA pushed SERA to use it for tenant communication and virtualization and HSW to use the model for layouts. Although more scheduling power could be harnessed, this is the first project for GSA R10 to achieve 4D with BIM. Eventually, GSA would like HSW to conduct cost estimates (5D) with the model and bill material outputs to each subcontractor using it as a calibration tool.

The model was very effective at facilitating coordination between the many disciplines and confirmation from those who will build it. For example, there was a complex change request from the owner to change the ceiling height from 9' to 9'-6". The team was able to effectively communicate with all the affected team members and made the change almost instantly. There were major benefits to the owner just given the flexibility; however currently there are also major vulnerabilities and risk due to the various proprietary software used that become problematic when the model is translated to the different trades. GSA is trying to track those issues as they come up so that they can more effectively predict these translation issues and mitigate risk in the beginning of modeling for future projects.

The team found two primary challenges with using BIM to create the implementation documents that became the subcontractors' coordination and fabrication drawings.

First was learning how to articulate design/model requirements for the different disciplines. The team found that they were being too literal with the requirements for each discipline and phase. They found they couldn't predict (or expect) that mechanical or electrical follow the same design path as structural or plumbing, and in some cases this was forcing the architecture before the contractor needed it for buyout. To address this and track each design path, the team used what they called Snap Shots, literally taking pictures of design development status, using Revit to print the 2D document set of exactly what they had at certain points in time Implementation. Each Snap Shot was a deliverable package, which looked similar to traditional submissions, that got more specific by discipline or building system as the project evolved to match what HSW needed for procurement and buyout. This process would not have been possible without the intense coordination made possible by co-location and early contributions by the trade contractors.

Second was determining the deliverables for the project. Traditionally they would be providing GSA with a marked up print; however in this case they are delivering a model that will embed a great deal of information including construction photos and digital survey information. Part of the problem is they are "still making the sausage" and aren't exactly sure what it will look like in the end.

Autodesk Inc.

PROJECT
Autodesk Inc.
AEC Headquarters

OWNER
Autodesk Inc.

ARCHITECT
KlingStubbins

CONTRACTOR
Tocci Building Companies

Overview

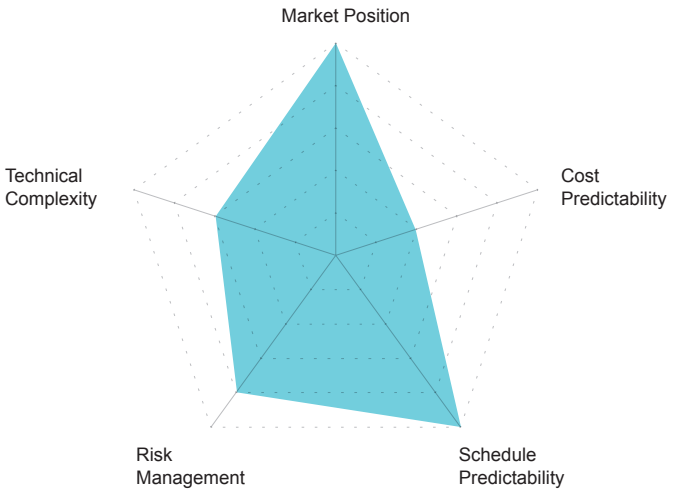
Project Description

Location	Waltham, Massachusetts
Type	Office - Interior Renovation
Contract	Multi-party contract
Owner	Autodesk Inc.
Architect	KlingStubbins
Contractor	Tocci Building Companies
Project Start	May 2008
Year Completed	January 2009

Autodesk Inc., a company that creates design software for the AEC industry, wanted to highlight ways in which its own technology could support Integrated Project Delivery (IPD), Building Information Modeling (BIM), design-to-fabrication, sustainability, and building performance analysis. The company decided to put those goals forward with its own project. So in spring of 2008, Autodesk sought an architect/builder team to complete a 55,000 square foot, three-story interior tenant improvement that uses all of the space in a new speculative office building in Waltham, Massachusetts along Boston's Route 128 technology corridor. Program elements included 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.)

Architect KlingStubbins and builder, Tocci Building Companies, together responded to the RFP and were selected for their qualifications and willingness to enter into a "pure" IPD contract agreement, the first for both firms. 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. Both had aggressive design and construction schedules -- 3 ½ months for design, 6 months for construction. Unique to Waltham, several major subcontractors were tied to the integrated contract and incentive program from an early stage.

IPD Profile



** This motivation profile was created by our research team with input from Jonathan Cohen, based on the January 2010 publication, "Integrated Project Delivery: Case Studies," written by Jonathan Cohen, FAIA. Project teams did not have direct input to the profile scoring.*

Market Position
Autodesk was motivated for unique reasons. As the primary developer of software for the AEC industry, Autodesk was motivated to select IPD as the delivery method to showcase how their products support this emerging delivery method.

Cost Predictability
As with any project, cost predictability is important, but in this case schedule and quality design were the driving forces.

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

Risk Management
Autodesk is experienced with office build-outs and typically followed either design-bid-build or CM at Risk delivery methods. Given the aggressive schedule and demanding sustainable design goals, they determined the only way to deliver the project in was to use an IPD approach.

Technical Complexity
As an interior office build-out, this project was not complex; however there were some complex design elements such as the curved wood panels in the conference briefing center as well as a late but major design change by the owner requiring the team to cut a 3 story atrium through the existing space.

Survey Data

* This case was conducted by Jonathan Cohen, FAIA for the January 2010 publication, "Integrated Project Delivery: Case Studies." The questionaire developed by our research team for the 2011 Case Study report was not administred to these teams. No survey data available.

Contract

Contract Type
- Integrated Project Delivery Agreement (IPDA)

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. 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.

Commercial Terms
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. Major subcontractors (mechanical/fire protection, electrical, and drywall) were also brought in to the agreement, worked at cost, and shared in the incentive program.

Relational Expectations
Distinct roles and responsibilities are delineated in contract language and in a "responsibility matrix."

Implementation Tools
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. Traditional profit targets originally set design budgets; this number includes all A/E fees at direct cost, plus incentive payments as targeted.

Goals

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.

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 plus or minus 20% depending on whether project goals (see Goals) were met or exceeded and 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.

Lessons Learned

According to Autodesk executives, the contingency and incentive structure on IPD projects need to be better defined and adapted to achieve the desired behavioral goals from the team. Gail Boettcher, Autodesk's corporate real estate senior manager 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." 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.

Furthermore, Phil Bernstein, Autodesk's Vice President for Industry Strategy and Relations, expounded that a lesson for future projects is "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."

Liability

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.

Insurance

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.

Leadership

Champion

- Owner

Team Structure

- Senior Management Team (SMT),
- Project Management Team (PMT),
- Project Implementation Team (PIT)

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 (see Decision Making). 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.

Firm Selection

Autodesk management wanted the design and build team to self-select; they did not want to "mix and match" architects with builders. They 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. 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.

Lesson Learned

On Autodesk's first experiment with IPD, a 45,000sf corporate office and briefing center in downtown San Francisco, there were separate architects for the two major components. Anderson Anderson was in charge of the 16,400sf briefing center and HOK was responsible for the 29,300 sf office space. Both architects worked with one builder, DPR Construction. Both DPR and HOK were interested in "getting their feet wet" with IPD. 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."

Team Selection

No information available regarding participant selection characteristics.

Project Planning

According to Phil Bernstein, Autodesk's Vice President for Industry Strategy and Relations, one of the fundamental "first steps [of IPD] 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."

One major advantage of IPD for the builder is the ability to enable early procurement of time- and cost-variable materials and services. 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 (see Risk/Reward) and 45% was traditionally procured.

Another benefit of Tocci's early involvement in planning and 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. (See also Risk/Reward and Early Involvement)

Implementation

There was a BIM execution plan that defined roles and responsibilities for the model. No information available regarding Lean or other custom tools in this project.

Early Involvement

Autodesk required in the RFP that the architect and contractor "self-select," therefore KlingStubbins and Tocci Building Companies worked together from the very start of the project. Additionally, several major subcontractors (mechanical/fire protection, electrical, and drywall) were brought in to the agreement early on, worked at cost, and shared in the incentive program.

Another strategy to provide needed information to the building team in a timely manner was the creation of a Building Advisory Team that 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.

One of the major benefits of early and integrated partnering was the flexibility it provided the owner. Scope changes, totaling about 30% of the original budget, were added by the owner over 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 as well as an upgrade to the shell building's mechanical systems.

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.

Transparency

Project finances were very transparent, which helped enable the team to make innovative design and construction decisions that improved design quality and saved time and money, see Decision Making for detail.

Decision Making

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. 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.

Culture

No information available.

Workplace

Co-located – key project participants/part time

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. 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 the model was moved from KlingStubbins' to Tocci's servers and Sarah Vekasy, KlingStubbins' project architect, moved to the construction site.

Information Sharing

Tools

- BIM
- Face to face exchange
  (part time co-locating for key project participants)

BIM

Model Manager

- Shared: Architect (KlingStubbins) during design phases and CM (Tocci) during implementation documents and construction phases.

Management Protocol

- Custom BIM Execution plan

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 so co-location of key project participants was used to ensure the model could progress with input from both the contractor and architect as needed, (see Workplace). At-risk subcontractors were all BIM-enabled. They provided detailed unit costs up front and Tocci assumed responsibility for taking quantities off the model.

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."

Design-to-fabrication was used for the customer-briefing center's distinctive wood panel ceiling; the curved elements were 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.

KlingStubbins learned that close collaboration with builders (see Early Involvement) 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.

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.

Sutter Health Fairfield Medical Office Building

PROJECT
Sutter Health Fairfield Medical Office Building

OWNER
Sutter Regional Medical Foundation, Sutter Health

ARCHITECT
HGA

CONTRACTOR
Boldt

Overview

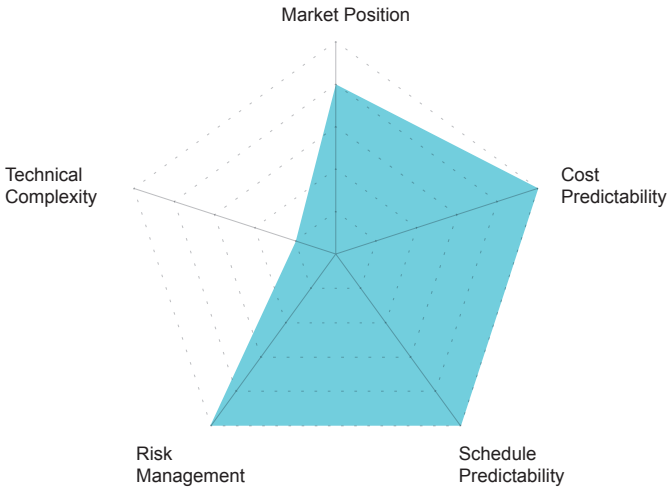
Project Description

Location	Fairfield, California
Type	Healthcare - MOB
Contract	Sutter IFOA
Owner	Sutter Regional Medical Foundation
Architect	HGA
Contractor	Boldt
Year Begun	2005
Year Completed	2007

This project was the, or close to the, first "true" IPD project in the country. In spring of 2005, Sutter Health, one of the largest not-for-profit health care providers in Northern California, was seeking an architect and builder to design and build a 70,000 square foot medical office building in Fairfield, California. HGA Architects and Engineers won the job and almost immediately was introduced to the builder, Boldt, to ensure each firm had compatible cultures. The principals met and decided it was good fit. Early on in the design process, Sutter, HGA and Boldt collaboratively selected the main design-build subcontractors.

This project, a $19.4 million, three-story medical office building housing primary care medical practices and laboratories, was the first built component of a $6.5 billion capital program. It was a relatively small project for Sutter and as such, gave them the opportunity to test out a new process of collaboratively designing and building facilities. Sutter worked with the Lean Construction Institute to develop this new collaborative delivery method and with attorney Will Lichtig, whose Sacramento firm has represented Sutter for 50 years, to draft the integrated, tri-party contract.

IPD Profile



** This motivation profile was created by our research team with input from Jonathan Cohen, based on the January 2010 publication, "Integrated Project Delivery: Case Studies," written by Jonathan Cohen, FAIA. Project teams did not have direct input to the profile scoring.*

Market Position

As an organization that builds and owns multiple large and complex facilities, Sutter Health had both short and long term incentives to improve the delivery process and create better buildings. In 2004, they hosted the Sutter Lean Summit 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. Sutter believes an integrated form of agreement is the best way to do this, and by supporting its development and adoption, has had a significant impact on improving the capacity and quality of local design and construction firms. This was one of the first projects completed using the integrated delivery.

Cost Predictability
Reducing and managing costs while improving value was a primary motivation for Sutter to use an integrated project delivery method on this project and future projects.

Schedule Predictability
Schedule management was a primary motivation for Sutter to invest in and test the IFOA contract and collaborative delivery method. Although this project did not have particularly challenging schedule requirements, Sutter believes this delivery method can offer better predictability of schedule, which would be critical for larger and more complex future projects where schedule.

Risk Management
One of the primary reason Sutter developed an integrated project delivery system was to reduce their exposure to unforeseen risk and number of disputations. By using a shared risk structure, they prevent risk from being shifted between contracting parties and believe it can reduce overall project risk.

Technical Complexity
This project was small and simple compared to other healthcare projects undertaken by the parties involved and therefore did not require any special coordination to achieve the design and technical goals. This project was selected to test this delivery method because of its relative simplicity.

Survey Data

* This case was conducted by Jonathan Cohen, FAIA for the January 2010 publication, "Integrated Project Delivery: Case Studies." The questionaire developed by our research team for the 2011 Case Study report was not administred to these teams. No survey data available.

Contract

Contract Type
- IFOA (Integrated Form of Agreement)

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.

Commercial Terms
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 Expectations
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."

Implementation Tools
The 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.

Goals

A finish date of December 2007 was set and benchmarking of comparable medical office buildings was established. 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.

Outcomes and Lessons

Sutter needed the building delivered in 25 months and that was accomplished under budget despite a three-month delay for reprogramming at the start of the project and with the addition of extra scope. Overall, Sutter was very pleased with the building and the process. 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.

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.

Risk/Reward

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."

Boldt felt that financial incentives would have been a benefit to this project, with the incentives flowing down to the trade contractor level. All of the considerable project savings in this case went only to the owner.

Dave Kievet, the Boldt Group's president, thinks the alignment of commercial interests is key. "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."

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 consultants and trade contractors participate in the pool as well.

Liability

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 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.

Insurance

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.

Leadership

Champion

- Owner

Team Structure

As an organization, Sutter Health paved the way for IPD. As an owner of a large healthcare system, Sutter is a serial builder and 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. The Fairfield MOB was the first Sutter Heath project to use a tri-party, integrated form of agreement drafted by attorney Will Lichtig, as the basic design and construction contract.

The project team was organized into three leadership levels.

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; representatives of other trade contractors and stakeholders augmented the committee when appropriate.

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.

Firm Selection

Sutter issued an 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. The tri-party 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 sub-trades were competitively bid with lump sum prices.

Team Selection

No information available regarding participant selection characteristics.

Project Planning

IPD requires a significant time commitment during Project Planning stages. 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.

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, (see Early Involvement).

Implementation

The Lean Construction Institute played an integral role in the planning and implementation of the integrated process (see Leadership). Several lean construction techniques such as, "Last planner," "reliable promises," "pull scheduling," and end-of-day "huddles" were employed with success. Just-in-time materials management, another lean process, was not used in this project, in part because there were large areas available for staging.

One tool implemented on this project that helped document and preserve programming decisions were "room data sheets," (see also Decision Making). This tool helped identify special requirements and verify the final outcomes met the needs identified during programming.

Early Involvement

The initial project team consisted of Sutter Health (the overall corporate entity), Sutter Regional Medical Foundation (the local Sutter affiliate,) HGA and Boldt. This group, or Core Team, together selected and brought on the main design-build subcontractors very early in the design process, see Project Planning.

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 trades selected early to fully engage early in design.

An example of the benefits of early involvement in conjuncture with Building Information Modeling (BIM) is evident from the number of issues identified before construction. 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.

Transparency

All books in regard to the project are open. Also see Information Sharing.

Decision Making

Implementation tools, such as lean construction process, helped provide a framework for the team to collaborate and make decisions, (see Implementation). Room data sheets and narratives were used to guide the team's decision making to achieve the detailed requirements for each room including equipment needs, finishes, utilities and other special requirements. This approach was used to document and preserve decisions made by stakeholders during programming and ensure that the final product met stated needs.

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 that 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.

Lesson Learned
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 might have slowed decision-making.

Culture

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.

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.

Workplace

No information available.

Information Sharing

Boldt's project web site became the repository of project information and the place where submittals were made and processed electronically. The architect was able to process over 50% of the submittals without paper documentation.

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.

BIM

The extensive use of BIM was a new experience for architect, builder and owner, although the MEP subcontractors had limited prior experience.

BIM enabled the group to identify over 400 systems clashes during design, providing increased accuracy and planning ability for fieldwork and significant cost and schedule savings. During construction, 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 prefabricated ductwork and less field labor. For casework, much less detailing effort was needed from the architect – with no loss of design and quality control.

Lessons Learned

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.

Cardinal Glennon Children's Hospital Expansion

PROJECT
Cardinal Glennon Children's Hospital Expansion

OWNER
SSM Healthcare

ARCHITECT
Christner, Inc.

CONTRACTOR
Alberici Constructors, Inc.

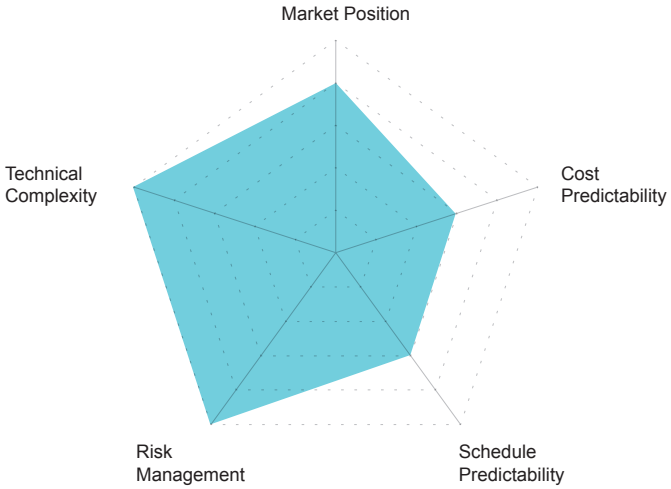
Overview

Project Description

Location	St. Louis, Missouri
Type	Healthcare
Contract	Multi-party contract
Owner	SSM Healthcare
Architect	Christner, Inc.
Contractor	Alberici Constructors, Inc.
Year Begun	2004
Year Completed	2007

The project began in October 2004. SSM Healthcare assembled a team including the architect Christner Inc., MEP engineer McGrath Inc., and builder Alberici to design and build a 138,000 square foot, $45.5 million children's hospital expansion. The project delivery was not IPD to begin with, but in late 2004 SSM invited Greg Howell of the Lean Construction Institute to conduct a two-day seminar with SSM and their project partners. SSM Healthcare's Executive Director of Design and Construction, Donald E. Wojtkowski, who first learned of IPD and lean construction by attending the Sutter Lean Summit in 2004, initiated this event. 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. Following the LCI workshop, a four party integrated contract was put in place on this project.

IPD Profile



** This motivation profile was created by our research team with input from Jonathan Cohen, based on the January 2010 publication, "Integrated Project Delivery: Case Studies," written by Jonathan Cohen, FAIA. Project teams did not have direct input to the profile scoring.*

Market Position
SSM Healthcare develops, owns, and operates many large-scale facilities and therefore had a short and long term incentive to improve the delivery process in their region. SSM Healthcare's Executive Director of Design and Construction, Donald E. Wojtkowski, who first learned of IPD and lean by attending the Sutter Lean Summit in 2004, brought the lessons back to their region and began educating their local industry partners to improve their market options.

Cost Predictability
IPD was implemented after the budget was set and therefore this was not a primary motivator for SSM to implement IPD and Lean.

Schedule Predictability
IPD was implemented after the schedule was set and therefore this was not a primary motivator for SSM to implement IPD and Lean.

Risk Management
This was one of the primary motivations for SSM Healthcare to more towards a collaborative delivery method. They felt strongly that traditional design-bid-build models too often result in risk shifting between contracting parties and felt IPD would help eliminate this.

Technical Complexity
This project had a high level of technical complexity. All parties seemed to agree that IPD is well suited for large, complex projects.

Survey Data

* This case was conducted by Jonathan Cohen, FAIA for the January 2010 publication, "Integrated Project Delivery: Case Studies." The questionaire developed by our research team for the 2011 Case Study report was not administred to these teams. No survey data available.

Contract

Contract Type
- Custom contract based on Sutter's Integrated Form of Agreement (IFOA)

This project used a four-way IFOA contract among the owner, architect, MEP engineer and builder; however this project did not begin with this IPD contract. No information is available regarding the state of the project at the time of the IFOA was implemented. The contract also ties prime trade contractors, including the ceiling framing and finish, and fire protection, using a "Lean Pool" or risk/reward pool.

Commercial Terms
The contract is based on Sutter's IFOA and includes a risk/reward pool and open book accounting. The contract did not have special insurance requirements and teams did not agree to limit liability. The actual contract was not available for this summary, and therefore we cannot comment on relational language.

Relational Expectations
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.

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.

Implementation Tools
No information available.

Goals

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.

Risk/Reward

"Lean Partners" (parties inside the risk pool) included the architect and contractor, but also extended to included MEP, wall and ceiling framing and finish, and fire protection subcontractors. Smaller pieces of the work were bid out with fixed prices.

Sidebar Comment
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."

Liability

There was not a "no-sue" clause in the IFOA.

Insurance

Each party carried typical general and professional liability insurance.

Leadership

Champion

- Owner – SSM Healthcare

Team Structure

- Owner's Management Team
- Core Team
- IPD Field Team

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, (also see Decision Making). 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."

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."

Firm Selection

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.

Team Selection

No information available regarding participant selection characteristics.

Project Planning

Donald E. Wojtkowski, SSM Healthcare's Executive Director of 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.

Implementation

Lean processes were applied and the Lean Construction Institute (LCI) institute participated in a 2 day planning event early in the project. No detailed information regarding implementation tools and strategies is available.

Early Involvement

This project started using a traditional delivery method, however all of the major players had previous working relationships and the primary contractor was selected early in design.

Transparency

All books with regard to the project were open.

Decision Making

The team structure and decision making process was set up to be collaborative and transparent between the primary project participants, which provided a great deal of flexibility while working towards the best decisions for the project.

An example of how this collaborative decision making process worked came up 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."

One major challenge that arose during construction was effectively managed by leveraging the flexibility provided by open, transparent, and 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.

Culture

For the owner, there was no culture clash due to the move toward IPD. 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.

Workplace

No information available.

Information Sharing

No information available.

BIM

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.

Christner has since transitioned to BIM and expects it to support future IPD projects.

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.

St. Clare Health Center

PROJECT
St. Clare Health Center

OWNER
SSM Healthcare

ARCHITECT
HGA

CONTRACTOR
Alberici Constructors, Inc.

Overview

Project Description

Location	Fenton, Missouri
Type	Healthcare
Contract	NA
Owner	SSM Healthcare
Architect	HGA
Contractor	Alberici Constructors, Inc.
Year Begun	2005
Year Completed	2009

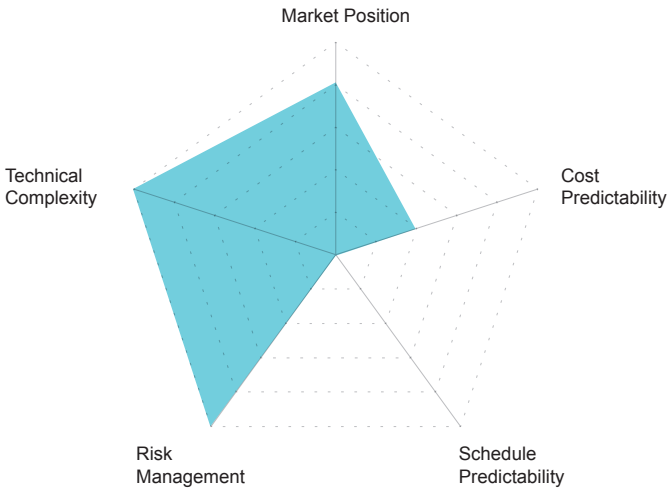
In 2005, SSM Healthcare assembled a team of architect, HGA, and contractor, Alberici, to implement IPD and lean construction on their St. Clare Health Center in Fenton, Missouri; a $157 million replacement hospital and medical campus. This project just followed the completion of SSM's Cardinal Glennon Children's Hospital, on which SSM and Alberici tested the implementation of IPD and lean strategies, albeit late into the project (see Cardinal Glennon Children's Hospital Case Study for details.)

SSM Healthcare had been actively engaged with Greg Howell of the Lean Construction Institute. In late 2004, SSM invited Howell to St. Louis and held a two-day Lean and IPD seminar with their local industry partners. After having some success with IPD and Lean on the Cardinal Glennon project, 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.

This was SSM's and Alberici's first IPD project from conception. HGA had prior IPD experience with Sutter Health in California, but the process was new to HGA's Milwaukee office. Over time, however, the Milwaukee office became more comfortable with this new way of working.

The project is comprised of a 430,000 square foot 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."

IPD Profile



** This motivation profile was created by our research team with input from Jonathan Cohen, based on the January 2010 publication, "Integrated Project Delivery: Case Studies," written by Jonathan Cohen, FAIA. Project teams did not have direct input to the profile scoring.*

Market Position

SSM Healthcare develops, owns, and operates many large-scale

facilities and therefore had both short and long term incentives to improve the delivery process in their region. SSM Healthcare's Executive Director of Design and Construction, Donald E. Wojtkowski, who first learned of IPD and lean by attending the Sutter Lean Summit in 2004, brought the lessons back to their region and began educating their local industry partners to improve their market options.

Cost Predictability
The budget appeared to be flexible and therefore cost predictability was not the primary reason for selecting IPD as the delivery method. SSM Healthcare did not hold the team to a GMP and compensated the primary project partners at cost plus a fee. SSM felt releasing the contractor from financial risk was the only way to ensure the team would truly change their behavior and work towards the good of the project.

Schedule Predictability
No specific information available for interpretation.

Risk Management
This was one of the primary motivations for SSM Healthcare to move towards a collaborative delivery method. They felt strongly that traditional design-bid-build models too often result in risk shifting between contracting parties and felt IPD would help eliminate this.

Technical Complexity
This was one of SSM's primary motivations for moving towards IPD. They prioritized incentives that would shift the team's behavior and optimize team performance in order to achieve high quality in a complex project. All parties seem to agree that IPD is best suited for large, complex projects.

Survey Data

* This case was conducted by Jonathan Cohen, FAIA for the January 2010 publication, "Integrated Project Delivery: Case Studies." The questionaire developed by our research team for the 2011 Case Study report was not administred to these teams. No survey data available.

Contract

Contract Type
- Custom tri-party based on IFOA

The tri-party 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.

Commercial Terms
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.

Relational Expectations
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.

Goals

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.

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.

Risk/Reward

At the beginning, SSM felt that this project, with its significant scope, had to have an enforceable GMP. As noted in the goals section, 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.

The owner learned from an earlier project, Cardinal Glennon, that a release from GMP was preferred by the builders over financial incentives. Donald E. Wojtkowski, SSM Healthcare's Executive Director of 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."

Liability

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

Insurance

No information available.

Leadership

Champion

- Owner-SSM Healthcare

Team Structure

- Senior Leadership Team, Core Team, IPD Field Team

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.

Firm Selection

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.

Team Selection

No information available regarding participant selection characteristics.

Project Planning

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.

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.

Implementation

The Lean Construction Institute (LCI) played a significant role in implementing lean construction tools, such as the Last Planner System, on the project from the very beginning.

Early Involvement

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

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.

Transparency

Books were open and audited.

Decision Making

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 (see Early Involvement) 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."

Culture

"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."

Workplace

Co-located part time – BIG Room

Each contracting party did their work in their respective offices and would be brought together periodically in a co-located room, or "Big Room," for coordination and detailing in 3D.

The process worked like this; 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 and was augmented with a project management web site used to share design progress with team members who could not physically be present. 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."

Information Sharing

This project utilized BIM (3D Architectural Desktop), a web enabled project management site, and a "Big Room." See also Workplace and BIM.

BIM

BIM was used extensively, not only to detect clashes between systems but also to increase the proportion of prefabricated assemblies with their greater tolerances and lower requirement for field labor.

Utilizing the "Big Room" and early involvement of trade contractors improved the efficiency and accuracy of the design process. 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 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."

Encircle Health Ambulatory Care Center

PROJECT
Encircle Health
Ambulatory Care Center

OWNER
Encircle Health

ARCHITECT
HGA

CONTRACTOR
Boldt

Overview

Project Description

Location	Appleton, Wisconsin
Type	Healthcare
Contract	NA
Owner	Encircle Health
Architect	HGA
Contractor	Boldt
Year Begun	2006
Year Completed	2009

In 2006, Encircle Health selected architect, HGA, and contractor, Boldt, to design and build a $38.6 million ambulatory care center in Appleton, Wisconsin. Encircle Health is somewhat unique in that they are an LLC, composed primarily of ThedaCare in addition to several independent physician groups. ThedaCare, the largest tenant, is a regional healthcare organization with considerable construction experience and a focus on lean operations and therefore took the primary role in managing the project. They decided before selecting the design and construction team to follow an integrated form of agreement based on the Sutter Health contract model. ThedaCare, HGA and Boldt all had worked together previously on projects in the Midwest, which was a major factor when selecting the team for this new delivery method. Encircle Health did not self-fund the project, and so additional effort was required up front to educated and persuade the bank providing lending that IPD was a viable form of project delivery.

The Encircle Health project 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.

IPD Profile

No information available on the LLC's motivation to select IPD. There was no mention of particular limitations or challenges.

Survey Data

* This case was conducted by Jonathan Cohen, FAIA for the January 2010 publication, "Integrated Project Delivery: Case Studies." The questionaire developed by our research team for the 2011 Case Study report was not administred to these teams. No survey data available.

Contract

Contract Type

- Custom Multi-Party Agreement based on Sutter Health IFOA

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.

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."

Goals

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 system wide 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. 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. The harsh weather affected the typical sequencing of trades, but due to the just-in-time design process and close collaboration between architect and builder, the architects could fluidly shift effort to provide the design information needed in the field (see Decision Making). Furthermore, IPD leveraged the early involvement of trades to more efficiently design the building systems, almost eliminating duplication of work (see Early Involvement).

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.

There was a general consensus that a more precise method of distinguishing design refinements from scope changes from contingency items 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 (see also Goals and Early Involvement).

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.

Liability

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.

Insurance

Each entity maintained typical insurance.

Leadership

Team Structure

- LLC Board of Directors, Core Team, Specialized Component Teams

This was the first IPD project for ThedaCare. The west coast offices of 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.

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 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.

Firm Selection

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 (see Early Involvement). Smaller subcontracts were procured in a traditional manner with hard bids.

Team Selection

No information available regarding participant selection characteristics.

Project Planning

No information available regarding project planning or resources consulted.

Implementation

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 sub trades couldn't be followed and the designers were able to adjust.

There is little direct reference to specific lean process tools that were implemented on this project. The just-in-time strategy is a lean tool, and there is reference to scheduling similar to the Last Planner System, which records and track reliability of promises to complete work by a given date. (see Culture).

Early Involvement

Prior to the start of schematic design, four of the major sub trades--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.

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 (see BIM).

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. 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.

Transparency

The project team operated in a very transparent manner with cost information available for designers to make better design decisions early on, (see also Early Involvement and Decision Making).

Decision Making

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.

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 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.

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.

Culture

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."

Several of the participants did comment that they wished 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. But according to Jezwinski, this project ran significantly different than his past experience thanks to the implementation of IPD culture and the Last Planner Process in the field:

"I've never had a job run this smooth in 23 years. 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."

Workplace

No information available.

Information Sharing

In addition to BIM, Boldt maintained a project web site for information exchange open to all participants.

BIM

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 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.

Walter Cronkite School of Journalism

PROJECT
Walter Cronkite
School of Journalism

OWNER
City of Phoenix

ARCHITECT
Ehrich Architects,
HDR Architecture

CONTRACTOR
Sundt Construction

Overview

Project Description

Location	Phoenix, Arizona
Type	Higher Education
Contract	NA
Owner	City of Phoenix
Architect	Ehrich Architects, HDR Architecture
Contractor	Sundt Constrution
Year Begun	2006
Year Completed	2008

In 2006, Arizona State University (ASU) in partnership with the City of Phoenix had 24 months to complete the Walter Cronkite School of Journalism on a downtown site in Phoenix, Arizona. ASU had a long-term master lease for the site, however the City owned the downtown campus. The downtown site, part of a new ASU campus that will ultimately fill a nine-block area, is an important component of the Phoenix redevelopment vision.

Plans based on another downtown site had fallen through, leaving ASU and the City with only 24 months to complete the project on a new site. The primary issue forcing an extremely tight schedule was the "drop-dead" date for move-in prescribed by the bond measure that financed project, which also limited the budget. The Cronkite School was expected to set a high standard of design quality given its significance to developing ASU downtown campus and prominence within the city. Finding an alternative project delivery method was essential to achieve the design goals within the schedule and budget constraints; there was no time for a design-bid-build scenario.

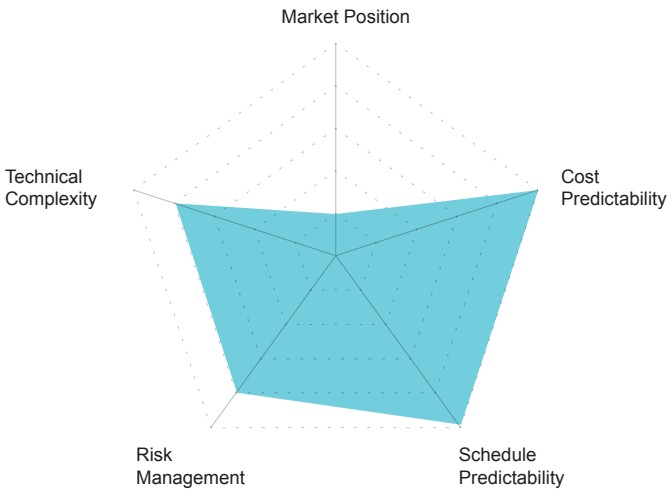
The City issued a public RFQ to select an architect and builder together, purely on the basis of qualifications with no price attached. ASU in its own capital programs had been exclusively using CM-at-Risk for the previous five years, a delivery method more closely aligned with IPD, however the city procurement regulations dictated a two way owner/design-builder contract structure. The selected team was a partnership between HDR and Sundt, with Ehrlich Architects partnering with HDR as the design architect.

Both HDR and Sundt are headquartered in Phoenix and the opportunity to work for both the City and ASU was very attractive to each of their firms. The two firms had previously pursued work together but never landed a job, although key individuals at HDR and Sundt had prior working relationships.

HDR brought mechanical, electrical, and plumbing engineering in house and Sundt's preferred mechanical, electrical, and glazing subcontractors were introduced to the selection committee and began work simultaneously with Ehrlich/HDR and Sundt. All of the disciplines needed for a complete design were on board when the design process began.

Although the team could not enter into a pure tri-party IPD contract and were not able to make changes to the City's standard contract, the team agreed to follow IPD principles for managing the project delivery, including strategies such as early involvement of key participants, open books, and partial co-location.

IPD Profile



** This motivation profile was created by our research team with input from Jonathan Cohen, based on the January 2010 publication, "Integrated Project Delivery: Case Studies," written by Jonathan Cohen, FAIA. Project teams did not have direct input to the profile scoring.*

Market Position
This was not a primary motivation for ASU and the City. Modifying their standard delivery methods was the result of project specific constraints that did not fit well with traditional delivery methods, see Cost and Schedule Predictability below. HDR and Sundt also were primarily motivated by the opportunity to gain work experience in general with the two large entities for the possibility of future work, not specifically for IPD experience.

Cost Predictability
The project costs were tightly fixed due to the bond funding mechanism. The promise of flexibility offered by IPD was a major factor in choosing this delivery method to achieve the desired project within the budget constraint.

Schedule Predictability
The bond funding mechanism prescribed the project drop-dead date for move-in, which created an inflexible and challenging project schedule for the level of design quality required. Schedule predictability was therefore a primary motivation for the team to follow IPD principles, as early involvement of key trades was one of the only ways to achieve the schedule.

Risk Management
With the schedule and budget constraints as well as the expectations for high quality design, the team had an uphill battle with many potential risks. IPD was seen as an opportunity to reduce these risks due to the collaborative nature and transparency of the IPD philosophy.

Technical Complexity
This project was critical component of ASU's new downtown campus. As a signature project, there were high expectations for design and program for the building, adding another challenge to the tight budget and schedule requirements. Given this complexity, the team felt IPD was the only way to get the right people in the rooms when decisions needed to be made to achieve the design and program goals.

Survey Data

* This case was conducted by Jonathan Cohen, FAIA for the January 2010 publication, "Integrated Project Delivery: Case Studies." The questionaire developed by our research team for the 2011 Case Study report was not administred to these teams. No survey data available.

Contract

Contract Type
- Design/build

The contract was a two-way owner/designer-builder contract as prescribed by City procurement regulations; the contract was so inflexible that even misspellings could not be corrected without action by the city council.

Commercial Terms
As a public project, the team was not able to make changes to the contract and so the contract did not include IPD specific language. Nevertheless, many IPD features were implemented on a non-contractual basis.

Relational Expectations
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 City's design-build 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."

Implementation Tools
No information available.

Goals

Although the budget was fixed, the program was flexible. However, early on in design it seemed clear that the budget would not buy the entire program the University desired. Additionally, 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.

ASU was able to find an additional $2 million from another budget to partially fill the gap. Even then, it was expected that a certain amount of space would be left as an unfinished shell. 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 to. Owner, architects, and builder were able to collaboratively decide how to spend the funds for maximum gain.

In the end, efficiencies achieved during construction and buyout, allowed the entire program to be achieved and all the space to be finished without touching the extra $2 million.

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.

Liability

The standard City of Phoenix contract contained a limitation of consequential damages provision but there was not a "no-sue" clause.

Insurance

No information available.

Leadership

Champion

- All primary project participants

Team Structure

- Executive Committee, rest unknown

An Executive Committee that consisted of high-level representation of all participants and stakeholders managed project oversight. This executive team met every other week through the life of the project, even frquently including the Dean of Journalism.

No other information regarding the project level organization is available.

One important change to the leadership structure on an IPD project that teams need to be aware of is the participation required by owners. According to Michael Jackson of HDR, "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."

Firm Selection

The City issued a public RFQ to select an architect and builder together, purely on the basis of qualifications with no price attached. There were 13-15 responses 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.

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 design team then partnered with Sundt in response to the RFQ. The two firms had previously pursued work together but never received a contract, although key individuals at HDR and Sundt had prior working relationships.

The designers and builders were selected as one team. HDR brought mechanical, electrical, and plumbing engineering in house. The builder's preferred mechanical, electrical, and glazing subcontractors were introduced to the selection committee and

began work simultaneously with Ehrlich/HDR and Sundt.

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.

Team Selection

No information available regarding participant selection characteristics.

Project Planning

No information available regarding project planning or resources consulted. While ASU was familiar with CM-at-risk, it is unclear if any of the entities involved had previous IPD experience.

Lessons Learned

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.

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.

Implementation

Most participants felt that some of the lean construction thinking is doctrinaire and inflexible. While this indicates that lean processes were used, there is no specific information as to exactly what or how this was implemented.

Early Involvement

All of the disciplines needed for a complete design were on board as the design process began. The architect and contractor were selected as one team. Engineers and critical trades were also brought on board immediately and participated in the design process, (see Firm Selection).

Another strategy employed by the City to get the right people involved to achieve the tight schedule was the creation of a dedicated team of building inspectors for the downtown ASU campus. The project still had to go through the City's full design review process and did not cut short review time, but the City worked closely with the project team and committed to reasonable turnaround times. A number of variances were required, which extended the schedule with public review and comment periods.

Transparency

The project operated very transparently with open books. Even subcontractors were required to keep open book accounting of costs. The project participants believed that their risk was reduced due to the completely transparent way in which the project was managed.

Decision Making

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. 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.

One of the tenets of lean construction is "optimize the project, not the pieces." Thanks to the flexibility provided by early involvement, transparency and collaborative decision-making, several design decisions were made to optimize the project within the schedule and budget constraints. For example, 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.

Culture

"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.

According to Michael Jackson of HDR, "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." Mathew Chaney of Ehrlich Architects pointed out they do not provide quantity take-offs on design-bid-build projects, "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." Jackson concluded, "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."

Workplace

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." The co-location of team members helped leverage the benefits of BIM, (see BIM)

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." Howard Shugar said, "we were really learning. As architects we never sat in a general contractor's office and understood what they do."

As a result of the success of this project HDR has built out a new space in its office specifically for co-location.

Information Sharing

Every Monday the latest design ideas were published as a set of 20 or more 11"x17" sheets.

BIM

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.

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.

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, (see Workplace). Navisworks was used to stitch together models created in various software packages. The mechanical engineer led the clash-detection process.

Lessons Learned

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. HDR has since transitioned completely to Revit.

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

USCF Mission Bay Medical Center

PROJECT	OWNER	CM ADVISOR	ARCHITECT	CONTRACTOR	
USCF Mission Bay Medical Center	USCF	Cambridge CM, Inc.	Stantec (Anchen + Allen at project start)	DPR	

Overview

Project Description

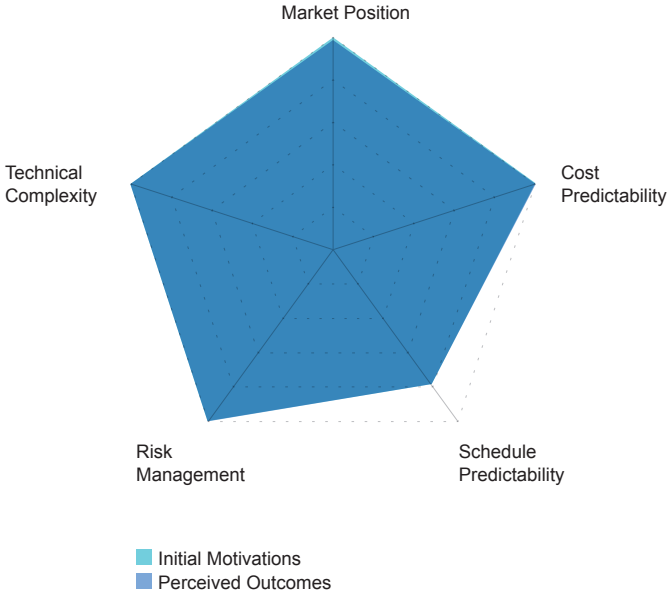
Location	San Francisco, CA
Type	Hospital
Contract	Multiple Independent Contracts
Owner	USCF
CM Advisor	Cambridge CM, Inc.
Architect	Stantec (Anshen + Allen at project start)
Contractor	DPR
Project Start	January 2007
Est. Completion	August 2014

In late fall of 2006, UCSF began their search for an architect. Stantec (at that time known as Anshen + Allen) was contracted in early 2007 to design the large hospital complex. At $1.5 billion there are three buildings: the main hospital, an outpatient building, and an energy center. The new medical center will provide 289 patient beds and specialize in children, women, and cancer patients.

The project began by following a traditional design process, even as concurrently the UCSF Director of Design and Construction was working to pursue an integrated and collaborative delivery model. UC was able to adopt a collaborative delivery process however contracts and contractual relationships remained fairly traditional. DPR was selected as Contractor and brought onto the team in August 2008 under a GMP contract with UCSF. Following DPR's selection, major trade subcontractors were added to the team to assist in completing the design.

Shortly after joining the project, the Contractor provided an estimate that highlighted the overages to the established budget and the focus for the pending target value design. Several subs, including MEP, drywall and concrete contractors, provided design assist services during the construction document phase. The team co-located on site and collaboratively developed and coordinated the construction documents. As the team expanded, it remained co-located onsite for the duration of construction.

IPD Profile



Market Position

This was a primary driver for UCSF to opt for an IPD model. At the time UCSF was initiating the project, there was tremendous competition with several other large hospital projects underway in the region. It was difficult for UCSF, a public organization that typically does hard bid projects, to attract firms with the capability to do a job of this size and complexity. In the end, UCSF was successful in creating a project team interested in creating a project with IPD characteristics.

Perceived Benefit: The owner was able to contract a tier 1 team, they have performed as expected and the owner feels they are getting good value from the IPD process. Although the contract structure was not integrated, the collaborative experience proved very valuable to the contractor and architect and they are marketing their experience to win additional work.

Cost Predictability
As with most large projects, budget was a significant factor and was a major driver for UCSF to select an IPD delivery model. The Director of Design and Construction, who had helped build the alliance building program while at Kaiser, felt cost was most predictable under the integrated model. The contractor was confident it would provide more control as it had on past project experience that also used a Target Value Design process.
Perceived Benefits: IPD and Target Value Design provide much more control over cost. The team was able to price before the design was drawn, allowing the team to optimize the design to what the client could afford.

Schedule Predictability
Schedule predictability was a driver because UCSF was to complete this project to satisfy the requirements of Senate Bill 1953.
Perceived Benefit: The team believes there are positive schedule predictability benefits however the contractor attributes benefits primarily to the Last Planner System, a Lean process tool. Overall, compared to 2007 projections the project duration was extended by two months, however most of the schedule changes occurred during the design phase where additional effort reduced the construction duration by 2 months. The owner noted this equaled substantial savings.

Reduced Risk
Risk management was a major driver to selecting IPD. The project was very large and complex with high risks. The project director felt the project would have been at far greater risk if it had been a hard bid job.
Perceived Benefit: The team felt there were significantly lower risks due to the transparency and high functioning team provided by the integrated delivery. The contractor in particular noted, "you can only do so much as one company, having an entire team that works collaboratively has demonstrated significant risk reduction."

Design Complexity
IPD was almost a necessity in order to build the team capable of successfully completing a project of this size and complexity. Many healthcare facilities provide primary care, while this hospital will be at the tertiary care level. Furthermore, this project is generating new care protocols that outpace typical healthcare evolution, which is typically a 6-8 month rate. Firms identified by the owner as capable, were unwilling to participate in a hard bid procurement process. The owner believed successful completion required the people who were going to build it to design it. The architect noted benefits from contractor and trade input.
Perceived Benefit: The architect felt the integration gave them the ability to react to the technical complexities, providing more certainty and control to the owner. The project team felt the project required IPD and co-location in order to meet the OSHPD submittal dates, without it they estimate an additional 6 months would have been needed.

Survey Data

* The survey questionnaire was not given to the UCSF project.

Contract

Contract Type
- Multiple independent contracts

Contract Issued
- Architect – Standard Architectural contract, issued January 2007
- Prime – GMP Phase 1-Preconstruction Services Contract, issued August 2008
- Design Assist Subs – DA services, issued March 2009 under the CM
- Construction contract-GMP Phase 2- awarded late 2011

The UC system has not adopted multi-party agreements and so this project uses a traditional contract structure. The architects were contracted with UCSF using their standard contract providing design services.

The Contractor was under a GMP contract with the owner. This contract referenced collaborative behavior, but did not extensively define those expectations. Contracted under the Contractor were several major subs including MEP, concrete, and drywall. They were brought on shortly after the Contractor was contracted to provide design assist (DA) services. The DA contracts included detailed descriptions of collaborative working expectations. None of the DA contracts were directly tied to UCSF, however the owner reviewed them.

UCSF also had separate contracts with equipment planners and third party reviewers.

Commercial Terms
No IPD commercial terms were included.

Relational Expectations
Collaboration was required by contract, but the specific organizational structure to support it required development once the majority of the team was in place. The team invested in organizational and team building activities with outside organizations and facilitators (see Early Planning), however the decision to engage these methods was made collaboratively.

Implementation Tools
BIM modeling, clash detection, continuous cost modeling and collaborative project management software were all explicit requirements of the contract. The owner did not dictate specific software vendors leaving flexibility until the major team members were on board to develop the specification of the process and software brand (see Implementation).

Goals

The owner created an incentive program, whereby the team is rewarded for schedule performance, collaborative behavior, safety performance, change order mitigation, quality control, workforce collaboration and overall budget performance. The majority of these incentives are awarded based on performance to an established metric. The overall budget performance is a shared savings incentive in which the Contractor and the MEP subs with GMP subcontracts participate in a portion of the savings acquired through successful execution of the work under the budgeted cost. The Contractor believes these incentive arrangements played a significant role in tying the subs together, promoting open dialogue, and supporting the desired collaborative behavior. The MEP trades recognized that if they help their partners be more efficient, without significant impact to their own scope of work, there was mutual benefit. Conversely, if a situation caused a partner to lose money, it cost everyone money.

Communication and Alignment
Several approaches were used to align the team and communicate performance goals and behavioral expectations. The first, and possibly most significant strategy, was to contract the Center for Integrated Facility Engineering (CIFE) and an independent team facilitator to work with, educate, and build the team (see Project Planning). To reinforce and share those lessons, project leadership continue to hold alignment meetings to discuss how the team should work together to deliver the best project possible. These meetings range in size from very tight groups of representatives from each firm to a meeting including several hundred people including the building trades.
Another approach taken by the project team, was to clearly articulate goals, collaborative expectations, and incentives within the design assist (DA) contracts. Using the contract ensured subs understood expectations for meeting incentive requirements from the beginning. Additionally, the Contractor found that meeting with the superintendent and PM's participating in upcoming milestones was very effective at maintaining alignment and proactively ensuring each participant had a clear understanding of the relational behaviors needed to achieve that goal. These meetings served as a reminder of shared milestone goals.

The shared savings program is another alignment tool. Subcontractors, who were tied to the shared savings plan, meet monthly with the Contractor's executives to discuss items and issues affecting the entire project. The shared savings program is an effective cultural tool that maintains give and take between subs; after each executive meeting, individual participants spread the message about the importance of interaction, noticeably reinvigorating the larger team to work as one organization. One of the project's BIM coordinators commented, "Sometimes I feel like there's a lot of love in this room …people will say, 'Oh I'll move.' In the 2 years I've been doing coordination [for this project], there are maybe 5 instances where people said, 'No, I cannot move.'"

Informal events, intended to maintain relationships, collaboration, and alignment, are another strategy. Each quarter, lunch is held for all the management on the project, close to 200 people. As an unstructured event, it gave everyone a chance to slow down and check in with each other in a relaxed, social environment to help maintain positive relationships.
A strategy implemented by the team to build and maintain trust was a questionnaire and trust discussion (see more in Culture under Market Impact). A questionnaire was sent to the entire team, it asked individuals how they perceived each organization, owner, architect, contractor, in terms of good and bad behaviors or actions. Project leadership learned a great deal of information by reviewing the results. An all hands meeting was held where each organization committed to actions that would address the concerns raised, demonstrating their willingness to change.

For example, DPR adapted their communication style so that factors other than cost (such as quality or sustainability) could be acknowledged more readily. Another follow-up exercise enabled team members to identify principles of trust that all individuals should abide by. Those principles were recorded in a visual format and displayed throughout the shared workspace as daily reminders.

The time spent communicating team performance expectations and maintaining the desired behavioral characteristics sometime competed with demands of project specific work. The leadership carefully considered the frequency of all hands alignment meetings; continual adjustments were made to balance time spent team building and that devoted to project specific work.

Risk/Reward

There was no shared risk/reward pool on this project; no fees were put at risk. Separate from the contract, there was an incentive program tied to project milestones and team performance metrics as well as a shared savings incentive for MEP subs, see details under Goals.

Liability

No limits on liability were included in the contract.

Dispute Resolution

The dispute resolution process follows an "Alternative Dispute Resolution model". If an issue cannot be resolved within the project leadership levels, it is elevated to the executives of each company. If the executives cannot reach a resolution, the issue goes through mediation or arbitration, and if those outlets have failed, litigation.

The team has found non-contractual processes are most critical to preventing escalation of an issue, time spent working out the RFI and submittal processes helped to avoid major issues.

Insurance

Typical professional insurance was used, no project specific insurance product.

Leadership

Champion

- Owner, Architect, Contractor

UCSF's Director of Design and Construction had previous experience with collaborative delivery models similar to IPD and championed the process through the UC system. The architect, Contractor and sub contractors fully supported the collaborative goals of the owner. There were individuals from these firms who had previous experience with IPD or similarly collaborative models. Each party demonstrated this commitment by equally sharing the costs of outside consultants and facilitators that focused on integrated team building.

The team felt a major advantage of IPD over design build is owner involvement. In this case, the owner dedicated significant resources to the project and committed to being onsite for the duration of the project. The team was relatively small during design, but during construction, the owner's team consists of a total of 19 people. Eleven members of the owner's team are with Cambridge, the consulting PM/CM firm that provides support in contract and construction administration, estimating and project management. Other roles ranged from architectural and interior project management, schedule and budget project administration, public relations, information technology, finance, and administrative. At peak construction, the owner's team will increase by 10 to include additional Inspectors of Record as required by OSHPD-California's state agency having jurisdiction over hospital projects. In addition UCSF also hired an equipment and logistics-planning consultant to handle the equipment coordination and procurement.

Integrated Team Structure

Team Structure: Executive group, Captains/Project Solutions Group, cluster groups, building production groups

The team structure consists- of three primary levels of leadership groups: senior leadership or the executive level, project leadership, and a third design and construction level

that included cluster groups and production groups. The executive team did not change significantly between design and construction. The project level leaders called Captains during design, were later reorganized into members of the Project Solutions Group (PSG) during construction. The design and construction level groups shifted as the team size grew and detailing focuses evolved.

At the beginning of CDs, DA subs became involved, and representatives from each organization participated in an event led by the Center for Integrated Facility Engineering (CIFE) to plan production team organization and group overlap strategy, (also see Project Planning). As a result, team structure became layered, with multiple teams interfacing horizontally and vertically to ensure cross collaboration and coordination between groups.

Hierarchically above the building groups were the cluster groups, with representatives from each primary organization including owner, architect, PM/CM, DPR and DA subs. The cluster groups were broken up by system, such as mechanical, electrical, plumbing, exterior skin, etc. to solve system-wide problems. For example, if a mechanical issue came to the mechanical cluster group, representatives would first talk to mechanical leads from each building group, then develop standardized solutions within and across all of the buildings. Clusters were also broken down by non-building systems, such as cost control, schedule, sustainability, quality, etc. These non-building systems groups helped connect issues between the system clusters and building groups. For example, the cost group identified net project savings when changes allowed one group to save $3 million even though those changes cost another group $1 million. They also evaluated decisions that would save cost, but negatively affect schedule and sustainability.

All groups, at both the production and cluster level, identified a lead individual responsible to coordinate with other groups. Overlap and cross talk between groups enabled flexibility and control of cost, schedule and quality.

Anticipating the shift from design to construction, a small representative group was charged with redesigning the organizational strategy to meet changing needs. Without outside facilitators, the group built on the CIFE strategies and their experiences during the design process, (see also Project Planning). They took into consideration the schedule, DPR's strategy for tackling the work, and available personnel resources. The work of the group was transparent, cycles of review and feedback improved the new strategy and created buy in from the team.

As the construction phase began, the design and construction production group was re-organized by building: the main hospital, the outpatient building, and energy center. Above the cluster groups, at the project leadership level was the Project Solutions Group. They were charged with resolving construction issues as quickly as possible and to mediate between the production and cluster groups as needed. Their primary objective is to eliminate barriers for the subcontractors in the field, (see details in Decision Making).

Firm Selection

There were pre-existing relationships at both the firm and individual level for most of the participants, including major and minor subs. The architect noted, "healthcare building is a pretty small community. We do tend to know each other." The owner added, "that was true of many of the other firms we were talking to."

Architect

The selection of the architect followed a traditional path. In the fall of 2006, five firms responded to the RFP and UCSF shortlisted three that qualified. Part of the evaluation involved a competition that required each firm to put together a preliminary design. UCSF was interested in hearing each firm's approach and understanding of the site. Although not formally part of the RFP or the selection consideration, there were discussions regarding the collaborative aspirations of the project. The architect, at the time Anshen + Allen (now Stantec) was awarded the contract in January 2007. Once the architect was awarded the project, they worked with UCSF to select their major design consultants.

Contractor

UCSF developed a questionnaire that could be administered as part of UC's best value selection process, which allows UC to select contractors based on experience and expertise rather than low bid. In the initial RFP, UCSF requested the contractor assemble their entire team including the major subs. At that time, the market for healthcare construction was highly competitive and prime contractors were unable to assemble their ideal teams for the RFP. In response, UCSF revised the RFP to focus on selection of the prime contractor.

Subcontractors
DPR with the owner's and Cambridge's participation, followed UCSF's best value selection process to evaluate firms based on quality of experience. Unique to this project, bid documents included a page that described expectations for teams relative to the principles of IPD. Criteria were aligned to support these goals; collaborative experience qualification was heavily weighted. Several subs were actively engaged in their first collaborative experiences. In these cases, DPR solicited feedback from those projects regarding subs' participation and performance. The design assist services were paid as a lump sum.

Team Selection

There was no special consideration given to personality types or collaborative skills when individual participants were selected for the integrated team. However, both the architect and contractor recognized that an individual's preference for, or aversion to large projects was key. The architect commented, "we are always looking for a good dynamic and good fit, especially for a project of this size and duration, but I don't think it's anything special that came from the fact that this was integrated."
The Contractor had an open office culture, so it was not a difficult transition to the integrated, co-located work environment. They observed that subcontractors who were used to closed-door offices had difficulty adapting to the open environment; everything worked on is visible, open and accessible to everyone. On the positive side, most subcontractors (and the design team) recognized the benefit to having so many resource people available immediately; it saved time researching and eliminated the need for drafting emails or leaving phone messages.

Project Planning

Resources Referenced:
- Center for Integrated Facility Engineering
- External facilitators
- Participant experience and expertise

The team focused a great deal of effort on non-contractual methods of creating team alignment. Since a true multiparty IPD contract was not possible in the UC system, non-contractual means were used to establish relational expectations and implementation details. Team building events and facilitation were thoroughly documented and resulted in formal or informal agreements between the owner, architect, Contractor, and DA subs. Agreements covered topics such as: team organization, collaborative working process, team performance metrics, and behavioral objectives.

The first facilitator was Lou Bainbridge, of Lou Bainbridge Consulting, LLC. Bainbridge got involved in August 2008, after the CM was on board. He worked with the team over approximately 3 months through the end of DD. He focused on alignment of the then newly formed team by helping individuals recognize and accept personality differences and facilitating a culture of open dialogue.

Once the DA sub contracts were awarded in March 2009, thirty team members participated in a weeklong boot camp facilitated by the Center for Integrated Facility Engineering (CIFE). CIFE is a center at Stanford University that specializes in virtual design and construction (VDC) management practices for building projects. This event was a significant investment for the team; it took least 200 hours of preparation and 30-team members attended for five full days. The boot camp started by teaching some general team building lessons and describing the growing pains teams typically experience before the team truly gels. The attendees went through several exercises and scenarios that demonstrated how a high functioning team produces better results, leading to project specific strategies participants could take back to the larger team.

At a firm level, DPR has several internal experts with research expertise gained through PhD work and/or engagement with research centers such as LCI or CIFE. These experts focus on innovative process management tools and BIM practices; they also disseminate information throughout the company, supporting teams with new methods and techniques. During the design phase of the project, two of DPR's experts were on-site part-time, training the BIM managers to facilitate detailer coordination.

Budgeting Team Effort
Without industry experiential models, predicting time allocation and resource intensity was difficult for the team. Added complications were the traditional-integrated hybrid delivery method required by the particular situation of this project and late engagement of the contractors. The architects' original effort estimates were based on traditional contracts, document deliverables and timescales. Once the CM and DA subs were

on board, the integrated team had to recreate and revalidate the schedule based on a collaborative plan. The revised schedule added 5 months to the design phase and extended the overall project schedule by 2 months. The additional design development time can be attributed to several factors including transitional time to educate and team build with late arriving contractor team members, time to collectively reassess the project's objectives and milestones, and a potentially overly optimistic original time estimate. Most saliently, the team spent time reducing costs to fit within an aggressive budget and shifted the traditional shop drawing process into the CD coordination phase. This resulted in a highly integrated and coordinated set of CD documents, or what AIA defines as Implementation Documents. Even with the additional design and coordination time, ultimately the team significantly reduced estimated costs and saved 5 months from the construction schedule another major savings for the owner.

Rethinking Staffing

Managing the collaborative team changed effort distribution; the resources were allocated differently. Processes that would normally be completed end to end became overlapped. For example, work that subs typically do in CA was shifted up into the CD phase. Changes had to be made in staffing for the architect and DPR. For the architect, the primary increase in resources and staffing came from additional project leadership required to support the new overlapping process flows. Overall this increased the duration of certain team resources and required more dedicated resources to the project. There was also investment in team building efforts and workshops not typically done in traditional or design build projects. Give and take was needed to accommodate the costs for this different way of working; team members shared costs for team building.

Implementation

Tools

- Multiple Lean processes
- Project Modification and Innovation or PMI (modified A3)
- Co-location
- BIM
- PSG

During design, the team developed a tool for capturing and exploring innovation ideas that could optimize project results. The tool, referred to as a Project Modification and Innovations (PMI), (see more in Decision Making). A PMI is a mechanism to allow everyone on the team to offer input, similar to the Lean tool known as an A3 form. The process was introduced to the team by Cambridge, the owner's consultant. As a result of the PMI process, the team was able to add back original scope that had been deleted to meet budget under the traditional design process of designing first and estimating second. During construction, the team is using Lean process tools and metrics, extensively tracked by weekly reviews. The contractor implemented the Last Planner System managed by their proprietary schedule software called "Our Plan." The visual and interactive format provided facilitated planning and serves as a learning tool; it helped subcontractors more accurately predict schedules and time commitments. To date, the project maintains an average of 82% reliability for the majority of the construction phase. The contractor noted they would have loved to get higher, but they were cautious that "sandbagging" commitments to reach a higher reliability would decrease willingness to pursue aggressive goals.

Another valuable implementation tool was the daily huddle. Huddles allowed the subs to meet early in the morning with the architect and CM to identify items that may hold up their work for the day, such as an RFI. This allowed the team to prioritize work and decisions to avoid inefficiencies in the field. Decisions that cannot be made in the daily huddle are sent to the Project Solutions Group (PSG) for solution and or direction.

Early Involvement

A/E: Conceptual Design & Program Validation
Cambridge: Schematic Design
CM/GC: End of Design Development
Trade Contractors: Start of Construction Documents

The architect was contracted in January 2007. In August 2008, late into the DD phase, the contractor DPR was brought on. This timing was not considered ideal by either the UCSF project management team or the architect team. UCSF had intended that a GC and major trade subcontractors would participate earlier in the DD phase. When DPR was brought on, they evaluated the design and current estimate and found the project was well over the established budget. In March 2009, 7 months after the Contractor was contracted, DA subs were brought on to participate in design and find options to bring the design

within target. Participants agreed this was later than ideal but also found that it was difficult to know what timing would have been preferable. As a firm, DPR has been trying to determine the ideal time to involve DA subs. Based on their experience, DA involvement during SD may be too early, it can be unclear how much value subs add when the design is still in its infancy and pace of development may not warrant dedicated time of the DA subs.

The project team has seen significant value added through integrating subcontractors into the team. One of the biggest advantages of the collaboration is the level of detail and reliability of the BIM that was achieved. For example, the detailed coordination of systems enabled shop welding of connections between structural steel and pre-cast and curtain wall elements. Welds were all shop welded by the structural steel sub, far more efficient for the project than field welding by multiple subs. This added some time to structural steel erection, but there was a significant net savings of time and cost to the owner. This would have been very difficult to achieve without IPD because it required accelerated coordination to meet tight time constraints for the steel fabrication submittals and full participation by the architect to determine the location of curtain wall sooner than expected.

Another example of integrated collaboration leading to significant owner savings was an inventive cable support system. The project originally specified expensive cable trays. J-hooks are the less costly alternative, but were unacceptable since they limited flexibility for UCSF's facilities team. One of the team members came up with a triangular hook configuration that solved the flexibility issue yet remained low cost. The architects reviewed the option and the electrical sub confirmed they could easily install it, the idea was accepted, saving the project significant cost while meeting user needs.

Transparency

Open books are an inherent part of GMP contracts, so the project operated transparently financially.

The Contractor contract required the team to work collaboratively, and the team agreed early on that in order to have collaboration you must have transparent communication and sharing of information. Although not explicitly stated in any of the written contracts, transparency was discussed and the team has understood that it was expected of everyone on the project from the start.

Decision Making

One of the biggest differences between IPD and design build is owner involvement. As an active part of the decision making process, the owner had significant influence on the project outcomes by offering valuable insight to the design and construction team, especially with regard to operational issues. Their perspective was critical to evaluating the true cost/benefit tradeoffs. Co-location was a critical part of leveraging the benefit of owner involvement. With everyone easily accessible, the team was able to confer with the owner immediately before they invested resources and time chasing down a user group request, or exploring a solution that may not be desirable to the owner. During design, the primary decision makers were the Captains, representatives from every major firm involved at the time. Captains played several roles and met as needed, at times daily, sometimes every other day. The Captains group was responsible for helping resolve issues at many levels, from team structure and relationships to significant project decisions. Sometimes the group would function as mediator if there were disagreements at the cluster level. One of key roles they played was revising and streamlining the Project Modification and Innovation (PMI) process (see Implementation), which was a powerful tool for harnessing the expertise of all team members in problem solving. Most issues, including over 600 PMIs, went through the captain's group before going to the executive level. Their level of authority evolved as the confidence level rose between the executives and the Captains. In the beginning, every PMI was elevated to the executive level because the executives wanted control over decisions that may have significant impacts to construction. After about a 5-month calibration period, the executives granted the Captains power to make decisions with impacts up to $50,000.

During the construction phase, the Captains group dissolved, replaced by the Project Solutions Group (PSG). The PSG group coordinates issues, evaluates solutions and provides direction on issues that are not resolved in the daily huddles. The group includes leaders from the owner, architect, and Contractor, and PM consultant, often the same people who had served as Captains during the design phase. Anyone on the integrated team can bring an issue to the PSG group; items are tracked on a PSG log. The individual that sponsors the issue, or a representative from their respective organization, attends the meeting to present the problem. This process enables - the project leadership to respond very quickly. PSG meetings occurred daily during "office

hours," a time when no other meetings could be scheduled. This ensures all team members are available to address any urgent issues. PSG items are sorted daily and color coded to help prioritize time critical items over issues that could be addressed at a later time. The PSG log also tracked costs so budget implications are known. Once a solution was identified, the issue was relegated to the appropriate path typically (RFI, field order, change order or submittal) for official resolution and documentation.

Most decisions were made through the PSG, with the exception of Elective Change Requests (ECR). Elective changes are brought to the executive level decision makers who control the elective contingency budget.

Culture

The team leadership observed team members generally had positive attitudes and personal commitments to the project. As a landmark project for one of the top ranked medical centers in the country, there was awareness that it was important to get it right. These attitudes may have enabled the successful implementation of behavioral rules, even though they weren't contractually required.

Co-location was identified as one of the most critical factors in creating the culture and relationships desired on the project, (see also Workplace). Separate parties work face to face with a higher degree of interaction compared to a non-integrated, non-co-located project. In addition to facilitating work communication, co-location supported social interactions outside of work hours, such as going out to lunch. Team members note that the level of social comfort carries over to work; people are more willing to accommodate one another.

Architect
When the project began, many architects on the team were hesitant to move from their home office to the site. Architecture is very peer oriented and many were concerned about losing touch with their peers. When the project started, the architect stationed only 4 people on site with others based in the home office. This split was not well received from the larger integrated team, so they successfully adjusted by bringing more team members to site. The architect observed the engineers struggled most with culture change that affected traditional relationships and hierarchies.

Contractor
As an organization, DPR has an open office culture, so the transition to the co-located, integrated working environment was smooth.

Cultural Change
According to the project leadership, the most noticeable cultural shifts could be seen within the primary organizations -- Stantec, DPR, and Cambridge (the owner's consultant). Some degree of change penetrated to the level of MEP subs, but to a lesser degree. Team members speculated that the degree of culture change may be related to the size of the group at the time a particular firm joined. As the project shifted into the construction phase, new team members were brought on and people redistributed. Team members noted relationships formed during construction were less close compared to earlier ones leading to more difficulty with communication and less enforcement of behavioral principles. To alleviate this disconnection, a team member from the architect team created an orientation packet for new team members; it outlined logistical information about the team as well as the team charter (goals and expectations) of each particular group.

Contract
The contract did not appear to have much of an impact on the culture of the team at large, although it might have had some impact at the Captain/PSG level and above. Since the contract was traditional, several individuals thought the contract might have even been a barrier to the integrated and collaborative goals of the project. Both the architect and contractor felt that although they have been very successful in achieving the collaborative culture without a multiparty agreement, there was an underlying concern that should a dispute arise, firms would fall back on traditional adversarial behaviors. For the most part though, the team agreed the contract had more to do with the business relationships than the behavior of the team.

Market Impact
The market crash of 2008 was the biggest obstacle to maintaining a culture of trust on this project. The rumor of a hard bid circulated throughout the local industry. Sub-contractors who assumed that design assist would lead to construction contracts were concerned that their trust had been abused. In fact, the project did not switch to hard bid and the DA subs were awarded contracts as anticipated,

In response to the tension, the project leadership took action to restore the team relationships. They first developed

a survey and distributed it to the entire team, giving everyone the opportunity to share their concerns and make suggestions for improvement (also see Goals under Communication & Alignment). Questions focused on each organization, UCSF, Stantec, and DPR. Once the results had been reviewed, an all hands meeting were held to share the results and identify action items that each organization could take to improve their standing with the team. At the time of this study, the team was still in the process of determining how frequently to follow-up on this exercise, but improvements in team morale have been noted.

Workplace

- Co-located (full time)

In the design phase, the team, up to 105 individuals from 19 firms, co-located to a large (12,000 sf) trailer complex adjacent to the building site. During construction, the complex more than doubled (sf) in size to accommodate the larger number of project engineers on the DPR and the subcontractor teams.
The team unanimously placed high value in co-location, attributing to it many of the benefits achieved on the project and the success of the collaborative relationships (also see Decision Making, Culture, and BIM). However, the architect noted that there are nuances to co-location, for example line of sight seems to have played a larger factor than originally anticipated. They noticed some of the relationships forged during design disintegrated somewhat as team members shifted around and were no longer located directly next to one another.
Most team members adapted well to the co-located and open office environment, however the team recognized that not all activities were well suited to the active and open environment. To address this, they provided breakout rooms that gave individuals a place to work quietly in order to have a conference call or if they needed a private area to focus, think, and work out solutions independently.

The team identified several benefits of full time co-location. Co-location significantly reduced latency on the project. The team discussed trying to measure this benefit and found software that could do it, but did not see the purpose in trying to document the time savings "of a ten second conversation with thirty seconds trying to track it." Even without official metrics, the team felt latency was very minimal. Time was not wasted drafting emails or waiting for responses. When there were delays, most involved consultants not located on site. One factor that likely optimized the benefit of co-location was that most team members, including the owner, were full time on the project – allowing all the resources to be immediately available. Another significant benefit of co-location was the way it leveraged integration for continuous coordination during the BIM development process. The team was able to fully model and coordinate the 878,000 SF building in 18 months. DPR remarked that the speed and quality of the document production would not have been possible without the integrated, co-located team.

Information Sharing

Tools

- CMiC (Networked collaborative Project Management software)
- ProjectWise (Networked document repository software)
- BIM
- Smart Boards
- Face-to-face exchange/Co-location
- Lean tracking
- Visual Management Tools (publicly posted project metrics)

The team used several tools to make information available. The Project Team tracked project metrics, such as Last Planner reliability and project cost goals, which were publicly posted throughout the workspace. One of the project's BIM managers noted that their particular combination of physical, cultural and software tools created the advantages; for example, co-location ensured the people critical to making decisions were present and the project management software, CMiC, provided the information when needed.

Meeting Frequency

- Weekly Report Out Meeting (building and system group reporting)
- Daily Project Solutions Group Meeting
- Weekly Change Order Meeting
- Weekly Work Plan Meeting (for each building and system group)
- Daily Huddles (for each building and system group)

Regular meetings were frequent, although some team members felt the number of formal meetings may be less than other projects due to co-location, where informal conversations were common.

BIM

Model Manager: Shared between Architect (Anshen + Allen, now Stantec) through DD and Contractor (DPR) for duration.

Management Protocol: Team Charters developed during VDC Training with the Center for Integrated Facility Engineering (CIFE)

Custom MEP Coordination Process developed by DPR based on owner requirements

UCSF requested the project team utilize Building Information Modeling (BIM) tools to the greatest extent possible. This meant using BIM for coordination purposes, quantity take-off, estimating and for pre-fabrication. The focus of the coordination effort was on the MEP systems. The team was expected to work collaboratively within the Big Room onsite and follow Lean construction principles to minimize waste and redundancy through the coordination process.

The architect and engineer (ARUP) were responsible for high-level coordination of the model through 100% DD. The architecture model, built in ArchiCAD, served as the basis for MEP coordination from an architectural perspective. The engineers were required to use AutoCAD MEP 2008 for MEP models and Autodesk Revit Structure 2009 for structural models. Engineers were expected to coordinate software interoperability and hand-off so MEP design assist (DA) subs could use the engineers' models to the greatest extent possible to produce the coordinated CD set. At the transition from DD to CD, the design team turned over MEP modeling responsibility to the Contractor and DA subs. Most subs were able to provide the detailers in-house, but some had to contract outside help. The structural engineers (Rutherford and Chekene) were responsible for modeling and coordinating the structural model through both DD and CD phases.

The Contractor was responsible for managing the MEP coordination process during the CD phase. The Contractor appointed several BIM coordinators to manage the process; they acted as a liaison between the design team and DA subs and were responsible for creating the development schedule and addressing technical logistics between software platforms. Interoperability issues with multiple software platforms resulted in some lost data, but all geometry was transferred to the coordinated model. In addition to managing the BIM coordination process, the Contractor modeled the drywall and concrete portions to provide additional detail for coordination and clash detection.

The goal was for the 100% CD model to be fully coordinated and clash free for submission to OSHPD. The model was used to extract the 2D drawings stamped by the design team and submitted to OSHPD. Post OSHPD submittal, the models were used for shop drawing and prefabrication documents. The owner felt "it was critical to have the people who were going to build the building, design the building" in order to leverage the model to that extent.

A BIM matrix outlined detailed roles and responsibilities by discipline; a format created by the Contractor based on past hospital BIM experience. For the most part, the modeling and coordination only included overhead, not in-wall. Some of the subs went above and beyond, modeling additional detail or in-wall systems because they saw benefits for construction. It also allowed those who did model in-wall to claim space in the field. When the DA subs first co-located, many only located one detailer onsite. Quickly, more detailers were added as the benefits, such as the decrease in latency, became apparent. During the CD coordination process, the detailers were arranged by building team, not by company. There was close interplay between detailers, it was difficult to tell who worked for whom; it all looked like one company. During construction, staff shifted back to a more conventional arrangement by company to work on specific needs with greater internal coordination. To ensure continued cross collaboration, they held planning sessions every other day and daily huddles in the field. The Contractor noted that the relationships established in the cross-disciplinary teams allowed strong communication even after the teams rearranged along company lines.

One of the biggest challenges to the BIM coordination was communicating changes to the entire team. A successful tool was a map of design changes with modifications clouded by the designers. Issues arose making sure other system changes were fully distributed to the team. For example, structural steel discoveries proved difficult to communicate to all systems affected -- some just slipped through.

The team used ProjectWise, a shared, server based document management system, to manage the models. All project models were live, so everyone had access to the most current information. The server-based system allowed team members working remotely from other parts of the country to also work in real time.

In addition to coordination, BIM was intended for use in quantity take-offs, estimating and pre-fabrication. The team was able to use the models for some quantity take-offs and

prefabrication, but not for estimating. The team pulled quantities for several key performance indicators, although the Contractor was fairly certain the subs still manually verified quantities. Overall, the software did not have the capacity for the team to model everything efficiently. This was a major factor explaining why cost estimating was not adopted, the information and data required to use BIM for accurate estimating was not modeled. The team added additional BIM functionality by linking the model with "Our Plan," the Contractor's software program used to track the Last Planner Schedule. The concept was to link quantities to schedule commitments, and use the information to validate field commitments. They were able to track how long it took trades to complete certain scopes of work, so they could better estimate future work durations. For example, when planning the slab on deck work, they were able to identify areas in the building with a higher number of inserts and adjusted the duration of that piece of work appropriately. BIM was valuable in helping trades visualize challenges to certain areas.